

**A STUDY OF THE FACTORS WHICH CONTRIBUTE TO EFFECTIVE
CLASSROOM PRACTICE IN SECONDARY SCHOOL MATHEMATICS**

A Thesis

**Submitted in Partial Fulfilment of the Requirements for the Degree of
Master of Education – Concentration in Curriculum**

Of

The University of the West Indies

Nalini Ramsawak-Jodha

2008

School of Education

Faculty of Humanities and Education

St. Augustine Campus

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ABSTRACT

A study of the factors which contribute to effective classroom practice in secondary school mathematics.

Nalini Ramsawak-Jodha

Secondary schools throughout Trinidad and Tobago have been plagued with poor performance results and decreasing interest in mathematics. An exploration of literature pertaining to this situation revealed that a link exists between teachers' classroom practice and students' interest and performance in mathematics. This study aims to identify the factors that contribute to effective classroom practice in mathematics.

The study will employ a correlational design. The focus at this stage was on development of the data collection instrument for the study. The process of developing, pilot testing, analyzing and revising the instrument are explored. The final instrument that will be used in the data collection process is also generated.

Keywords: Nalini Ramsawak-Jodha; Effective Classroom Practice; Secondary School Mathematics.

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TABLE OF CONTENTS	Page No.
Abstract.....	i
Acknowledgments.....	ii
Table of Contents.....	iii
Background	1
Rationale.....	5
Statement of the problem.....	8
Purpose of the study.....	8
Research Questions.....	9
Operational definitions.....	10
Assumptions.....	10
Limitations.....	11
Delimitations.....	11
Significance of the study.....	12
Literature review.....	13
Methodology.....	32
Instrument development.....	41
Instrument analysis.....	56
Instrument revision.....	63
Conclusion.....	65
References	
Appendices	

BACKGROUND

The twenty-first century has dawned bringing a new and exciting era in mathematics education. Blackhouse, Haggarty, Pirie and Stratton (1992) have noted that mathematicians are faced with challenges in creating mathematical curricula for a multicultural society, infusing technology and most importantly teaching mathematics as the dynamic subject that it is. They have highlighted the fact that while researchers of the 1960's focused primarily on curricula, today the focal point is more instruction oriented.

Blackhouse et al (1992) pointed out that teachers are often frustrated in trying to create an effective classroom where reasoning, communication and problem solving prevail and yet skills are acquired to be successful at examinations. The frustration of teachers has been exacerbated by the fact that the success rate in mathematics is ranked amongst the lowest in the Caribbean. Baldeosingh (2008) showed that the average Ordinary Level pass rate in mathematics in the Caribbean during the period 1977-1982 was 31% and from 1995-2000 it was 50%.

At the Caribbean Secondary Education Certificate Examinations, (CSEC), the present Ordinary Level examinations, the current trend indicated a further decline in mathematics performance. An annual report on candidates work in the CSEC examination is published by the Caribbean Examination Council (CXC). The reports have shown that less than 40% of students have passed mathematics during the last four years. In 2004 only 35% of candidates entered for the examination achieved a passing grade in mathematics. The

results for 2005, 2006 and 2007 revealed a pass rate of 39%, 35% and 34% respectively. These disturbing results point to continued low performance in mathematics over a period of time.

Dismal performance in mathematics examinations is not limited only to the Caribbean region. In their research on mathematics education, Schoen and Hallas (1993) stated that students in the United States are underperforming in mathematics. Bynner and Steedman (1995), reported that a large percentage of English adults do not possess basic numeracy skills.

The CXC annual reports also included recommendations for the classroom. CXC (2004) advocated that teachers need to present meaningful contexts in the teaching of mathematics, allow students to explore concepts, integrate mathematics with other disciplines, give students practical experience, use investigative and problem solving methods, employ a variety of authentic situations and allow students to make oral presentations. These recommendations speak directly to teachers' classroom practice. They provide suggestions for organization of the teaching/learning activities needed to facilitate better engagement of the mathematics curriculum. Similar recommendations have been made repeatedly by CXC in 2005, 2006 and 2007.

The literature reviewed indicated that there is a link between teachers' classroom practice and students' performance in mathematics. Research conducted by Galton and Croll (1980) revealed that there is a consistent relationship between teachers' style, strategies,

tactics, classroom interactions and student achievement. Stronge, Ward, Tucker and Hindman (2007) reiterated that there is dramatic evidence showing that the pedagogy employed by the teacher has a significant impact on student performance.

Another disturbing trend noted was that there is a decrease in the number of students pursuing mathematics at post CSEC level. Findings by Muijs and Reynolds (2001) indicated that students' are normally disenchanted with mathematics. Reports from CXC (2006) on the Caribbean Advanced Proficiency Examinations (CAPE) showed that of the approximately 30,000 successful CSEC mathematics candidates only 15% went on to pursue mathematics at a higher level. The CXC (2007) CAPE report indicated that only 14% of the approximately 30,000 successful CSEC mathematics candidates enrolled for mathematics in Form Six.

Lazim, Abu Osman and Wan Salihin (2002) published the results of a study which indicated decreasing interest in mathematics among school children. Lim (2002) also reported findings that showed a decrease in the number of students pursuing science subjects in form 4 and form 6. The lack of interest was attributed to the mathematical content in these subjects.

The literature has indicated that the decline in student interest in mathematics is linked to teachers' classroom practice. Stronge et al (2007) pointed out that the classroom teacher has a considerable influence on student interest in mathematics. Beswick, Watson and

Brown (2007), stated that declining enrolments in post-compulsory mathematics in many countries may be attributed to students' classroom experiences.

Research has shown that the current state of low performance and interest in mathematics is linked to teachers' classroom practice. To address this dilemma an examination of teachers' classroom practice has to be undertaken. Stronge et al (2007) stated that effective teachers are, indeed, essential for student success.

RATIONALE

Teddlie and Reynolds (2000) noted that in the last twenty years there has been a worldwide movement to study what makes more effective schooling. The evidence generated in school effectiveness research showed that classroom experiences are far more important than schools in determining how children perform at school.

Seeger, Voigt and Waschescio (1998) pointed out that the study of interaction in the mathematics classroom has received increasing attention in the literature on mathematics pedagogy. In particular, analyses of existing situations in standard classrooms have shown that classroom interactions give rise to patterns and routines. These pattern and routines influence students' performance and interest in mathematics.

Seeger et al (1998) stated that the culture of the mathematics classroom has become a significant topic of discussion in mathematics education. They noted that studying what happens in the mathematics classroom allows researchers to recognize the social character of mathematical pedagogy. Analyzing classroom practice can be a starting point for the development of alternative and new ways of making mathematics classrooms more lively and interesting places.

Initial research on classroom practice undertaken by Good and Grouws (1979) identified a number of behaviours that were considered effective. Cooney, Brown, Dossey, Schrage and Wittmann (1999) believed that it is important for teachers to develop a knowledge

base that will enable them to become experts in revising and shaping curricular for their students. The teacher should have the ability to create learning environments that foster student interest and improve student performance in mathematics.

McLeod (1992) suggested that students' performance and interest in mathematics are influenced by the role of the teacher and the teaching/ learning activities in which they are engaged. According to DeCorte and Op't Eynde (2002) student performance is influenced by the cognitive, motivational and affective dimensions of the teacher functioning. Lazim et al (2002) stated that students' experiences in the classroom are definitely related to their learning and can significantly impact on their interest and performance. Mawhinney and Sagan (2007) also cited the results of research that pointed to the teacher having a significant impact on student achievement.

The literature identified age as a factor that influences teachers' opinions and beliefs. In Erikson's (1950) psychosocial stages he noted that individuals experience differences in opinion at different stages. Erikson (1950) noted that as an individual gets older they gradually begin to think differently about the future of both society and their own children, sometimes changing formerly held opinions. The implication here is the effect that age has on teachers' classroom practice.

Elliot, Kratochwill, Cook and Travers (2000) stated that teacher gender influences the success of instruction, classroom management and student's learning. They noted that at an early age boys and girls construct different social categories from the world around

them and attach different characteristics to their experiences. It was further noted that these experiences impact on their opinions and beliefs based on gender stereotyping. Petty (1995) pointed out that gender is a factor that impacts on teachers' classroom practice.

Research conducted by Steinberg (1996) showed that location of a school impacts on teacher effectiveness. It was noted that schools in busy and crowded urban areas experienced slightly lower performance than schools in sub-urban areas. Elliot et al (2000) noted that environmental contexts lead to variations in teachers' classroom practice which impact on student performance.

Research has shown that there is a significant link between teachers' classroom practice and students' performance and interest in mathematics. It was further indicated that teachers' age, gender and environmental context has an impact on classroom practice. Conducting research on teachers' classroom practice is a step towards improving the delivery of the curriculum which will benefit both the teacher and the student. This research is geared toward investigating the factors that contribute to effective classroom practice.

STATEMENT OF THE PROBLEM

Current classroom practice is not producing a mathematical experience that results in high performance and a positive disposition to the subject.

PURPOSE OF THE STUDY

According to Chee Mok (2007), the mathematics classroom as a system requires a study of the interaction between the content, the teacher and the students. In the interaction the teacher contextualizes the content and presents it to the student. In contextualizing the subject matter the teacher draws on a multiplicity of knowledge, experience and reflection as a guide for engagement of the curriculum. This study will investigate the factors that contribute to effective classroom practice in secondary school mathematics.

RESEARCH QUESTIONS

1. What factors are essential for effective mathematics classroom practice?
2. Do mathematics teachers from different age groups share similar perceptions of effective classroom practice?
3. Do male and female mathematics teachers share similar perceptions of effective classroom practice?
4. Do environmental contexts influence teachers' perceptions of effective classroom practice?

OPERATIONAL DEFINITIONS

Classroom practice - all teacher directed activities that guide teaching and learning.

Environmental contexts - the type (government, government assisted or private) and location (urban, sub-urban or rural) of the school at which a teacher works.

ASSUMPTIONS

In conducting this study the following assumptions were made:

- All mathematics teachers who participate in the study view their classroom practice as effective.
- All mathematics teachers who participate in the study provide honest responses.

LIMITATIONS

In conducting this study the following limitations may exist:

- Results only imply relationships between variables and do not establish cause and effect.
- The correlation index depends on the reliability of the measurements of the variables.

DELIMITATIONS

In conducting this study the following delimitations were set:

- The research will be conducted at secondary schools in Trinidad which vary in environmental contexts.
- The sample will comprise all the mathematics teachers in the selected schools.
- The mathematics teachers sampled will be heterogeneous in age and gender.
- The study will be conducted over a period of six months.

SIGNIFICANCE OF THE STUDY

This study aims to identify the factors that contribute to effective classroom practice for secondary school mathematics teachers. It is hoped that the results of this study will help the researcher make valuable inferences and recommendations to help improve teachers' classroom practice. This study will contribute to the existing body of knowledge pertaining to teachers' classroom practice and it is hoped that the study will also stimulate interest and promote further research and investigation on the topic.

The National Council of Teachers of Mathematics (1989) developed a document outlining professional standards for teaching mathematics. In Trinidad and Tobago no such document is available. Through this study the researcher plans to collect, analyze and present data highlighting factors that influence effective classroom practice in the local context. Knowledge about the factors which contribute to effective classroom practice can then be used to aid in the development of standards for the teaching of mathematics in Trinidad and Tobago.

This research on the factors that contribute to effective classroom practice would provide suggestions for more effective engagement of the mathematics curriculum. Through the provision of guidelines for engagement, mathematics teachers may be able to create more positive learning environments for students. This may then lead to improved mathematics education.

