AN INVESTIGATION OF BELIEFS AND ATTITUDES OF HIGH SCHOOL STUDENTS IN THE SOLOMON ISLAND TOWARDS LEARNING MATHEMATICS

A thesis

submitted in fulfilment

of the requirements for the degree

of

Masters of Mathematics Education

at

The University of Waikato

Hamilton, New Zealand

THE UNIVERSITY OF WAIKATO
Te Whare Wānanga o Waikato

by

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2014

ABSTRACT

Mathematics is omnipresent in all walks of life in our society. For instance, every day, citizens all over the world are faced with a complex array of mathematics–from mathematics of business and employment to risks of household accidents. A knowledge of mathematics is needed to solve problems that are encountered in our everyday life. However, in reality, most people in general, and students in particular, dislike mathematics. Researchers had revealed that the majority of secondary school students in western countries find mathematics difficult because of their negative beliefs and attitudes. Research is needed that gives specific attention to beliefs and attitudes in the Pacific Islands.

My study investigated the beliefs and attitudes of high school students in the Solomon Islands towards learning mathematics. Students from two year-12 senior national high schools were selected for the study. Two overarching paradigms that set the conceptual framework for this study were positivism and interpretivism. Research data were obtained through a mixed-method approach. A survey instrument was designed to explore students' beliefs and attitudes towards learning mathematics. Focus group interviews were conducted with some students to solicit factors that impacted on their beliefs and attitudes. To explore factors students thought had affected their mathematics achievement, semi-structured interviews were conducted. Frequency percentage and thematic analysis were used to analyse data.

Findings from the written survey revealed that students were very positive about learning mathematics. They seemed to believe that knowing and doing mathematics required logical thinking and applying mathematics procedures. They highly regarded the utility of mathematics in school and the practicality of it in everyday life. They were very optimistic about their self-efficacy in mathematics learning; for instance, 96% of the students thought they were confident in learning mathematics.

Students' attitudes toward mathematics were both positive and negative. Students who demonstrated positive attitudes tended to enjoy and learn effectively when they clearly understood mathematics well. Conversely, students with negative attitudes usually put less effort into their learning process. Most students disliked learning mathematics because it was difficult. Mathematics anxiety was ascertained as contributing negative beliefs and attitudes towards students' mathematics learning.

Interesting findings were revealed in semi-structured and focus group interviews. Data from semi-structured interviews revealed that students' beliefs about the nature of mathematics reflected on the aspects of mathematical content, mathematical processes, cognitive processes and the utility of mathematics. Furthermore, a major contributing factor that affected students' mathematics achievement was the teacher. Additionally, students' poor mathematical background was an area of concern that affected mathematics achievement. Focus group data revealed three key factors that impacted on students' beliefs and attitudes. These are students themselves, teachers and peer groups.

Considering the findings of this study, there is a need to advocate students' affective domain in teaching and learning of mathematics. It is recommended to put more attention on students' mathematics learning to provide an avenue by which teachers might better support them in nurturing their beliefs and attitudes and, in turn, enhance their mathematics achievement.

ACKNOWLEDGEMENTS

First of all, I would give credit to God for the life, knowledge and wisdom that he has given me throughout my academic years and especially the years of writing this thesis. I have been through thick and thin, but He is always there to comfort me, answering my prayers and providing me blessings for which I will forever give praise and glory back to Him.

This thesis would not have been possible without the assistance and support of the following people. I would like to thank:

- First my supervisor Dr. Sashi Sharma for her time and effort providing invaluable feedback and critical evaluations over a year of my masters study.
- New Zealand government (NZAID) for scholarship towards my study. Further acknowledgement is rendered to the International Student Office (ISO) team such as Caitriona Gyde, for monitoring my daily routine and study life, Deonne Taylor for constantly getting my financial stipends in on time and Huy Vu for managing and directing some social engagements.
- Student Learning Support staff: Andrea Haines, Katherine Brown and Dawn Marsh for some valuable techniques on how to write academically.
- Mr. Alistair Lamb for your rich skills and wealth of knowledge during tutorials on how to do referencing and the formatting of thesis.
- Grant Harris for your time and effort in proofreading my thesis.
- Dr. Sue Dymock and Dr. Charlotte Matheson for my last minute challenge. Your tireless effort, invaluable advice and comprehension of my challenge during that particular week will be always remembered.
- The Ministry of Education in the Solomon Islands for permission to allow my research to be carried out in two high schools.

- The students who gave up their time to participate in this research
- My beloved whanau (family), thank you for your prayers and support all the way right through my study to the completion of my thesis.
- My nephew Pr. Kele Hana and father in-law, Mr. Kenny Tutua for your kindness and hospitality while I conducted this research.
- My aunty, Lanelle Olandrea Tanangada for providing the support at home and encouragement towards my postgraduate study in 2012.
- And lastly my two inspirations, precious little daughter Shadriana Lellana Kele, and my wife Sharon Pasepadalileke Kele for providing support at home. You have both given me motivation and encouragement.

DEDICATION

I dedicate this thesis to:

my precious daughter

Shasha,

my two lovely nieces

Laurelle Alezama and Patisah Kele,

my nephew

Neldrine Jenky,

my dearest of all the dearest

Sharon Pasepadalileke Kele

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ABBREVIATIONS

CDD	Curriculum Development Division
MEHRD	Ministry of Education Human Resources and Development
MSTE	Mathematics Science and Technology Education (500 level paper)
PaBER	Pacific Benchmarking for Educational Results
PILNA	Pacific Islands Literacy and Numeracy Assessment
SINSO	Solomon Islands National Statistic Office
SISTA	Solomon Islands Standardised Testing Assessment
SNZMPIA	Statistics New Zealand and Ministry of Pacific Islands Affairs
SPBEA	Secretariat of the Pacific Board for Educational Assessment
TIMSS	Trends in International Mathematics and Science Study

CHAPTER ONE: INTRODUCTION

1.1 Background

Mathematics dominates almost every field of our modern society. For instance, every day, citizens all over the world are faced with a complex array of mathematics – from mathematics of business and employment to risks of household accidents. Having mathematical knowledge could help solve some of the problems that we face in our daily lives. However, in reality, most people, and students in particular, dislike mathematics. They do not seem to be very interested in talking about mathematics and the way mathematics should be learnt. Research revealed that the majority of students found mathematics as most difficult and boring subject (Nardi & Steward, 2003). When 201 students in Malaysia were surveyed about their attitudes towards a statistics course, the findings revealed that the majority of the students found the subject more difficult due to their lack of mathematical knowledge (Ashaari, Judi, Mohamed, & Wook, 2011). These students faced problems with their thinking, reasoning so they did not understand the mathematics concepts.

Students' negative beliefs and attitudes contribute to many of the difficulties they face in learning mathematics. These negative conceptions diminish students' interest and have a major impact on their mathematics learning (Amirali, 2010). Students have the ability to be successful in mathematics, yet believe they are incapable of success for facing obstacles in developing conceptual understanding and applying procedural skills in mathematics (Beghetto & Baxter, 2012; Tambychik & Meerah, 2010). Moreover, several scholars revealed that students find mathematics difficult in understanding language, and problem solving (Chinn, 2011; Lazim, Abu-Osman, & Wan-Salihin, 2004) and lacked many mathematical skills in visualizing number-fact (Tambychik & Meerah, 2010).

My interest in investigating beliefs and attitudes of students was kindled by my five years of experience teaching mathematics at the senior high school levels, year-10 and year-12.

Throughout my teaching, I had a major concern about the large number of students being unenthusiastic and developing poor attitudes towards learning mathematics. Generally, students showed little interest and often disliked learning mathematics. Mathematics seemed difficult and challenging for them. As a result of they develop poor beliefs and attitudes, and it affects their performance.

Due to these first-hand experiences, I decided to investigate the beliefs and attitudes of high school students. My intention to investigate students' beliefs and attitudes was cemented by two papers (MSTE 501 & MSTE 504) that I studied at postgraduate level. Both papers provided me insights into the issue of students' beliefs and attitudes in learning. It further amazed and intrigued me when I read the work of mathematics education researchers who investigated students' beliefs (Jansen, 2008; Kloosterman, 2002; Lomas, Grootenboer, & Attard, 2012; McLeod, 1994; Presmeg, 2002) and attitudes (Amirali, 2010; Asante, 2012; Di Martino & Zan, 2007; Grootenboer, Lomas, & Ingram, 2008; Mahanta & Islam, 2012) towards learning mathematics. The striking point drawn from these studies is the fact that beliefs and attitudes have played a major role in mathematics learning and achievement.

The fundamental principle now is that students need to be helped to see mathematics from a positive perspective. There is a need to explore their existing beliefs and attitudes toward learning mathematics. Identifying students' conceptions is important so that educators can address these through designing appropriate teaching and learning programs. This small-scale research is an attempt to make a contribution to the existing mathematics literature pertaining to year-12 high school students in learning mathematics by investigating their beliefs and attitudes.

1.2 Mathematics Education in the Solomon Islands

According to Treadaway (1996), mathematics education in the Solomon Islands is viewed as Western mathematics because it uses a mathematics concept that was introduced by the British during their colonial power. The secondary mathematics curriculum heavily relies on the localized version of British Cambridge curriculum (Alamu, 2010). This contributes to many challenges encompassing the learning of mathematics because Solomon Islands students are introduced to read and write in English language (Malefoasi, 2010).

Numeracy[1] teaching and learning in the Solomon Islands is based on the national primary mathematics curriculum called the Nguzu nguzu (MEHRD, 2007). This curriculum document came into effect in the 1990s (Alamu, 2010). It provides a teacher's guide and pupils' activity book for schools. Several aims of mathematics education in the Solomon Islands which are highlighted in the document include linking classroom mathematics to real life situations; contextualising mathematics; and encouraging problem solving, exploration, investigation, and discussion about mathematical activities (CDD, 2005).

Mathematics assessment is compulsory at all entry levels in the secondary schools (MEHRD, 2011). Similar to the Papua New Guinea context, mathematics is externally assessed at each transition point (year-6, year-9, year-11 & year-12) (Clarkson & Galbraith, 1992). The formal education system requires all students to take four external examinations (MEHRD, 2012). The first examination in primary school occurs in year-6 to gain entry into secondary school. There are three examinations in the secondary schools (year-9, year-11 and year-12). An above average pass in mathematics and other core subjects (English, Science and Social Science) determine students' ability to move to the next level.

It is quality mathematics education that helps students to form a positive image of mathematics (MEHRD, 2011). However, acquisition of

[1] Numeracy is used interchangeably with mathematics (Alamu, 2010), which refers to as the concepts, skills, contents and processes in mathematics

mathematical knowledge and mathematical proficiency in every aspect of learning is a great concern. Issues arise which have affected students' beliefs and attitudes towards learning mathematics.

1.3 Issues of Learning Mathematics in the Solomon Islands

Mathematics learning in the Solomon Islands remains a huge challenge. In particular, many students often come to school carrying baggage of negative or unconstructive self-image in relation to mathematics. Students have little input into their mathematical work and often merely execute activities. This adds more difficulties for students when they have negative beliefs and attitudes towards learning mathematics.

Currently, the Solomon Islands is faced with a numeracy crisis. Overall numeracy in the Solomon Islands needs urgent interventions and actions to be addressed (SPBEA, 2013). Alamu's (2010) qualitative interpretive study on teachers' beliefs and perspectives about numeracy confirmed that numeracy achievement in the Solomon Islands in primary school is very low. For instance, the data from standardised tests showed the underachievement of primary students in numeracy (SISTA, 2011). Interestingly, a survey conducted in 2012 on the numeracy situation in fourteen pacific islands nations (including the Solomon Islands) in primary schools confirmed that the majority of the students (51.7%) completing six years of schooling still lack basic numeracy skills (SPBEA, 2013).

Numeracy underachievement has been a trend at all secondary high school levels as well. Students' mathematics achievement is reflected in the high stake examination results. Of all the subjects assessed in year-11 in 2004, Mathematics, Science and Home Economic proved to be poorly done for they were very difficult. For instance, the Mathematics external exam result showed that the mean percentage for the whole country was 29.7% (MEHRD, 2005). In year-9, the mean percentage for mathematics was 42 %. These results portrayed a sad situation about students' beliefs and attitudes towards their learning and achievement.

The language barrier is a big challenge that often constrains students from doing well in mathematics. English language being used in mathematics is always an issue for students. A research study conducted in the Solomon Islands with 45 students using language mathematical assessment portfolios and semi-structured interviews revealed students' challenges in English language (Malefoasi, 2010). Malefoasi found that students were facing linguistic challenges and language proficiency in solving mathematics word problems. Further findings highlighted that word problems written in English are difficult for students. This implies that mathematics language is not the students' mother tongue and they were not proficient in writing and speaking English. Therefore, understanding its meaning used in mathematics will be quite difficult.

1.4 Context of the Study

This study was conducted in the Solomon Islands in 2013 with high school students. The following sections briefly outline the geographical and physical features, and socio-cultural context of the Solomon Islands.

1.4.1 Geographical and physical features

The Solomon Islands is one of the tiniest nations located in the Pacific Ocean; it lies east of Papua New Guinea and northeast of Australia. It is the third largest scattered archipelago in the South Pacific with many mountainous islands and low-lying coral reefs. It covers a total land area of approximately 28, 400 square kilometres.

The nation's six major islands are Guadalcanal, New Georgia, Choiseul, Malaita, San Cristobal and Santa Isabel. These islands have high mountains and thick rainforests. The smaller islands are made of atolls and raised coral reefs.

1.4.2 Socio-cultural context

There are different ethnic diversities in terms of people, religions, cultures, customs, and languages in the Solomon Islands. The origin of the people is uncertain; however, the archaeological and linguistic evidence suggest they migrated from Southeast Asia in 1000BC from Austronesian, during the Neolithic period (Kakai, 2010; Sade, 2009). The country is a conglomeration of mostly Melanesian and Polynesian people, as well as Micronesians, Asians and Europeans.

The population of the Solomon Islands as recorded in the recent census in 2009 was 515,870 (SINSO, 2010). Melanesian people (94.5%) occupy mostly larger Islands. This class of people has recognition for their physical appearance of dark-coloured skin and wavy hair. Polynesian people (3.2%) are characterised by their fair skin and long curly hair. They inhabit low lying atoll islands and raised coral reefs. This ethnic group occupies land in the Renell/Bellona province. Micronesians (1.2%), who are characterised by their long straight hair and lighter skin colour, occupy territory in Vagina, Choiseul Province and Gizo, Western Province. Micronesians are mostly settlers from Kiribati. The other ethnicities (1.1%) are Asians and Europeans.

There are about 80-90 different indigenous languages spoken within the nine provinces across the country, of which English is the official language but spoken often by only very few people. Solomon Islands pijin, an English–based creole is the country's national lingua franca (Watson-Gegeo, 1987). It is a commonly known as 'broken English', language in which more people understand each other well when used it is used in spoken communication in many regions of the country (Kakai, 2010; Watson-Gegeo, 1987)

Solomon Islands is a 96 % Christian nation. The early settling in of the Christian missionaries in 1900 from western countries brought the gospel message to the natives. During that time they started to introduce the formal education system (Alamu, 2010; Malefoasi, 2010). The growth of Christianity during that time paved the way for Christian churches to run their own education systems (Watson-Gegeo, 1987).

1.5 Importance of Research on Beliefs and Attitudes

In recent years, mathematics education researchers have been interested in the affective domain in mathematics education (Gómez-Chacón, 2000; Leder & Grootenboer, 2005). Researchers established an awareness that the elements of the affective domain can be conceptualised in the form of beliefs, attitudes and emotions (Leder & Grootenboer, 2005; McLeod, 1994). These researchers viewed affective domains as key features in understanding students' behaviour in mathematics (Gómez-Chacón, 2000). Each element of the affective domain in mathematics is important for it empowers or disempowers students' beliefs and attitudes in relation to mathematics (DeBellis & Goldin, 2006). DeBellis and Goldin believed that that if mathematics is still a problem for students, attention must be given to understand their beliefs and attitudes towards learning mathematics. Therefore, more research needs to be done to inform educational practice, and to intervene and provide assistance in students' mathematics learning.

Taking into consideration the needs and expectations for a mathematically literate society, there must be some ways to "improve the attitudes of the students who are not interested in studying mathematics, but need to acquire mathematical literacy" (Hodges & Kim, 2013, p. 59). White, Way, Perry, and Southwell (2006) stressed that exploring students' beliefs and attitudes in the learning of mathematics is very important as one way to improve these beliefs and attitudes.

Mathematics education often stresses the importance of assisting students in developing positive motivational beliefs and attitudes to promote better understanding of mathematics (Beghetto & Baxter, 2012). Research that focusses on students' beliefs and attitudes may provide opportunity to ascertain how students cope with their mathematics learning. It can provide avenues for researchers to inform stakeholders (e.g. teachers) on how to nurture students' learning to develop their positive beliefs and attitudes (Whitin, 2007).

1.6 Rationale

As mentioned earlier in section 1.1, students with negative beliefs and attitudes seemed to find difficulties with mathematics. In fact, students transitioning from primary into secondary level appear to show that their interests, effort and motivation to learn mathematics decline (Lazim et al., 2004). What factors that cause the decline of students' enjoyment and motivation in learning mathematics in secondary school is aligned with the topic of this study.

This study resembles the work of Asante (2012), Di Martino and Zan (2007), Hannula (2002), Amirali (2010) and Presmeg, (2002) that investigates students' beliefs and attitudes towards mathematics learning. These authors claimed that beliefs and attitudes heavily influence students' thinking and actions. Additionally, students' well-formed negative beliefs and attitudes towards mathematics contribute to their poor performances.

The aim of mathematics education is for all citizens to acquire the knowledge and skills needed to perform effectively in their society. However, hampered by their poor mathematical knowledge, acquisition of conceptual understanding is not guaranteed. It is important that teachers need to understand students' beliefs and attitudes towards learning mathematics so that they can design appropriate teaching strategies to address these affective domains in relation to mathematics learning, however, this goes beyond the objectives of this thesis.

1.7 Research Questions

There is a need to improve students' mathematical performance by first changing their negative beliefs and attitudes into a positive way of thinking (Tarmizi & Tarmizi, 2010). Promoting positive beliefs and attitudes of students in learning is an important aspect of curriculum documents in the Solomon Islands (MEHRD, 2011).

Three fundamental questions that set out to gather data for this study are:

i. What beliefs and attitudes do selected senior high school students have towards learning mathematics?
ii. What factors do students believe have impacted on their beliefs and attitudes towards learning mathematics?
iii. How do students think their mathematics achievement has been affected by their beliefs and attitudes?

1.8 Structure of the Thesis

This thesis comprises six chapters. In Chapter one, the background, issue, mathematics education in Solomon Islands, context, importance of research on beliefs and attitudes, rationale and research questions are presented, followed by the structure of the chapters.

Chapter two provides a review of literature which is relevant to the topic and the research questions of this study. In the later section of this chapter, the gaps in the literature are revealed.

Chapter three describes the purpose of research in mathematics education and the paradigms, research methodology and ethical principles that guide this research. The enhancement of quality is explained, followed by data analysis procedures.

Chapter four is the presentation and analysis of findings. Findings from the survey, focus group and semi-structured interviews are categorized into different themes and the direct quotes from the students' interviews provide a clear picture about their beliefs and attitudes.

Chapter five is a discussion of the findings in chapter four linking current literature with the researcher's interpretations.

Chapter six, the final chapter concludes the thesis. It also provides the limitations, and implications for teaching and future research.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

Students' belief systems about mathematics are made up of their views about the nature of mathematics, teaching and learning, as well as beliefs and attitudes (Jin, Feng, Liu, & Dai, 2010). Students' beliefs and attitudes are key element in the academic context that shape their cognitive and affective processes in learning mathematics (Garcia, 2012; Mapolelo, 2009). Over the past years, students' beliefs and attitudes towards mathematics has been the subject of considerable (Aiken, 1976; Amirali, 2010; Ashaari et al., 2011; Tahar, Ismail, Zamani & Adnan, 2010). The greater emphasis on beliefs and attitudes emerged from the need to intervene and improve students' mathematical thinking and competencies shaped by their negative beliefs and attitudes (Hodges & Kim, 2013). A critical stance, therefore, needs to be taken to understand students' beliefs and attitudes towards mathematics learning and to determine effective teaching and learning strategies to enhance students' learning.

This chapter provides background literature on students' beliefs and attitudes towards mathematics learning. It begins by stating a variety of definitions of beliefs which have evolved from previous research (section 2.2). Students' beliefs about the nature of mathematics are discussed in section 2.3. Section 2.4 examines students' beliefs about learning mathematics. In section 2.5, students' beliefs about the self in learning mathematics are discussed. Students' beliefs about important aspects of teaching of mathematics are explored in section 2.6. Section 2.7 reviews literature on students' attitudes towards mathematics which must be carefully understood to provide adequate support for their mathematics learning. Factors impacting on students' beliefs and attitudes are discussed in section 2.8. In section 2.9, the literature is synthesised to explore factors that affect students' mathematics achievement. Literature on gender difference is discussed in section 2.10. Section 2.11 discusses the gaps in the literature. The chapter concludes with a summary.

2.2 Defining Beliefs

Mathematics educationists have tried to define beliefs in a variety of ways. Generally, beliefs, as seen among international research literature reveal an area of considerable complexity because it has no common definition (Francisco, 2013; White et al., 2006). One of the major difficulties is to distinguish beliefs from knowledge (Hannula, 2007; Francisco, 2013) and other affective domains such as emotions, attitudes and values (McLeod, 1994). Several mathematics education researchers consider beliefs to be part of knowledge (e.g. Furinghetti & Pehkonen, 2002; Pajares, 1992). Others suggest that beliefs are individual constructs and knowledge is socially constructed (e.g. Yackel, Corte, & Verschaffel, 2002).

According to Leder, Pehkonen and Torner (2002), beliefs constitute to individual's knowledge about their opinions, facts, hypothesis, logic, and faith. Basically, beliefs are perspectives, conceptions and ideas people have which are influenced by their knowledge and often give rise to a certain degree of objectivity, judgmental or validation of the reality of life being experienced (Kloosterman, Raymond, & Emenaker, 1996).

Goldin (2002) claimed that beliefs are internal representations whereby individuals attribute truth and validate information based on what they believe, and these beliefs are usually stable. In fact, beliefs are personal principles constructed from experiences that people employ to interpret information (Amirali, 2010; Pajares 1992). In other words, beliefs are well-established within individuals (Schommer-Aiken, 2004). They are inbuilt in one's life and can be difficult to change (Ertmer & Ottenbreit-Leftwich, 2010). Despite beliefs being stable and intact, Pehkonen and Pietilä (2003) suggested that they are open to change; it depends on the individual's decision to accept such change and adapt to a new set of beliefs.

The working definition of belief for this study is that 'belief is about making personal meaning and preferences constructed from experiences that individuals consider to be true. From the above definitions, beliefs are powerful and can influence individuals' behaviour (Op't Enyde, De Corte,

& Verschaffel, 2006). However, they can produce negative consequences (Mason & Scrivani, 2004) for learning. Therefore, we need to know what sort of beliefs are held by students with respect to the nature of mathematics Research on students' beliefs about the nature of mathematics is discussed in the next section.

2.3 Students' Beliefs about the Nature of Mathematics

Students' mathematical beliefs are the judgments, ideologies, worldview, and opinions about mathematics that they have developed from their learning experiences (Kayaaslan, 2006, as cited in Memnun & Katranci, 2012; Op't Eynde, Corte, Verschaffel, 2002). What students experienced during their mathematics learning determines the kind of beliefs they have about the nature of mathematics(Amirali, 2010; Fleener, 1996; Mason & Scrivani, 2004; Presmeg, 2002), although determining students' beliefs is a difficult undertaking (Schink, Neale, Pugalee & Cifarelli, 2008). Research showed that students' beliefs about the nature of mathematics can be categorised into four distinctive areas. These are mathematical contents, mathematical processes, cognitive processes and the utility of mathematics.