LITERATURE REVIEW

The dawn of the twenty-first century brought new and exciting changes to the educational arena. It also brought new challenges and problems for the teacher in the classroom. The effective teacher, according to Stronge, Tucker and Hindman (2004) must adapt to these changes. In adapting the teacher has to modify or develop new strategies to cater to the student of the twenty-first century. Petty (1995) noted that this is where research and reflection are of utmost importance. Educational research in the field of mathematics, according to Wilson (1993), can provide important directives as to how teachers can improve and enhance their classroom practice.

The 1970's and 1980's saw a drastic increase in research on the teacher. Concern about what took place in the classroom led many researchers to focus on teachers' classroom practice. Research by Good and Grouws (1979) pointed out that teachers operated differently from classroom to classroom with regards to instructional methods and the distribution of their time and resources. The data showed that some teachers produced more mathematics learning than other teachers operating in comparable settings. In their research Good, Grouws and Ebmeier (1983) stated that the classroom practice of teachers differs and the differences are significant enough to identify and study effective practices.

One of the first and most important studies on teachers' classroom practice was the Missouri Mathematics Effectiveness Study (MME) by Good and Grouws (1979). The study showed that teachers trained to use effective teaching strategies realized higher

student achievement than those who were not. Good and Grouws (1979) concluded that effective classroom practice can be successfully taught to teachers.

Galton and Croll (1980) conducted a research program on effective teaching in the United Kingdom. The research focused on teachers' strategies and tactics and on the interaction process that took place in the classroom. The findings from this research indicated that some consistent relationships could be discerned between teachers' classroom practice and student achievement. One major omission noted in this research was any explicit consideration or analysis of the content taught.

The research conducted on effective classroom practice by Good and Grouws (1979) and Galton and Croll (1980) highlighted that effective classroom practice can be identified and taught. However analysis of the research by Galton and Croll (1980) showed that special attention must be given to the content being taught. It should be noted that contrary to previous research, Muijs and Reynolds (2001) pointed out that it is difficult to identify key factors that influence classroom practice since teaching is viewed as an "art". As such the factors which contribute to classroom practice are thought to be personal and idiosyncratic.

Educational theorists of the early twenty-first century have challenged the view posited by Muijs and Reynolds (2001). Marzano, Pickering and Pollock (2001) noted that teaching is now classified as a "science". Therefore it should be possible to identify similarities and differences in the factors that contribute to teachers' classroom practice.

It was pointed out that there is a need to identify what highly effective teachers do and use the information to aid in professional development of other teachers.

Stronge et al (2004) noted that effective teaching involves a continual learning process. They believed that for this learning process to be beneficial, it must focus on what was done by effective teachers in the classroom. It will be useful to identify the different factors that contribute to effective classroom practice in the local context because the information can be used to improve teachers' practice. Mawhinney and Sagan (2007) reiterated that educators can learn to be good teachers and continue to improve their practice.

Teaching mathematics successfully, as noted by Stiff, Johnson and Johnson (1993), is a very complex task that is influenced by a number of factors. Borich (2000) concurred that effective teaching is one of the most difficult tasks to accomplish and defining an effective teacher is a complicated undertaking despite decades of research in the field. This is because many factors contribute to effective teachers' patterns of behaviour. Research conducted by Stronge et al (2007) examined what constitutes effective classroom practice. They noted that effective practice was determined by measured increases in student learning with a focus on teachers' classroom practice.

The classroom practice implemented by a teacher, according to Stronge (2002), results from an intricate mixture of factors such as a teacher's knowledge of subject content, pedagogy, sociology, psychology and philosophy. Stronge (2002) noted there are

common attributes that characterize effective classroom practice. He stated that this includes an identifiable range of characteristics and behaviours. The domains identified included instruction, student assessment, classroom management, and personal qualities. Handal (2003) proposed that some of the factors that influence effective teaching include teachers' thoughts on efficacy, resources, instructional strategies, assessment, student characteristics, school culture and theory among others.

The Junior School Project, conducted by Mortimore, Sammons, Stoll, Lewis and Ecob (1988), was a study of effective classroom practice. The study highlighted factors that were associated with effective classroom practice. Significant positive relationships were found with factors such as structured sessions, use of higher order questions and statements, frequent questioning, restricting sessions to a single area of work, involvement of students and the proportion of time utilized in communicating with the whole class. Negative relationships were found with teachers spending a high proportion of their time communicating with individual students.

The limitations of effective classroom practice in the Junior School Project noted by Muijs and Reynolds (2001) included the discrepancy in effectiveness for different groups of students and the fact that it is more suited to teaching basic skills than to teaching higher order thinking skills. In a review of Dutch research, Creemers (1994), found that despite employing effective practices such as whole class teaching and time spent on homework, minimal student gains were experienced.

The factors which affect classroom practice that were identified have been organized into seven categories. The categories are teacher characteristics, student characteristics, school characteristics, subject characteristics, policy, resources and classroom context. Each category will be discussed individually.

Teacher Characteristics

Teacher characteristics, as explained by Wilkins (2008), influence how teachers implement the curriculum which impacts on student learning. These characteristics are related to the teachers' notions of effective teaching and classroom practice. Individual characteristics vary widely and are not exhaustive but the focus here is on how teachers' philosophy, personality, qualifications, mastery of content, experience, training and preparation influence effective practice.

The literature abounds with support for the role that personal philosophy plays in determining teachers' classroom practice. Clark and Peterson (1986) noted that one's philosophy of teaching acts as a filter through which all decisions are made. Ernest (1991) stated that the teachers' philosophy impacts greatly on the teaching of mathematics. This view is also supported by Zhihui (1996) and Richardson (1996). Gordon, Dembo and Hocesvar (2007) indicated that there is a relationship between teachers' ideology and their classroom practice.

Additional support for the role that philosophy plays in teachers' practice is provided from studies done by Thompson (1992), Kagan (1992) and Fang (1996). They indicated

that teachers' philosophy relate to their classroom practice. Pajares (1992) stated that few would argue that the beliefs teachers hold, influence their perceptions and judgments, which, in turn, affect their behaviour in the classroom. Thompson (1992) noted that it has become an accepted idea that teachers' philosophy plays an important role in shaping teachers' characteristic patterns of instructional behaviour.

Ernest (1989), stated that teachers' philosophy regarding mathematics, other subject matter, pedagogy, curriculum, classroom management, context of teaching, and education all influence a teacher's choice of instructional methods. Wilkins (2008) noted that teachers' beliefs about mathematics and mathematics instruction are very important. This is because the nature of one's mathematical knowledge may lead to a particular belief about the way that mathematics is best taught.

The second characteristic to be discussed is teachers' personality. Effective teachers, according to Borich (2000), have been found to possess certain personal and emotional qualities. Wang and Jinfu (2007) stated that an effective teacher is one who is passionate and committed to the teaching profession and is always sensitive to the social and cognitive needs of the student. Stronge et al (2007) indicated that effective teachers consistently demonstrate fairness and respect towards students. Mawhinney and Sagan (2007) noted that demonstrating courtesy, respect and fairness are the hallmarks of an effective teacher.

Stronge (2002) and Mawhinney and Sagan (2007) advocated that effective teachers have high expectations of students and are very caring and understanding. Additionally Mawhinney and Sagan (2007) stated that effective teachers have a sense of humor and possess a love of teaching, learning and children. They highlighted that one of the most important skills an effective teacher possesses is the ability to help students feel emotionally secure both inside and outside of the classroom. This skill promotes a positive teacher/student relationship. Mawhinney and Sagan (2007) further noted that teachers who allowed students to get to know the teacher as another human being have recorded a measure of success in the classroom.

The aspect of teacher qualifications and its impact on classroom practice is the next characteristic to be discussed. Stronge et al (2007) noted that effective teachers must have certain basic qualifications. Wilkins (2008) pointed out that teachers' qualifications play an important role in teachers' effectiveness and their choice of instructional practices. Wilkins (2008) further stated that variables such as degrees or diplomas earned have direct or indirect influences on classroom practice.

Qualifications in the subject area being taught are very important. According to Wenglinsky (2000), teachers who are qualified in the subject area that they teach are able to obtain better results from their students. Darling-Hammond (2000) pointed out that

teachers who are certified in their subject area are able to encourage higher levels of student accomplishment.

The next characteristic to be examined is mastery of subject content and its effect on teachers' practice. Borich (2000) stated that at the mastery stage of teaching the focus is on how best to deliver instruction. Planning focuses on improving teaching skills and achieving even greater mastery over the content being delivered. Langer (2001) proposed that successful teachers master the content of their subject area and can integrate the essential knowledge and skills their students need into their lessons. Stronge et al (2004) agreed that teachers who master their subject area become experts at sharing the necessary information with their students.

Wang and Jinfu (2007) acknowledged the fact that in order to be an effective teacher one must use cognitively appropriate mathematical content. The effective teacher should have a thorough knowledge and understanding of the material and be able to carefully craft the knowledge from the textbook for teaching. A teacher who has mastered the content is better able to design and lead coherent lessons to facilitate students' understanding.

Brooks and Suydam (1993) pointed out that teachers who mix higher and lower level objectives are more effective in the classroom. Stronge et al (2007) stated that effective teachers who master the content to be taught provide more complex instruction. These teachers place more emphasis on meaning rather than memorization. Stronge et al (2007)

further indicated that teachers who have mastered their content are able to ask higher level questions and set higher level tasks.

Experience is another factor that contributes to teachers' classroom practice. Wenglinsky (2000) explained that experienced teachers are able to realize higher levels of achievement with their students. Handal (2003) stated that a teacher reproduces his/her previous learning experiences in classroom instruction. It was further noted that as a result of ongoing experiences teachers develop beliefs about how to teach and perpetuate it in their practice.

Stronge et al (2004) suggested that experience makes a difference in teacher effectiveness. It was noted that with experience teachers improve their practice because they understand the content to be taught and the needs of their students better. Wilkins (2008) pointed out that some teachers attribute their success in the classroom to the ways they were taught or not taught. They use their experiences to either recreate successful teaching situations or to avoid unsuccessful ones.

Another factor found to contribute to teachers' classroom practice is teacher training. Raymond (1993) stated that teacher education courses influence instructional practice. Darling-Hammond (2000) highlighted the fact that teacher preparation training results in higher levels of student achievement. Lim (2002) and Wenglinsky (2002) agreed that training helps teachers acquire professional skills that lead to better student retention, attendance and academic success. Posamentier (2003) lauded the value of proper training

in helping teachers become more effective in the classroom. Stronge et al (2004) stated that the courses teachers take in teaching and education help them acquire skills and knowledge that influence the learning that takes place in their classroom.

The literature indicated that a link exists between teacher preparation and effective classroom practice. Erickson (1993) revealed results of a study which indicated that lack of preparation is an obstacle to effective practice. Brown and Rose (1995) concurred that teachers who are more prepared are better able to satisfy instructional needs. Stronge et al (2007) found that effective teachers were more organized as a result of preparation leading to efficient routines and procedures for daily tasks.

Student Characteristics

Student characteristics, as noted by Gordon, Dembo and Hocevar (2007), are highly correlated with academic achievement. Wilkins (2008) explained that student characteristics influence how the teacher implements the curriculum and have an impact on learning. Student characteristics are many and varied. The characteristics that will be examined are student's ability, level of preparedness and motivation and their support system.

Student ability is one factor that affects teachers' classroom practice. Rosenthal and Jacobson (1968) cited the results of research that indicated that student' ability results in markedly different interactions and expectations from the teacher. Van Zoest, Jones and

Thornton (1994) postulated that teachers' beliefs about the ability of their students have a significant impact on their practice.