2.3.1 Mathematical content

Many people would wonder that mathematics is the study of number Mathematics is more about content than just number. Mathematics content refers to basic concepts, topics, computation, number facts, rules, arithmetic and operation (Delvin, 2000; Tatsuoka, Corter, & Tatsuoka, 2004).

Several studies revealed students' beliefs about the nature of mathematics reflecting on the aspect of mathematical content (Presmeg, 2002, Amirali, 2010; Kloosterman, 2002; Young-Loveridge, Sharma, Taylor & Hawera, 2006). For instance, a qualitative study conducted in New Zealand interviewed 400 students (6-13 year-olds) attending six primary schools and six intermediate schools in urban centres about their perspectives on the nature of mathematics (Young-Loveridge et al., 2006). The findings revealed that students reflected on particular aspects of mathematical content in their interpretation of what mathematics is about. Many students mentioned number and operations while others spoke about learning patterns and memorising number.

High school students also held common beliefs about mathematics as content. Kloosterman's (2002) study which was conducted in United States high schools interviewed 56 students enrolled in high schools, year-9 to year-12, about their beliefs on what mathematics is. The question given was: *what words best describe mathematics?* Findings revealed that 15 of the 56 students described how mathematics involves memorizing steps, procedures and formulas. They felt that having the ability to memorize procedures is an important part of being successful in mathematics. Other students disregarded memorization because it was difficult to remember procedures. In another study, Presmeg (2002) interviewed seven high school students about the nature of mathematics. Students often expressed their beliefs about the nature of mathematics in their explanations in terms of numerical aspects, word problems and symbols. Two students' responses indicated the aspect of using number to solve problems. Four students believed that mathematics is learning about how to solve word problems. A particular students perceived mathematics as learning four basic operations (+,-, / x). Students normally thought about mathematics this way due to the influences of classroom experiences with mathematics.

What do undergraduate students think of mathematics? Hekimoglu and Kittrell (2010) analysed students' written reflections and conducted classroom observation into what students thought of mathematics. The authors revealed students' common and short-sighted view of mathematics as consisting of numbers, symbols, rules and algorithms that must be followed precisely. However, from students' perspectives mathematics is more than just numbers, symbols or algorithms, also requiring understanding the processes.

2.3.2 Mathematical processes

The ideas of mathematical processes can be characterised as thinking and reasoning, communicating ideas, problem solving, and making connections (Scusa, 2008). Mathematics advocates mathematical processes as communication where students can express their thinking (Cai & Kenney, 2000).

Seven participants interviewed in Presmeg's (2002) study held similar conceptions about mathematics as learning and understanding all the processes. These students believed that mathematics requires understanding possible ways to solve complex problems using numbers and equations. Another study showed that secondary school students' typical belief about understanding mathematics problems is using direct application of rules, formulas and procedures illustrated in text books and exemplified by the teacher (Mapolelo, 2009).

One of the features of mathematical processes involves students developing reasoning. Year-8 students in Pakistan were surveyed about their beliefs and attitudes towards mathematics (Amirali, 2010). The findings showed a majority of those students viewed mathematics activities and acknowledged that they are required to reason out numerous ways to solve related mathematical tasks to reach the correct answer. Many students viewed that the process of reasoning through a problem and finding a solution is more important than memorizing facts and rules. Scusa (2008) suggested that students that involve in problem solving situation felt that they require to use their reasoning ability to solve problems. This view is reflected by an Italian study conducted with year-8 (ages 13-14) to year-12 (ages 18-19) high school students (n=599) that set out to explore beliefs about the nature of mathematics and mathematical problem solving using a self-report questionnaire and individual interview (Mason, 2003). The findings showed that students believed that mathematics problems solving is a process in which it is necessary to reason on the problem and think of appropriate procedures and formulas to use to find the solution.

According to Sakshaug and Wohlhuter (2010), students working together to communicate ideas is an important element of mathematical processes. They claimed that the positive outcome of working together in mathematics enabled students to gain understanding and confidence to solve problems. Communication is an aspect of the learning process that gives confidence for students to interact with their teacher and peers. The process of reflecting on learning activities and trying to communicate ideas successfully are meant to develop students' positive views in their learning (Cobb & Steffe, 2011). Learning that involves a great variety of interactions and participation develops students' mathematical thinking and reasoning.

2.3.3 Cognitive processes

A cognitive process is an important element in learning problem solving. Other elements that interplay with general cognitive processes are learning, thinking, analysis and synthesis based on internal knowledge that individuals employ in their problem solving situations (Wang & Chiew, 2010). In short, cognitive processes require an understanding of the mathematical concepts and related task that are learnt. It demands higher intellectual thinking patterns to be carried out in order to develop a solid and coherent basis for integrating the theories and practices of solving various mathematical related tasks.

A study of the beliefs, cognitive thinking and mathematical performance of high school students revealed that students believe mathematics problems require deep understanding of the problems (Gómez-Chacón, García-Madruga, Vila, Elosúa, & Rodríguez, 2014). The notion of cognitive processes comes to light when learning mathematics for it helps students to think better. Students considered that acquiring knowledge to carry out complex or realistic skills can promote higher order thinking (Collins, Brown, & Newman, 1989). In Young-Loveridge et al.,'s (2006) findings from their interviews with primary and intermediate students regarding their perspective about the nature of mathematics revealed that students viewed mathematics as a subject that develops their learning and thinking.

One emphasis on the cognitive thinking processes in relation to mathematics problem solving is that students may be able to apply concepts and procedures and invent new methods of solving problems. Long time ago, this view was recognised by Blake, Hurley and Arenz (1995) as a key thought process of having mathematical understanding. The authors claimed that students' belief about understanding the problems and be able to use their ability to apply procedures to solve problems. By having this ability, it allows room for more innovative thinking which prepares students to face the future.

2.3.4 Utility of mathematics

Mathematics is perceived by students as useful and relevant for present life and in the future. Op't Eynde et al., (2002) claimed that beliefs about the utility of mathematics are categorised as nature of mathematics. This idea influenced Kloosterman (2002) to see that there is a direct connection between students' beliefs and the utility of mathematics.

Students in both Kloosterman's (2002) and Amirali's (2010) studies showed that they believed mathematics learnt in school has an important relationship in the real-world context. For instance, 34 high school participants in year-9 and year-10 (age range from 14-16 years old) who were interviewed about their mathematics related beliefs expressed the idea that mathematics is a tool that is helpful to individuals in a society. For instance, some older students' beliefs in Boaler's (2002) study were based on certain premises about life in that they expected to apply mathematics knowledge in jobs, sports and banks. Likewise, students in year-7 and year-8 expressed the opinion that mathematics is needed for many jobs and employments in the future (Young-Loveridge, et al., 2006). However, the utility of mathematics is inconsistent with typical students' beliefs about the nature of mathematics as revealed by Schoenfeld (1992). Those students believed that mathematics learnt in school has little or no relevance to the real world.

During interviews, the elementary students in year-4 believed mathematics is needed in school to pass to the next grade (Kloosterman & Cougan, 1994). In a similar finding in Milan, Italy aimed at ascertaining students' beliefs about mathematics and learning mathematics, students revealed positive beliefs. Eighty six fifth graders who filled out a questionnaire perceived the usefulness of mathematics as helping them to think more clearly when they study other subjects.

Some scholars claimed that students' beliefs of mathematics are established from their school learning experiences (Fleener, 1996; Mason & Scrivani, 2004). Students' beliefs about mathematics as content resonated from their exposure to many topics, formulas and steps they had used to solve mathematical tasks. This was similar to the mathematical processes which result from their engagement and experiences as mathematics students during learning problems-solving, by which they were able to reflect and reason out appropriate ways to solve mathematics problems. Importantly, cognitive thinking and understanding are important elements in mathematics. Many students believed that mathematics is useful in school and in society.

There is a relationship between students' beliefs and mathematics learning. The next section discusses literature on students' beliefs about learning mathematics.

2.4 Students' Beliefs about Learning Mathematics

Students' beliefs about learning mathematics can have a substantial impact on their interest in mathematics. These beliefs may be assumed to mean how students make sense of mathematics, how they view it in a social learning context and what sort of discovery they find in their learning. This section discusses three insights into students' beliefs about learning mathematics as revealed in Francisco's (2013) study with five year-12 students (17-18 years-olds) using individual interviews. These are sense-making, social processes and discovery learning.

2.4.1 Learning mathematics as sense-making

Sense-making in learning involves constructing meaning, interpreting, reasoning and reflecting ideas from information provided. Ultimately, understanding is the key idea in sense-making. Francisco (2013) found that high school students generally reflected on the aspect of sense-making as understanding and justification. More specifically, having a good mathematical understanding of the concepts, content and processes is a key aspect of being successful in mathematics. Furthermore, students believed that they must be able to explain and justify as making connections between mathematical ideas is the ultimate goal in learning mathematics.

Young-Loveridge and Mills (2010) explored the beliefs, values and attitudes of 64 students in year 5/6 (9 to 11 years-olds) in New Zealand and found that the majority of the students (95%) thought that when working on mathematics problems it is important that their answer makes sense to them. In addition, the boys held more positive (100%) views about answers making sense than the girls (91%) did, and a significantly higher proportion of the girls (67%) than boys (61%) believed that knowing why an answer is correct is as important as getting the right answer.

Learning mathematics seeks to understand the processes, as discussed in section 2.3. Presmeg (2002) found that students believed that one aspect of becoming successful in mathematics is understanding and applying memorized rules and procedures when solving mathematical problems (Presmeg, 2002). Mapolelo (2009) seemed to agree with Presmeg's finding when interviewing and surveying three rural senior secondary schools in Botswana about their beliefs about the nature of mathematics, mathematics learning and factors that impact on learning mathematics. Mapolelo's finding revealed that students feel learning by memorization determines their success in solving problems.

Providing justification backed by mathematical reasoning is one key feature for making sense of mathematics (Francisco, 2013). For instance, one student in Fransico's study mentioned that it was not enough just to come up with a solution to a mathematical problem without explaining the strategies for getting the answer. Presenting strategies to justify their own work to their classmates was important. The importance of explaining and justifying their own solution strategies to others is also argued by Young-Loveridge (2005). While 20 students of the 27 in Young-Loveridge's study had positive views, two students seemed to believe that explaining their own strategies is important.

2.4.2 Mathematical learning as social process

Constructivists believe learning often takes place in social interactions (Jones, Jones & Vermette, 2010) in which students actively construct their own mathematical knowledge (Lau, Sing, & Hwa, 2009). In developing students' mathematical knowledge, it is likely that the teacher and students are part of shared learning to communicate mathematical ideas (Blankstein, 2012).

Students' learning of mathematics occurring in social interactions can promote positive beliefs. Students' beliefs about learning mathematics as social process was illustrated by Young-Loveridge and Mills's (2010) study. The findings from one of the questionnaires (statement 8): *I talk about my ideas in mathematics in a group or with a partner*, revealed that the majority of students (84%) reported that they communicate their mathematical ideas in group or with their peer(s). The authors affirmed that students had positive views about sharing mathematical ideas with other people. Students recognised that their involvement in small group discussions with other students may help develop their mathematical thinking by listening and exploring each other's ideas (Fransicso, 2013). Working with a group of students in class with a range of mathematical ideas could strengthen students' mathematical understanding (Jansen, 2008; Liu, 2010). This way of working provides an avenue whereby students' confidence is heightened and their motivation to learn mathematics is enhanced.

There are students who might have reservations about becoming legitimate participants in the peripheral discourse of learning. Others who might not like to share ideas are those who lack confidence in their mathematical ability. Young-Loveridge and Mills (2010) describe a student in this group as the pessimist, who gives up doing a task when mathematics is difficult.

2.4.3 Learning mathematics as discovery activity

Discovery learning activities are designed to engage students in inquiry which is guided by the teacher and materials (Hammer, 1997). The students' task is to discover the intended objectives of that particular activity. Students in Francisco's (2013) study believed that discovery learning allows them to be legitimate participants in the construction and justification of their mathematical knowledge rather than being a mere reflector of knowledge from the teachers. They believed that they must learn new things and discover for themselves.

In the process of discovery learning, students believed that their teacher was there just to explain and demonstrate procedures for them to follow (Yackel et al., 2002). However, the rest of the activity would require them to discover what they intend to learn. This is clearly the belief that students hold about the nature of mathematical activity in the classroom.

Schink et al., (2008) found that students believed that learning mathematics by discovery is a better way to enhance their mathematical knowledge. Francisco (2013) further explained that deep exploration left an impression in the students' mind which, in turn, helped them build long lasting forms of mathematical understanding. Hammer (1997) said that discovery learning is "a matter of discerning and responding to students' particular strengths and needs" (p. 485). Students' thinking is developed from discovering new ideas, and employing innovative reasoning. In this way students beliefs and attitudes is developed from exploring new insights in their learning.

There will always be a positive outcome when learning occurs through social interactions. However, some students might not have the ego to be part of interactions. Mathematics knowledge and understanding develop from shared learning within the premises of discovering new ideas and exploring each other's strategies of solving problems. Research reported that students believed that unassisted discovery learning does not benefit the students at all (Alfieri, Brooks, Aldrich, & Tenenbaum, 2011). What is believed critical in this learning is providing feedback, scaffolding, and eliciting clear explanations to enhance learning. The next section discusses students' beliefs about the self in learning mathematics.

2.5 Students' Beliefs about Self in Learning Mathematics

The belief about self refers to "student's self-concept and to their confidence and causal attributions in relation to mathematics" (Op't Eynde et al., 2002. p. 18). According to McLeod (1994), it may include students' self-concept, self-efficacy and confidence for success or failure in mathematics. The notion of students' beliefs about the self are categorised under two areas. These are academic self-concept beliefs and academic self-efficacy. These two beliefs will be discussed in the following sections.

2.5.1 Academic self-concept beliefs

Academic self-concept is an individual's perception of himself/herself (Shavelson, Hubner, & Stanton, 1976) in relation to academic setting. Moreover, it is how an individual thinks and feels about him/herself in relation to learning situations encountered (Bong & Skaalvik, 2003).

Research studies showed that academic self-concept is important for students because it positively affects subsequent academic achievement and other educational outcomes, such as academic motivation, effort and grades (Marsh, Trautwein, Lüdtke, Köller, & Baumert, 2005; Valentine, Dubois, & Cooper, 2004). The more students take responsibility by putting much effort into their own learning, and remain persistent, the more likely they are to perform successfully (Fryer & Elliot, 2012). Having a positive self-concept will determine students to perform better in their academic achievement. For instance, a self-concept statement: *if I study hard, I will have better results.*

According to Shavelson, Hubner, and Stanton (1976), belief about the self is formed through the individual's experiences with the environment and is influenced by environment reinforcements. For instance, students normally evaluate their high performance relative to their strong mathematical ability and the quality of their learning process (Zimmerman, 2000). Similarly, their academic self-concept tries to characterise such perceptions as having the cognitive abilities and competences in relation to good academic performance (Bong & Skaalvik, 2003; Chmielewski, Dumont & Trautwein, 2013; Haines & Mueller, 2013).

One particular view of students' self-concept belief can be seen in the form of goal orientation belief. It focuses on reasons why students learn mathematics the way they do. Goal orientation beliefs suggest that students have their goals in learning mathematics (Op 't Eynde & De Corte, 2006; Velayutham, Aldridge, & Fraser, 2011). In Mapolelo's (2009) study he interviewed year-12 high school students to inquire if they were good at mathematics. Findings revealed that most students believed that they enjoyed the challenge and aimed to do better in their mathematics study. In addition students would desire the ability to work harder and to achieve success in mathematics (Mason & Scrivani, 2004). Their goal in learning mathematics is to gain mathematical knowledge and understanding and to work to achieve better result in mathematics, which demonstrates by capability and cognitive skills (Schunk & Richardson, 2011).

However, from negative experiences of learning, for example, some students believed they have poor mathematical ability and that their performance is far from other excellent students (Garcia, 2012). These students would often find mathematics to be a very difficult subject. Consequently, students with negative self-concept attribute their poor performances to lack of confidence, effort and ability, and to insufficient strategy (Zimmerman, 1998, as cited in Marchis, 2011) to successfully complete the task (Bandura, 1986). A student's negative self-concept, for example, might be expressed as *no matter how much time I spend doing mathematical tasks, I cannot get better result.*

2.5.2 Academic self-efficacy

Bandura (1983) defines self-efficacy as one's capabilities to organize and execute the course of action required to produce a desired outcome. Schunk and Pajares (2009) said that self-efficacy is a belief that emerges from thinking about what a person can learn or do; it is totally different from knowing what to do (as cited in Schunk & Richardson, 2011). Self-efficacy requires students to reflect on their skills and capabilities and to gain confidence to successfully accomplish a particular task (Bong & Skaalvik, 2003; Zimmerman, 2000).

Furthermore, positive self-efficacy students are motivated, and concentrate more easily on doing mathematics. With their strong mathematical knowledge background they use effective and efficient strategies are time management-oriented and usually seek for assistance whenever they need it (Pintrich, 1999; Ryan & Deci, 2000). Moreover, those who have high self-efficacy tend to work persistently have commitment to achieve their goals, and consider themselves capable of executing their skills (Bong & Skaalvik, 2003; Mezei, 2008). Salomon (1984) also supports positive sense of self-efficacy leads to greater mental effort, which can often result in better performance (as cite in Marchis, 2011). Nevertheless, Gafoor and Ashraf (2012) argued that everybody has skills and cognitive knowledge but they must be able to use them appropriately to accomplish tasks.

Consequently, extremely high self-efficacy can be detrimental to students learning mathematics (Marchis, 2011). Knowing that they have more confidence and capability to know everything, they will be more prone to put less effort into their learning. The sense of complacency and procrastination interfere with a student's ability in such cases.

Students with very low self-efficacy belief tended to judge themselves to be incompetent for they considered themselves incapable and lacking mathematics knowledge. Bandura (1983) pointed out very clearly that these students might run a high risk of potential threats of anxiety and might experience disruptive arousal which will lower their sense of self-efficacy when trying to perform the task skilfully. This type of student can find mathematics difficult and might think that they are unable to be good at mathematics. In addition, Schunk and Richardson (2011) attested that students may avoid doing mathematical task, whereas those that feel self-efficacious are more willing to participate.

Students' self-image or beliefs about the self in relation to mathematics can influence their learning in mathematics by taking into account their negative views toward their self-concept beliefs and self-efficacy beliefs. De Corte, Mason, Depaepe, and Verschaffel (2011) stated that mathematics classroom norms and practices shape students' beliefs and attitudes but, on other hand, these are fashioned by the teacher and the type of teaching approaches. Hence, students' beliefs about mathematics teaching are explored in the next section.

2.6 Students' Beliefs about Mathematics Teaching

Students' beliefs about mathematics teaching, according to Op't Eynde et al., (2002) refers to their perceptions about the role of the teacher during mathematics instruction in the classroom. In other words, it refers to students' views of their teachers who take responsibility for their learning (Tarmizi & Tarmizi, 2010).

Op't Enyde et al., (2006) constructed a mathematics-related beliefs questionnaire (MRBQ) to explore 365 year-10 junior high school students' mathematical–related beliefs. One major category of students' beliefs constituted their mathematics–related beliefs system in relation to the roles and functions of their mathematics teacher. Findings showed that students believed that a best teacher first provides clear explanations and carefully guided examples for students to solve mathematical problems. This is consistent with the study conducted by Francisco (2013) and Kloosterman et al., (1996) which they saw their teacher as the authority who imparted knowledge to them. Students in both studies simultaneously believed that the role of their teacher is to transmit mathematics knowledge and skills to students and the students' role is to acquire that knowledge.

There was a report from Young-Loveridge (2005) that explored 27 year 5-6 students in the New Zealand context about their views of mathematics learning during an individual interview. The author discussed that students tended to see their teacher as a mentor, a source of help and assistance whenever there was a need in learning mathematics. Hence, students expected their teacher to take optimum control in most of their mathematics learning process.

To recognise pupils' voice in learning mathematics, Johnston-Wilder and Lee (2013) conducted a study in England with 284 girls in year-8. The study aimed to highlight the fact that students could play an important role in enabling schools to develop their teaching to improve students' mathematical learning when their voice is recognised. Data revealed that students reflected such understanding on the idea of effective teaching, and effective ways to learn mathematics which can be well understood. In addition, the students expressed that their mathematics learning will be enhanced if the teacher move from being authoritative in mathematics classroom giving traditional teaching type methods, to encouraging students to work with other pupils to develop their mathematical understanding.

Moreover, students believed their teacher had a role in helping them understand the topic. Several studies claimed that students valued understanding mathematics concepts that were clearly explained by the teachers (Afari, Aldridge, Fraser, & Khine, 2013; Diaz-Obando, Plasencia-Cruz, & Solano-Alvarado, 2003). The authors explained that students can do better when the teaching of mathematics is carefully guided with a variety of dynamic and suitable learning activities that are based on real world situations. To further elaborate this, teaching topics that require practical applications should be aided by appropriate teaching materials or resources and must be clear to students. Jin et al., (2010) affirmed that teaching mathematics must ensure to help students understand mathematical concepts and enable them to apply skills to counteract social problems such as making decisions and solving problems in real life situations. On the other hand, if mathematics is not well-explained to students, it could result in their frustration for they might not understand the concepts or solutions of mathematical problems.

Students have clear expectations of their teacher's role in mathematics teaching and their own role as learners in learning mathematics. Teaching of mathematics is always anticipated to develop students' potential in their mathematical understanding. Therefore, mathematics teaching needs to pay attention to engaging students in mathematical activities. Teachers need to assist students develop positive beliefs and attitudes toward learning mathematics. The next section discusses students' attitudes towards learning mathematics.

2.7 Students' Attitudes towards Learning Mathematics

Attitudes play many significant roles in mathematics, and can influence students' learning and performance (Farooq & Shah, 2008). Furinghetti and Pehkonen (2002) stated that the way mathematics is presented in the classroom and how students look at it are dependant context that can serve to alienate students from learning mathematics. Certainly, students who perceive mathematics in a positive sense will develop positive attitudes and can perform successfully in mathematics courses. Consequently, those who construct negative attitudes towards mathematics often resist studying it and this can affect their learning.

This section discusses definitions of attitudes, the meaning of positive and negative attitudes, and students' negative and positive attitudes towards learning mathematics.

2.7.1 Defining attitudes

The term 'attitude' is used widely in a variety of disciplines. There is no particular reason to restrict the definition at this stage; however, an attitude focuses on the favourability of reactions. Attitude can be thought of as an acquired behavioural disposition. When it is acquired it affects the cognitive feeling of an individual to view something and the individual tends to behave towards it (Eagley & Chaiken, 1993; Maio & Haddock, 2010). In other words, there is a high tendency to favour or disfavour certain entities in life (Eagley & Chaiken, 1993). Others confirm that an attitude is an affective feeling of like or dislike of anything that has an influence on behaviour (Hannula, 2002; McLeod, 1994).

Attitudes can be determined from their evaluative aspects. Attitudes develop from a person's state of conscious mind to feel either negatively or positively about something (Maio & Haddock, 2010). They can be changed as times goes on according to the contexts and situations where an individual operates or experiences.

The working definition of attitude for this study is a state of feeling positive and negative towards mathematics. In addition, attitudes towards mathematics will be defined as the construct that determines the way of reacting to mathematics in certain contexts (Hodges & Kim, 2013). For instance, liking or disliking, being interest or uninterested in learning mathematics. These two emotional dispositions have an impact on an individual's readiness to learn mathematics.

2.7.2 What does positive or negative attitudes really mean?

The definitions of positive or negative attitude clearly depend on the definition of attitude itself (Di Martino & Zan, 2007, 2010; Tahar et al., 2010). Di Martino and Zan (2007) tried to distinguish between positive and negative by simply defining positive attitude as a positive emotional disposition towards something, and a negative attitude as a negative emotional disposition towards the subject.

A positive attitude might have other elements attached to its meaning. More than just its name, the meaning varies and may refer to emotions, beliefs and behaviour (Di Martino & Zan, 2007). When it refer to emotion, 'positive' normally means 'perceived as pleasurable'. As affirmed by Hannula (2002) in his study, for example, Rita, a year-9 student had achieved her cognitive goal of understanding mathematics concepts and therefore her emotional experiences in the class were more pleasurable. Likewise, students will like mathematics when they understand it. They are interested when they see the important values in the mathematics lessons (Johnston-Wilder & Lee, 2013). They can develop positive beliefs and attitudes towards learning mathematics when they enjoy it.

When attitude refers to behaviour, 'positive' generally means 'successful' (Di Martino & Zan, 2007). In a learning context, successful behaviour is generally identified as high achievement. A New Zealand government report known as TIMSS that measured trends in mathematics and science achievement in year-4 and year-9, revealed that students with positive attitudes were confident in their mathematics ability and achieved higher than those that were less positive or confident (Caygill & Kirkham, 2008). To consolidate this finding, Hannula (2002) revealed that positive attitudes promote success while negative attitudes result in failure or lack of improvement in mathematics.

In contrast with positive attitude, negative attitude is often expressed in emotional feelings such as frustration, fear, laziness, anxiety, boredom and hating something. This can often lead to negative behaviours. When negative behaviours are amalgamated with pessimistic belief, things will be perceived as gloomy, unfavourable or impossible with undesirable results or conditions. For instance, negative attitude can impose in students a lack of interest and dislike for learning mathematics.

Negative attitude is subjective to a person when encountering obstacles. It is enhanced when individuals place themselves in a situation when they face difficulties which is not satisfying or enjoyable (Stylianides & Stylianides, 2014).

In short, positive attitudes lead to success, while negative attitudes could lead to failure. While positive attitudes drive individuals to have confidence in their own ability and excel in their mathematics achievement, negative attitudes pressure individuals to perform poorly over demanding tasks and could lead them to become uninterested in learning. The next section discusses students' positive attitudes toward mathematics.

2.7.3 Students' positive attitudes towards learning mathematics

A positive attitude towards mathematics reflects a positive emotional disposition in relation to the subject. Students who have positive attitudes tended to enjoy, like or become interested in mathematics. Positive attitudes motivate students to achieve better in their mathematics performance. What motivates students to have positive attitudes towards mathematics is the scope of discussion for this section.

In a current study, Hodges and Kim (2013) investigated the effectiveness of a treatment designed to improve college algebra students' attitudes towards mathematics. With 43 participants in the Atlantic region, the data showed that students who had positive attitudes towards mathematics were good achievers and developed more positive attitudes than the lower achievers. Several research studies showed that students usually construct positive attitudes of liking mathematics because of its relevance, knowing their capability and having confidence (Evans, 2007; Sirmaci, 2010).

Students normally construct knowledge of becoming interested in learning mathematics. A study in Malaysia that set out to explore college students' attitudes toward mathematics used factor analysis to measure attitudes (Tahar et al., 2010). The survey data revealed that a substantial majority of college students indicated that they were interested in learning mathematics. This view suggested that students may display positive interest and can enjoy learning mathematics if they perceived the usefulness and relevance of mathematics in real-life situations (Ashaari et al., 2011; Marchis, 2011). It was also noted that students were interested in mathematics when they enjoyed being challenged at the appropriate level. In addition, students were interested if the mathematics lesson was comprehensible, concise, and easy (Di Martino & Zan, 2010; Hunter, 2008) and includes a variety of stimulating tasks related to the topic (Anthony & Walshaw, 2007; Ashaari et al., 2011).

A positive mathematics attitude resonates with a feeling of emotional satisfaction. For instance, a feeling of liking mathematics can influence beliefs and attitudes. A qualitative research was conducted in Turkey with 24 seventh grade students to identify factors that affected their attitudes (Yılmaz, Altun, & Olkun, 2010). Data obtained from qualitative semi-structured interview revealed that students liked mathematics in general.. Students feeling of liking mathematics develop from the early years when they were introduced in learning solving problems in primary school which allow them to think (Vanayan, White, Yuen, &Teper,1997). As they progress into secondary school, liking mathematics declined and often became negative (Lourdes Mata, Monteiro & Peixoto, 2012). For example, a survey was conducted with 200 elementary students in year-6, year-7 and year-8 in Turkey to explore students' attitudes towards mathematics (Köğce, Yıldız, Aydın, & Altındağ, 2009). They found significant differences between younger and older students' attitudes towards mathematics, with year-8 having lower attitudes than year-6.

Although mathematics appeared to be the favourite subject of many students, other students may have developed negative attitude of disliking the subject. The next section discusses students' negative attitudes towards mathematics.

2.7.4 Students' negative attitudes towards learning mathematics

Students can also develop negative attitudes, despite holding a positive disposition about mathematics. One of the reasons for having negative feelings about mathematic is drawn from their belief that they are not good at the subject (Brinkworth & Truran, 1998). In fact, students' self-concept determines their interest in mathematics, and for some they dislike mathematics (Tahar et al., 2010). Among these negative feelings, unfavourable attitudes are generated which can result in obstacles forming towards the learning of mathematics (Utsumi & Mendes, 2000).

Burns (1998) and Grootenboer (2001) confirmed that students really disliked mathematics. The students in general thought this way because mathematics a subject they did not quite clearly understand and so they put less effort into studying it (McLeod, 1994). Students also lacked knowledge and understanding of concepts. The students who disliked mathematics and find it difficult are driven by their negative attitudes towards the subject (Ignacio, Blanco Nieto, & Barona, 2006).

Mathematics is perceived by most students as neither useful nor practical but rather, a subject that makes them frustrated and discouraged (Ignacio, et al., 2006). In this sense, students who thought mathematics a subject giving them no satisfaction were incapable of utilising their mathematical knowledge and skills to do mathematics (Amirali, 2010; Ignacio et al., 2006). Due to these negative beliefs and attitudes students have little preconceived knowledge which limits them from appreciating the importance of mathematics in school and applying it to their daily lives (Burns, 1998).

There are specific factors that positively or negatively impacted on students' beliefs and attitudes towards learning mathematics. The next section discusses these factors.

2.8 Factors impacting on Students' Beliefs and Attitudes

From a review of the literature, there are three factors that play vitally impact on students' beliefs and attitudes in learning mathematics. These include factors that associated with the students themselves, factors associated with the teachers and teaching, and factors associated with the peer group. Each of the factors will be discussed in the following sections.

2.8.1 Factors associated with students themselves

Factors that are associated with students cover a range of aspect such as anxiety, self-efficacy, self-concept, and experiences at school. In this section, the relationship between self-concept and self-efficacy will be briefly highlighted as to how it influences students' beliefs and attitudes. More details of these two notions were already discussed in section 2.5.

Students with a positive self-concept are more capable of doing mathematics and achieve good results. A survey was conducted in Malaysia using a self-response questionnaire administered to 473 university students to explore students' mathematics beliefs (Suthar, Tarmizi, Midi, & Adam, 2010). The findings showed that students who recognize their own mathematical ability and maintain their effort to work hard in doing mathematics were performing better. Students with high self-concept would tend to take responsibility for their learning and be "more likely to attribute success to their own effort" (Marchis, 2011, p. 787). Another study in Spain that aimed to explore affective factors in determining success or failure in mathematics learning included 346 students (13 to 18 years-old) (Ignacio et al., 2006). The quantitative data from the survey revealed that students who were motivated to get good marks felt more competent and capable at mathematics, which reinforced their self-concepts, further stimulated their academic performance. Great success in mathematics comes when students believe in their effort and they work to expend higher levels of effort in their learning.

Self-efficacy further reinforces that having a high level of confidence maintained a positive level of engagement in learning mathematics. Students who believe in their ability can successfully and confidently apply their skills to execute the task (Barkatsas, Kasimatis, & Gialamas, 2009). Recently, the idea of having confidence as one of the qualities of learning resonated with Winheller, Hattie and Brown's (2013) study. In the context of New Zealand, their study was conducted with 336 year-8 and 272 year-10 high school students using questionnaire scales to examine student's perceptions regarding mathematics learning. This study showed that students who show continual interest in liking mathematics are confident and tend to enjoy learning mathematics a lot. Moreover, students who are actively involved in learning gain self-efficacy and increased performance.

However, negative self-concept and self-efficacy beliefs can lead students to poor performance. Gafoor and Ashraf (2012) stated that students in their study lacked confidence, and showed deficiency in their mathematical ability to perform better. These students believed that they were incapable of applying necessary knowledge and skills to perform a certain course of actions. Generally, students who have this sort of problem are subjected to failure when learning mathematics (Ignacio, et al., 2006; Bandura, 1983). Ignacio et al., (2006) commented further that lack of confidence in mathematics could result in having attitudes of rejecting mathematics tasks and gave up easily when encountering difficulties.

2.8.2 Teachers and teaching

Several studies showed that the most important factor that influences secondary school students' beliefs and attitudes towards mathematics is the teacher (Marchis, 2011; Yaratan & Kasapoğlu, 2012). Research in the Maldives used a survey method to investigate 395 high school (year-9 and year-10) students' attitudes towards mathematics (Mohamed & Waheed, 2011). This study affirmed that students' mathematics attitudes could be influenced by the teachers' attitudes towards mathematics, teaching approaches and instruction, teachers' roles, teachers' personality and pedagogical content knowledge.

Teachers' attitudes towards mathematics have long been recognised as an important influence on students' mathematics attitudes. Teachers' attitudes towards mathematics have also been shown to influence their instructional techniques (Gunderson, Ramirez, Levine, & Beilock, 2012). If teachers have shown positive attitudes towards mathematics and how they behave in their teaching, then the students will be more likely to develop positive attitudes towards their learning (Anthony & Walshaw, 2009). Teachers must ensure that they maintain their positive attitudes so as to motivate students in the development of their mathematical understanding (Whitin, 2007).

Teachers' teaching approaches and instruction tended to influence students' mathematics beliefs and attitudes. Students will be positively impacted when mathematics is more interesting, meaningful and enjoyable. This enjoyment comes from the teacher who explains mathematics concepts clearly (Yılmaz et al., 2010). Moreover, a good teacher has the ability to make subject content interesting, provide appropriate challenging tasks and make connections between and the real world concepts (Anthony & Walshaw, 2009; Grootenboer et al., 2008). Most importantly, the teacher works closely with students in developing their beliefs and attitudes, in turn, improving their mathematics performance.

The teacher's role is to support students' learning of mathematics (Afari et al., 2013). A study conducted with children in New Zealand on children's perspective about the teachers' roles showed that children strongly established their views of the teacher helping them with strategies when they experience difficulty (Taylor, Hawera, & Young-Loveridge, 2005). The teacher ensures to encourage students to cooperate and discussing ways to find solution to mathematical problems (Parangi, Wilson, & Klaracich, 2005; Yackel, Cobb, & Wood, 1991). According to Beswick (2006), teachers have an on-going professional responsibility to engage student in their daily practice of teaching mathematics by developing students' mathematical thinking into a more positive way of learning. Even Maori children in New Zealand mentioned that they greatly rely on the teacher to help them to develop particular mathematics skills and assure them when mathematics is difficult (Hawera, Young-Loveridge, Taylor, & Sharma, 2007). These are some ways that can impact students to develop positive attitudes towards learning mathematic.

Teacher's interpersonal behaviours which contributes to their being helpful, friendly, understanding, caring and admonishing, have greater influence on students' mathematic attitudes (Goh & Fraser, 1998). The teacher who maintains care and provide a safe classroom environment for students can be very influential in developing students' positive beliefs and attitudes towards learning mathematics. Students thought that teacher who can help them in learning mathematics are easy to approach, caring and make them feel important is a good teacher (Balenaivulu, 2008). Such treatment from teachers will influence students to take active responsibility in their mathematics learning for they see their teacher as a mentor imparting mathematical knowledge (Korthagen, 2004; Taylor et al., 2005).

However, teachers' interpersonal behaviour that is directive, drudging, tolerant, aggressive, stereotyped, intimidating and repressive in communication with students has strong association with negative outcomes which affects performance (Goh & Fraser, 1998).

Students believed that their teachers are the experts in mathematics to impart knowledge to develop their mathematical knowledge and understanding (Ball, Thames, & Phelps, 2008; Mansor, Halim, & Osman, 2010). However, there can be a major blow to students' beliefs and attitudes towards learning if teachers have inadequate content knowledge for teaching mathematics. Students' understanding of mathematical concepts can be definitely affected if teachers do not have solid background knowledge of mathematics (Evans, 2011).

2.8.3 Peer group influences

The peer group also contributes to influencing students' attitudes and beliefs towards learning mathematics. According to Ryan (2001) the peer group is seen as an important context in adolescent development which may influence motivation and achievement. Several writer claim that students spent less time with parents and more time with peers (e.g. Larson, Richards, Moneta, & Holmbeck, 1996). Students communicate more mathematical ideas with peers than with parents. As a result they value the support from their peers.

A study in US was set out to examine 290 year-5, 207 year-8, 185 high schools and 870 college students' perspectives about from which social group they gained greater social support for learning mathematics (Rice, Barth, Guadagno, Smith, & McCallum, 2013). The finding revealed that students gained greater social support from their peers. It was further highlighted that students who gained adequate learning support from peers had better attitudes and higher perceptions in their mathematics abilities.

Undoubtedly, the peer group can positively influence students' attitudes, beliefs, and performance in mathematics. Ryan (2001) stressed an important point that students who affiliate with other students or classmate who had similar academic characteristic help motivate each other to learn mathematics. It was affirmed that when low achievers congregated with the high achiever in sharing mathematical ideas, the lower achiever performance had gradually improved (Ryan, 2001). In addition, students who might not have understood the concept were assisted by those who had relevant knowledge, which elicit positive impact to their learning (Goldin, Epstein, Schorr, & Warner, 2011).

Cooperative and collaborative learning help students in their mathematics problem solving. For example, Te Maro, Higgins, and Averill's (2007) study on exploring Maori students' responsiveness to classroom practice revealed that working in pairs with somebody who does know mathematics well helps students in their thinking strategy.

Despite the importance of learning mathematics with support from peer groups, many students are reluctant to accept mathematical ideas from others, which they do see as cheating or misconstrued (Young-Loveridge et al., 2005). In other words, some students feel reluctant to share mathematical ideas due to their incapability and lack of knowledge. This idea is quite congruent with Jansen (2008) who reported students dislike being corrected when sharing mathematical ideas at it seems a personal attack to them.

Students' beliefs and attitudes are greatly influenced by many factors. Three of the many factors that play key roles are discussed in relation to students, teachers and peer support. Furthermore, there are factors that affect students' mathematics achievement either explicitly or implicitly in the learning processes. These factors are discussed in the next section.

2.9 Factors affecting Mathematics Achievement

This section discusses studies that investigated factors affecting students' mathematics achievement. The discussion is based on mathematics anxiety, students' emotional factors, student's mathematical background, teachers, and influences from parents.

2.9.1 Mathematics anxiety of students

Mathematics anxiety is preventing students from their learning. Many students suffer from mathematics anxiety (Boaler, 2002). For instance, students are often worried and have uncomfortable feelings when encountering situations in which they were challenged to perform mathematical tasks. In reality, mathematics anxiety can adversely affect students' mathematics attitudes (Chinn, 2009; Das & Das, 2013) and their mathematics achievement. The role of mathematics anxiety and its negative impacts on students' learning practices and outcomes need further consideration. This section defines mathematics anxiety, examines the causes and effect on students' performance, and discusses how to mitigate the effects.

A more recent study showed that mathematics anxiety is an adverse emotional reaction to mathematics or the prospect of doing mathematics (Maloney & Beilock, 2012). According to Whyte (2009), mathematics anxiety has been also considered as a fear or phobia that produces "a negative response to learning or doing mathematical activities that interferes with performances" (as cited in Whyte & Anthony, 2012, p. 4; Jain and Dowson, 2009). Students are easily triggered to have negative mind-set when they are anxious about mathematics (Vinson, 2001).

Students' mathematics anxieties are caused by several factors. Trujillo and Hadfield (1998) assert that intellectual and environmental can interfere with students' learning performance (as cited in Peker, 2009; Yaratan & Kasapoğlu, 2012). Intellectual factors include having with difficulty with mathematics, lack of mathematics knowledge, lack of confidence and ability. Environmental factors include insensitive teacher and teaching styles.

Intellectual factors include students' beliefs about mathematics and themselves in a negative way. Mathematics anxious students tend to lack mathematics knowledge and have very poor skills and strategies in carrying out problem solving activities (Das & Das, 2013). Having poor skills includes, for example, difficulties remembering and applying rules, and the manipulation of symbols increases anxiety (Das & Das, 2013; Gómez-Chacón, 2000). For instance, Gómez-Chacón's (2000) case study on how affective factors influences mathematical knowledge revealed that students who found mathematics difficult to understand were provoked by their frustration and anxiety so they avoided studying it. Some authors claimed that these types of students somehow perceive their incompetence which lowers their confidence and ability in doing mathematical activities, and as a result they perform very little (Sheffield & Hunt, 2006; Ashcraft & Moore, 2009).

The effect that mathematics anxiety has is tenacious by which the students may feel helpless, insecure, worried or inferior when they feel less confident and lack mathematics ability (Núñez-Peña, Suárez-Pellicioni, & Bono, 2013). Furthermore, mathematics anxieties give feelings of discomfort, tension and apprehension (Witt, 2012). Students who do not understand their mathematics tasks quite well may experience panic, and mental block in mathematics (Carroll, 1994; Evans, 2000; Hoffman, 2010).

Environmental factors for example, include teachers (Taylor & Fraser, 2013) and their behaviours. Research studies claimed that the classroom teacher is the key element in passing mathematics anxiety to their students (Bekdemir, 2010; Ma, 1999; Yaratan & Kasapoğlu, 2012). A qualitative study in the US that examined 87 pre-service teachers' mathematics anxiety showed that if the teachers had negative attitudes toward mathematics, it can produce negative results in students (Vinson, 2001). Geist (2010) found that teachers who exhibit nervousness and put less effort into explaining mathematics tasks clearly to students can instil a sense of anxiety in them.

Teacher's insensitive behaviour in teaching can impose more anxiety feelings on students (Breen, 2003 as cited in Whyte & Anthony, 2012).

Teachers' negative attitudes such as being hostile, angry, grumpy, intimidating or embarrassing students in front of their peers if a student does not understand concepts can inherently impact on students' attitude (Whyte & Anthony, 2012). More specifically, teachers can intensify their students' mathematics anxiety by responding negatively to questions, demonstrating insensitivity and an uncaring attitude towards students (Jackson & Leffingwell, 1999).

The impact of mathematics anxiety on students' attitudes and learning practices needs to be comprehended to help them avoid suffering the negative effect. It is undeniable that failure in mathematics can be achieved from the negative attitudes caused by environmental and intellectual factors (Harper & Daane, 1998; Wilson, 2013). Negative attitudes caused by the above factors must be detected in order to constitute proper strategies to effectively counteract the influence of anxiety. Consequently, the teacher's role is to prevent students from having mathematics anxiety (Whyte & Anthony, 2012).

Firstly, teachers need to identify and understand the origin of mathematics anxiety. Zambo and Zambo (2006) state that identifying students' affective needs in mathematics and how they feel about learning mathematics is important (as cited in Whyte & Anthony, 2012). Furner and Duffy (2002) attest that teachers need to consider what they observe and listen to their students' feelings toward mathematics so they can create possible ways to combat this issue. The best way to identify and understand students' mathematics anxiety is through one-to-one interviews (Tobias, 1978). Clark (2013) states that teachers can obtain feedback from students about their feelings and implement programs that are geared toward developing students' confidence and ability in learning mathematics.

Creating a safe environment that is conducive to learning, where students are secured in taking risks and their thinking is respected can prevent them from experiencing anxiety (Whyte & Anthony, 2012). It is suggested that creating a positive environment that promotes building relationship with students, incorporating their interests into lessons and building their existing knowledge with new knowledge (Furner & Duffy, 2002; Sullivan, Mousley, & Zevenbergen, 2006). It is important to create an environment that makes students feel unthreatened and maintains a high level of participation (Zakaria & Nordin, 2008).

As seen so far, mathematics anxiety is very detrimental towards students' mathematics learning and performance, but it can be solved. The next section discusses students' mathematics background.

2.9.2 Students' mathematics background

Higher competence in mathematics can lead to higher levels of mathematics achievement. Students who have lower mathematical competence, ability and proficiency will have lower levels of achievement in mathematics. This section discusses students' mathematics background from the notion of having very little or poor knowledge of mathematics.

Students' limited background knowledge of mathematics can have an impact on their mathematics achievement. Students who have poor mathematical ability may perceive mathematics is not within their reach and can achieve very low performances. A research study revealed that students with poor mathematics background often had poorer academic performance (Lourdes Mata et al., 2012). For example, students who had poor mathematics background may find it difficult to understand mathematics content, processes and problem solving (Sheffield & Hunt, 2006).

Students who have poor mathematics background may face difficulties developing correct intuitions about understanding mathematics ideas. Two reasons underpin such cases. First, students encounter difficulties when they respond to complex concepts which require them to understand the underlying mathematics principles (Garfield & Ahlgren, 1988). For instance, students might find it difficult recognising and translating mathematical problems into their proper knowledge of making sense of mathematics (Dubinsky & Wilson, 2013; Stein & Lane, 1996). Secondly, mathematics ideas sometimes appear to conflict with students' mathematical background how they view themselves in learning mathematics. They might lack a high level of mathematics skills (Garfield & Ahlgren, 1988), or ability in coordinating mental processes and manipulating mental concepts (Tall & Razali, 1993).

Having personal low self-esteem of having limited knowledge can put off students to participate in class (Yaratan & Kasapoğlu, 2012). Yaratan and Kasapoglu study showed that year-8 students having put very little mathematical ability leads to their poor participation in class due to negative attitudes towards learning mathematics. Interestingly, a study conducted on undergraduate mathematics students revealed that the poor personal ability of students in relation to mathematics heightens their mathematics incapability and anxieties, and lowers their performances (Maloney, Waechter, Risko, & Fugelsang, 2012).

2.9.3 Teacher

Teachers' attributions and teaching quality are the most important factors affecting student performance (Al-Agili, Mamat, Abdullah, & Maad, 2012). As has already been pointed out in section 2.8.2, the teacher is the most influential figure that influences students' beliefs and attitudes which in this case, also affect students' achievement in mathematics. Whether the teachers effectively influence students in either a positive or negative way is a way forward to be considered.

Students are going to be affected in their learning if the teaching process is regulating inferences which undermine the goal of learning. Mapolelo (2009) study reported that the teaching of mathematics is of poor quality at the secondary level. As a result there is a considerable perentage of students failing mathematics in the secondary high school (Ignacio et al., 2006). If students are not supported with their mathematical problems it will lessen their confidence in doing mathematics to achieve better results.

Mathematics teachers can affect students' beliefs and attitudes towards their achievement by how they teach mathematics (Vandecandelaere, Speybroeck, Vanlaar, De Fraine, & Van Damme, 2012). Their conceptual understanding of mathematics and how they convey it can influence students' mathematical learning by permitting them to either to engage or not engage in a mathematics lesson (Bishop, 2008).

Teachers who lack content knowledge can have a great impact on students' achievement because they might not explain content that prepares students for their future achievement. It was argued that teachers who do not have a strong mathematical knowledge may not best teach (Shulman, 1986) mathematics subject. This is the obvious reason for a lot of misconceptions and students' misunderstanding that takes place in the classroom for teachers are representing mathematics poorly (Ward & Thomas, 2008) to students. A poor representing mathematics to students' understanding will result in their poor performance.