Students' level of motivation is another contributing factor in determining teachers' classroom practice. Petty (1995) stated that motivated students possess the persistence and determination that encourage them to follow teachers' instructions. Gordon, Dembo and Hocesvar (2007) indicated that students who demonstrate self-awareness, self-monitoring, motivation, and good behaviour are more likely to perform well. This is because self-motivated and self-directed students persist at tasks set by the teacher which assists the teacher in achieving their goals and objectives.

The type and quality of support that a student receives in and out of school also influences teachers' practice. Borich (2000) noted that peer groups influence the ways students behave in class, interact with their teachers and study for tests. For students to be accepted by their peers they reconciled their actions accordingly which can work against the teacher. Zevenbergen (2003) proposed that peer groups exert powerful influences on students in and out of the classroom. Positive peer support, as noted by Petty (1995) enhances teachers' classroom practice, especially in the area of group work.

Similarly a lack of positive reinforcement and encouragement at home or in the students' community are counterproductive elements that work against the teacher being able to reach a student in the classroom. Borich (2000) stated that a learner's family is a prominent source of influence on students' approach to learning. This can contribute to

the success or failure of a teacher's practice. Petty (1995) noted that teachers' classroom practice is aided when students come from encouraging home environments.

School Characteristics

The characteristics of the school, as explained by Anderson (1997), influence how the teacher implements the curriculum and impacts on learning. School characteristics may vary depending on the school. The characteristics that will be studied are school culture and the level of stakeholder involvement the school experiences.

School culture has been found to contribute to teachers' classroom practice. Raymond (1993) pointed out that school culture plays a part in determining teachers practice. Anderson (1997) stated that school culture plays a major role in influencing teachers practice especially if their beliefs differ from the environment in which they work. He further stated that certain school cultures may effectively foster progressive practices while others may not. Teachers are sometimes forced to compromise their practice or conform in order to reduce or avoid conflict. Gordon, Dembo and Hocesvar (2007), noted that the culture of a school impacts strongly on teachers classroom practice and motivation, and on student motivation and academic behaviour.

Teachers' practice can be influenced by the level of stakeholder involvement at the school. Borich (2000) indicated that teachers are aided in achieving their objectives if there is active participation by parents, community groups and other educators. Erickson (1993) stated that non-supportive administration and parents impede effective practice.

Borich (2000) proposed that for teachers to achieve their goals genuine partnerships with stakeholders is required. He further stated that stakeholder partnerships are an essential teacher practice which result in a variety of benefits including effective instruction.

Subject Characteristics

Skemp (1978) noted that subject characteristics are influential in planning curriculum implementation and has an impact on teachers' practice and student learning. Subject characteristics may differ depending on the discipline. The characteristics that will be explored are related to the nature, content and assessment of mathematics.

The nature of mathematics has a profound effect on teachers' practice. Much can be gleaned about individuals' beliefs on the nature of the discipline by the manner in which instruction in mathematics is conducted. Skemp (1978) noted that different conceptions about the nature of mathematics account for profound differences in instructional approaches and emphases. Thompson (1984) stated that good mathematics teaching must address important issues related to the nature of mathematics. One's conception of what is mathematics leads to the type of instruction that one uses. Ernest (1989) agreed that teachers' beliefs or conceptions about the nature of mathematics exert a direct influence on their instructional practice.

Curriculum content also influences teachers' practice. Raymond (1993) stated that teachers viewed the mathematics curriculum as a factor that influenced their instructional practice. Perry, Howard and Tracey (1999) noted that teachers found curriculum demands

a limiting factor in implementing effective practice. When the pressure to complete the curriculum within a certain time frame is high teachers may opt for more teacher centered approaches to the teaching of mathematics.

The mathematics topic being taught also determines the approach selected by a teacher. Raymond (1993) reported that teachers identified the particular topic to be taught as a factor that impacted on their practice. Wilkins (2008) indicated that the value that some teachers placed on particular course content influenced the way that it was taught. The value attributed to a particular topic varies depending on the teacher and the circumstances at the time of teaching the topic.

Formal and suggested assessment activities also influence teachers' practice. Taylor (1990) indicated that teachers' awareness of having to teach for particular assessment activities and for covering the syllabus impacts on their practice. Orton (1991) suggested that teachers might decide on particular approaches to teaching in order to help students develop the skills that will be tested in different types of assessments.

According to Taylor (1990) drill and practice may be used by teachers as opposed to other approaches due to the fear of jeopardizing students' results. Raymond (1993) agreed that the pressure of formal examinations forces teachers to compromise on their practice. Handal (2003) noted that school instruction is guided by external examinations.

Policy

Existing policies play a part in determining teachers' practice. These policies can be drafted by the Ministry of Education, the school and the department. Perry, Howard and Tracey (1999) stated that despite teachers' personal philosophy there must be compromise and conformation with existing policies. Handal (2003) pointed out that there are serious implications for classroom practice if there is dissonance between teachers' beliefs and educational policy. Gordon, Dembo and Hocevar (2007) noted that policies and procedures established help teachers make important decisions about the type of practice they implement in their classroom.

Resources

Resources are another characteristic that contributes to shaping teachers' practice. Stronge et al (2007) stated that teachers who are more effective in the classroom use a variety of materials and media to support the curriculum. According to Wilkins (2008) student resources are an important part of effective teaching. Wilkins (2008) further stated that the quality and value of mathematical inquiry is enhanced by the availability of appropriate tools and materials such as manipulatives, calculators and computers.

Thompson (1985) stated that a lack of materials manifests itself as a constraining force in teachers practice. Erickson (1993) stated that teachers find the lack of availability of technology and other materials to be an obstacle to effective practice. Handal (2003) pointed out that teachers' are sometimes obligated to stick to a particular textbook and this affects the context of their instruction.

Classroom Context

In this study classroom context focuses on the physical environment of the school. According to Adler and Rodman (2000) context informs how messages are coded and how they are received. In the education system the context within which the teacher operates is vital towards achieving goals and objectives.

The physical context deals with the classroom and natural environment in which communication takes place. The classroom size, layout, lighting and ventilation set the tone for any communication which is to take place. Vygotsky (1978) noted that educators are better able to achieve their goals if there is a comfortable, stimulating and engaging environment.

The optimum size of the classroom for different subjects and the number of children to be accommodated in the room vary from subject to subject. Erickson (1993) pointed out that teachers indicated that the lack of an adequate size classroom has a negative effect on their instruction. Overcrowded classrooms, as noted by Petty (1995), can communicate chaos and confusion and impede effective practice. He further noted that special attention should be paid to subjects which require more room for student activities involving motor-skills and artistic expression so that effective practice can be facilitated.

The layout of the classroom is another aspect which requires serious consideration. The arrangement of desks and chairs, as noted by Alder and Rodman (2000), in the classroom send non-verbal messages to the students. Many different classroom arrangements are

possible and each arrangement communicates a different message to students. These messages can either hamper or enhance teachers practice.

The traditional classroom arrangement with the teacher's desk at the front and students arranged in rows conveys a message of teacher as the head and primary focus of the class and individual work as important. The circular classroom arrangement makes the teacher seem less daunting and allows for each student to have equal visual access of other students. This arrangement sends a message that each student is equal and there is no superior person in the class. The modular classroom arrangement allows for students to sit in groups and conveys the message that collaboration with peers as important. Adler and Rodman (2000) stated that layout of the classroom does impact on teacher effectiveness and student learning.

Classroom lighting and ventilation is another aspect of classroom context that has to be discussed. Petty (1995) pointed out that a poorly lit classroom does not aid teacher and student concentration and might even facilitate a feeling of drowsiness. A classroom that is too bright would negatively impact on teacher and students visual faculties and concentration. Petty (1995) noted that classroom lighting and ventilation does have an impact on teacher effectiveness and student achievement. He stated that a well lit and ventilated classroom aids teacher and student concentration and participation.

Conclusion

Literature related the role that teacher characteristics, student characteristics, school characteristics, subject characteristics, policy, resources and classroom context play in determining teachers' classroom practice have been examined. There is much more evidence to be gleaned from the literature about other factors that contribute to effective practice. Borich (2000) noted that knowledge about the factors that contribute to effective teaching will not result in an effective teacher. The effective teacher must be able to use this knowledge to help blend, orchestrate and integrate key factors that will result in effective instruction.

Stronge et al (2007) stated that by focusing on the hallmarks of effective teachers we may be better equipped to educate teachers more expertly, to set meaningful performance expectations for teachers, and to evaluate and reward teachers more fairly. Given the clear and undeniable link that exists between teacher effectiveness and student learning, the use of student achievement information, when it is curriculum based, can provide an invaluable tool to explore the classroom practices of teachers who enhance student learning beyond predicted levels of accomplishment.

Stronge et al (2007) indicated that calls for accountability are now permeating the educational environment. Therefore, more attention must be paid to the effectiveness of teachers. Moreover, given the central role that teachers have always played in successful schools, connecting teacher performance and student performance is a natural extension

of the educational reform agenda. Investigating the factors that contribute to effective classroom practice will be beneficial in guiding this educational reform.

METHODOLOGY

Research Design

Cohen and Manion (1994) stated that the relationship between two or more paired variables or sets of data is known as a correlation. This study will employ a correlational research design. Correlational studies are a form of descriptive research which fall in the quantitative research paradigm. According to Best and Kahn (2003), descriptive research is concerned with hypothesis formulation and testing, analysis of relationships between non-manipulated variables and development of generalizations or predictions.

Correlational studies are purely quantitative. This design was selected because the focus of this study is to identify the factors that contribute to effective classroom practice and try to discover if any relationships exist between the non-manipulated variables. Quantitative studies help identify the direction and magnitude of the relationship that exists between the variables. It was also pointed out that a correlation only indicates the extent to which certain events occur together it does not indicate cause and effect.

Correlational studies have many advantages in educational research. Cohen and Manion (1994) stated that correlational studies are especially useful as an exploratory tool in doing groundwork studies which is the intention of this study. They also noted that correlational studies are useful when the focus of the project is a group rather than an individual. The focus group in this study will be mathematics teachers. According to Best and Kahn (2003) correlational studies allow for research variables that already exist to be

selected and observed. The research variables to be studied will be teachers' gender, age group and environmental contexts.

Borg and Gall (1979) pointed out that several variables may contribute to a pattern of behaviour. Another advantage of correlational research is that it allows the researcher to study how variables singly or in combination may contribute to a particular pattern of behaviour. In this study the pattern of behaviour to be studied is teachers' classroom practice. According to Borg and Gall (1979) and Cohen and Manion (1994), a further advantage is that correlational studies allow for variables and their relationships to be studied in realistic settings simultaneously. This is a condition which is required in this study since the variables will be studied in individuals who are presently engaged in teaching secondary school mathematics.

Correlational studies, as noted by Cohen and Manion (1994), provide evidence about the degree of a relationship between variables instead of just determining whether an effect is present or not. This is an advantage since it allows researchers to estimate the probable accuracy of their predictions or generalizations. This study will help determine the degree of the relationship if any, that exists between teachers' gender, age group and environmental contexts and their perceptions of effective classroom practice.

Borg and Gall (1979) pointed out that there are some disadvantages to correlational studies. One criticism is that it attempts to break down complex behaviour into simpler components. Stronge (2002) stated that effective classroom practice results from complex

behaviour. Borg and Gall (1979) highlighted that it is debatable whether breaking down complex characteristics into smaller elements will be meaningful. This study aims to identify the elements that contribute to the complexity of effective classroom practice. Mention should be made of the fact that identifying elements that contribute to effective classroom practice may still not be able to generate effective practice. As noted by Stronge (2002) acquiring all or most of the skills required to be effective in the classroom is not a guarantee of effectiveness.

Borg and Gall (1979) stated that another disadvantage of correlational studies is that even if there is evidence of a relationship a number of undetermined factors may still have contributed to the phenomenon under study. Behaviour patterns are so complex that careful interpretation of correlational data is required. In this study the factors examined are not exhaustive and there may be many unidentified factors which can contribute to effective practice.

Sampling Procedure

The participants for this study will be selected using purposive sampling. Best and Kahn (2003) defined the term purposive sampling as the process where individuals or cases are selected based on the fact that they can provide the information needed to address the purpose of the research. In purposive sampling the researcher specifies the characteristics of a population of interest and then tries to locate entities with those characteristics. According to Cohen and Manion (1994) handpicking the cases to be included in the

sample allows the researcher to select a sample that satisfies the specific needs of the study.

The population for this study will comprise all the secondary school mathematics teachers in Trinidad. The sample selected will cater to all the variables that are to be investigated in this study. Teachers in the sample will be of different genders and age groups, teach in different types of schools (government, government assisted or private) and the schools will be located in different areas (urban, sub-urban or rural). Best and Kahn (2003) pointed out that, careful sampling procedures must be employed so that generalizations can be made.

Sample Size

Best and Kahn (2003) indicated that sample size is one feature of a study design that has a significant influence on the detection of differences, relationships or interactions. This is of particular importance since this study is aimed at discovering if any relationships exist between teachers' perceptions of effective classroom practice and their gender, age grouping and environmental contexts. Bartlett, Kotrlik and Higgins (2001) stated that sample size influences the quality and accuracy of research.

The sample size selected is influenced by a number of factors. Cohen and Manion (1994) stated that the number of variables to be analyzed always informs the decision about sample size. They indicated four issues that must be taken into consideration when deciding on sample size. The researcher must decide upon the confidence required in the

data, the margin of error that can be tolerated, the type of analyses to be undertaken and the size of the population. Additionally, Saunders et al (2003) pointed out that for research involving questionnaires a calculation of the response rate must be taken into consideration when determining sample size

The hypotheses for this study will be tested at a 95% confidence interval. According to Bartlett et al (2001) and Saunders et al (2003), this level of significance is acceptable in most educational research studies. Bartlett et al (2001) and Saunders et al (2003) developed tables with all the relevant calculations necessary for determining sample size. The calculations take into consideration the population size, the level of significance required and the type of data to be collected. These tables will be consulted when determining the sample size for this study.

According to Bartlett et al (2001) the use of an adequate sample in conjunction with high quality data collection will generate more reliable, valid and generalizable results. When the sample for this study is decided upon it must contain adequate numbers of individuals representative of each of the variables under study, i.e. gender, age group and environmental contexts to allow for multiple correlational analysis.

Method of Data Collection

A questionnaire will be used to collect the data for the study. According to Best and Kahn (2003) a questionnaire is a data-gathering instrument which requires respondents to answer questions or respond to statements in writing. Different types of questionnaires

exist. The one to be used in this study is an opinionnaire. An opinionnaire is a specific type of questionnaire that asks for respondents' beliefs or feelings, i.e. their opinion on a particular topic.

The format of the questionnaire will involve the use of a Likert scale. According to Gay and Airasian (2003) this scale requires respondents to indicate whether they strongly agree (SA), agree (A), are neutral (N), disagree (D) or strongly disagree (SD) with a series of statements. The questionnaire to be used will also request biographical and demographic data from respondents. This data is required so that analysis can be carried out to determine if the opinions indicated about effective classroom practice are related to characteristics such as age, gender and environmental context.

As a method of data collection questionnaires have been noted to have many advantages. Best and Kahn (2003) stated that administering a questionnaire personally allows an individual the opportunity to establish rapport with respondents. This would allow the researcher to explain the purpose of the study and clear up any misunderstanding regarding items. Additionally, Best and Kahn (2003) stated that using a questionnaire to collect data saves time and expense with the added advantage of obtaining a large quantity of usable responses. A questionnaire once properly constructed and administered is a very useful and appropriate source of data collection

Research has shown that there are limitations associated with using a questionnaire to collect data. Best and Kahn (2003) noted that despite a guarantee of anonymity and

confidentiality respondents may conceal their true feelings on a questionnaire. It was also noted that respondents may give what they perceive to be socially acceptable responses. Additionally, the issues addressed in the questionnaire may not be ones that respondents have given serious thought to previously and they may just report their feeling at the time of completing the questionnaire. Furthermore, if the issues addressed in the questionnaire are not in respondents' realm of experience they may be unaware of how they truly feel about it.

The limitations mentioned above have serious implications for research. Using a questionnaire as a data collection instrument for this study may result in a mismatch between teachers' beliefs and practice. According to Thompson (1984) sometimes a lack of congruence exists between teachers professed beliefs and their actual practice. This could result from changing beliefs and different internal and external factors. Careful analysis of the data obtained is therefore necessary. Any conclusions drawn in this study must be made with the awareness that it is possible to have a disparity between what teachers believe constitutes effective practice and what is actually done.

Data Analysis

In this study a variety of methods will be used to analyze the data. The data will be analyzed through the use of descriptive statistics, analysis of the Likert scale and multiple correlational analysis. The descriptive statistics to be used may include percentages, frequencies, mean and mode. This will help describe and summarize the information collected as well as help in the identification of patterns in the data.

Analysis of the Likert scale will require responses to be assigned a point value. For positively phrased statements the points will be assigned as follows: SA = 5, A = 4, N = 3, D = 2 and SD = 1. The scores will be reversed for negatively phrased statements. An individual's score is collated by summing the point value for each statement. High total scores will indicate a positive attitude to the topic being investigated and vice versa.

Best and Kahn (2003) pointed out that some limitations exist in using the Likert scaling technique to analyze data. Firstly the interval between the responses 'Strongly agree', 'Agree', 'Neutral', 'Disagree', and 'Strongly disagree' may not be consistent. Also it is possible that respondents can obtain equal scores even though they have different combinations of responses. Therefore equal scores do not necessarily indicate equivalent positions.

A correlation coefficient will be calculated to indicate the degree of the relationship that exists. According to Borg and Gall (1979) a correlation coefficient is a statistical tool that helps provide researchers with answers to questions about relationships between variables. The correlation coefficient will express the degree of relationship between variables in a mathematical form.

Cohen and Manion (1994) stated that the magnitude of the correlation coefficient must be substantial to permit valuable and accurate predictions or generalizations. The numerical value of the correlation coefficient will determine the strength and the direction of the

relationship between variables. A high correlation will indicate a high relationship and vice versa.

The study will be carried out at a 95% confidence interval so that the correlation coefficient will have statistical significance. Borg and Gall (1979) stated that statistical significance indicates that one can be reasonably confident that a true relationship exists between the variables. According to Cohen and Manion (1994) statistically significant correlation coefficients indicate actual relationships rather than chance ones. It should be noted that it is possible to have a low correlation even though it is statistically significant.

INSTRUMENT DEVELOPMENT

The instrument development process constituted the major part of this report. Instrument development is intimately related to the general plan or design of the study. According to Oppenheim (1966) a questionnaire is a scientific instrument that has to be specially designed following particular specifications with specific aims in mind. The data collection instrument for this study was designed to gather data related to teachers' perceptions of the factors that contribute to effective classroom practice. The data was obtained in a quantitative form to facilitate analysis.

Questionnaire Development

Best and Kahn (2003), stated that a good questionnaire requires careful preparations and involves a great deal of time, ingenuity and hard work. Cohen and Manion (1994) as well as Best and Kahn (2003) pointed out that a questionnaire must not be too long or tedious to complete. Also, if items are vague and ambiguous or the questionnaire does not have an encouraging format the result can be a poor response rate or a low quality of responses. The data thereby obtained will be of low validity and will not provide a strong basis for generalization.

In developing the questionnaire for this study (see Appendix 1) guidance was sought from the literature, colleagues, peers in the field of research and the faculty advisor assigned to the study. They provided feedback regarding the format of the questionnaire, the instructions and the items included. Oppenheim (1966) pointed out that in developing

a questionnaire one has to think not just about wording of particular questions, but first and foremost, about the design of the investigation as a whole. Cohen and Manion (1994) stated that there are different stages in questionnaire development.

DESIGN OF QUESTIONNAIRE

The focus of this study was to investigate teachers' perceptions of the factors that contribute to effective classroom practice. In the development of the questionnaire careful attention was paid to fact that the questionnaire must focus on obtaining data related to answering the research questions. Cox (1996) proposed that the first stage in the process of developing a questionnaire is to identify the questions that will guide development of the questionnaire. He noted that for graduate students using a questionnaire in a thesis the questions to be answered in stage one of questionnaire construction are likely to be the research questions for which the questionnaire is deemed appropriate.

After reviewing the literature relevant to this study factors found to contribute to effective classroom practice were presented to respondents in the questionnaire. This approach was decided upon as opposed to asking respondents to identify factors that they think contribute to effective classroom practice. This was done because the literature and published research had identified an overwhelming number of factors that contribute to effective practice. According to Cox (1996), obtaining input from the literature and specialists in the particular area of interest helps in the development of the questionnaire.

This study employed a purely quantitative design so the questionnaire was designed to collect data that can be analyzed quantitatively. The questionnaire was used to collect respondents' opinions about the factors that contribute to effective classroom practice. The type of questionnaire used in this study was an opinionnaire. An opinionnaire is a specific type of questionnaire that asks for respondents' beliefs or feelings, i.e. their opinion on a particular topic. Oppenheim (1966) pointed out that the design of the study and the issues to be investigated inform decisions about the type of questionnaire to be used.

A closed-form questionnaire was selected for use. It was decided that a closed-form questionnaire was best suited for the data collection in this study because the responses obtained would be in a structured form that can be analyzed quantitatively. According to Best and Kahn (2003) a closed form questionnaire requires short, check-mark responses that can be easily analyzed.

Best and Kahn (2003) indicated that there are many advantages of a closed-form questionnaire. These include that it is easy to complete, not very time consuming, keeps the respondent on the subject, is reasonably objective and moderately easy to analyze. It was further indicated that closed-form questionnaires are more likely to be completely filled out by respondents.

An open ended response section was included in the questionnaire. This provided respondents with the opportunity to identify any omitted factors they felt would have

contributed to effective classroom practice. Even though a review of the literature was done to help identify factors that contribute to effective classroom practice it was likely that the list generated was not exhaustive. Best and Kahn (2003) suggested that when a closed-form questionnaire is utilized it is advisable to make some provision for unanticipated responses.

A closed-form questionnaire was decided upon even though there are disadvantages associated with its use. The planning involved in developing and revising the instrument for data collection was geared towards minimizing any disadvantages. Best and Kahn (2003) noted that one disadvantage of closed-form questionnaires is that due to the limited range of options for respondents to choose from misleading conclusions may be drawn. It was further noted that there is no opportunity to qualify or clarify responses. In order to address these disadvantages careful analysis of the data obtained will be conducted to reduce the likelihood of drawing misleading conclusions.

In designing the questionnaire it was ensured that the participants were not requested to fill in or sign their name anywhere on the instrument. This was done in an effort to promote confidentiality and anonymity. Data obtained by means of questionnaires, as noted by Oppenheim (1966), must always be regarded as confidential. He stated that that no responses or findings should ever be published which could be traced back to the respondents or institution where research was conducted. Cox (1996) pointed out that persons completing the questionnaire should not be asked for or requested to sign their names.