2.9.4 Parental influences

Parental involvement and academic achievement had been demonstrated to be positively related. The greatest influences on children's' success are in the relationship between parents and their children. Parents play an invaluable role in fostering essential qualities and the well-being of their children's learning (Khajehpour & Ghazvini, 2011). However, they can also be regarded as one of the factors that can affect students' mathematics achievement. It is important to understand what is meant by parental support and in what ways it plays a role in affecting achievement. Several factors associated with parent involvement in children's learning are parental support, educational background and the socio-economic status of parents.

Parent involvement in schools that focus on learning activities are believed to be very effective in improving children's achievement (SNZMPIA, 2010). Research has confirmed that parent involvement in supporting children's success generally benefits children and provides a range of quality experiences in learning for their academic success (Hoover-Dempsey & Sandler, 1997; Karbach, Gottschling, Spengler, Hegewald, & Spinath, 2013). For instance, parents are supporting their children's educational progress by assisting their children with their homework, attending school activities (Gonzalez-DeHass, Willems, & Holbein, 2005), and giving physical and emotional support. Some parents would like to support their children providing assistance with school work but sometimes they do not know how.

There are cultural factors that can cause ineffective involvement of parents in their children's learning. Research study showed that African American parents found standard-based mathematics instruction unfamiliar (Jackson & Remillard, 2005) because they did not understand many of the conventions (language) used in the curriculum and did not understand assignments or homework and therefore provided little or no help to their children. A report endorsed by the SNZMPIA further elaborated that Pacific families' who lack of English fluency (SNZMPIA, 2010) and understanding often prevented them from supporting their children in their related school work.

Parental education is seen as an impact on students' attitudes and achievement. Parents who are well-educated tend to provide better learning assistance to their children's' education. Reynolds and Conaway (2003) found that parents who had higher education tend to support their children better by providing essential learning support for their children. In the contrary, parents who have low educational background provided little assistance to their children. This finding suggests that parents who provide little assistance to their children have weak numeracy and language skills and may not be able to adapt to new changes in supporting children's mathematics learning. Therefore, the experiences of having mathematical knowledge for parents from low educational background can be minimal to provide mathematical support for their children (Reynolds & Conaway, 2003).

Findings from research on parental influence towards children's learning revealed that low-income parents provide significantly few or less support compared to middle and upper class parent (Starkey & Klein, 2008). Parents with low socio-economic status may have very little knowledge to support their children's school related learning (Gorinski & Fraser, 2006).

These have a major impact on children mathematical learning and achievement.

To conclude this section, it has been evident from the literature that mathematics anxiety adversely impacts on students' attitudes and mathematics achievement (Sheffield & Hunt, 2006). Students' poor mathematical background is a huge influence on their own mathematics achievement. Further, lack of mathematical abilities and confidence to learn mathematics is negatively correlated with poor mathematics achievement (Das & Das, 2013; Di Martino & Zan, 2007). Although teachers' can positively influence students' mathematics attitudes, interpersonal behaviour and their mathematical knowledge can also affect students' mathematics achievements. Parental involvement and academic achievement are found to be positively correlated. However, lack of parental support has a major impact on students' mathematics achievement.

Research literature revealed considerable gender differences in students' beliefs and attitudes towards learning mathematics. The next section discusses these differences.

2.10 Gender Differences

There are common beliefs regarding gender and mathematics. For instance, females are often stereotyped as inferior in mathematics. Issues of gender equity in mathematics learning had been of concern in the past years (Chipman, 2005; Fennema & Sherman, 1977; Preckel, Goetz, Pekrun, & Kleine, 2008). Much of the concerns were based on gender differences related to issues of beliefs and attitudes, achievement and mathematics anxiety. These issues will be discussed below.

2.10.1 Gender differences in mathematics beliefs and attitudes

Generally, girls have been reported to have more negative attitudes towards mathematics than boys have (Frost, Hyde, & Fennema, 1994; Spencer, Steele, & Quinn, 1999). In a recent research article on gender–

related mathematics attitudes, it was reported that girls at the elementary level tended to have more negative self-concepts beliefs than boys (Gunderson, Ramirez, Levine, & Beilock, 2012). This view suggests that mathematics is favoured as a male domain. A quantitative study set to examine 114 students in year-8 (67 girls and 47 boys) mathematics performance, spatial skills and attitudes revealed that girls view themselves as less confident in their mathematical abilities than boys do (Ganley & Vasilyeva, 2011). The findings from Brady and Bowd (2005) study specified that girls main difficulty with mathematics is problem solving.

Compared with boys, girls have significantly lower levels of self-efficacy and perceived competence on mathematics-related tasks (Hyde, Lindberg, Linn, Ellis, & Williams, 2008). Task performance skills, for instance, boys' skills in mathematics increased faster than girls at the age of 12 or 13 (Hyde & Mertz, 2009). Even recent findings revealed that while the behaviours and performance of girls and boys are growing, boys' skills in mathematics increased faster than girls (Reilly & Neumann, 2013). This may result in more boys taking advanced mathematics in high school (Hyde & Mertz, 2009) than girls. This creates a gender gap in mathematics performance in high school.

2.10.2 Gender differences and mathematics achievement

Earlier studies suggest that more attention was given to boys which showed in boys' mathematics performance scoring higher than girls (Brady & Bowd, 2005; Watt, 2004). Hyde, Fennema, Ryan, Frost and Hopp (1990) study clearly concurred that boys outperformed girls on tests. This idea is not consistent with Kenney-Benson, Pomerantz, Ryan and Patrick (2006) who examined whether the tendency for girls to outperform boys in mathematics during a survey. Finding with year-5 and year-7 students revealed that girls performed similarly to the boys. This is consistent with Hyde and Mertz's (2009) and Ganley and Vasilyeva (2011) findings which showed that middle school boys and girls had similar levels of mathematics performance on standardized mathematics tests. This reinforces the ideas that in the United States, gender differences in mathematics performance are slightly decreasing (Else-Quest, Hyde, & Linn, 2010). Therefore, it is believed that this gender issue will continue to narrow in the future.

Similarly, several studies reported gender difference in terms of performance in mathematics (Hyde & Mertz, 2009; Jacobs, Lanza, Osgood, Eccles, & Wigfield, 2002). For instance, in high school students, mathematics performances are higher in boys than girls but in a small difference (Hyde & Mertz, 2009). But Watt's (2004) finding on Australia's adolescents' investigating their self-perceptions, values and task according to gender revealed that girls tended to have higher values for mathematics than boys did and performed better.

2.10.3 Gender differences and mathematics anxiety

Gender differences in mathematics anxiety and self-concept have received considerable research attention, revealing girls tend to have higher anxiety and lower self-concepts about their mathematics abilities (Fredricks & Eccles, 2002).

Mathematics anxiety is experienced by both sexes in different ways. Several scholars have concluded that "conflicting evidence has been found in regard to gender differences in mathematics anxiety" (Haynes, Mullins, & Stein, 2004, p. 297). Both boys and girls develop anxiety towards mathematics because of their poor performances. However, some studies revealed that girls have more mathematics anxiety than boys do (Devine, Fawcett, Szucs, & Dowker, 2012; Fotoples, 2000; Furner & Berman, 2003; Goetz, Bieg, Lüdtke, Pekrun, & Hall, 2013). This is in contrast to other studies which find no significant difference in the level of mathematics anxiety between both sexes in mathematics performances (Hyde et al., 1990; Yaratan & Kasapoğlu, 2012). Chinn's (2009) findings on mathematics anxiety in English high school students (year-7 & 8) following a survey with 200 participants revealed similar levels of anxiety were evident from both sexes during tests or examinations.

2.11 Gaps in the Literature

What has been reviewed in the literature described the studies conducted in western countries. Obviously, these ideologies, opinions, beliefs and perspectives are based on a western context. Many research studies conducted on students' beliefs and attitudes were conducted with primary children (e.g. Young-Loveridge & Mills, 2010; Young-Loveridge, et al., 2006) and intermediate students (e.g. Op 't Eynde et al., 2006; Amirali, 2010), and only a few studies were conducted with senior high school students(e.g. Hodges & Kim, 2013; Francisco, 2013; Ignacio et al., 2006).

There are other limitations in the existing literature. Some studies favoured using either qualitative or quantitative methods of generating relevant data (Francisco, 2013; Beghetto & Baxter, 2012; Johnston-Wilder & Lee, 2013; Liu & Lin, 2010). For instance, Johnston-Wilder and Lee's (2013) quantitative study used a questionnaire tool to investigate how students learn mathematics. Similarly, Tahar et al.,'s (2010) quantitative research that investigated students' attitudes toward mathematics used only a survey method. Rich data could be obtained by using triangulation method. In addition, using mix-method approaches to obtain data from more than one source, for instance, survey can be triangulated with interviews. When gathering information from human beings, it would be important to have some form of interviews to get in-depth information.

One of the limitations found in other studies (e.g. Gresham, 2008; Asante, 2012) was that in their survey or questionnaire there was a big gap in the gender sample of participants. For instance, in Gresham's (2008) study there was a big gender difference in the sample for the study that set out to investigate mathematics anxiety and mathematics teacher efficacy on their influences toward students' attitudes. Of the 156 participants, 148 were female and 8 were male. This can be seen as gender bias.

One of the major gaps in the literature compared to this present study is that, while many countries already investigated students' beliefs and attitudes, in the Solomon Islands to date, there has been no study that investigated the beliefs and attitudes of high school students in learning mathematics. This study could be ground breaking, by taking on board research on affective issues in mathematics education.

While Francisco (2013), for example, used qualitative semi-structured interview to find out students' mathematics related beliefs about learning mathematics, this study used both qualitative and quantitative approaches to gather data. Instead, a mix-method research design was used. The data were obtained through using a written survey, focus group and semi-structured interviews.

2.12 Chapter Summary

The literature revealed that beliefs are socially shared intuitions about the nature of knowledge and the nature of learning (Mason & Scrivani, 2004). These beliefs are internally built in a person and can be difficult to alter. Other writers attest that despite beliefs being intact and unchangeable, they are open to change. These lead us to perceive how students' mathematical beliefs can shape their behaviours as to how they relate to learning mathematics. Attitude is described as a long term positive or negative emotional disposition towards mathematics (Maio & Haddock, 2010; Marchis, 2011). Students tended to make evaluative emotional responses to liking or disliking mathematics.

Students' beliefs about the nature of mathematics are classified under main categories such as mathematical content, mathematical processes, cognitive processes and the utility of mathematics.

Students' specific view of learning mathematics that it is about sense-making, social process and discovery learning. Understanding concepts in mathematics is important, but due to inadequate mathematical knowledge, understanding mathematics can be very difficult. Communicating mathematical ideas in a social context develops students' mathematical understanding.

Students' general attitudes towards mathematics are both positive and negative. Students develop positive attitudes when they feel that mathematics is interesting, satisfying and clearly understood. However, students develop negative attitudes because they see mathematics is abstract, incomprehensible and not useful (Macnab & Payne, 2003).

Several factors have been examined from the literature that impacted on students' beliefs and attitudes towards learning mathematics. These are the students, teachers and peer groups. Furthermore, several factors were discussed that affect students' mathematics achievement. These could be seen as students' poor mathematical background that often results in their negative attitudes which, in turn, affects their mathematics achievement. Mathematics anxiety often adversely impacts on students' mathematics achievement (Núñez-Peña et al., 2013). Teachers who do not provide support or show patience can have a negative impact on students' achievement. Finally, providing less support for children's learning of mathematics can also affect their achievement.

The issue of gender is also examined in this chapter. It has been argued that mathematics anxiety is a gender issue (Hyde et al., 1990). Mathematics favours boys who hold more positive attitudes towards mathematics than girls do. In addition, girls experience more mathematics anxiety than do boys. Regarding mathematics performance, girls have lower competence beliefs than boys. However, gender differences with respect to mathematics achievement shows a very small difference (Goetz et al., 2013). It seems that boys' and girls' achievement in mathematics are alike.

Some of the gaps in the literature were found to be associated with the context of the study, which is more westernised, the samples and the type of study and methods used to generate data. It was also shown that most studies were done with primary school students and few studies were conducted in high schools. The major gap is that while beliefs and attitudes of primary and high school students have already been done in most countries, no similar study has been conducted in the Solomon Islands.

Therefore this study aims to investigate the beliefs and attitudes of high school students in the Solomon Islands towards learning mathematics. In addition, it also explores factors that impact on students' beliefs and attitudes and further examines factors that affect students' mathematics achievement.

The following next chapter provides a description of the methodology and procedures that have been utilised to generate data for the study.

CHAPTER THREE: RESEARCH DESIGN

3.1 Introduction

Mathematics education research is a field of study that is interested in finding solutions to problems affecting the teaching and learning of mathematics. Mckenney and Reeves (2012) said that knowledge generated through research can inform educational policy and contribute to improve teaching. Researchers who seek to improve the quality of education normally follow a research design to address the problems. Research designs set out the guidelines to gather information for the basis of inference, interpretation, explanation and prediction of the issue or phenomena (Cohen, Manion, & Morrison, 2011). Research design covers a range of aspects which include understanding of the methodology, data generation instruments, enhancement of quality, ethical considerations and data analysis (Mutch, 2005). Most importantly, research questions are addressed and then suitable research methodology is designed to gather data.

The following research questions were used in this study.

i. What beliefs and attitudes do selected senior high school students have towards learning mathematics?
ii. What factors do students believe have impacted on their beliefs and attitudes towards learning mathematics?
iii. How do students think their mathematics achievement has been affected by their beliefs and attitudes?

This chapter examines the research approach adopted to investigate the beliefs and attitudes of high school students in learning mathematics. In section 3.2, purpose of research in mathematics education is discussed. Section 3.3 describes the two overarching paradigms that set a framework for this study. Section 3.4 reviews literature on research methodology and outlines the specific research approaches used in this study. Section 3.5 describes research procedures, including an outline of how the participants were selected. Section 3.6 discusses the research ethics that set the guidelines of this research. Section 3.7 states the data recording techniques. In section 3.8, data analysis procedures used to analyse the data are explained. Section 3.9 discusses the quality of this research in terms of validity. The chapter concludes with a brief summary.

3.2 The Purpose of Research in Mathematics Education

Research in mathematics education aims to improve teaching and learning of mathematics. Research is conducted for the purpose of understanding the nature of mathematical thinking, teaching and learning for the future improvement of mathematics (Magidson, 2005; Schoenfeld, 2000; Suri & Clarke, 2009). Godino, Batanero, and Font (2007) also raised an interesting point that researchers aim to study factors affecting mathematics education so that they can develop programs and usable materials to improve the teaching and learning of mathematics.

The implications of mathematics education research serve as a framework for helping teachers organize their teaching pedagogies, understand students' thinking and to help students construct mathematical understanding (Hennessey, Higley, & Chesnut, 2012; Magidson, 2005). Stinson and Bullock (2012) pointed out that research in mathematics education must be an on-going practice. They recommended that there must be an investigation of mathematics teaching and learning within the classroom discourse from dynamic interactions between teachers-and-students, and students-and-students in their engagement with mathematics to meet the professional teaching standard.

According to Groth and Bergner (2007), mathematics educational research serves to review mathematics and mathematics education based on a problem in the specific context. Through research data, relevant solutions can be offered to understand the situation and to achieve desirable outcomes in future. Therefore, researchers in mathematics education have a set of beliefs, perceptions and ways of interacting within the context of mathematics education to understand the reality of knowledge that is created. In conducting research, appropriate paradigms are sought to set the conceptual framework for the inquiry. The next section discusses the paradigms for this study.

3.3 Research Paradigms

Any qualitative or quantitative study is governed by paradigms that inform and guide research inquiry (Creswell, 2005; Guba & Lincoln, 1994). According to Briggs and Coleman (2007, p. 19), a paradigm is “a network of coherent ideas” that guides thinking and action in research. Several scholars further elaborate that a paradigm is a set of basic beliefs that inform researchers’ worldviews, their perspectives for making claims of knowledge and reality (Creswell, 2009; Menter, Elliot, Hume, Lewin, & Lowden, 2011). Understanding the research paradigm provides researchers with a clearer picture of what is involved in the research process (Cohen et al., 2011). Paradigms also determine the type of research methodology that will govern the research process (Cohen et al., 2011). This section discusses two well-known paradigms: positivist and interpretive.

3.3.1 Positivist paradigm

A positivist paradigm is a scientific approach to a research activity that predominantly uses a quantitative approach (Kraus, 2005). This paradigm believes that the construction of knowledge in a social environment can be discovered by scientific examination of evidence (Burton & Bartlett, 2009; Felder, 2012) through hypotheses, experiments and quantitative data (Basit, 2010; Guba & Lincoln, 1994). The positive paradigm is used when data is quantifiable to generate general laws, test a hypothesis and make predictions (Broom & Willis, 2007). This paradigm verifies hypotheses by using survey and experiment for collecting data.

Positivists use statistical methods for analysing result and make generalisations about their findings (Basit, 2010). Hence, data are analysed quantitatively and usually presented in a statistical table (Burton & Bartlett, 2009). The data and their analysis are value-free and do not change because researchers observe them through a single lens analogy

(Healy & Perry, 2000; Guba & Lincoln, 1994). Positivists see things as they are and tend to ignore or rule out unexplained phenomena (Cohen, et al., 2011). They can eliminate other data when making inferences to draw conclusions. Critics further argue that if gathering data is achieved though observation, then a thorough understanding of human behaviour must be taken into account (Cohen et al., 2011; Mertens, 2010).

3.3.2 An interpretive paradigm

In contrast to the positivist paradigm, interpretive paradigm operates using qualitative methods. The interpretive paradigm maintains that knowledge of truth is internally rooted in the subjective world of human experiences (Burton, Brundrett, & Jones, 2008; Cohen et al., 2011; Markula & Silk, 2011). The interpretive paradigm sees human beings as having the tendency to construct meaning (Mack 2010) attached to their behaviour, actions and experiences (Nudzor, 2009). Researchers recognise human experiences with their own background knowledge to make interpretations.

Furthermore, in attempts to explore knowledge, qualitative researchers need to have a deep understanding about human experiences, beliefs, ideas and issues affecting them in order to provide meaningful interpretations (Creswell, 2005). The researcher's interpretations are subjected to the participants' interpretations and are supported with a high level of argument (Cohen, et al., 2011). Burton and Bartlett (2005) said that knowledge is constructed from researchers' interactions with participants. Participants interpret their own behaviours and practices in light of how they make sense of their socio-cultural settings. This calls for researchers to examine situations through the eyes of the participants rather than the researchers making their own interpretations (Ginsburg, 2009).

To comprehend the socio-cultural situation in a mathematics classroom, an interpretive researcher needs to capture the students' beliefs and attitudes towards learning mathematics. Therefore, an interpretive paradigm guides this study to have interactions with students in order to capture their beliefs and attitudes, and to some extent, provide interpretations about the issue investigated.

Importantly, the interpretive researcher considers research methodology for generating data to make interpretations about knowledge they want to find (Creswell, 2005). Therefore, the methodology used in this study was a mixed-method approach. A mixed-method will be discussed in the next section.

3.4 Mixed-method Approach

A mixed-method is defined as the “class of research where the researcher mixes or combines quantitative and qualitative research techniques, methods, approaches, concepts or language into a single study” (Johnson & Onwuegbuzie, 2004, p. 17). It is attractively used in most research because of its remarkable gains in systematically combining quantitative and qualitative research approaches and techniques into a particular study (Cohen et al., 2011; Johnson & Christensen, 2008; Lankshear & Knobel, 2004). This method provides more comprehensive evidence for studying a particular research problem than by using either quantitative or qualitative research alone (Creswell & Plano-Clarke, 2007).

Generally, mixed-method research is an approach to knowledge that attempts to consider multiple view points, perspectives, and positions (Johnson & Christensen, 2008). According to Greene and Caracelli (2003), researchers who use a mixed-method approach are more susceptible to the diversity of thinking, knowing and valuing their study for having better understanding of the possible area of their interests during the research inquiry. With that understanding, mixing of methods during the research inquiry helps to clarify a number of aspects of the phenomena that are under investigation and provides better results for informing future improvement of education (Giannakaki, 2005).

Mixed-method approaches provide researchers with many research design strategies to choose from and then use to generate data for their study (Terrell, 2012). Three methods of data generation were used in this study. These are:

i. Written survey
ii. Semi-structured interviews
iii. Focus groups

The following sections discuss the above methods in more detail.

3.4.1 Survey

A survey is a systematic method of gathering data from a large population or sample using quantitative descriptions (Groves, Fowler, Couper, Lepkowski, Singer & Tourangeau, 2009, p. 2). Groves, et al., (2009) further add that surveys not only attempt to collect information from large population but sometimes go for just a sample. Bartlett, Kotrlik, and Higgins (2001) concur that within a quantitative survey design, determining sample size and dealing with nonresponsive bias is essential. In other words, researchers use sample size as a criterion to make generalisations about the larger population (Burton et al., 2008; Cohen et al., 2011).

The purpose of a survey is to produce statistical description. According to Fowler (2009), survey uses quantitative or numerical descriptions to present information. Cohen, et al., (2011) add that researchers take numerical data and use statistical description to analyse and interpret data for decision making regarding issues of particular interest (Cohen, et al, 2011). These are widely used methods to gather information pertaining to the background, behaviours, beliefs or attitudes of participants (Neuman, 2011).

The survey is adaptable because the best possible way to gather information is through written questionnaires (McMillan, 2012). The main avenue for obtaining data is asking people questions, which means their answers determine how the data is going to be analysed (Fowler, 2009). The questionnaire used for gathering data is usually at reasonably low cost and effort compared to other methods such as observation or interviews (Muijs, 2011). Data can be structured for easy analysis because of straightforward questions (Coles & McGrath, 2010).

Furthermore, Macmillan (2012) affirms that survey research is flexible. One features of its flexibility is how convenient it is to be administered. A wide range of research questionnaire can be asked in a given time (Muijs, 2011). The participants can complete the questionnaire at their own convenience (Rea & Parker, 2005). Furthermore, the participants have enough time to elaborate on answers, and ask questions, if necessary regarding the issue of study.

According to Krosnick (1999), survey requires rating scale questions. The author explains that "rating scale questions asked people to choose a descriptor from a set that represents a dimension or continuum" (Krosnick, 1999, p. 549). For instance, a descriptor can range from a continuum of "strongly disagree" to "strongly agree".

Although survey method may appear to be simple, the design and development of survey questions require a significant amount of knowledge, planning and skills to carry it out effectively (Krosnick, 1999; Lodico, Spaulding, & Voegtle, 2010). The analysis of raw data obtained from a large sample demands intellectual thinking, skills and motivation to perform the necessary takes so that biased reporting can be avoided (Krosnick, 1999).

Bias can evolve in the demographic composition of samples from the population (Neuman, 2011). One potential source of bias in the results of a survey is failure by researchers to collect answers from participants (Fowler, 2009) to represent the sample. It is always the case that some people may not be available to answer questions due to their health, difficulty answering questions, refusal to answer the questions or language barrier.

The written survey method was used for data collection in this study. The process of developing the written survey (see Appendix G) commenced with a review of literature pertaining to the nature of mathematics, and beliefs and attitudes towards learning mathematics. Questionnaire used by Mapolelo (2009) in investigating students' views about mathematics learning was reviewed while developing the written survey questions. In addition, some questions regarding beliefs and attitudes from MSTE504 postgraduate course work assignment 1 in 2012 (Young-Loveridge, 2012) were also reviewed and used in this study.

The written survey was structured with a variety of questions on a four-point Likert Scale (strongly disagree, disagree, agree and strongly agree). It consisted of both closed and open-ended questions. The closed-ended questions required participants to choose among a set of provided response alternatives on a Likert Scale. The open-ended questions required students to provide answers in their own words.

The written survey was administered to the whole class by the researcher. After the survey was conducted, the researcher randomly selected students for semi-structured interviews.

3.4.2 Semi-structured interview

Mutch (2005) defines semi-structured interviews as "having a set of key questions that are followed in a more open-ended manner" (p. 126). Mutch (2005) built on the previous concept by Kvale (1996) that there is a potential construction of knowledge which can be developed from guiding open-ended questions during an exchange of views between interviewer and interviewee. Zhang and Brundrett (2011) make an important contribution about the notion of semi-structured interviews, in that open-ended questions that are designed must reflect the main topic of study and must not deviate from it. Auguste-Walter (2011) and Mutch (2005) discuss that semi-structured interview questions are intended by researchers to get down to the bottom of the discussion with the participants regarding the issue of study. Therefore, to get in-depth information regarding the issues of study requires carefully designing the set of questions and must be followed up in open ended way (Cohen et al., 2011; Bell, 2010; Morrell & Caroll, 2010).

The semi-structured interviews provide an avenue for researchers to delve deeply into the social and personal life of the participants (DiCicco-Bloom & Crabtree, 2006; Longhurst, 2010). In addition, semi-structured interviews are designed to explore issues thoroughly by digging into people's attitudes, beliefs, feelings and perceptions, and issues affecting them (Auguste-Walter, 2011; Coles & McGrath, 2010). Having an understanding of how to use it, Bell (2010), Mertens (2010) and Cohen, et al., (2011) have suggested that preparing a few prompts or probing questions will enable researchers to uncover people's own knowledge, beliefs, thoughts, and feelings regarding issues affecting their lives. Rich data are gathered from the issues explored because the researcher elaborates, clarifies questions and encourages the participants in a non-threatening way to openly express their opinions, beliefs and knowledge.

Even though semi-structured interviews are a very useful tool to dig into people's mind, the process of interviewing demands time and very is costly. According to Longhurst (2009) and Menter et al., (2011), to conduct qualitative semi-structured interviews and analyse data can be time consuming and costly. It requires many hours for formulating questions, recruiting participants, and organizing times and spaces for interview. In addition, it demands more time for transcribing and analysing data (Longhurst, 2009). Furthermore, as most things are not cheap nowadays, it is very expensive to conduct interviews when participants are located in different settings, meaning the researcher has to spend money to reach participants.

One potential drawback of semi-structured interview is that participants may not feel comfortable speaking freely, especially if they want make some negative and evaluative comments about people, institutions or organizations (Longhurst, 2009).

Semi-structured interviews were adopted in the present study to gather data in order to explore factors affecting students' mathematics achievement. It seemed appropriate because it provides deep insight into student's thinking, expressing how their beliefs and attitudes towards learning mathematics affected their mathematics achievement. Knowledge was developed from mutual interactions between researcher and student participants through the availability of research interview questions. The interview questions (see Appendix I) may not be particularly specific to mathematics achievement, but, from students' responses the researcher developed probing questions to elicit thinking and, in general followed the participants' thought processes to tease out some possible factors affecting them.

As much as possible, the researcher made every effort possible to be student-centered, that is, to let the students themselves see the issues from their own perspectives. The semi-structured interviews took 20 minutes, with in-depth interactions to gather enough information to support the reasonable interpretation of the students' beliefs and attitudes regarding the issue investigated.

3.4.3 Focus group interviews

Focus group interviews are very fundamental when collecting data about specific topic of interest in qualitative research (Ary, Jacobs, & Razavieh, 2002). This method is used to focus discussions or questions on a particular issue or one for which little information is available (Ary et al., 2002). It is useful because it can elicit more collective ideas, views and perceptions from participants within the group than individual responses (Bell, 2010; Mertens, 2010; Morrell & Caroll, 2010; Cohen et al., 2011). In other words, different perspectives, opinions and ideas are converged to suggest solutions for an issue studied.

Focus group interviews require four to twelve people selected and assembled by the researcher to be interviewed in a group (Creswell, 2005; Morrell & Caroll, 2010; Powell, 1996). A small number of participants in the study will make it easier for the researcher to control the discussion. While ideas are open up for small group discussion, people are encouraged by the researcher to talk, ask questions, exchanging anecdotes and making comments on each other's experiences and views (Kitzinger, 1995). Nevertheless, having more people in a group is opposed by several researchers (Bozkurt et al., 2012; Creswell, 2005). For instance, Bozkurt, et al., (2012) pointed out that having more than 10 people in the group may affect the group and makes it difficult for the researcher to control the group discussion. Further, others may want to control the whole discussion when talking about the issues, leaving no opportunity for other members to contribute.

Focus group can be difficult to conduct. According to Gibbs (1997), getting a representative sample may not be easy and may discourage certain members in the group from participating. For instance, some may not have confidence or communication problems to share information. The discussion part of focus group may also discourage some members from trusting others with sensitive or personal information. When information is share with others in the group, focus group interviews are not fully confidential or anonymous.

The focus group interviews were used in this study to gather in-depth information about students' opinion of factors they believed had impacted on their beliefs and attitudes towards learning mathematics (see Appendix J). Together with the predetermined topic, focus group interview questions were developed by the researcher.

Due to the possibility of student participants not understanding some of the questions for focus group interviews, a copy of the questions was made available to the participants before schedule. During the interview session, the researcher commenced the discussion by posing questions, and then asked members in the group to contribute. Ground rules were set as to how the interview would proceed. In addition, in the middle of the discussion, alternative probing questions were raised to clarify misunderstandings. Alternatively, new questions were raised to probe for more responses on the basis of the answers given by the students. Students who remained silent were encouraged to contribute.

3.5 Research Procedures

Before collecting any data, the researcher must gain access to the site selected for study. Researchers, therefore, need to obtain permission to conduct research, and more than that to develop relationships with participants and authorities based on trust and mutual respect (Lodico, et al., 2010). This section outlines the site selection, invitation to participants and selection of participants.

3.5.1 Selection of site

This research was conducted in two senior high schools in the Solomon Islands. My preference for recruiting participants was one high school in the capital city, Honiara (urban) and the other in Western province (rural) to provide two different settings. These two schools were administered under two different education authorities (EA). The urban school was managed and operated under Honiara City Council and the rural school was administered under the Seventh-day Adventist education authority. These schools were selected, based on my familiarity and the availability of transportation and communication when this study was conducted. Also, I have worked in the rural high school.

3.5.2 Invitation to participants

After gaining formal approval from the Faculty of Education Research Ethics Committee at the University of Waikato in April 2013, the formal letter and application (see Appendix B) was sent to the Permanent Secretary of the Ministry of Education Human and Resources Development (MEHRD) in the Solomon Islands seeking permission to conduct research in the two high schools. After receiving formal approval from the MEHRD, information letters seeking permission to undertake the study were mailed to the education directors (see Appendix C) to seek permission to conduct research in their schools.

After securing permission from the education directors, letters were sent to the principals (see Appendix D) of the two schools to obtain consent to conduct research with their students. Hence, permission was granted by the school administration.

3.5.3 Selection of participants

There were 107 year-12 students who took part in the written survey. Of the 107 students, 55 students (21 girls and 34 boys) were from the urban school and 52 students (25 girls and 27 boys) were from the rural high school. One of the reasons for selecting year-12 for the study was that year-12 is best representative of a secondary level as this is the last level in the secondary school and I could explore the general tendency of secondary students' beliefs and attitudes towards learning mathematics by engaging them in the study before they venture into tertiary level. Most of the students were 17 to 19 years old.

There were 10 students (five boys and five girls) randomly selected in each high school for semi-structured interviews after getting feedback from the written survey. Student participants' mathematical ability was unknown because the researcher, acting as an outsider, made the selection.

With regards to the limitations of focus group interviews, only four students were selected from each high school for interviews. For gender equality, four girls were selected from the rural high school and four boys from the urban high school.

During the research study every effort was made to ensure that ethical guidelines were adhered to so as to safe guard the researcher and the participants (Cohen, et al., 2011; Punch, 2009). The research ethics safeguarding researchers and participants will be discussed in the next section.

3.6 Research Ethics

When research is carried out on a large or small scale, ethical considerations must be upheld because people are involved (Punch, 2009; DiCicco-Bloom & Crabtree, 2006). Researchers have an obligation to ensure that the rights and interests of the participants are safeguarded throughout the research study (Rodie, 2011). This section outlines three ethical principles that were maintained during this study. They are:

i. Informed consent
ii. Privacy and confidentiality
iii. Cultural considerations

3.6.1 Informed consent

Gaining information from participants requires briefing them about the purposes, goals and objectives of the research study (Burns, 1994; Cohen et al., 2011). According to Punch (2009), some issues that will be investigated affect people’s lives so they should be aware of the purpose and how they will contribute to the study. Preferably, some agreements need to be addressed such as an informed consent form needs to be signed before research study can commence.

Informed consent in this study was adhered to by first providing information to students. The information letter (see Appendix E) which was given to students outlined the purpose of the research, methods of gathering data, overall expectation of the study, participants’ right to withdraw at any time and the confidentiality of participants. The researcher made certain these points were made clear to the participants before their willingness was sought to participate in the study. A consent form (see Appendix F) was attached with the information sheet for students to sign.

3.6.2 Privacy and confidentiality

Participants’ rights to privacy means protecting their identity such as personal life, experiences or interests (Cohen, et al., 2011; Basit, 2010) from public awareness. This means that the researcher undertakes to respect the participants’ rights to privacy throughout the research process (Cohen, et al., 2011).

Under confidentiality the researcher keeps the participants’ identity or data secret from disclosure to the public. This means that information about the participants and their institution must be kept confidential, unless permission is granted to reveal their identity for the purpose of the research (Check & Schutt, 2010; Basit, 2010). The sensitive issues revealed by participants must also be confidential (Basit, 2010).

In this study, to maintain participants' rights to privacy, a pseudonym (code) was used to identify student participants and the name of the two schools. With regards to sensitive information students shared during focus group and semi-structured interviews, for instance, negative comments about teacher , this was treated with great confidentiality during the research process.

3.6.3 Cultural and social considerations

Every researcher must ensure adherence to a high degree of sensitivity to the participants, their culture and circumstances being studied (Cohen, et al., 2011). One main issue that must not be overlooked by foreign researchers in the Solomon Islands is the diversity of cultures, values and beliefs among indigenous communities (Malasa, 2007). Malasa strongly emphasised that a common mistake often overlooked is the issue of generalisation of cultures. Therefore, the researcher must be very sensitive towards holding interactions with student participants from differing cultural background (Malefoasi, 2010).

The cultures and customs of Solomon Islands can restrict some research ideologies. Individual interviews between those of opposite sex are not common practice in our society due to some cultural standards and expectations. For instance, Bosamata (2011) explained that it may not be acceptable for a married man to hold a discussion with a young woman if it is held in private. Someone has to be present to witness the interview. However, it is acceptable to hold a discussion in a public place.

In this study, the venue for individual interview was chosen by the school administration. In terms of the participants' cultural values and practices, the researcher was sensitive about such issues, especially when interviewing student participants from diverse cultural backgrounds. As much as possible, great care was taken and the researcher just adhered to the expectations and practices of the school.

By abiding by the above ethical principles, the smooth running of the research study was maintained and quality data were obtained. The next section describes the data recording techniques.

3.7 Data Recording Techniques

Cohen, et al., (2011) and Punch (2009) highly recommend the use of an audio-tape recording to catch verbal communication. Recording data by means of audio device is useful to capture the whole setting of the interviews. However, great care must be taken to keep the data secure, otherwise potential data will be lost or distorted.

In this study, semi-structured interviews and focus groups were audio-taped and transcribed. The written survey data were already in text document format so it was analysed straight away. Data analysis procedures will be discussed in the next section.

3.8 Data Analysis Procedures

Three basic data analysis techniques used in this study are:

i. Data transcription
ii. Thematic analysis
iii. Frequency percentage

3.8.1 Data transcription

Data transcription is a useful way of representing data in a written text (Tilley & Powick, 2002). In this phase, the researchers have paid some attention to the complexities of the interpretive process they have mentioned during the interview process (Cohen, at al., 2011). The transcribing of data is almost inevitably interpretive from listening to the audio recorded file from interviews to generating meaning from the actual words spoken (Cohen, et al., 2011).

The language of communication that all participants felt comfortable to use was Solomon pijin (lingua franca). This is the language in which students could express their views more openly and clearly. The data were transcribed into English according to what the participants were saying.

This was done in the Solomon Islands as I had to return the transcription texts back to the students to check for approval and confirmation. The coding of participants began to take shape after all the data was approved by the student participants.

Codes were used for students involved in the study (see Appendix K). Since data came from two different high schools, the researcher designated students in the rural school with capital letter ‘R’ and for urban students, capital letter ‘U’. To distinguish gender, boys were indicated by letter ‘M’ and girls by letter ‘F’. For example, 21 girls in the urban high school were coded as FSU1-FSU21, and for 34 boys, MSU1-MSU34. For the rural high school, 25 girls were coded as FSR1-FSR25 and 27 boys, MSR1-MSR27. The first letter indicates the gender, the second letter indicates the students, the third letter denotes school location and the numeral shows the order of the participants.

After transcribing the data, they were categorised into common themes and patterns. The next section discusses this thematic analysis approach.

3.8.2 Thematic analysis

Thematic analysis is a qualitative method of data analysis that involves systematically identifying and describing themes or patterns from a qualitative data set (Joffe & Yardley, 2004). According to Cohen et al., (2011) thematic analysis allows the researcher to note patterns and organise themes into categories. Creswell (2005) explained further that one important feature of analysing data is to have a continual reflection, asking analytical questions and making interpretive judgments of the information before reporting. This is the fundamental part of thematic analysis.

This study used thematic analysis technique to analyse data generated from the focus group and semi-structured interviews. Likewise, part B of the written survey was also analysed thematically. It was interesting at this stage to identify patterns and emerging themes from students’ responses regarding their beliefs and attitudes towards learning mathematics. In addition, it is notable that during data analysis there were commonalities of responses emerging from the participants' responses in the semi-structured interviews about factors affecting their mathematics achievement. At this stage, data were coded and analysed into similar categories from the emerging themes about factors that impacted on students' beliefs and attitudes in the focus group interviews.

3.8.3 Frequency percentage

Referring to the purpose of the survey in section 3.4.1, the written survey is quantitative and the numerical and statistical descriptions are used to illustrate the data. The frequency percentage technique is one element of statistical description that can be used to analyse data (Cohen, et al., 2011). This technique converts the number of responses for each statement to a percentage which is represented in a frequency table. Cohen et al., (2011) attested that this form of data analysis is one way of presenting data in a much clearer portrayal of the evidence gathered from the participants.

Frequency percentage was used to analyse the belief statements from the written survey (see Appendix G). The procedures of creating a percentage frequency involves, first, identifying the total number of participants. Secondly, the total number of participants who responded to that particular statement are identified. Thirdly, the number of participants who responded to that particular statement is divided by the total number of participants and then that figure is multiply by a hundred.

Frequency percentage is a useful method for this study, as it displayed the data that specify the percentage of students for each of the belief statements. Data analysis using this technique adhered to certain conventions. That is, categories are placed in rows, followed by the ordinal data (4-point Likert scale) which are placed in columns (for example, see table 4.2 in chapter 4).

3.9 Validity

Cohen et al., (2011) highlighted the issues of validity by referring to the correctness or credibility of a study from the conclusion, explanations, interpretations or any other sort of account. They further explain that validity in any study can be demonstrated by means of what types of instruments are used to measure the outcome of an activity. This requires stating how best the researchers select their research methods, instruments or items that can draw meaningful, justifiable, convincing results they supposed to measure in the research inquiry (Bell, 2010; Creswell, 2005). In qualitative research, validity can be addressed in so many ways. One of the significant features of the validity of data can be addressed through the use of triangulation (Basit, 2010).

Triangulation of data has been identified as an approach for improving the validity of the research study (McMillan, 2012). This is a multi-method that generates data from more than one source, which can be combined to address the same research questions (Cohen et al., 2011; McMillan, 2012). In triangulating data, the outcomes of the study can be trusted, gaining credibility, honesty and robustness to serve what it purports to measure (Cohen et al., 2011; Coles & McGrath, 2010; Mutch, 2005). Research study has enhanced quality when several sources of obtaining data are adopted when exploring a particular issue.

Another aspect that maintains validity for the study is the importance of participants re-checking the data on how they interpreted interview questions. Obtaining feedback from participants could alleviate misinterpretation of their self-reported views regarding the issues (Yin, 2011). Creswell (2005) and Cohen, et al., (2011) affirm that returning the transcript results to the participants to check their responses from audiotape and to confirm their responses is one important way to justify the data.

The intention behind adopting a mixed-method in this study is for the purpose of triangulation. The methods used to collect data in this study were useful in triangulating the data to answer the main research question.

Using three sources of data added quality to this study. The written survey set out to explore students' beliefs and attitudes towards learning mathematics. Then the focus group interviews were conducted to examine factors which impacted on students' beliefs and attitudes. Next, the semi-structured interviews were designed to investigate factors that had affected students' mathematics achievement.

The transcribed data were given to every participant for checking, verification and confirmation that the way the data was transcribed from Pijin to English was agreed with. In addition, the researcher ensured that at the end of each stage of interview, for example, the semi-structured interviews, the participants' responses were summarized and they were able to add more to what they meant to say.

The data were trustworthy as data analysis methods were properly accepted, and the researcher was there to gather the information needed. Additionally, the data collected from the written survey, semi-structured interviews and focus groups were analysed according to themes or categories which added to the quality of this study. However, if research data had not carefully analysed they may not have been trusted, then the validity of the findings could be questioned.

3.10 Chapter Summary

This chapter discussed the research methodologies used in this study to answer the research questions. It began with the purpose of mathematics education research. It was pointed out that research in mathematics education provides an avenue to improve and advocate for quality teaching and learning of mathematics. It was essential to investigate students' beliefs and attitudes towards learning mathematics from the perspective of positivist and interpretive paradigms. These paradigms set the conceptual framework for generating data in this study.

The chapter also discussed the quantitative and qualitative approach of research methodologies adopted to gather data. The research data were sourced from written survey, focus group and semi-structured interviews.

Hence, research data were analysed using thematic and frequency percentages.

The consideration of ethical principles that protects human rights is fundamental to this study. Quality in research was enhanced by maximizing the notion of validity. The mixed-methods approach was intentionally used for the purpose of triangulation, which further added quality to this study. The findings of this study will be presented in chapter four.

CHAPTER FOUR: RESULTS

4.1 Introduction

This chapter is all about the presentation of results and data analysis from the study that investigated beliefs and attitudes of high school students towards their mathematics learning. The three main research questions of this study were:

i. What beliefs and attitudes do selected senior high school students have towards learning mathematics?
ii. What factors do students believe have impacted on their beliefs and attitudes towards learning mathematics?
iii. How do students think their mathematics achievement has been affected by their beliefs and attitudes?

A mixed-method approach was used for data collection in order to answer the above research questions. Research data were obtained through a written survey, focus group and semi-structured interviews.

There were 107 high school students (ages 17 to 19 years-old) participated in a written survey. Fifty five students came from an urban high school and 52 students came from the rural high school. After a written survey was conducted, 10 students in each school were randomly selected for semi-structured interviews and four students in each school volunteered to participate in the focus group interviews. The students were coded for their identity (see Appendix J).

This chapter begins with the presentation and analysis of data pertaining to students' beliefs about the nature of mathematics (section 4.2). In section 4.3, data on students' beliefs about learning mathematics are presented. Section 4.4 presents and analyses data on students' attitudes towards learning mathematics. Section 4.5 is the analysis of data on factors that impacted on students' beliefs and attitudes. In section 4.6, data on factors affecting students' achievement in mathematics is presented and analysed. The chapter concludes with a brief summary.

4.2 Beliefs about the Nature of Mathematics

The first question in the semi-structured interviews (see Appendix I, question 1: *What is mathematics?)* solicited students' beliefs about what they thought about mathematics. The semi-structured interviews were conducted in pijin. Data were transcribed into simple English but retain the original meaning of what the participants meant to say. The students interpreted the question in a variety of ways. Some students interpreted the question in terms of the content of mathematics (e.g. number, calculations). Other groups of students interpreted the question with regards to mathematical processes (e.g. problem solving) and cognitive processes (e.g. thinking and learning). Few students' responses reflected on the utility of mathematics. Students' responses to the question are organised into four major themes, and these are discussed below.

i. Mathematical content
ii. Mathematical processes
iii. Cognitive processes
iv. Utility of mathematics

4.2.1 Mathematical content

Seven of the 20 students' responses indicated the aspect of mathematical content. Three students stated that mathematics dealt with number and calculations using formulas.

> Mathematics is all about number and calculations. It involves counting and using numbers (MSU6)

> Maths mainly deals with calculations. It is more of dealing with formulas (FSU9)

> Mathematics is a subject that has to do with number and calculations. It requires us to remember rules and formulas to calculate things (MSU12)

Two students mentioned using number to calculate unknown quantities.

> Mathematics is mainly about calculations of finding unknown quantities. It deals with numbers by which we use numbers to calculate the unknown quantities (MSU13)

> Mathematics is a subject that deals with calculations and using numbers. It has to do with counting and calculating unknown answers (FSR14).

One student's view reflected on some topics and exploration.

> Mathematics is statistics, algebra, etc. Mathematics is all about finding and exploring new topics. It involves formulas and calculations (FSU10)

Another student mentioned mathematics as playing around with number when doing calculation.

> I think maths involves mainly calculations. I think of it as playing around with numbers. It deals with numbers to calculate to find an answer to a question (MSR6)

4.2.2 Mathematical processes

Four rural high school students mentioned mathematical processes. Some general reflections on processes were referred to as problems solving, using rules and procedures. Three of the four girls from the rural high school felt that applying rules and formulas is necessity for problem solving, but gave no clear explanations of their views.

> Mathematics is a subject that deals with rules and problem solving. People remember formulas and procedures to use and to make calculations in solving problem (FSR9)

> Mathematics is mainly calculations. It involves solving problems activities (FSR4)

> Mathematics is a subject that deals with formulas and procedures to problem solving. People are used to memorizing formulas, and follow procedures to do calculations (FSR3)

It seemed that one of the students recognized mathematics as an important part of science. Part of her interview script was based on the concept of investigation and analysing of problems. FSR23 said that:

> Mathematics is one of the subjects in science. It deals with calculations and numbers. It requires one to solve problems following certain rules and methods to solve problems. It also involves investigation of problems and analysing information.

4.2.3 Cognitive processes

Four students mentioned the notion of cognitive processes such as learning and thinking as their interpretation of mathematics. One student mentioned the nature of mathematics reflected an emphasis on learning mathematics concepts.

> Mathematics is like learning about numbers and how to calculate problems. It involves learning graphs and understanding concepts. And it is an easy subject to learn (MSU17)

Three students (one urban and two rural) commented that the nature of mathematics was about thinking

> According to my thinking about mathematics, it is one of the subjects… that make us think. For instance, when you do mathematics it will make your mind think better and can expand your thinking capacity (FSU19).

> Mathematics is a subject that makes people think. (MSR9)

> Mathematics is one of the subjects … that requires one to think before getting the answer when doing calculations and solving questions (MSR10)

4.2.4 The utility of mathematics

Five students mentioned the usefulness of mathematics. Some considered mathematics in terms of immediate need now, and some were more concerned about their long term future. One girl in the urban school reflected on the usefulness of mathematics learnt in school to her everyday life.

> I thought about mathematics is all about how we live. We live in a world of mathematics. Everything we deal with involve calculations. It involves thinking and solve problems we face using ideas of mathematics. That's how I thought about it (FSU11)

Two rural and one urban students mentioned how worthwhile mathematics is for overcoming problems experienced and its omnipresence in commercial businesses.