ITEM WRITING

In developing the questionnaire writing items was of paramount importance. Oppenheim (1966) noted that at this point it is important to think well ahead to the analysis stage. Thinking ahead may help to simplify questions. Oppenheim (1966) noted that in writing questions or statements the researcher must try to avoid putting ideas into respondents' minds since it could lead to inaccurate data being collected.

Several precautions were taken in developing the items for the questionnaire following suggestions from Best and Kahn (2003). An attempt was made to use words and phrases that could not be easily misinterpreted and to omit the use of descriptive adjectives and adverbs such as 'frequently', 'occasionally' and 'rarely' which have no clear boundaries. Care was taken to develop statements that had no double negatives and were not double-barreled. A specific number of statements were provided to make it easier to summarize the results. An effort was also made to avoid leading statements. Rewriting and rephrasing items was done as often as necessary based on feedback from colleagues, peers and specialists in the field.

Cox (1996) stated that for data to be accurate the items in the questionnaire must be precise and not open to various interpretations. A very important aspect of questionnaire development highlighted by Best and Kahn (2003) is clarity of the questions. Care must be taken to ensure that the right questions are asked and are phrased properly in order to obtain the desired data. Words must be carefully selected as the same word may hold

different meanings and interpretations for different people. The language used must not be too technical or colloquial.

For this study the factors found to contribute to effective classroom practice were gleaned from the literature. These factors were then organized into seven major categories: teacher characteristics, student characteristics, school characteristics, subject characteristics, policy, resources and classroom context. A set of statements was then developed for each category to help identify respondents' attitude to the role that each category plays in contributing to effective classroom practice. The number of statements developed for each category was based on the amount of supporting literature that was found on the topic.

The statements in Section B of the questionnaire were structured and randomly distributed according to the suggestions made by Oppenheim (1966). Respondents' attitude to the role that teacher characteristics play in contributing to effective classroom practice was measured using 9 items. These items can be found in statement numbers 2, 6, 7, 16, 19, 25, 28, 31 and 33. Six items were used to determine respondents' feelings about the role that student characteristics play in determining effective classroom practice. These items can be found in statement numbers 10, 12, 18, 22, 26 and 38. To determine respondents' attitude to the role that school characteristics play in contributing to effective classroom practice four items were used. These items can be found in statement numbers 1, 13, 21 and 24.

Respondents' attitude to the role that subject characteristics play in determining effective practice was ascertained from 5 items. These items can be found in statement numbers 9, 17, 23, 30 and 37. The role that policy plays in contributing to effective classroom practice was investigated using 6 items. These items can be found in statement numbers 3, 5, 8, 15, 34 and 35. Respondents' attitude to the role that resources play in determining effective classroom practice was examined using 5 items. These items can be found in statement numbers 11, 27, 32, 36 and 39. Four items were used to identify respondents' attitude to the role that classroom context plays in contributing to effective classroom practice. These items can be found in statement numbers 4, 14, 20 and 29.

The statements used in Section B of the questionnaire were attitude statements. It was noted that sets of statements give more consistent results mainly because vagaries of wording will probably apply only to particular items and thus any bias may cancel whereas the underlying attitude will be common to all the items in a set or scale. The best guide to the writing of attitude statements, as noted by Oppenheim (1966), is to develop ones that are meaningful and interesting, even exciting to the respondents. According to Oppenheim (1966) sets of questions are more reliable than single items. He noted that researchers should not rely on single statements when measuring attitudes important to the study.

By using sets of statements, provided they all relate to the same attitude, Oppenheim (1966) noted that the researcher maximizes the more stable components while reducing the instability due to particular items, emphasis and mood changes. Cox (1996) stated

that there should be roughly equal number of items dealing with each main aspect of the attitude.

FORMAT OF THE QUESTIONNAIRE

In determining the format of the instrument attention was paid to the length, appearance, spacing, alignment, font type and size, sectioning and sequencing of the items. The questionnaire was formatted to fit on three pages. Cohen and Manion (1994) suggested that a questionnaire should not be longer than three pages. Anything longer than that dissuades respondents from attempting to complete the entire questionnaire.

In the development of the questionnaire attention was paid to spacing and alignment of items to avoid a jumbled appearance. The font selected was Times New Roman, size twelve. Time was spent to ensure that the appearance of the questionnaire was aesthetically pleasing. Response choices were neatly aligned.

It was decided to organize the questionnaire for this study into three sections. Section A requested biographical and demographic data from respondents. Respondents were asked to indicate their gender, age grouping, the location and type of school at which they work. This information was required so that analysis can be carried out to determine if the opinions indicated about the factors that contribute to effective classroom practice were related to characteristics such as gender, age and environmental context.

A major consideration in deciding on the format for Section A, included whether respondents will be asked to place a tick or circle their selection. Eventually it was decided that respondents will be asked to place a tick as some of the selections would have been too cumbersome to circle. Also, Cohen and Manion (1994) stated that respondents are encouraged and guided by simple instructions such as 'Place a tick' and are more likely to respond.

Attention was also paid to the groupings that were used for the age range. This is because respondents needed to feel comfortable indicating the age group that they belong to. Oppenheim (1966) pointed out that asking respondents for their age is a sensitive area. A certain amount of embarrassment is associated with indicating age and the researcher must consider what is going to be done with this information. Petty (1995) noted that the researcher need not ask respondents for their exact age, they should merely be asked to indicate their age grouping. Information about respondents' age was required in this questionnaire to facilitate analysis about whether teachers from different age groups shared similar perceptions of effective classroom practice. Age groupings were used in an effort to reduce any embarrassment for respondents.

Section B of the questionnaire addressed the factors that contribute to effective classroom practice. The format of this section involved the use of a Likert scale. The Likert scale required respondents to indicate whether they strongly agree (SA), agree (A), are neutral (N), disagree (D) or strongly disagree (SD) with a series of statements. This questionnaire

required respondents to place a tick indicating their level of agreement to a series of statements.

This questionnaire was developed for administration to groups of mathematics teachers and the data obtained must be analyzed quantitatively so a Likert scale format was very appropriate. Oppenheim (1966) stated that a Likert scale format is suitable for questionnaires that will be administered to groups. It was further stated that this format allows for some kind of score to be calculated. Section C of the questionnaire consisted of an open response section.

Another aspect of format involved sequencing of the items on the questionnaire. Section A of the questionnaire requested factual information and Section B dealt with attitudinal items. Oppenheim (1966) noted that sequencing of items in a questionnaire is of paramount importance. He suggested that researchers may wish to start with some factual questions followed by attitudinal ones.

The sequencing of the actual items in Section B required special attention. The statements were selectively placed in a sequence that was designed to stimulate interest and a willingness to complete and return the questionnaire. Oppenheim (1966) suggested that initial statements should be simple and have high interest value to encourage respondents to continue completing the questionnaire. The middle section may contain more challenging items and the statements in the end must be of high interest value to

encourage return of the completed instrument. Cox (1996) suggested that the items be scrambled by putting them more or less in random order.

Format development, as noted by Cox (1996), determines the overall impact of the questionnaire. The respondents' attitude towards a questionnaire is often determined at first glance by how the form looks and not by what it contains. The format of a questionnaire contributes greatly to the success of the instrument for data collection. Cohen and Manion (1994) stated that the format of the questionnaire must maximize cooperation from respondents. From the beginning the respondent must be encouraged to continue completing the questionnaire. Format includes length of form, grouping items, spacing, type style, lining up items and response spaces.

WRITING INSTRUCTIONS

Another area that required special attention was the development of the instructions for the questionnaire. Instructions were highlighted in bold and clearly displayed. This was in an effort to ensure that they were easily identified. Instructions were kept simple and clear and were strategically placed at the beginning of each section in the questionnaire. Oppenheim (1996) noted that each questionnaire must contain instructions for the respondents. According to Cohen and Manion (1994) instructions should be clear and uncomplicated. Also instructions must be repeated as often as necessary stated Cohen and Manion (1994). This ensures that respondents know exactly what is required of them.

ALIGNMENT CHECK

Upon completion the questionnaire for this study was cross-referenced with the literature, colleagues, peers and the faculty advisor to establish if it was ready to be pilot tested. Cox (1996) stated that a critical aspect of questionnaire construction involves cross-referencing. The proposed questionnaire items must be checked to ensure that they are in alignment with the research questions of the study.

Pilot testing

The instrument was pilot tested as a part of the refining and revising process. Oppenheim (1966) noted that pilot testing a questionnaire provides feedback regarding the wording of the statements, ordering of question sequences and the reduction of non-response rates. He further pointed out that weaknesses in the design are frequently not realized until the results have to be analyzed. It is therefore important to pilot test the questionnaire to improve its quality.

THE SAMPLE

In order to obtain the sample for the pilot test data pertaining to the population for the study, the number of mathematics teachers in secondary schools, was obtained from the Ministry of Education Planning Division (see Appendix 2). The only data available was from a 2005-2006 survey. It was decided to sample 20% of the mathematics teachers due to the fact that the data was not up to date and also because Bartlett et al (2001) recommended over sampling when using questionnaires for data collection. They

regarded this as a necessary, although sometimes costly, precaution to cater for unreturned questionnaires.

Best and Kahn (2003) pointed out that pilot testing with a sample of individuals representative of those to be used in the study would help determine if the instrument is yielding the type of data required for the study. An assessment of the reliability and validity of the instrument can then be undertaken. Further revisions can then be made before using the instrument to collect data for the study.

The best way to appraise a questionnaire, as noted by Oppenheim (1996), is to pilot test it with a sample which is similar to those in the main study. Cohen and Manion (1994) indicated that pilot testing helps determine the response rate for the instrument which is an important feature required when deciding on sample size for the study. They recommended a sample size of 5% to 10% of the final sample number for the pilot test.

SAMPLING PROCEDURE

Purposive sampling was used to select the individuals for pilot testing (see Appendix 3). Individuals selected for the pilot test were of different genders, from different age groups and taught in different types of schools from various locations. Oppenheim (1966) indicated that the members of the sample selected must cater to all the variables under study. Apart from completing the questionnaire the individuals in the pilot test were asked how long they took to answer the questionnaire, if they found the format appealing,

if the instructions and the statements were ambiguous or not, if they had any objections to items and for any recommendations they might have.

ADMINISTRATION OF THE QUESTIONNAIRE

Permission was requested in writing from the principal of each school where the instrument was being pilot tested (see Appendix 4). The target group for completing the questionnaire was identified i.e. members of the mathematics department. The principal was provided with an explanation of the purpose of the study and a copy of the instrument. Where possible the support of the head of the mathematics department was also solicited.

When conducting a pilot test it is essential that permission be obtained before administering the questionnaire. Cohen and Manion (1994) stated that this is an ethical issue that must be addressed. One must obtain access to the institution where the research will be conducted and get approval from the relevant authorities before data collection can begin. Cohen and Manion (1994) suggested that obtaining permission from the head of an organization may result in the added benefit of a better response rate for the questionnaires. This is because the heads of an institution may be able to elicit co-operation from the individuals who are required to participate in the study.

A covering letter, explaining the purpose of the study, was attached to the questionnaire (see Appendix 5). In addition to explaining the purpose of the study and requesting respondents' assistance by completing the questionnaire a phone contact was also

included in the cover letter. This facilitated respondents being able to contact the researcher in the event that anything needed to be clarified and also to let the researcher know when the completed questionnaires could be collected. Cohen and Manion (1994) indicated that a cover letter providing the aim, nature and procedure of the research is another ethical requirement. Cohen and Manion (1994) stated that the letter should be brief.