> Mathematics involves our daily aspect of life. It is used in our daily life to overcome difficulties we experience in our daily lives. It can be used in business, industry and the commercial world (MSR3)

> Apart from numbers it involves problem solving and dealing with real life situations. Mathematics involves plenty of jobs today. Most work nowadays deals with mathematics such as engineering, mining and businesses (MSR23)

> Mathematics mainly deals with daily lives. It is also seen in business for solving problem (FSU21).

One student acknowledged the usefulness of mathematics for making decisions and its use in everyday life.

> Mathematics is involved in life situations to make decision, for example, in the probability topic you can predict the likely event whether it will be going to rain or not. It involves calculations of numbers. Mathematics is used in the market, time and finding rates (MSR4)

Students' beliefs about the nature of mathematics may have come directly from what they had experienced in school. It seemed that students mainly referred to the aspects of mathematical content, processes and cognitive processes in their explanations of what mathematics is. Some students had also acknowledged the usefulness of mathematics in their daily lives and its relevance in work places.

The next section presents and analyses data from a written survey pertaining to students' beliefs about learning mathematics.

4.3 Students' Beliefs about Learning Mathematics

To investigate students' beliefs about learning mathematics, a written survey was used in two high schools – one urban and one rural. This written survey consisted of two parts (see Appendix G). In part A, there are 21 closed belief statements. Data from part A are discussed in this section. Part B has four open-ended questions about attitudes, and the data will be presented in section 4.4.

In the analysis process, effort was made to organize all belief statements into some specific categories to actually configure a type of belief that refers to a particular statement. The four belief categories are outlined in Table 4.1 below with the number of statements.

Table 4.1. Category name and number of statements for each belief category

	Belief category	**Number of statements**
A	Students' beliefs about doing and knowing mathematics	7
B	Students' beliefs about the utility of Mathematics	3
C	Student's beliefs about gender differences	1
D	Students' beliefs about their self-efficacy	10

According to the above table, category A incorporated 7 statements (4, 6, 7, 8, 9, 11 & 20) related to *students beliefs about doing and knowing* *mathematics (for more detail, see table in Appendix H)*. In category B, there are 3 statements (13, 14 & 15) grouped under *students' beliefs about the utility of mathematics.* These statements refer to the belief about the relevance and usefulness of mathematics in school and in the future. Only a single statement (16) was categorized under *gender differences* in category C. This particular statement tries to solicit students' views regarding their belief about gender in learning mathematics. In category D, 10 statements are grouped as *students' beliefs about their self-efficacy in learning mathematics*. These statements refer to students' beliefs in their confidence, ability, and effort when doing mathematics.

This section will first present the overall findings from part A of the survey, and this will be followed by the presentation and analysis of each of the belief categories in table 4.1 in turn.

4.3.1 Overall findings

Students were required to rate each statement using a 4-point Likert scales (see Appendix H). These scales range from "strongly disagree (SD)" to "strongly agree (SA)". Ratings at each end of the scale are aggregated as "strongly disagree" with "disagree (D)" and "strongly agree" with "agree (A)". The number of student(s) who did not respond (NR) to each statement is shown in italics. There were a total of 107 students.

The table in Appendix H presents the number of students who agreed or disagreed with each statement for the overall sample. When students' 'agreement' is mentioned this refers to a combination of strongly agree (SA) and agree (A), and strongly disagree (SD) and disagree (D) are interpreted as 'disagreement'. For example, for statement 7, 83 students have indicated their agreement which represent the combined number of students who agreed (A= 57) and strongly agreed (SA=26). Similarly, the number of students' disagreement for statement 7 (n=24) is obtained by combining 6 students who strongly disagreed and 18 students who disagreed. NR is referred to as 'non-responder', indicating the number of students who did not respond to each statement.

The highest levels of agreement for belief statements in each category are outlined below.

In category A, the first statement that most students agreed with was doing mathematics is a matter of working logically in a step-by-step fashion (n=106, statement 4). Secondly, a majority of students (n=100, statement 6) thought that mathematics required original thinking and creativity. Thirdly, most students (n=94, statement 8) agreed that knowing the reason why an answer correct is important. Next, the majority of the students (n=101, statement 9) believed that when working at mathematics problems their answer must be sensible. The final statement (n=106, statement 20) showed that most students highly regarded was about the importance of explaining to others how they got an answer.

In category B, most students (n=101, statement 14) believed that mathematics is needed in many jobs and careers. The majority of the students (n=96, statement 13) also thought that mathematics helped them in their thinking.

For category D, most students (n= 94, statement 2) agreed that learning mathematics is interesting. Furthermore, most students (n=96, statement 10) believed that they never give up in mathematics even though mathematics is hard. Moreover, the majority of students (n= 103, statement 17) believed that they had confidence in mathematics. Nearly all the students surveyed thought that to be good at mathematics they must memorize formulas, procedures and rules (n=106, statement 18). Most students (n=101, statement 19) believed that through working hard they can be good at mathematics. Many students (n=97, statement 21) highly regarded having a mathematical mind as an indication of being good at mathematics.

Despite the highest levels of agreement, the majority of students disagreed with some statements. The highest levels of disagreement in category D were on statements about: mathematics is difficult (n= 78, statement 5), and being poor at mathematics (n=67, statement 12). In category C, most students (n= 84, statement 16) disagreed that men are better at mathematics than women are.

In the following sections, each category is analysed in terms of percentage. See section 3.9.3 for procedures of converting frequency into percentage.

4.3.2 Students' beliefs about knowing and doing mathematics

The data for this category (see table 4.3) revealed students' positive responses towards knowing and doing mathematics. This was indicated by the percentage of agreement in their responses to the statements. The difference between the genders is shown in italics.

Table 4.3. Percentages (rounded to whole numbers) of students who agreed with each statement in terms of gender.

Statement	**Overall (%)**				**A or SA (%)**		
					Boys	Girls	
	SD	D	A	SA	n=61	n=46	*Diff*
4. Doing mathematics is usually a matter of working logically in a step-by-step fashion			43	57	100	98	*2*
6. Doing mathematics allows room for original thinking and creativity		4	50	46	98	87	*11*
7. It is okay for learners to come up with their own ways of solving mathematics problems.	6	17	53	24	72	85	*13*
8. Knowing why an answer is correct in mathematics is just as important as getting the right answer.	1	6	57	36	92	83	*9*
9. When working on mathematics problem, it is important that your answer makes sense to you.	2	3	34	61	95	93	*2*
11. Learning mathematics involves more thinking than remembering	3	14	30	53	77	89	*12*
20. It is important to explain how I solved a problem to other pupils in class	1		47	52	100	98	*2*

Table 4.3 presents the percentage of students who agreed or disagreed with each statement, for the overall sample, and the percentage of students who agreed in terms of gender. There were differences on how the boys and girls responded to each statement. For the highest levels of agreement, all boys thought that doing mathematics required working

logically in a step-by-step fashion (100%, statement 4), while just 98 % of the girls took this view. All boys believed that learning mathematics is a social process in which they can share mathematics ideas with other pupils (100%, statement 20), and about 98% of the girls had that view. Moreover, nearly all boys believed that when working on maths problem their answer must be sensible (95%, statement 9), with which 93% of the girls agreed. Doing mathematics allows room for original thinking and creativity was regarded as important (statement 6) by 98% of the boys and 87% of the girls. More boys (92%) than girls (83%) thought that knowing why an answer is correct is as important as getting the correct answer (statement 8).

Both statements (7 and 11) showed that the number of boys' responses declined compared to the other statements in which almost all took a positive view. Nearly a quarter of the boys (28%) seemed quite in disagreement about doing mathematics and coming up with their own ways of solving mathematics problems (statement 7). Similarly, less than a quarter (23%) of the boys disagreed that learning mathematics involves more thinking than remembering (statement 11).

The above results showed that majority of the students have positive beliefs towards knowing and doing mathematics. This was revealed from their high levels of agreements with most of the statements. Students also believe that mathematics is useful now and in the future. Students' beliefs about the utility of mathematics will be analysed in the next section.

4.3.3 Students' beliefs about the utility of mathematics

Data in table 4.4 present the percentage of students who agreed or disagreed with each statement, and the percentage of students who agreed in terms of gender. Data revealed that the majority of students thought that mathematics learnt in school is important and has future implications. Most students thought mathematics helped them in their thinking (92%, statement 13). In addition, 58% of the respondents strongly agreed that when they learnt mathematics it helped them to think better. Furthermore, the notion of mathematics needed for many jobs and careers was rated by most students as very significant (96%, statement 14). More than half of the students (68%, statement 15) agreed that, to succeed in school, they have to be good at mathematics.

Table 4.4: Percentages (rounded off to whole number) of students who agreed with each statement in terms of gender.

Statement	Overall (%)				A or SA (%)		
					Boys	Girls	
	SD	D	A	SA	n=61	n=46	*Diff*
13. Mathematics helps me learn to think better.	1	7	35	58	95	87	*8*
14. Mathematics is needed for many jobs and careers.	2	2	44	52	97	91	*6*
15. To succeed in school, you need to be good in mathematics.	9	22	51	17	62	74	*12*

Overall, the majority of boys (95%) and girls (87%) had similar beliefs that mathematics helped them to think better (statement 13). Almost all boys (n=59, 97%) and girls (n=41, 91%) thought mathematics was related to many jobs and careers. Less than three-quarter of the boys (62%) and girls (74%) agreed that their relative success in school depends on their mathematical proficiency.

Students believed that learning mathematics in school is important. It helps develop their cognitive thinking and ability. Moreover, many believe that mathematical knowledge is needed in many jobs and to prepare them to cope with real world challenges.

4.3.4 Students' beliefs about gender differences

Student beliefs about gender in learning mathematics will be presented and analysed in this section. Table 4.5 presents the percentage of students who agreed or disagreed with a gender statement, and the percentage of students who agreed, in terms of gender.

Table 4.5: Percentages (rounded to whole number) of students who agreed or disagreed with a statement in terms of gender.

Statement	Overall (%)				A or SA (%)		
					Boys	Girls	
	SD	D	A	SA	n=61	n=46	*Diff*
16. Men are better at mathematics than women	40	38	11	9	23	20	3

The data in table 4.5 reveal that less than a quarter of the students (n=21, 20%) agreed men are better in mathematics than women. Moreover, a slightly similar number of boys (n=14, 23%) and girls (n=9, 20%) agreed with this view. However, 78% disagreed with the statement. In addition, 40% of the students strongly disagreed. Among this group of students were 46 boys and 36 girls. Only one girl did not respond to this statement.

The last section analyses the data about students' self-efficacy beliefs in learning mathematics.

4.3.5 Students' beliefs about their self-efficacy

Table 4.6 presents the percentage of students who agreed or disagreed with each statement about self-efficacy in mathematics learning. The highest levels of agreement were on statements about: learning mathematics is interesting and having the kind of mind to do advanced mathematics (90%, statement 2), confidence (98%, statement 17), remembering formulas, rules and procedures (99%, statement 18), being hardworking (95%, statement 19), and having a mathematical mind (90%, . statement 18).

Table 4.6. Percentages (rounded to whole number) of students who agreed with the self-efficacy belief statements, in terms of gender.

Statement	Overall (%)				A or SA (%)		
					Boys	Girls	
	SD	D	A	SA	n=61	n=46	*Diff*
1. I am good at mathematics and I enjoy the challenge of it.	4	20	54	22	87	59	*28*
2. Learning mathematics is interesting. I have the kind of mind needed to do advanced mathematics.	1	10	43	47	95	78	*17*
3. I feel okay about making mistakes in mathematics. While I am not especially strong at it, I am not fearful of it either	6	14	39	41	74	85	*11*
5. Maths is difficult for me so I avoid it whenever possible.	30	45	18	8	23	28	*5*
10. When my work in maths is hard I don't give up.	3	7	29	61	95	83	*12*
12. I am very poor at doing mathematics.	23	41	26	10	31	43	*12*
17. To be good at mathematics you need to have confidence you can do it.	2		24	74	98	93	*5*
18. To be good at mathematics, you need to remember formulas, procedures and rules.	1		18	81	100	98	*2*
19. To be good at mathematics you need to work hard at it.	1	5	19	76	95	96	*1*
21. To be good at mathematics you need to have a kind of "mathematical mind".	2	6	37	55	89	93	*5*

The data in table 4.6 show that students had a higher sense of self-efficacious belief toward learning mathematics. The majority of students (n=94, 90%) thought that mathematics is interesting and they have the kind of mind needed to do more advanced mathematics (statement 2). In addition, more boys (95%) than girls (78%) were interested in mathematics. While 90% of the students thought they never give up even though mathematics is hard, 10% did not agree (statement 10). There were 61% of the respondents who strongly agreed with this view. Having confidence in order to be good at mathematics was rated highly by most students (98%, statement 17) as very important. Likewise, 98% of the students strongly agreed that remembering formulas, procedures and rules inherently makes a student good at mathematics (statement 18). Most students (n=99, 95%) thought that to have a good performance in mathematics one has to work hard (statement 19). About 92% agreed that they are capable of doing mathematics if they have the kind of mathematical mind (statement 21).

Most of the students did not find difficult or poor at doing mathematics. Three-quarters of the students (75%) thought that they did not find mathematics difficult (statement 5). However, more than a quarter (26%) thought mathematics is difficult so they avoided it whenever possible. Less than a quarter of the boys (23%) and more than a quarter of girls (28%) found mathematics difficult. Similarly, more students (64%) believed that they were not poor at doing mathematics compared to those that were poor (36%) (statement 12). Among those who thought they were poor at doing mathematics, there were 31% of the boys and 43% of the girls.

Students' beliefs about learning mathematics have highlighted several aspects. First, students believed they know and can do mathematics. They thought that they are good at mathematics and so mathematics is not a difficult subject for them. Second, the majority of the students believed that mathematics is important to learn now so that it prepares them for careers in the future. Third, most students opposed the view that men are better at mathematics than women. Finally, the notion of self-efficacy for students implies that they have confidence and ability, and are capable of doing mathematics.

Students' attitudes towards learning mathematics were also explored during the written survey. Data on students' attitudes will be presented and analysed in the next section.

4.4 Students' Attitudes towards Learning Mathematics

This section presents and analyses data in part B of the written survey (see Appendix. G) that contains four open-ended questions purposely designed to explore students' attitudes toward learning mathematics. Students were asked to write their responses for these questions.

Student's writing was edited for clarity but original meaning was retained during data analysis. A thematic analysis was undertaken to identify common themes within the students' written data (see section 3.9.2).

The findings from the two high schools were categorized into four main sub-themes. The main areas of focus are: students' feelings toward learning mathematics, changes in students' attitudes, mathematics anxiety of students, and students' attitudes towards the importance of mathematics.

Students in both schools were coded according to their written response for each question. The code was given for each student participants (see Appendix K).

4.4.1 Student s' feelings towards learning mathematics

This section presents and analyses data from students' responses to the first question in the written survey which related to their feelings about learning mathematics: *How do you feel about learning mathematics in secondary school?* (Appendix G).

Different types of feelings were expressed by student participants. These feelings are organized into seven themes and presented in table 4.7 below.

Table 4.7. Students' feelings towards learning mathematics according to gender.

Participants	Urban		Rural		Total
	boys	girls	boys	girls	
Difficulty	6	6	8	13	*33*
Laziness	1				*1*
Boredom			2	3	*5*
Worry/fear				2	*2*
Interest	12	7	8	5	*32*
Enjoyment	12	6	9	2	*29*
Value	3				*3*

Overall, both boys and girls expressed similar feelings towards learning mathematics. However, the most notable difference is that, whereas most girls (n=19) stated mathematics was very difficult, only 14 boys had this view. More boys (n=20) were interested in mathematics than girls (n=12). Similarly, more boys (n=21) than girls (n=8) indicated their enjoyment of mathematics. Note that two students did not give their responses to the question.

Students' feelings towards mathematics were expressed in both negative and positive ways. Most students had negative feelings that mathematics is difficult. Others expressed their laziness in learning. Few students found mathematics boring. However, positive feelings were expressed when students found mathematics interesting and enjoyable. Both negative and positive feelings of students towards learning mathematics are presented below.

Difficulties with mathematics

The most frequent feeling expressed by 33 students (see table 4.7) was the difficulty of mathematics they encountered in secondary school. For example, MSU4 stated:

> I feel that learning mathematics is such a very difficult subject to understand. But it is easier when students are interested and put more effort into it by doing a lot of practice.

Many students felt mathematics is difficult because they may not understand the concepts. For instance, two students felt mathematics was difficult because they lack procedural knowledge:

> I feel learning mathematics is too hard for me, but I try my best at least to understand the steps of getting correct answers (MSR6).

> I find maths very difficult but sometimes I find it very interesting to learn many new formulas and procedures (FSR11).

A student had experienced difficulty in learning mathematics and blamed the mathematics teacher for not clearly explaining the concepts. FSR18 stated that:

> I feel that mathematics is hard for me because the teacher does not clarify the concepts. But if the teacher makes ideas clear for me then I feel better able to learn maths.

One student in the urban high school honestly admitted his laziness in learning mathematics. Doing difficult questions made him quite lazy because he felt much the same way as the others who lack mathematical knowledge and understanding. He stated:

> Sometimes I feel lazy doing harder questions in mathematics because I do not understand them. (MSU6)

Mathematics was not only felt as difficult for students. Some students felt learning mathematics was boring.

Mathematics is boring

Five students from rural high school expressed the feeling that learning mathematics was boring (table 4.7), not interesting or enjoyable. MSR24 and MSR25, for example, stated

> I felt sometimes mathematics is really boring and not enjoyable (MSR24)

> I feel that it is not an interesting subject, and sometimes I feel it is more boring (MSR25)

Worry and fear

From the data in table 4.7, two girls from the rural high school felt worried about learning mathematics. They were worried and fear because they were not good at understanding mathematics activities that involve calculations.

> I feel worried and fear that some of the calculations of mathematics activities that I did not know how to solve them (FSR6).

> I feel scared and worried because I am not good in mathematics (FSR9).

Enjoyment of mathematics

Thirty two students (19/55 urban & 13/52 rural) indicated that they were interested in mathematics. Eight boys in the rural high school were particularly interested in learning and to explore new ideas. MSR11 and MSR12, for example stated:

> I feel interested about learning mathematics (MSR11)

> It is very interesting and makes me feel great to explore new ideas when dealing with number (MSR12).

Twelve boys in the urban high school expressed the idea that mathematics is interesting. For example, two boys found it more interesting to gain mathematics ideas and when they were offered appropriate challenging tasks.

> I feel interested in learning mathematics in secondary school. I gained lots of ideas and short cuts in finding solutions to various mathematics topics (MSU9).

> I feel that learning mathematics in secondary school is very interesting when I learn challenging tasks (MSU11).

Students' mathematical interest can also develop from the conceptualisation of learning new rules and formulas. For instance, two girls stated

> Learning mathematics in secondary school is very interesting to learn new rules and formulas but sometimes very tricky (FRS13).

> In secondary school I feel interested about learning mathematics because I learn many formulas, ideas which I feel like working hard (FSU19).

Learning mathematics at secondary level is more interesting and develops students' thinking capacity. This was the sentiment of three students (MSR15, MSR16 and FSR23) who had strong feelings of interest in learning mathematics. MSR15 and MSR23 indicated:

> Learning mathematics in secondary school is more interesting because it allows me to think critically and beyond what I need to do in mathematics (MSR15).

> I feel good about mathematics. It really helps expand my mind to develop and think mathematically (MSR23).

Twenty nine students felt that learning mathematics was enjoyable. More boys (n=21) than girls (n=8) stated they felt this way. Students enjoyed mathematics when they learnt new ideas, faced new challenges and were able to solve new problems. As stated by MSR17, for example:

> I feel that it is worth enjoying by getting to know new mathematics problems and being able to solve them.

One student saw his academic competency, achieving good results enjoyed learning mathematics. For MSR21 stated:

> I feel it is enjoyable and interesting because I usually get good results in mathematics tests or exams (MSR21).

Some feelings mentioned by minority group of students were happy, excited and proud. These students felt excited when they understood lessons and being able to think well. For example:

> I would always feel proud and happy of myself when I understand new lesson in maths and be able to solve maths problems (MSU31).
>
> Learning mathematics in secondary school is an exciting thing because it helps me to think more logically (MSR22)

Most students feel positive towards mathematics learning if they feel interested and enjoy the challenges and understand it clearly. On the other hand, difficulties in understanding mathematics develop their negative attitudes. The next section presents and analyses data on changes in students' attitudes.

4.4.2 Changes in students' attitudes

This section presents and analyses data for the second question in part B of the written survey: *Have your attitudes to mathematics changed during learning mathematics in secondary school? How? (Appendix G).* There were various views expressed by students in both high schools about how their attitudes had changed during learning mathematics. Students' responses were organised into themes and are presented in table 4.8.

Table 4.8. Number of students in each high school showing various ways in which their attitudes towards mathematics had changed.

Urban high school	Boys	Girls	Total	Rural high school	Boys	Girls	Total
Difficulties with mathematics	5	3	8	Difficulties with mathematics	1	-	1
Learning improvement	5	2	7	Learning improvement	2	1	3
Hard work/effort	3	5	8	Hard work/effort	6	5	11
Discover new ideas	5	3	8	Discover new ideas	2	3	5
Interest in mathematics	4	-	4	Interest	4	-	4
Value	4	5	9	Value	4	3	7
Teacher's influence	1	-	1	Teacher's influence	1	4	5
High level maths	3	3	6	Enthusiasm	2	2	4
Self-efficacy	3	-	3	Listen attentively	-	1	1
Favourite	1	-	1	Love maths	4	-	4
Work Pressure	1	-	1	Boring	-	3	3
				Lack of interest	1	3	4

Difficulties with mathematics

Some students expressed that encountering difficulties in mathematics had changed their attitudes. Data in table 4.8 revealed that nine students' (8/55 urban and 1/52 rural) were influenced by the difficult questions encountered. For example, three students had expressed their view:

> When I am studying mathematics at secondary level, my attitude has been changed when dealing with difficult questions to which the solution is already provided and you have to show how to get the answer for that question, which I cannot do (MSU1).

> During learning mathematics in secondary level my attitudes towards mathematics changed because I go through some difficulties trying to understand questions (MSU3)

> My attitude towards learning mathematics changes. Now I find it difficult to solve some mathematics problems so I do not like it (MSR27)

Some students' attitudes towards mathematics had changed when they felt their learning was improving.

Learning improvement

Ten students (7/55 urban and 3/52 rural) expressed the feeling that learning performance have been improving. For instance, two urban students and one rural student stated their performance is improving:

> I found that my mathematics performance is improving when I am beginning to get into mathematics (MSU23).

> My learning was improving when I started to get serious in mathematics subject (MSU16).

> During my intermediate levels mathematics subject was in a total mess, but when I was in form 5 I started to improve in my mathematics (FSR25).

Similarly, FSU18's performance in her junior secondary was all good, but she disliked mathematics in senior secondary. However, she did her best effort as much as she could as a result her performance was improving:

> Learning mathematics in forms 1, 2, 3 and 4 was all good. I learnt very well. But when I reached form 5 my mathematics performance slightly dropped and I did not like mathematics anymore. But in form 6 I did my best and improved in my performance. (FSU18).

Some students stated that their attitudes had changed when they were started to feel interested in learning mathematics.

Interest in mathematics

Eight students (4/55 urban and 4/52 rural) indicated that they were not mathematically bright in high school, but because of their positive interest and persistence in mathematics they did better. For example, MSR20 and MSU 12 stated:

> I was not good at mathematics in my previous junior high school. But when I pursue myself on doing mathematics activities I tend to become more interested in maths (MSR20).

> I was not a good student in mathematics while in secondary school. But as time went on, I began to learn more and become interested in this subject (MSU12).

Some students started to change their attitudes by putting extra effort into their mathematics learning.

Hard work/effort

Nineteen students (8/55 urban & 11/52 rural) indicated that their attitude toward mathematics changed though hard work and putting extra effort into their mathematical tasks, FSU20 and MSR13 noted some improvements in their learning:

> When I learnt mathematics in secondary school, I put more effort into thinking and solving the mathematics tasks, activities, etc. Also, I studied hard for it and did a lot of practice to become good in maths (FSU20).

> … by giving all my full effort in doing mathematics such as exercises, assignments and doing a lot of studying in it. I noticed that I am performing well (MSR13).

Some students stated that their attitudes were changed when they learnt and discovered new ideas.

Discovering new ideas

Thirteen students (7/55 rural & 6/52 urban) indicated that throughout their learning mathematics in secondary school their attitudes had changed when discovering new mathematics concepts such as learning new theories, formulas and procedures. For example, FSR22 and FSR11 stated:

> My attitudes have changed during learning mathematics in secondary school because I learn more new things which really go deeper (FSR22).

> My attitude to mathematics has changed in secondary school. I learn more of how to find the short cut of algebra and other topics (FSR11).

It is most likely teachers had greatly influenced some students' mathematics attitudes.

Teachers' influences

Five girls in the rural high school indicated that their mathematics teacher influenced their learning. They developed negative attitudes when the teacher did not teach mathematics properly. For example, FSR3 stated:

> My attitude changes due to my mathematics teacher. My past mathematics teacher did not really teach according to my expectation. Not like in my lower forms I liked mathematics. This time I don't feel I like mathematics… (FSR3).

Two other girls' indicated that they hated their mathematics teacher and the subject because they felt that the teacher did not teach well:

> In primary I loved mathematics, but when I come to secondary level I hate the teachers and that's how my attitude toward mathematics changed (FSR15).

> I started to hate maths when I was in form 4 [year-10] because of our teacher. She did not explain the mathematics problem clearly. I hate mathematics starting from that time (FSR21).

Apart from the above factors that simultaneously influenced student' mathematic attitudes in both high schools, there were other factors as well that contribute to change students attitudes towards learning of mathematics (see table 4.8).

Self-efficacy

Three boys in the urban high school expressed the opinion that they performed exceptionally well in their mathematics. They thought they had the capability to do mathematics better to achieve good results, as MSU6 and MSU8 stated:

> My attitude changed as I began to know and do more mathematics and when I scored good marks in maths (MSU6).

> I learn more and doing mathematics by myself. Not like in primary I just wait for an answer from the teacher (MSU8).

Enthusiasm

Four students in the rural school mentioned that they were more enthusiastic about learning mathematics: They were eager to learn mathematics in secondary school; for example, FSR2 stated:

> My attitudes have changed during learning mathematics in secondary school. I was always eager to learn maths at this level, but not like in primary school.

Love of mathematics

Four boys in the rural high school had negative attitudes towards mathematics in the past. However, their attitude had changed as they tended to develop interest and love for mathematics which, in turn, made them do well in their learning. For example, MSR21 stated:

> At first I was not good in Maths but for the sake of my interest and love for the subject I started to do well in my mathematics (MSR21).

Boredom

Three students indicated that the classroom environment was not conducive for learning to take place which caused them to feel bored about mathematics, as FSR5 stated that:

> During the class time especially in the early morning I am interested to learn. But in the afternoon I feel mathematics is really boring. My mind is not working in line with mathematics activities.

Lack of interest

Four students in the rural high school acknowledged that their attitudes did not change for some reasons. They felt that there they were not interested in mathematics: MSR25 mentioned that:

> My attitude to maths does not change because mathematics did not grab my interest at this level (MSR25)

Students' attitudes toward mathematics are changing as they continue to learn mathematics because there are internal and external factors that drive their attitudes. General factors that caused changes in students' mathematics attitudes are the nature of mathematics, students' negative and positive attitudes (e.g. feelings, choices, interests, boredom), teachers, and classroom. (More on factors influencing attitudes will be presented in section 4.5).

The next section explores students' mathematics anxiety in learning mathematics.

4.4.3 Students' mathematics anxiety

This section presents and analyses data on students' responses to the third question in part B of the written survey (See appendix G): *Have you felt anxious about mathematics? Why?* Data were analysed and organized into six major themes. The six focus areas are: *uneasiness, boredom, worry, concern, fear* and *neutral* (refer to table 4.9).

Table 4.9: Number of students (gender) showing various ways in which they felt anxious about mathematics.

Urban high school	Boy	Girl	Total	Rural high school	Boy	Girl	Total
Uneasiness	4	1	5	Uneasiness	4	6	10
Boredom	4	2	6	Boredom	1	3	4
Worry	9	4	13	Worry	10	11	21
Fearful	1		1	Fear	2	1	3
concern	10	8	18	Concern	4	4	8
Neutral	6	6	12	Neutral	6		6

The data in table 4.9 reveal some notable differences in the number of students who felt anxious about mathematics in both high schools. Most rural students (n=21) expressed they were more worried about mathematics than rural students (n=13) were. More urban students (n=18) have many concerns about mathematics than rural students (n=8) do. While 10 students in rural high school felt uneasy, only 5 students in the urban high school felt the same way.

Overall, the number of boys' and girls' responses was quite similar as to how anxious they felt about mathematics. However, the most notable difference is that more boys in both schools (n=19) were very worried about their mathematics than girls (n=15) were, but more girls in the rural (n=11) group were most worried about mathematics. More boys (n=14) than girls (n=12) had much concern about mathematics. In addition, more boys in the urban group had much concern about mathematics than did boys in the rural group.

When analysing the data, there were reasons that students stated why they felt anxious about mathematics. Students' views about their anxiety are presented below.

Uneasiness

In table 4.9, fifteen students felt uneasy about mathematics. Many students expressed putting less effort, facing difficulties and challenges. Some students indicated putting in less effort into doing exercises and facing difficulties.

> I usually felt uneasy with this subject because I did not practice a lot in doing exercises and activities (MSU4).
>
> I often felt uneasy because the questions were too hard and I did not understand them (MSR5).

One female student indicated her lack of effort and creative thinking to do mathematics. FSU14 stated:

> I feel uneasy in mathematics when I don't do more practice and have creative ideas to know about it. It also needs more concentration to think and to in order to understand it (FSU14).

Students in the rural high school expressed their difficulties with mathematics. Understanding the concepts in other topics was not that easy. Even though they often worked hard at solving mathematics problems, they ended up getting the wrong answers. For example, two girls mentioned that:

> I felt uneasy about maths because it gives me a lot of pressure when I just couldn't understand it or get the right answer (FSR2).
>
> Sometimes I feel uneasy if I did not find the right working out to get to the correct answer (FSR22).

Students being bored about mathematics were one of the responses that students indicated.

Boredom with mathematics

Six students in the urban high school stated that teaching of mathematics in class was not represented properly as they expected. The effect turns out to be a boring lesson for them. Two students expressed:

> Nothing, but boring is how I feel about this subject. There are some kinds of responsibilities that teachers need to take into account in teaching this subject so that every part of it will be interesting (MSU27).

> Mathematics is boring because the teacher does not explain the mathematics topics clearly (MSU18).

Four rural high school students indicated lack of interest and little knowledge to understand concepts as the causes of their boredom. For example, FSR4 stated that:

> I often feel bored about mathematics because I am not interested in doing mathematics activity. I am not good at mathematics.

Worried about mathematics

Among 34 students who were worried about mathematics, some were worried about becoming failures. For example, two students stated:

> I am worried about failing or getting poor results in test or exam because that is the only subject that I usually get good marks compared to other subject (MSU29).

> I often feel worried if I fail my exam. This concerns me a lot because I would not get good grades for this subject (FSR5).

Five students (1 urban & 4 rural) felt worried about mathematics just because they were not good at it. For example, FSR24 stated:

> I feel worried about mathematics because I am not good at it.

Similarly, students were worried about mathematics because of their lack of understanding mathematics concepts. MSR9, for example, stated:

> I feel worried because mathematics is a difficult subject and I did not understand the concept.

Teachers' lack of proper instructional approaches was also indicated as one of the contributing factors that made students worried. They were worried when the teacher did not explain exercises, homework and concepts very well. As MSU32 said:

> Sometimes I feel worried because there is no proper explanation of exercises or homework from the teacher. I could not understand the topic. At the same time more work was given for us to do (MSU32).

Some students no only worried but were having fearful experiences of mathematics.

Fear of mathematics

Only four students were having fearful experiences with mathematics. Three rural high school students (2 boys & 1 girl) indicated that they fear getting poor results in mathematics. For example, MSR18 and MSR7 stated:

> Sometimes I feel that I am not good in mathematics. I often have the feeling of fear that I might fail the subject (MSR18).

> My greatest fear is getting poor marks in my test and exam. I felt afraid of getting zero in my test (MSR7).

Concern about mathematics

Most students were concerned about how their teachers taught them mathematics. Some indicated that the teacher is not explaining mathematics well. MSU11 & FSR18, for example, stated:

> I am really concerned about learning mathematics when the teacher is not properly explaining mathematics problems in such a way that I can understand them (MSU11).

> It concerns me if the teacher does not teach mathematics properly, by explaining things well. In fact, when the topic is very hard to understand it I often feel not wanting to do its exercises (FSR18).

Other students were having major concerns because of the nature of mathematics that requires deeper thinking and remembering content. FSR 1, for example, stated that

> Mathematics needs more time to learn and do it. And it requires more thinking and remembering the procedures, rules and formulas.

Many students admitted they did not felt anxious about mathematics so they categories as neutral.

Neutral

There were 18 students (12 urban & 6 rural) who admitted they had never felt anxious about mathematics. Some students stated mathematics is easy, promotes deep thinking, and gain new ideas and enjoyment of mathematics.

Other students stated how they loved the subject. FSU10, for example, said

> I never felt anxious because I love getting the correct answer in mathematics.

Another student stated that she gained new knowledge to handle difficult questions. She said that:

> I am not anxious about mathematics. Mathematics gives me new ideas on how to calculate difficult questions to find their answer. I learn to use formulas to answer questions (FSU18).

Students admitted that they were sufferers of mathematics anxiety in their learning. Most of them felt uneasy, worried and concerned about mathematics. One group of students indicated they may not feel anxious about mathematics.

4.4.4 Students' attitudes toward importance of mathematics

This section presents and analyses data obtained from the final question in part B of the written survey (See Appendix G): *How do you use mathematics in your everyday life?* The objective of this question is to solicit students' attitudes toward the usefulness of mathematics.

A common major theme that emerged from the students' written responses underpinned the notion of the practicality of mathematics. Most of the students answered the questions reasonably well, that mathematics is important in everyday life.. However, 28 students in the urban high school and 10 students in the rural high school did not answer the question.

Twenty three students (8 girls and 15 boys) indicated that they used mathematics knowledge and skills to carry out their normal duties of life. Students' common responses are budgeting, estimating, playing games, cooking and counting. For example, three students used mathematics to do cooking and in sports.

> I use maths ideas in baking cakes, playing maths games and cooking lessons (recipes) FSU10

> I used maths in games, especially in calculating numbers (FSU12)

> I used maths knowledge in playing card games; estimates. Also estimating the area, sizes of objects (MSR3)

Forty one students mentioned the aspect of mathematics in relation to buying goods at the shop. For instance, the majority of the students used mathematics knowledge to do shopping. Three students stated:

> When I want to buy goods from the shops I am used to comparing the prices for the items first before I actually buy them MSU5.
>
> I use mathematics knowledge when dealing with some financial things like buying goods in the shop and being able to calculate the right amount of change to receive (FSU21).
>
> Mathematics can be used in everyday life. For me I use mathematics when it comes to shopping. I also use mathematics to estimate and calculate the cost of goods (FSR6).

Five students stated they used mathematics in other aspect of life such as measurement, weather prediction and navigation. For example, MSU19, MSR21 and MSR22 stated:

> I use mathematics when helping my dad in building a house. I use the knowledge of measurement to find the measurements of the house (MSU19).
>
> I used probability knowledge to estimate what the weather will be like (MSR21)
> I apply mathematics knowledge in terms of marine (ship, outboard motors) (MSR22).

From the above results, most students really do want to understand mathematics, but a lack of mathematics knowledge and understanding seems to promote the decline of students' mathematics attitudes. In addition, mathematics anxiety also affects students' attitudes towards their learning of mathematics. Furthermore, it was found that students' enjoyment and interest in learning mathematics comes from clear and well organised teaching approaches. Student involvement in learning, for example, discovery of useful information and having good mathematical understanding are likely to promote positive changes in students' mathematics attitudes. Another aspect that promotes positive attitude changes is the perceived usefulness of mathematics. Many students acknowledged they used mathematics knowledge in their everyday life.

There are factors that either positively or negatively impacted on students' attitudes toward their learning of mathematics. The next section presents and analyses data on factors that impact on students' beliefs and attitudes.

4.5 Factors Impacting on Students' Beliefs and Attitudes

To investigate factors that students believed had impacted on their beliefs and attitudes towards learning mathematics, focus group interviews were conducted (see Appendix J).

To avoid shyness between genders so that rich data could be obtained, four boys in the urban school and four girls in the rural school were interviewed separately (see section 3.4.3 how interview was conducted). The codes were used for the eight participants. The male students in the urban high school are identified as: MSU5, MSU24, MSU27 and MSU7; female students in the rural high school are: FSR22, FSR20, FSR24 and FSR7.

Data analysis involved reading and re-reading the data, noting down factors and then searching for themes. The next step involved defining and naming factors by generating clear specific name for factors impacting on students' beliefs and attitudes. Students' responses were organized according to a number of major themes (factors), and these are presented below.

4.5.1 Factors associated with the student themselves

This section presents and analyses factors associated with the students themselves. The analysis of the data revealed two factors. These are personal affective factors and cognitive factors.

Affective factors

Of the eight students interviewed, four mentioned their personal interests and positive feelings towards learning mathematics. For example, FSR22's reflections about her experience in learning mathematics tasks were closely linked with feelings of interest and love for learning mathematics. She mentioned:

> Learning activities, practical tasks in mathematics are very interesting for me and I am good at mathematics, and I will love to learn mathematics as long as I live.

For FSR20, her interest in learning resonates with her self-concept belief that she is good at mathematics but limited to several topics that she finds easy. She stated:

> I felt interested in learning mathematics because I am good at several topics that are very easy for me to understand. For the hard topics that I came across in my learning, I feel like trying them …

Associated with negative feeling is an attitude towards mathematics which FSR7 described. She disliked solving mathematics problems because they are very difficult.

> How to solve mathematics problems is something I am not good at. There are some that I did not like because they were difficult. It's the calculation part is the most hated one (FSR7).

Additionally, FSR20 shared her dislike about mathematics. She disliked learning mathematics which she claimed wasted her time doing the wrong thing and ended up getting nothing.

> In working out solutions for mathematics problems, if you get one part wrong you will end up getting all sections wrong. That is one of the things I dislike about mathematics. It just like wasting my time doing it and I end up getting wrong answers (FSR20).

Students' responses reflected their cognitive ability in terms of understanding.

Cognitive factors

Students' mathematical knowledge and understanding, and the nature of their understanding, were found to be a more significant discovery. Students mentioned their difficulty arose from their personal experiences in which they lack mathematical knowledge and procedural knowledge in understanding concepts, and remembering formulas to solve mathematical problems.

Four students mentioned that they really find mathematics difficult to understand. For instance, FSR22, had expressed her difficulty in understanding mathematics concepts and using formulas correctly.

> I sometimes faced difficulties in mathematics because I did not understand the correct use of formulas and concepts of the particular topic.

MSU24 expressed his problem of recalling formulas to use them correctly in solving mathematics questions. He mentioned that:

> I have a problem with remembering formulas. I faced problems when I could not recall them. Some of the formulas were very hard to memorize.

MSU27 expressed lack of understanding procedures when solving mathematical problems. He commented that:

> My problem of learning mathematics is not getting good a grasp of understanding procedures to solve mathematical problems. I see mathematics questions are linked to each other in some cases. So when I get the first questions wrong, then the rest of the questions have the same result.

FSR22 further explained that understanding mathematical terms used in the word problem questions were her challenges when trying to draw meaning from their context.

> Reading of the questions in the word problems is something I could not understand which makes it difficult for me to solve word problems. Also the mathematical terms used in the questions were quite challenging to understand. For example, word problems in probability were quite confusing to memorize and understand them.

Students who have strong mathematical knowledge and understanding seem to promote increased positive attitudes towards mathematics. However, some of the problems that students faced in mathematics may arise from personal experiences during their encounter with mathematics. All four students admitted their difficulties of lacking mathematical knowledge and understanding.

Teachers are the people who greatly influence students' mathematical beliefs and attitudes. The data that relates to teacher and teaching are presented in the next section.

4.5.2 Factors associated with the teacher

Students talked about the how the teacher taught mathematics. Students' responses were subdivided into those that considered the impact of teachers' content–area knowledge and those who were more concerned about teachers' attitudes.

Teacher's content – area knowledge

Teachers' content knowledge and their ability to convey mathematical content to students was expressed by MSU5. Teachers' lack of clarity in conveying mathematics content to students caused a lot of confusion.

> I was really having a problem in understanding the concept if the teacher is not making the explanation clear and simple to me. Such as explaining the topic and breaking down formulas into simple ways that I can understand. If the teacher's explanation is poor it makes me confused, then learning and understanding that particular topic becomes a problem for me.

The teaching instruction that involved the teacher making mistakes in their presentation of answers could be a problem for a particular student. As FSR7 mentioned:

> Sometimes when she [teacher] came in to class and gave corrections, her answers can be wrong and this makes us confused on how to get the correct answer.

Another student expressed his dissatisfaction over how a teacher managed mathematical tasks, that is, not providing solutions after all mathematical tasks such as exercises and assignments were marked. The teacher, instead, moved straight to the next topic without taking a few moments correcting the tasks. As MSU5 said:

> One part of teaching I see that was not satisfying for me was that the teacher did not give solutions to the problems as well as correcting the exercises or homework, etc. Instead, he gave other exercises and moved to the next topic without revising or correcting some maths exercises he left in the previous topic. This made me struggle to find the answers to the questions he provided. I need to see how and what steps to use to get the solution. When the teacher did that I felt frustrated and would want to know how to get the answer.

Despite some negative thoughts about the teacher's content knowledge, there are some positive aspects about their teacher's personality that positively impacted on students' beliefs and attitudes.

Some students commented about the approach their teacher used during mathematics lesson. Two students, for example, said that the teacher explained mathematics enthusiastically and meaningfully which they could understand:

> Our previous teacher in grade 10 was a good Mr. He explained mathematics concept plain and simple. His teaching is very good which can be understood. He is very interested to help us learn and grasp the topic before moving on to the next topic (FSR22).

> I learn mathematics better from my teacher who can really explain to make it simple to the level of my understanding. I can understand the concept properly when I seek individual help from my teacher (MSU27).

Another aspect about the teacher mentioned during the interviews is the teacher's attitudes.

Teachers' attitudes

Students felt that learning mathematics was taught by teacher who had uncaring attitude. Two of the eight students actually commented that her previous teacher was grumpy and often got mad at students. FSR20 said that

> Sometimes she taught with angry behaviors if we did not quickly grasp the content during her explanations.

A similar sentiment was expressed by FSR7 about the teacher's frustration if they did not get the correct answer. She said that

> If we did not answer her questions correctly she would just get on us. We did not make her angry but that was her type.

Apart from teachers' influences, the factors associated with peer group can also influence students' beliefs and attitudes. This will be discussed in the next section.

4.5.3 Factors associated with peer groups

This section presents data on students' perceptions about peer group support which can be seen as one of the factors impacting on students' beliefs and attitudes towards learning mathematics.

Getting support from peer group was mentioned by all students but in a very limited response. MSU24, for instance, acknowledged his classmates for their continuous support and assistance for sharing their mathematical knowledge.

> I had to ask my classmates mates for help. It was good to have other pupils' ideas in my learning of mathematics. Because what others knew, for me I did not have that type of idea. So I treasured seeking assistance from my classmates

MSU7 and FSR24 shared similar views as MSU24. Whenever they could not understand their teacher's explanation they would resort to seek assistance from fellow classmates. FSR24 said:

> When teacher's explanation is not clear, I asked my friends to help me. Simple things that students explain for me I can grasp them.

MSU5 firmly believed that learning in a communal environment had a positive impact towards his mathematics learning. He further emphasised that he learnt mathematics better from his small study group. He seemed to compare their ideas and try to integrate these new ideas into his existing knowledge.

> I learn mathematics better from my classmates and study group. Like I would compare their ideas on how they explain the concept for me. And I try to grasp those ideas.

FSR22 shared her views that, supposing the teacher was busy she would resort to asking her brilliant classmates for help. Moreover, she treasured her classmates for their willingness in lending their help to assist her to understand mathematics.

> I learn better from students. I have much confidence to seek help from students rather than teachers. Students who were good in mathematics are usually available and willing to help. Because teachers sometimes often get too busy to seek for assistance.

From the above results, it can be seen that several factors had impacted on students' beliefs and attitudes. Students' reflections about their experiences in learning mathematics were associated with affective feelings such as interest, enjoyment, and liking of mathematics. Personal positive feelings and interest promote positive attitudes. Personal negative feelings determined negative attitudes towards learning mathematics. Students' cognitive domain for lack of mathematical understanding promotes a decline in students' attitudes towards mathematics. Moreover, teachers' knowledge of mathematics and attitudes play a significant role in students' mathematics attitudes. A proper explanation of mathematics concepts in teaching promotes positive attitudes; however, negative attitudes are determined by lack of clarity in teaching. It can be learnt from the result as well that learning mathematics is a social process, where student shared and talked about their mathematics ideas in groups or with their peers.

4.6 Factors Affecting Students' Mathematics Achievement

Having adequate information about what students thought had affected their achievement in mathematics is essential and this determined the choice of questions for the semi-structured interviews (see Appendix I).

After the written survey was conducted, 20 students were randomly selected for the semi-structured interviews. There were 10 students in each high school who took part in the interview. This decision was chosen to elicit variety of responses from students despite their level of ability in mathematics. Otherwise, there could be bias if those who answered the written survey really well are to be selected. The student participants described in this section are coded for their identities (see Appendix K).

This section presents data on factors that affect students' mathematics achievement. These factors include students' mathematical background, students' attitudes toward mathematics, teachers' approaches on teaching mathematics and factors associated with lack of parental support.

4.6.1 Students' mathematics background

Six of the 20 students, the majority of whom were from the rural high school, mentioned that they had very poor mathematics background (see Appendix I, Interview question 2). Due to their limited knowledge and understanding, mathematics became very difficult.

> I have lacked knowledge about the subject. I am not interested to learn it. It's difficult, so I am very poor at mathematics. My performance in mathematics is very poor. I used to get very low marks in tests and exams (FSR9).
>
> I am not really good at mathematics, but I try as much as possible to be good at mathematics (TRS10).

Two students from the rural high school particularly spoke about their difficulty in understanding mathematical formulae, procedures and rules.

> I am not that good in my mathematics ability. It is very difficult for me to understand the methods, formulas, theories and rules. The mathematics questions are confusing, especially word problems. That is why in tests and exam I perform very low (FSR23).

> I don't understand mathematics. I don't like it. For me it's very hard to learn and remember too many things such as formulas, rules and procedures. I am not good at it. It's very complicated (FSR4).

Four students expressed that they disliked mathematics because solving problem questions was confusing and difficult to understand. For example, two students said.

> I did not like the solving problem part. They are very hard and confusing (FSU11).

> I am not really good at solving maths problem. They are too tough and confusing (FSR21).

MSR6 and FSR11 mentioned their difficulty in understanding the questions. When asked why this might be, MSR6 explained that reading the questions and trying to understand what it meant was his main problem.