INSTRUMENT ANALYSIS

In conducting a study a researcher should ensure that the data collected reflects what is true. The research must have confidence and accuracy and the findings must have credibility. Cox (1996) noted that in order to achieve these objectives the data collection instrument utilized must be good.

Oppenheim (1966) highlighted the fact that after the information from the pilot test has been collected the researcher is in a much better position to review the design of the questionnaire in order to make alterations. With this in mind the questionnaire was analyzed to determine if it met the criteria to be classified as “good”.

The questionnaire developed possessed some of the characteristics of a “good” questionnaire as outlined by Best and Kahn (2003). The topic was recognized as being important enough for respondents to spend time completing the questionnaire. This was ascertained through the many requests to present a summary of the findings when the study was completed. However, participants should be made aware that a summary of the findings will be made available to them without their request.

The format of the questionnaire was evaluated as being adequate. No complaints were received about it being time consuming or tedious to complete. Respondents indicated that the questionnaire was neatly aligned and printed clearly. The directions provided for filling out the questionnaire were followed suggesting that the instructions were clear and

complete. It was noted however that within a given school many of the respondents gave different responses for the location of their school. This indicated that some clarification is required for respondents to be able to identify whether their school is urban, sub-urban or rural.

Based on the feedback from the pilot test the statements elicited the required information and the statements were not deemed to be ambiguous or leading. It was indicated that the statements were objectively phrased and each statement dealt with a single idea. Oppenheim (1966) noted that the pilot test can be of the greatest help in devising the actual wording of questions and it operates as a healthy check. He pointed out that critical ambiguities may lurk in the most unexpected areas. Some questions may go through as many as eight revisions before producing satisfactory results.

In analysis of the questionnaire Oppenheim (1966) pointed out that the researcher must identify whether a statement needs rewording. He noted that the researcher must always try to see whether the responses give the required information. A poor statement will produce a narrow array of responses or it may be unclear in content or ask for data which the respondent does not have or cannot remember. Also it could be a leading question which biases the responses.

Analysis of the pilot test revealed that responses were provided for all the statements on the questionnaire. It was noted that there was a predominance of 'strongly agree' and 'agree' responses. However, only about 10 percent of the overall responses were neutral.

Oppenheim (1966) indicated that analysis of the responses obtained is required to determine whether the attitude statements developed were useful. He noted that a questionnaire is on a bad path when many of the respondents omit or cross out statements or when there is a predominance of neutral responses. Cox (1996) pointed out that a good sign in pilot testing is when respondents make use of the strongly agree and strongly disagree options.

This questionnaire provided attitude selections from one extreme to the next however it was found that the statements were only positively phrased. This could be the reason why the majority of responses were 'strongly agree' and 'agree'. Oppenheim (1966) pointed out that a questionnaire should have approximately the same number of positive and negative statements dealing with each main aspect of the attitude being studied. It was noted that the statements should address attitudes from one extreme to the next.

Some additional recommendations were made by respondents in the pilot test. It was suggested that the cover letter should encourage respondents to fill out the questionnaire by making them aware of the importance of the study to the profession instead of just providing information on what the study is about. It was also indicated that the cover letter should inform respondents that participation is not compulsory and that all the data obtained will be confidential.

Instrument Validity

The information obtained from the pilot test will help determine the validity of the questionnaire. The most important characteristic a measuring instrument can possess is validity. Cox (1996) stated that an instrument is valid if it measures what it is intended to measure. Validating an instrument, as noted by Cox (1996), enhances the credibility of the findings when the study is conducted. Gay and Airasian (2003) pointed out that a valid instrument allows the researcher to make appropriate interpretations. Instrument validation therefore must be undertaken after development of the questionnaire and before administration.

Validity, stated Gay and Airasian (2003), is specific to the desired interpretation of the data and to the group under study. Evidence must be collected to support the desired interpretation. Validity is best thought of in terms of degree ranging from highly valid to generally invalid. Different types of validity exist and the types of validity relevant to the questionnaire being administered will now be discussed.

It was established that this questionnaire possessed face validity based on the feedback obtained from peers, colleagues and the faculty advisor. The instrument developed appeared to contain items pertinent to the purpose of the study. Face reliability according to Borg and Gall (1979) refers to the subjective judgment that the instrument appears to contain items that are appropriate for what the instrument is supposed to measure. This would indicate that the instrument appears to contain relevant content. Gay and Airasian

(2003) noted that determining face validity is just a screening procedure to be employed before going on to establish content validity.

Establishing content validity is an essential part of instrument validation. Cox (1996) noted that an instrument has content validity if it contains appropriate content pertaining to the purpose of the study. Gay and Airasian (2003) stated that content validity involves item validity and sampling validity. Item validity refers to whether the items are relevant to measure the intended content area and sampling validity refers to how well the total content area is being sampled.

Item validity for this questionnaire was catered for when the items were being developed. Items on the questionnaire were developed that would yield the information required regarding the purpose of the study. Attention was also paid to phrasing in an attempt to reduce ambiguity, confusion and misinterpretation. According to Best and Kahn (2003) these basic precautions enhance the validity of the instrument.

In order to establish sampling validity Cox (1996) advised that the contents of the instrument be cross-referenced with elements found in the literature to see if there is a match or not. Gay and Airasian (2003) recommended that the bounds of the content area be clearly identified and examined for completeness when constructing the measuring instrument. Upon examination a match was found to exist between the contents of the instrument and the literature. However, the content area examined was not complete as many respondents made suggestions in the open response section.

The feedback from the pilot test indicated that the instrument possessed content validity. Borg and Gall (1979) stated that content validity is appraised very objectively. Specialists in the field and individuals with experience in the topic of the study should be approached for their recommendations in order to determine content validity. Gay and Airasian (2003) indicated that content validity relies on expert judgment and cannot be computed or expressed quantitatively.

Instrument Reliability

An instrument is deemed to be reliable if it consistently elicits the same results or responses over time. Cox (1996) stated that this is a very important challenge for questionnaire developers. According to Gay and Airasian (2003) the more reliable an instrument is the more confidence we can have in the data obtained from it. A degree of measurement error is to be expected. However, Gay and Airasian (2003) stated that the smaller the amount of error the more reliable the instrument.

Gay and Airasian (2003) pointed out that reliability is usually expressed numerically as a reliability coefficient. A high reliability coefficient implies a high reliability which indicates that the error measurement is small. Reliability works in conjunction with validity to determine the suitability of a measuring instrument.

The questionnaire was analyzed for internal consistency reliability. Gay and Airasian (2003) stated that internal consistency reliability refers to consistency among the items on the questionnaire. The split half method was used to assess the internal consistency

reliability of the questionnaire. It requires only one administration of the instrument and therefore minimizes measurement errors by eliminating differences in administration conditions. The internal consistency reliability provides an estimate of how well the items on the questionnaire related to all other items and to the overall questionnaire.

The split half method involved correlating the scores on the even items against the odd items on the instrument. Pearsons' product moment correlation coefficient was calculated. The coefficient of reliability was calculated to be 0.72 (see Appendix 6). The Spearman-Brown prophecy formula was applied to correct this value since the split half method yields lower correlations as a result of reducing the size of the instrument by half. The final coefficient of reliability was calculated to be 0.84 (see Appendix 6). Gay and Airasian (2003) stated that a coefficient of reliability greater than 0.8 is considered to be good.

Since the coefficient of reliability obtained was greater than 0.8 this indicated that the questionnaire developed possessed good internal consistency reliability. The items on the questionnaire related well to each other and to the questionnaire overall.

INSTRUMENT REVISION

The revised questionnaire for this study (see Appendix 7) was developed based on the analysis done after pilot testing. Lazim et al (2002) suggested that revision of data collection instruments should be done rigorously in order to produce a more reliable and comprehensive tool. Based on the analysis of the instrument after the pilot test it is imperative that, where necessary, revision of the questionnaire be undertaken.

The cover letter of the questionnaire was one area that needed revision. Respondents noted that the cover letter should increase participant awareness of the importance of the study to the teaching profession. Other recommendations made were that participants should be made explicitly aware that it is not compulsory to participate in this study and they should know that all information collected would be anonymous and confidential. It was also suggested that the cover letter indicate that a copy of the findings will be made available to respondents. These recommendations were taken into consideration and the cover letter was revised.

In Section A of the questionnaire some clarification was required on the location of schools since respondents gave varying answers on the location of a particular school. This suggested that specifications needed to be included to guide respondents in deciding whether a school is urban, sub-urban or rural. An urban school was described as a school located within a city or town. A sub-urban school was described as one located within a

20 kilometer radius of a city or town and a rural school as one located further than 20 kilometers from the nearest city or town.

Oppenheim (1966) noted that there should be an almost equal number of positively and negatively phrased statements. Due to the fact that the majority of responses were 'strongly agree' and 'agree' the decision was taken to review the phrasing of some of the statements in Section B. The large proportion of 'strongly agree' and 'agree' responses could have been as a result of the majority of statements being positively phrased.

CONCLUSION

The main focus of the study, at this stage, was on the development of the data collection instrument. Assistance was sought from the literature as well as from, colleagues, peers and the faculty advisor for this project on the development of questionnaires. It was noted that the process of developing, pilot testing, analyzing and reviewing the data collection instrument is a very important feature in implementing a study.

It was gleaned from the experience that working on the data collection instrument allows the researcher the opportunity to explore and refine many areas of the study. This is because the data collection instrument is the key to ensuring a smooth flow from the design of the study to analysis of the findings. It is extremely important therefore that the data collection instrument be appropriate for the intended study.

It is hoped that with the attention paid to the development and revision of the data collection instrument that the instrument will be adequate to address the concerns and meet the needs of this research as the study is implemented.

REFERENCES

- Adler, R. & Rodman, G. (2000). *Understanding human communication*. New York: Oxford University Press.
- Anderson, J. (1997). Teachers' reported use of problem solving teaching strategies in primary mathematics classrooms. In F. Biddulph & K. Carr (Eds), *People in mathematics education*. Proceedings from the 20th Annual Conference of the Mathematics Education Research Group of Australia, (pp50-57). NZ: MERGA.
- Baldeosingh, K. (2008, August 24). CXC, GCE and the lure of cheating. *Sunday Newsday*, p.8.
- Bartlett, J., Kotrlik, J., & Higgins, C. (2001). Organizational research: Determining appropriate sample size in survey research. *Information technology, Learning and Performance Journal*, 19(1), pp. 43-50.
- Best, J. & Kahn, J. (2003). *Research in education*. Boston: Pearson Education Inc.
- Beswick, K., Watson, J., & Brown, N. (2007). Teachers' beliefs that matter in secondary mathematics classrooms. *Educational Studies in Mathematics*, 65(1), pp. 95-120.
- Blackhouse, J., Haggarty, L., Pirie, S., & Stratton, J. (1992). *Improving the learning of mathematics*. Portsmouth: Heinemann.
- Borg, W. & Gall, M. (1979). *Educational research*. NY: Longman Inc.
- Borich, G. (2000). *Effective teaching methods*. New Jersey: Prentice-Hall Inc.
- Brooks, K. & Suydam, M. (1993). Planning and organizing curriculum. In P. Wilson (Ed.) *Research Ideas for the Classroom*. New York: Macmillan.

- Brown, D. & Rose, T. (1995). Self-reported classroom impact of teachers' theories about learning and obstacles to implementation. *Action in Teacher Education*, 17 (1), pp.20–29.
- Bynner, J. & Steedman, J. (1995). *Difficulties with basic skills. Findings from the 1970 British cohort study*. London: Basic Skills Agency.
- Caribbean Examination Council. (2001). *Mathematics syllabus*. Barbados: CXC.
- Caribbean Examination Council (2004). *Report on candidates' work in the secondary education certificate examination*. Barbados: CXC.
- Caribbean Examination Council (2005). *Report on candidates' work in the secondary education certificate examination*. Barbados: CXC.
- Caribbean Examination Council (2006). *Report on candidates' work in the secondary education certificate examination*. Barbados: CXC
- Caribbean Examination Council (2007). *Report on candidates' work in the secondary education certificate examination*. Barbados: CXC
- Caribbean Examination Council. (2007). *The Caribbean Advanced Proficiency Examination. Applied mathematics syllabus*. Barbados: Xpress Litho Ltd.
- Chee Mok, I. (2007). Research on classroom practice.
Retrieved July 20, 2008 from
<http://tsg.icmel1.org/tsg/show/25>.
- Clark, C. & Peterson, P. (1986). Teachers' thought process. In M. Wittrock (Ed.), *Handbook of research on teaching*. New York: Macmillan.
- Cohen, L. & Manion, L. (1994). *Research methods in education*. London: Routledge.

- Cooney, T., Brown, S., Dossey, J., Schrage, G., & Wittmann, E. (1999). *Mathematics, pedagogy, and secondary teacher education*. Portsmouth: Heinemann.
- Cox, J. (1996). *Your opinion, please! How to build the best questionnaires in the field of education*. California: Corwin Press, Inc.
- Creemers, B. (1994). *The effective classroom*. London: Cassell.
- Darling-Hammond, L. (2000). Teacher quality and student achievement: A review of state policy evidence. *Educational Policy Analysis Archives*, 8(1).
- De Corte, E. & Op't Eynde, P. (2002). Construct consistency in the assessment of students' mathematics.
- Retrieved July 20, 2008 from
<http://www.tsg.icmell.org/document/get/413>.
- Elliot, S., Kratochwill, T., Cook, J., & Travers, J. (2000). *Educational psychology: Effective teaching, effective learning* (3rd ed.), 332-334. United States of America: McGraw Hill Companies Inc.
- Erickson, D. (1993). *Middle school mathematics teachers' view of mathematics and mathematics education, their planning and classroom instruction, and student beliefs and achievement*. Proceedings of the Annual Conference of the American Educational Research Association. Atlanta, Georgia. (ERIC Document Reproduction Service No. ED364412).
- Erikson, E. (1950). *Childhood and society*. New York: Norton.
- Ernest, P. (1989). The knowledge, beliefs and attitudes of the mathematics teacher: A model. *Journal of Education for Teaching*, 15(1), pp.13-33.

- Ernest, P. (1991). Mathematics teacher education and quality. *Assessment and Evaluation in Higher Education*, 16(1), pp. 56-65.
- Fang, Z. (1996). A review of research on teacher beliefs and practices. *Educational Research*. 38 (1), pp. 47 - 64.
- Galton, M. & Croll, P. (1980). Pupil progress in the basic skills. In M. Galton and B. Simon (Eds.) *Progress and performance in the primary classroom*. London: Routledge.
- Gay, L. & Airasian, P. (2003). *Educational research competencies for analysis and applications*. NJ: Pearson Education Inc.
- Good, T. & Grouws, D. (1979). The Missouri mathematics effectiveness project: An experimental study in fourth grade classrooms. *Journal of Educational Psychology*, 71(3), pp. 355-362.
- Good, T., Grouws, D., & Ebmeier, D. (1983). *Active mathematics teaching*. New York: Longman.
- Gordon, S., Dembo, M., & Hocevar, D. (2007). 'Do teachers' own learning behaviours influence their classroom goal orientation and control ideology?'. *Teacher and Teacher Education*. 23(2007), pp. 36-46.
- Handal, B. (2003). Teachers' mathematical beliefs: A review. *The Mathematics Educator*, 13(2), pp. 47-57.
- Kagan, D.M. (1992). Implication of research on teacher belief. *Educational Psychologist*. 27 (10), pp. 65 – 70.

- Langer, J. (2001). Beating the odds: Teaching middle and high school students to read and write well. *American Education Research Journal*, 38(4), pp. 837-880.
- Lazim, M., Abu Osman, M., & Wan Salihin, W. (2002). The statistical evidence in describing the students' belief about mathematics. *International Journal for Mathematics Teaching and Learning*.
- Lim, C. (2002). *A study on Malaysian mathematicians way of knowing*. Report on short term research grant. Universiti Sains Malaysia, Penang.
- Marzano, R., Pickering, D., & Pollock, J. (2001). *Classroom instruction that works*. Virginia: Association for Supervision and Curriculum.
- Mawhinney, T. & Sagan, L. (2007). The power of personal relationships'. *Phi Delta Kappan*. 88(6), pp. 460-464.
- McLeod, D. (1992). Research on affect in mathematics education: A reconceptualization. In D. Grouws (Ed). *Handbook of research on mathematics teaching and learning*. New York: Macmillan.
- Mortimore, P., Sammons, A., Stoll, G., Lewis, L., & Ecob, H. (1988). *School Matters: The Junior Years*. Somerset: Open Books.
- Muijs, D. & Reynolds, D. (2001). *Effective teaching. Evidence and practice*. London: Paul Chapman Publishing.
- National Council of Teachers of Mathematics. (1989). *Effective mathematics teaching*. Virginia: Lawrence Erlbaum Associates.
- Oppenheim, A. (1966). *Questionnaire design and attitude measurement*. New York: Basic Books Inc.

- Orton, R. (1991). Summary. In P. Peterson & E. Fennema (Eds), (1989). *Mathematics teaching and learning: Researching in well defined mathematical domains*. Proceedings of the Michigan State University Conference. East Lansing, Michigan Elementary Subjects Center Services No. 40. (ERIC Document Reproduction Service No. ED341545).
- Pajares, M. (1992). Teachers' beliefs and educational research: Cleaning up a messy construct. *Review of Educational Research*, 62, pp. 307-332.
- Perry, B., Howard, P., & Tracey, D. (1999). Head mathematics teachers' beliefs about the learning and teaching of mathematics. *Mathematics Education Research Journal*, 11, pp. 39-57.
- Petty, G. (1993). *Teaching today*. Cheltenham: Stanley Thomas Ltd.
- Posamentier, A. (2003). Educating math teachers.
Retrieved July 20, 2008 from
<http://www.educationupdate.com/archives/2003/apr03/issue/col-educating-math.html>.
- Raymond, A. (1993). *Unraveling the relationships between beginning elementary teachers' mathematics beliefs and teaching practices*. Proceedings from the 15th Annual Conference of the International Group for the Psychology of Mathematics Education. Monteray, California. (ERIC Document Reproduction Service No. ED390694).
- Richardson, V. (1996). The role of attitudes and beliefs in learning to teach. In: J.Sikula (Ed), *Handbook of Research on Teacher Education*. (pp 102 – 119) New York: Macmillan.

- Rosenthal, R. & Jacobson, L. (1968). *Pygmalion in the classroom. Teacher expectations and pupils' intellectual growth*. New York: Holt, Rinehart and Winston.
- Schoen, H. & Hallas, D. (1993). Improving the general mathematics experience. In P. Wilson (Ed.) *Research Ideas for the Classroom*. New York: Macmillan.
- Seeger, F., Voigt, J., & Waschescio, U. (1998). *The culture of the mathematics classroom*. New York: Cambridge University Press.
- Skemp, R. (1978). Relational understanding and instrumental understanding. *Arithmetic Teacher*, 26(3), pp. 9-15.
- Steinberg, L. (1996). *Beyond the classroom*. New York: Simon & Schuster.
- Stiff, L., Johnson, J., & Johnson, M. (1993). Cognitive issues in mathematics education. In P. Wilson (Ed.) *Research Ideas for the Classroom*. New York: Macmillan.
- Stronge, J. (2002). *Qualities of effective teachers*. Virginia: Association for Supervision and Curriculum.
- Stronge, J., Tucker, P., & Hindman, J. (2004). *Handbook for qualities of effective teachers*. Virginia: Association for Supervision and Curriculum.
- Stronge, J., Ward, T., Tucker, P., & Hindman, S. (2007). What is the relationship between teachers' quality and student achievement? An exploratory study. *Journal of Personnel Evaluation in Education*, 20(3), pp.165-184.
- Taylor, T. (1990). Mathematical attitude development from a Vygotskian perspective. *Mathematical Education Research Journal*, 4(3), pp. 8-23.
- Teddlie, C. & Reynolds, D. (2000). *The international handbook of school effectiveness research*. London: Falmer Press.

- Thompson, A. (1985). 'Teachers' conceptions of mathematics and the teaching of problem solving'. In E.A. Silver (Ed.), *Teaching and Learning Mathematical Problem Solving: Multiple Research Perspectives*, (pp.281-294). Hillsdale, N.J: Lawrence Erlbaum.
- Thompson, A. (1992). Teachers' beliefs and conceptions: A synthesis of the research. In D. A. Grouws (Ed.), *Handbook of research on mathematics teaching and learning* (pp. 127–146). New York: MacMillan Publishing Company.
- Thompson, P. (1984). The relationship of teachers' conceptions of mathematics teaching to instrumental practice. *Educational Studies in Mathematics*, 15, pp.105-127.
- Van Zoest, L., Jones, G. and Thornton, C. (1994). 'Beliefs about mathematics teaching held by pre-service teachers involved in a first grade mentorship program'. *Mathematics Education Research Journal*. 6(1), pp. 37-55.
- Vygotsky, L. (1978). *Mind in society*. Cambridge, MA: Harvard University Press.
- Wang, T. & Jinfa, C. (2007). United States teachers' views of effective mathematics teaching and learning. *The International Journal on Mathematics Education*, 39(4), pp. 315-327.
- Wenglinsky, H. (2000). *How teaching matters: Bringing the classroom back into discussion of quality teaching*. NJ: Millikan Family Foundation and Educational Testing Service.

Wilkins, J. (2008). The relationship among elementary teachers' content, knowledge, attitudes, beliefs and practices. *Journal of Mathematics Teacher Education*, 11(2), pp.139-164.

Wilson, P. (1993). *Research ideas for the classroom*. New York: Macmillan Publishing Company.

Zevenbergen, R. (2003). Teachers' beliefs about teaching mathematics to students from socially disadvantaged backgrounds: Implications for social justice. In L. Burton (Ed.), *Which way social justice in mathematics education*. New York: Praeger Publishers.

Zhihui, F. (1996). A review of research on teacher beliefs and practices. *Educational Research*, 38, pp. 47-65.

APPENDICES

APPENDIX 1

Questionnaire for pilot testing

Section A

Instructions: Please tick where appropriate

- | | | | | |
|-----------------------------|--------------|---------------------|---------|--|
| 1. Gender: | Male | Female | | |
| 2. Age Range: | 22 and under | 23 – 29 | 30 – 36 | |
| | 37 – 43 | 44 – 50 | Over 50 | |
| 3. Location of your school: | Urban | Sub-urban | Rural | |
| 4. Type of school: | Government | Government Assisted | Private | |

Section B

Instructions: Please place a tick in the column indicating your response to the following statements.

Key:

SA – Strongly Agree, **A** – Agree, **N** – Neutral, **D** – Disagree, **SD** – Strongly Disagree

	SA	A	N	D	SD
1. Teachers' ability to be effective in the classroom varies depending on whether a school is government, government assisted or private.					
2. Teachers' who are more experienced are more effective in the classroom.					
3. The number of teaching periods allocated influences effectiveness in the classroom.					
4. A well ventilated classroom enhances classroom practice.					
5. The Education Act plays an important role in facilitating effective classroom practice.					
6. Teachers' mastery of subject matter leads to effective classroom practice.					
7. A prepared teacher is a more effective teacher.					
8. The internal policies drafted by a school are central to effective classroom practice.					
9. Particular topics in the mathematics syllabus lend themselves to more effective practice.					
10. A student's ability influences effective classroom practice					

	SA	A	N	D	SD
11. Availability and accessibility of resources is necessary to achieve effective classroom practice.					
12. Positive encouragement of students by parents, siblings and peers assists the teacher in being more effective in the classroom.					
13. The location of a school (urban, sub-urban or rural) contributes to effective classroom practice.					
14. Adequate lighting is required for teachers to be effective.					
15. The Government's vision for education affects classroom effectiveness.					
16. Teachers' personality factors into the effectiveness of their practice.					
17. The structure of the formal examinations for students facilitates effective classroom practice.					
18. Student regularity is critical to the achievement of effective classroom practice.					
19. Teachers' regularity contributes to their effectiveness.					
20. The layout of the classroom can help facilitate effective practice.					
21. The prevailing school culture plays an important role in effective classroom practice.					
22. Motivated students contribute to effective classroom practice.					
23. The content of the mathematics curriculum supports effective classroom practice.					
24. Stakeholder involvement aids effective classroom practice.					
25. Teachers' philosophy impacts on the effectiveness of their practice.					
26. Students' level of preparedness for class facilitates effective classroom practice.					
27. The textbook chosen can assist effective classroom practice.					
28. The academic qualifications of the teacher will impact on the effectiveness of their practice.					
29. A classroom with ample space aids effective practice.					
30. Assessment strategies suggested in the mathematics curriculum enhance effective practice.					
31. Teachers' punctuality contributes to their effectiveness					
32. The use of teaching aids supports the development of effective classroom practice.					
33. Professional training aids effective classroom practice.					

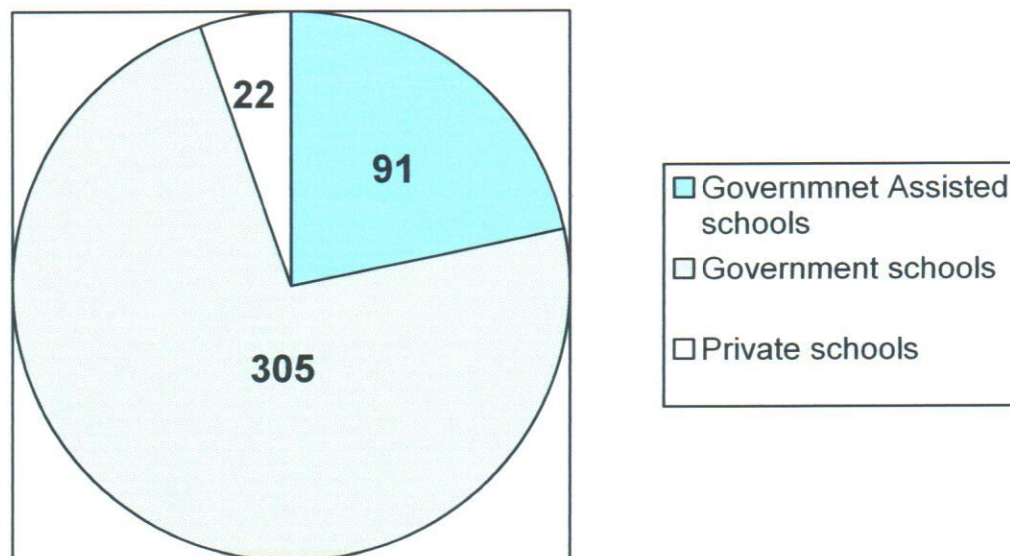
	SA	A	N	D	SD
34. The time of day when a subject is taught influences effectiveness in the classroom					
35. Guidelines found in the Education Policy Paper (White Paper) can help a teacher develop more effective classroom practice.					
36. Adequate furniture is required for teachers to be effective in the classroom.					
37. Mathematics is all about real life - problem solving, decision making, and logical, critical and creative thinking. These attributes lend themselves to effective classroom practice.					
38. Student punctuality assists in the achievement of effective classroom practice.					
39. In order to be effective in the classroom teachers must have a variety of technological tools.					

Section C

Instructions: Please indicate any factors that you feel contribute to effective classroom practice that has not been mentioned above.

APPENDIX 2

Pie chart showing distribution of mathematics teachers in secondary schools.



APPENDIX 3

Tables showing sample data for pilot test

Table showing distribution of participants by gender

GENDER	# IN SAMPLE
Male	36
Female	47

Table showing distribution of participants by age range

AGE RANGE	# IN SAMPLE
Less than 22	3
23-29	20
30-36	20
37-43	11
44-50	8
Greater than 50	21

Table showing distribution of participants by school location

LOCATION OF SCHOOL	# IN SAMPLE
Urban	21
Sub-urban	29
Rural	33

Table showing distribution of participants by school type

TYPE OF SCHOOL	# IN SAMPLE
Government	40
Government assisted	28
Private	15

APPENDIX 4

Cover letter for school administrator

Dear Principal,

I am a student of the University of the West Indies pursuing a Master of Education degree with a concentration in Curriculum. A compulsory requirement in reading for this degree is a research project on which I am currently working.

My research topic is “A study of the factors which contribute to effective classroom practice in secondary school mathematics.” I am seeking permission to have members of the Mathematics department at your school complete the attached questionnaire which will provide data for my research.

Many thanks in advance for your kind co-operation.

Respectfully,

Nalini Ramsawak-Jodha

Contact #: 752-1695

APPENDIX 5

Cover letter for respondents

Dear Colleagues,

I am a student of the University of the West Indies pursuing a Master of Education degree with a concentration in Curriculum. A compulsory requirement in reading for this degree is a research project on which I am currently working.

My research topic is “A study of the factors which contribute to effective classroom practice in secondary school mathematics.” I am seeking your assistance in completing the attached questionnaire which will provide me with data for my research.

Many thanks in advance for your kind co-operation.

Respectfully,

Nalini Ramsawak-Jodha

Contact #: 752-1695

APPENDIX 6

Calculating internal consistency reliability.

Pearsons' Product Moment Correlation Coefficient

x represents the scores on the even items on the questionnaire.

y represents the scores on the odd items on the questionnaire.

$$\bar{X} = \frac{\sum X}{n} = \frac{276}{83} = 3.3$$

$$\bar{Y} = \frac{\sum Y}{n} = \frac{226}{83} = 2.7$$

$$\begin{aligned} P_c &= \frac{\sum (X - \bar{X})(Y - \bar{Y})}{\sqrt{\sum (X - \bar{X})^2 \sum (Y - \bar{Y})^2}} = \frac{10.08}{\sqrt{(3.52 \times 55.12)}} \\ &= \frac{10.08}{\sqrt{194.02}} = \frac{10.08}{13.93} \\ &= 0.72 \text{ to 2 d.p.} \end{aligned}$$

Spearman Brown prophecy formula

$$\begin{aligned} r &= \frac{2r}{1+r} \\ &= \frac{2(0.72)}{1+0.72} \\ &= \frac{1.44}{1.72} \\ &= 0.84 \text{ to 2 d.p.} \end{aligned}$$

APPENDIX 7

Revised questionnaire

Dear Colleagues,

I am a student of the University of the West Indies pursuing a Master of Education degree with a concentration in Curriculum. A compulsory requirement in reading for this degree is a research project on which I am currently working.

My research topic is “A study of the factors which contribute to effective classroom practice in secondary school mathematics.” I am seeking your assistance in completing the attached questionnaire which will provide me with data for my research. Your responses will be extremely valuable in contributing to a body of research geared towards improving the teaching of mathematics.

Participation in this study is not compulsory. Respondents are not required to provide their name or sign the questionnaire and all responses will be treated with the strictest confidence. When the study is conducted a copy of the findings will be made available to your school.

Many thanks in advance for your kind co-operation.

Respectfully,

Nalini Ramsawak-Jodha

Contact #: 752-1695

Section A

Instructions: Please tick where appropriate

1. Gender: Male Female
2. Age Range: 22 and under 23 – 29 30 – 36
 37 – 43 44 – 50 Over 50
3. Location of your school:

 Urban (located within a city or town)

 Sub-urban (located within a 20 km radius of a city/town)

 Rural (located more than 20 km from nearest city/town)
4. Type of school: Government Government Assisted Private

Section B

Instructions: Please place a tick in the column indicating your response to the following statements.

Key:

SA – Strongly Agree, A – Agree, N – Neutral, D – Disagree, SD – Strongly Disagree

	SA	A	N	D	SD
1. Teachers' ability to be effective in the classroom varies depending on whether a school is government, government assisted or private.					
2. Experience does not contribute to effective classroom practice.					
3. The number of teaching periods allocated influences effectiveness in the classroom.					
4. A well ventilated classroom enhances classroom practice.					
5. The Education Act does not play an important role in facilitating effective classroom practice.					
6. Teachers' mastery of subject matter leads to effective classroom practice.					

	SA	A	N	D	SD
7. A teacher does not have to be prepared in order to be effective in the classroom.					
8. The internal policies drafted by a school are central to effective classroom practice.					
9. Particular topics in the mathematics syllabus lend themselves to more effective practice.					
10. A student's ability influences effective classroom practice					
11. Availability and accessibility of resources is not necessary to achieve effective classroom practice.					
12. Positive encouragement of students by parents, siblings and peers assists the teacher in being more effective in the classroom.					
13. The location of a school (urban, sub-urban or rural) does not impact on effective classroom practice.					
14. Adequate lighting is required for teachers to be effective.					
15. The Government's vision for education affects classroom effectiveness.					
16. Teachers' personality factors into the effectiveness of their practice.					
17. The structure of the formal examinations for students does not facilitate effective classroom practice.					
18. Student regularity is not critical to the achievement of effective classroom practice.					
19. Teachers' regularity does not contribute to their effectiveness.					
20. The layout of the classroom can help facilitate effective practice.					
21. The prevailing school culture plays an important role in effective classroom practice.					
22. Motivated students contribute to effective classroom practice.					
23. The content of the mathematics curriculum supports effective classroom practice.					
24. Stakeholder involvement aids effective classroom practice.					
25. Teachers' philosophy impacts on the effectiveness of their practice.					
26. Students' level of preparedness for class facilitates effective classroom practice.					
27. The textbook chosen does not affect teacher effectiveness.					
28. The academic qualifications of the teacher will impact on the effectiveness of their practice.					

	SA	A	N	D	SD
29. A classroom with ample space aids effective practice.					
30. Assessment strategies suggested in the mathematics curriculum enhance effective practice.					
31. Teachers' punctuality contributes to their effectiveness					
32. The use of teaching aids supports the development of effective classroom practice.					
33. Professional training does not lead to effective classroom practice.					
34. The time of day when a subject is taught influences effectiveness in the classroom					
35. Guidelines found in the Education Policy Paper (White Paper) can help a teacher develop more effective classroom practice.					
36. Adequate furniture is not a requirement for teachers to be effective in the classroom.					
37. Mathematics is all about real life - problem solving, decision making, and logical, critical and creative thinking. These attributes lend themselves to effective classroom practice.					
38. Student punctuality assists in the achievement of effective classroom practice.					
39. In order to be effective in the classroom teachers must have a variety of technological tools.					

Section C

Instructions: Please indicate any factors that you feel contribute to effective classroom practice that has not been mentioned above.