> I like solving problems but sometimes the questions in word problems especially in tests and assignments are difficult to understand in my little brain. Reading the questions usually challenged me if I do not know how to solve the problem (MSR6).

> For those problems that are easy, simple and understandable are the ones I like to solve. But for the complicated ones, I just forget them and I can't be bothered to attempt them because they are very hard (FSR11).

Understanding the mathematical language used in the word problems was mentioned by five students. For instance, when MSR3 was asked why this might be, he mentioned that his problem was not understanding English and mathematical terms. He further reflect on language barrier was his great challenge. He said that:

> Simple questions are quite easy for me to handle. But working with word problems really gives a great challenge for me. I have a problem regarding questions that involve word problems. When reading and trying to understand English and mathematical language, and applying rules and formulas in that particular word problems is what really confused me a lot (MSR3).

Another student further elaborated that mathematics was difficult when he did not understand English in the questions.

> Mathematics is difficult for me when sometimes I have read and did not understand English language or mathematical language used in maths. I see maths should be simple but English language makes me confused to know maths concepts better (MSU23).

Students' attitudes towards mathematics also affect their mathematics performance. This will be presented in the next section.

4.6.2 Students' attitudes towards mathematics

This section presents data regarding students' attitudes towards mathematics. Two specific areas of students' attitudes that will be examined are: negative attitudes and class attendance.

Students' negative attitude towards mathematics

Five of the 20 students, the majority of whom were from the rural high school, mentioned that they either disliked or hated mathematics because it was very difficult. For example, FSR4 said

> I hate mathematics. For me it is not my favourite. It is the very hardest subject for me. I just don't like it. I don't understand it. It's difficult for me to solve mathematics problems. I don't like it either (FSR4).

In addition, five students mentioned that they were lazy, lacked focus and could not understand their work. As two students below mentioned

> Sometimes mathematics is hard when at times I did not focus and lazy to do things. I lack concentration in class. Also I am lazy to read the topic before the teacher comes and talks about the topic. Maybe I did not ask questions because I am a shy girl in class (FSU10).

> I am feeling lazy that is why I did not want to do my homework. Besides I did not understand my work I so put little effort in doing it. (FSR23).

One student's response indicated that he had little knowledge and understanding so he disliked doing mathematics tasks. MSR10 said that:

> For sometimes I felt I did not want to do my mathematics tasks. I just did not want to do them because they were tough. Maybe I have very little knowledge about the topic. And I have other work to do in other subjects. So I just leave out those tasks and wait for the teacher to correct and then I get my answers.

One practised behaviour that other students mentioned was procrastination as a related effect on their mathematics achievement. For example, FSR4, who usually had negative views about mathematics, mentioned that she often put mathematics task off for later times.

> I just leave my work to the last minute. I don't even bother to study mathematics. I can ask my friends to help me with my assignments and homework. When

> studying for tests, I just cram to the last minute and then sit for my test and exams (FSR4).

When MSR3 was asked why he did not get best overall performances, he mentioned last minute work and cramming.

> I often do my assignments in the last minutes. In tests, I sometimes crammed for it so I normally did not do it to the best of my ability (MSR3).

Attitudes towards class attendance

Eleven students of the 20 interviewed, the majority of whom were urban students, mentioned that they prioritized class attendance. However, nine students admitted their absenteeism in mathematics class which had deliberately affected their performance. When students who skipped mathematics class were asked how this could be, FSU19, for example, expressed her negative feelings about her teacher and teaching:

> I often do this when I feel angry about my teacher. Why I feel bad is because when I wanted to seek help, the teacher was not bothered to give assistance. Also when the teacher is boring in class on how he explained the concept then I can skip maths class (FSU19).

Two students' responses indicated that they felt the teaching was boring and not interesting at all. FRS9 spoke about the boredom and difficulty she faced, while FSR23 mentioned she lacked interest and was not motivated.

> To be honest with you, if the topic is boring or difficult for me to grasp I decided not to attend that maths class. I have my own excuses for not attending class (FSR9).

> Sometimes I felt the class is boring, teaching of math is not motivating and not interesting at all. I am lazy to do mathematics work. For sometimes I just felt terribly sick, that is why I was absent (FSR23).

In addition, three students in the rural mentioned that mathematics was difficulty and they might not able to understand it. MSR9 expressed the same view as FSR9 and FSR23 above, but added that he was not coping with due dates.

> Sometimes I was absent in mathematics class if I sense that the topic is hard and I might not able to understand it. Also from experience last year, the teacher was boring in how she taught mathematics so I was not willing to attend class. The coping with due dates of mathematics task-assignments, homework put me off to attend class. I have that period (class) to do my mathematics assignments because it will be due the next day (MSR9).

Teachers are on major factor affecting students' performance. Students' view about their teacher is presented in the next section.

4.6.3 Teachers' approaches to teaching mathematics

This section presents data on factors related to teachers and teaching that were evident from students' interviews which affected their achievement. Four students compared both their previous teachers and the current teacher with regards to their teaching approaches. Most notably, they did not like their previous teachers' type of teaching approaches: FSR9 commented

> For my previous mathematics teacher I did not like them. Their teaching is not clear for me to grasp the concept in the mathematics topic they try to explain in class. They were too fast and rushed with their teaching. I cannot cope with their teaching approaches. They never ask our feedback whether we understand the previous topic or not, instead they move straight to the new topic. (FSR9).

FSR14 described her teacher in as much the same way as MSR9 did, but further stressed that his previous teacher could not follow through his explanation.

> My mathematics teacher sometimes really makes me confused how he tried to explain and correct exercises. I did not follow this teaching closely because I did not understand him much better. Sometimes when he went through the exercise in class, he did not provide the correct answers. He even lost sometimes along the way during his explanations. I am lost in maths for this type of teaching (FSR14).

Three students were concerned about the explanations and giving feedback on students' work. They expressed that the teacher did not explain topics properly in such a way that they could comprehend it. In some cases, the teacher did not provide examples or solutions of mathematical tasks. Also there was not much feedback the teacher gave to the student work. For example, MSR9 mentioned

> I dislike my teacher giving notes in class without explanations added on to it. Sometimes, the teacher did not deeply elaborate the topic. I did not like the teaching where there are no examples provided to relate it to the topic. Also, some teachers just give exercises and never give examples or provide solutions before going to the next topic. Some of my assignments and homework were marked but we never corrected them after receiving back from teacher. There were no feedbacks received from teacher in any assignments or tasks (MSR9).

One student recalled his past learning experiences of unqualified people teaching mathematics. He further explained that he could not cope with mathematics for they were untrained to take teaching as a profession. MSR4 said that

> My previous mathematics teachers were not good. For the past five years, I just could not believe how I learnt mathematics. I learnt mathematics in a scrappy manner. As previously stated, two of my mathematics teachers were not trained to take up teaching careers and yet they taught me mathematics. They did not properly explain mathematics concepts clearly. And that is the beginning of my life when I hate mathematics. They are the same how they taught me maths… (MSR4).

Parents also play a crucial role that may affect students' achievement. The final section presented data on lack of parental support in students' mathematics learning.

4.6.4 Lack of parental support

While eight students admitted they received parental support, twelve students of the 20 interviewed mentioned that they hardly received support from parents in their mathematics learning.

Five students mentioned that their parents have very little knowledge to understand year-12 mathematics. For instance, two students mentioned

> For this level of mathematics, parents could not handle them. So all I could say is there is little support from parents in my learning of mathematics (MSR3).

> No support from parents. I did not ask my parents because the level of mathematics at year-12 did not fit my parents to handle. (FSU21).

Four students mentioned either their brothers or sisters helped them with their mathematics, not their parents.

> Not from parents but from my elder brothers and sisters who are in form 7. I am able to seek help from them because they are in the upper grade than me. So they know how to go about mathematics in form 6. (FSU9)

> I seek help from brothers who are already reached form 6 level. They taught me mathematics. My parents were not involved in my learning (MSU23).

> Sometimes from my brother helped me. Not much from my parent (MSU12).

Three students mentioned that their parents had very low level of education so they provide little or no support in their education. For example, MSU17 and FSR23 commented

> My parents have very low level of education so I have very little or no support in my learning mathematics. I have to work on my own at home. My parents believed in me that I can do my mathematics (MSU17).

> When I asked my parents for help they have their own excuses and are busy. They might not understand mathematics so I have no parental support in my learning of mathematics (FSR23).

4.7 Chapter Summary

This chapter presents and analyses the data from written survey, focus group interviews and semi-structured interviews. First, the data obtained from the semi-structured interviews about the nature of mathematics were analysed and presented. The data revealed that students view the nature of mathematics in four categories: mathematical content (Mathematics is all about number, formulas, operation, arithmetic), mathematical processes (problem solving, investigating and analysing ideas), cognitive processes (mathematics involves learning and thinking) and the utility of mathematics.

The written survey revealed data pertaining to students' beliefs and attitudes towards learning mathematics. Students' beliefs about learning mathematic were first analysed and organised into four categories (section 4.3). First, data on students' beliefs about doing and knowing mathematics (section 4.3.2), for instance, showed that the majority of the students (90%) thought doing mathematics requires working logically in a step-by-step fashion. Second, data on students' beliefs about the utility of mathematics (section 4.3.3), for instance, 96% of the students thought that mathematics is needed for many jobs and careers. Third, data on students' beliefs about gender differences (section 4.3.4), revealed that most students (78%) disagreed that men are better at mathematics than women are. Fourth, data on students' beliefs about their self-efficacy (section 4.3.5), for instance, 96% of the students thought they had confidence in mathematics.

Furthermore, data on students' attitudes towards learning mathematics (section 4.4) were part of the survey that was analysed. Findings revealed that students hold both positive and negative feelings toward their mathematics learning (section 4.4.1). They expressed that they were interested, enjoyed and favoured learning mathematics. Positive changes in their attitudes take shape when they have positive attitudes towards mathematics. However, many of them find mathematics difficult due to their poor mathematical knowledge and understanding. Some students mentioned feelings such as boredom, laziness, and lack of interest that had developed due to the difficulty of mathematics. In addition, mathematics anxiety affects students' mathematics attitude (section 4.4.3). It impacts on students' learning which promotes negative attitudes. Students' attitudes towards the utility of mathematics are positive. Most students perceive the usefulness of mathematics in their everyday life and acknowledge its importance in jobs.

Several factors play a vital role impacting students' beliefs and attitudes towards mathematics learning (section 4.5). Three factors analysed from focus group interviews are: The factors associated with the student themselves (section 4.5.1), teachers (section 4.5.2) and peer group (section 4.5.3). Factors associated with the students includes; students' affective and cognitive domain. Factors associated with the teacher and teaching includes teaching content-area knowledge and teachers' attitudes.

Several factors affected students' mathematics achievement. These are the students' mathematics background, students' attitudes, teachers' teaching approaches and lack of parental support. Semi-structured interview data revealed that students' poor background mathematical knowledge is the main cause of difficulty in mathematics which affected their performance. Together with lack of knowledge and difficulty, students tend to develop negative attitudes towards mathematics which affect their achievement. Other students mentioned that if the teacher is not explaining the concept clearly they would not understand mathematics. Most students mentioned that they lack parental support in their learning. These factors, once they are continuously in force will negatively impact students' beliefs and attitudes. Likewise, they will adversely affect students' mathematics learning and could lead to students' poor mathematics achievement. The next chapter discusses the above findings by making link to the relevant literature in chapter 2.

CHAPTER FIVE: DISCUSSION

5.1 Introduction

The purpose of this study was to develop a deeper understanding of Solomon Islands students' beliefs and attitudes towards learning mathematics. Key findings from chapter four will be discussed in this chapter. The discussion is organised around seven key areas: students' beliefs about the nature of mathematics, students' beliefs and attitudes towards the utility of mathematics, students' beliefs about learning mathematics, students' attitudes towards learning mathematics, factors that impacted on students' beliefs and attitudes, factors that students thought had affected their mathematics achievement, and gender differences. This chapter ends with a summary.

5.2 Students' Beliefs about the Nature of Mathematics

Beliefs about the nature of mathematics were part of the semi-structured interviews. Findings with respect to students' beliefs are particularly important in this study. For instance, the analysis of students' responses to semi-structured interview question 1 (see Appendix I), *what is mathematics?* revealed qualitative differences between responses. This section discusses four conceptions, namely mathematical content, mathematical processes, cognitive processes and the utility of mathematics.

5.2.1 Mathematical content

As mentioned in section 4.2.1, mathematical content refers to the aspects of number, topics, quantities, formulas and rules. This section discusses data on students' view on mathematical content.

Seven students spoke about particular aspects of mathematical content when asked to define mathematics. Four urban and two rural students expressed the nature of mathematics in terms of number and calculations using formulas. This finding is consistent with the findings of Kloosterman

(2002) and Presmeg (2002) that students' views of mathematics tended to revolve around concept of number and calculations using formulas. One particular urban student's explanation reflected the ideas of statistics and algebra and still maintained ideas of formulas and calculations.

The findings suggested that students had well-formed beliefs about particular aspects of mathematical content. This view could be due to an emphasis in the mathematics curriculum on number and mental calculation (MEHRD, 2001). In addition, the curriculum puts more emphasis on assessment, but its use is limited (Walani, 2009). The teachers' perceptions about assessment are oriented towards written tests and examination for ranking purposes rather than assessment for learning (Kakai, 2010). This culture of written tests has directly influenced the learning of mathematics which may have prompted students to view mathematics as set of calculations using numbers and formulas rather than referring to the important learning skills and understanding.

5.2.2 Mathematical processes

The mathematical processes refer to problem solving, solving problems using rules and procedures, investigation and analysing information (see section 4.2.2). This section discusses data on students' views about the nature of mathematics in terms of mathematical processes.

Four rural students' interpretations about the nature of mathematics reflected on the aspects of solving problems using rules, procedures and formulas. Three girls provided responses that revolved around the idea of using formulas and applying rules for solving problems. One particular girl mentioned the same idea of these so-called rules and methods to solve problems, but further reflected on investigating problems and analysing information.

Students' views on solving problem that are associated with applying formulas and procedures resonate with the findings of Kloosterman (2002) that revealed 15 of the 56 students in year-9 to year-12 interviewed felt that mathematics is a set of rules to be mastered to solve problems. Other studies also revealed similar findings that students believed mathematics is using memorised formulas and applying them to solve problems (Amirali, 2010; Presmeg, 2002). Students in this study did not perceive mathematics as a subject that encourages critical thinking, reasoning and applying ideas as Mapolelo (2009) had suggested. Even their ideas about problem solving were not well-explained. Hekimoglu and Kittrell (2010) said that this view is not commonly seen among students as they were short-sighted because of rules, procedures and formulas they used in mathematics

One particular girl in rural high school viewed the nature of mathematics as investigating problems and analysing ideas but provided little explanation because she was still bombarded by these so-called rules, formulas and solving problems. Most of the students may not think of other important processes such as analysing ideas, reasoning and communicating ideas because they might not perceive the importance of mathematics in that context. Instead they still believed that having the ability to memorize procedures is a significant part of understanding mathematics. This limited view of the nature of mathematics stems from the fact that students are taught to memorize formulas and procedures for solving mathematical tasks may be in their high school years, acquiring these skills are significant part of learning outcomes in the national curriculum for Solomon Islands (MEHRD, 2011). The aim stipulated in the curriculum is to help students achieve knowledge and skills in preparation for internal and external examinations.

5.2.3 Cognitive processes

Students also recognized the nature of mathematics in terms of common cognitive processes such as learning and thinking (section 4.2.3). This section first discusses data on students’ beliefs about the nature of mathematics related to cognitive processes from the semi-structured interviews and then from the written survey.

Two rural students and one urban student expressed their views about the nature of mathematics as a thinking subject. They described how learning mathematics helped them to develop their thinking capacity when solving problems. Like the primary and intermediate students in Young-Loveridge, et al.,'s (2006) qualitative study, they expressed the idea that mathematics had helped them to think better.

A particular student in the urban school view mathematics as a subject where learning the concepts and understanding every aspect of it is important. In fact, students' general view of learning is understanding the mathematical concepts and meaning involved (Mapolelo, 2009). A similar study by Gómez-Chacón, García-Madruga, Vila, Elosúa, and Rodríguez (2014) examined high school students' beliefs about mathematics learning, mathematics concepts and procedures that helped develop students' understanding. This belief suggests that having a good sense of mathematical understanding may determine how easily mathematics can be approached.

Taking on board the data from the written survey on statements (section 4.3.2, statement 6 and 11 and section 4.3.2, statement 13) related to aspect of thinking had consolidated the data for semi-structured interviews. For instance, the majority of the students (93%, statement 13) believed that mathematics helped them in their thinking. Furthermore, majority of the students believed that doing mathematics requires original thinking and creativity (96%, statement 6), and learning mathematics involves thinking more than remembering (83%, statement 11). These findings imply to students that mathematics becomes fundamentally a thinking subject. Considering the age of these students, most of whom are in the 17 to 19 year-old group, such ideas are developed possibly because they are grown up teenagers who may think like that.

As noted by Presmeg (2002) and Kloosterman (2002), students' beliefs about the nature of mathematics are important because they help students understand what happens in the classroom and what motivates students. It will be difficult for students to capitalise on mathematics at school or everyday life if they do not have mathematics – related beliefs (Op't Eynde et al., 2002; Young-Loveridge, et al., 2006). These beliefs about the nature of mathematics are significant, as they shape students' learning of mathematics. The next section discusses data on beliefs and attitudes towards the utility of mathematics.

5.3 Students' Beliefs and Attitudes towards the Utility of Mathematics

The utility of mathematics refers to the relevance and usefulness of mathematic in everyday life. This section discusses the data on students' beliefs and attitudes towards the utility of mathematics gathered from the semi-structured interviews (section 4.2.4) and written survey (section 4.3.3). The data from semi-structured interviews is discussed first.

One of the five students commented that mathematics is useful in their daily life by connecting mathematical ideas to their everyday activities. Three students believed that mathematics is connected with commercial businesses. One particular student perceived it as useful for problem solving and decision making. These findings contradict the findings of Chouinard and Roy's (2008) quantitative study in Canada that investigated high school students' (year-7 to year-11) competence beliefs, utility value and achievement. There was a significant decrease in Canadian high school students' perceptions of the usefulness of mathematics. Many students encountered difficulty so they did not see it as important in their school life on its practicality in real life. However, the findings of this study resonate with research studies that students believed mathematics is significant in every walk of life (Kloosterman & Cougan, 1994; Schoenfeld, 1992; Young-Loveridge et al., 2006).

The findings from the written survey also revealed students' beliefs (see section 4.3.3) and attitudes (section 4.4.4) towards the utility of mathematics. Most students see the utility aspect of mathematics in school, everyday activities and employment. The findings revealed that the majority of students (n=71, 67%) thought success in school determines how good they are in mathematics. Most students (n=101, 94%) also believed that mathematics is needed in many jobs and careers. This finding is consistent with other studies that revealed students believed that having mathematical knowledge and understanding determined their success to move to the next grade (Kloosterman & Cougan, 1994; Presmeg, 2002). Therefore, they need to acquire skills and strategies to perform better in their mathematical tasks. The findings from Garica (2012) indicated that students perceived the usefulness and applicability of mathematics in work places and other practical duties of life such as sports, banking and shopping. The high response rate implies that many students are aware of the usefulness of mathematics at school and outside of the school setting.

These beliefs influenced student's attitudes towards mathematics which allow them to perceive the utility of mathematics (section 4.4.4). Findings revealed that most students recognised mathematics as a useful tool in the society. Many students develop positive attitudes when they can make connections to mathematics– related ideas with real world problem solving (Clark, 2013; Hodges & Kim, 2013). They use mathematics ideas to perform practical duties of life such as cooking, playing games, building and shopping. However, students may not react positively toward learning mathematics if mathematics is not real, or useful and is meaningless.

5.4 Students' Beliefs about Learning Mathematics

Two aspects regarding students' beliefs about learning mathematics gathered from the written survey findings include students' beliefs about knowing and doing mathematics (section 4.3.2), and students' self-efficacy belief (section 4.3.5). These beliefs are the focus of discussion in the following sections.

5.4.1 Students' beliefs about knowing and doing mathematics

The notion of doing mathematics means working logically, using steps and having one's own ways of solving mathematics problems. Knowing mathematics mean getting correct answers, making sense of answers and sharing mathematics ideas with peers. The aspects of knowing and doing mathematics are discussed.

The written survey data (section 4.3.2) revealed that 100% of the students thought that doing mathematics required working logically in a step-by-step fashion (statement 4). The findings are consistent with Goldin et al., (2011) and Francisco, (2013) who identify students' beliefs about learning mathematics as working with right procedures and applying rules to solve mathematics problems. This type of general belief is common to students where they perceive doing mathematics as having more procedural than conceptual understanding (Kloosterman, 2002). This view implies that the majority of the students considered learning mathematics as using steps, rules, procedures and formulas. This belief may be an integral part of students' mathematical identity as revealed in section 4.2.

Another major finding is that the majority of the students (99%) believed learning mathematics as a social process. They thought that explaining ways of solving a problem to their peers is important. This finding is consistent with Sue Johnston-Wilder and Lee (2013), Francisco (2013) and Young-Loveridge (2010) who found students liked to work and talked about mathematical ideas in group or with their peers. Undoubtedly, this view implies that the Solomon Island is culture that perceives conveying information through social interactions is an important aspect of life to share and inform each other about relevant things in life. But these interactions may be limited to similar age groups and those having common interests. Students' interactions with adult to discuss ideas are very minimal for students are not used to sharing ideas openly with adult.

5.4.2 Students' beliefs about their self-efficacy

Students' beliefs about self-efficacy in this study include statements about enjoyment, making mistakes, difficulties with mathematics, being poor at mathematics, confidence, being good at mathematics, remembering formulas and procedures, and having a mathematical mind. Overall, findings from the written survey (section 4.3.5), revealed that many students had positive self-efficacy beliefs. The main key findings are discussed below.

One interesting finding revealed that the majority of the students (75%, statement 5) did not find difficulties with mathematics. This is consistent with the findings of Young-Loveridge and Mills (2010) that revealed 81% of the students completing the questions did not find mathematics difficult. While this study revealed 8% of the students strongly agreed mathematics was difficult, it contradicted Garcia's (2012) findings that reported 34% of the students strongly agreed mathematics is considered as one of the difficult subjects. Students who feel efficacious about their learning mathematics have positive beliefs in mathematics despite the difficulties they encounter.

Similarly, the majority of students (90%) believed they never gave up when encountering difficulty in mathematics. This belief suggests that students who feel efficacious are eager to persist longer on difficult tasks and learn more (Schunk & Richardson, 2011). Beghetto and Baxter (2012) further discussed that students who are competence in their ability in mathematics usually do well. Students in this study thought they are competent working with rules and procedures to solve problems. They believed they may be competent and to make an effort to understand mathematical concepts and to work confidently with mathematics is highly necessary.

Students who disagreed with some statements in this category may argue that they had low self-efficacy beliefs with regards to learning mathematics. These students need to be facilitated for the development of their positive beliefs towards learning. As noted by Beyers (2011), students' well-formed beliefs with respect to learning mathematics could influence not only their mathematical thinking and performance but also their attitudes and decisions about mathematics in later years.

In short, students believed that knowing and doing mathematics requires them having sound mathematical knowledge to perform effectively in mathematics. Moreover, students who had positive self-efficacy beliefs about learning mathematics expended greater effort to succeed, despite encountering difficulties.

The next section discusses students' attitudes towards learning mathematics. Areas of focus include students' feelings toward learning mathematics, and factors influence their beliefs and attitudes.

5.5 Students' Attitudes towards Learning Mathematics

The findings from the written survey (Appendix G: Part B) about students' attitudes towards learning mathematics (section 4.4) revealed quantitative differences in students' responses. The next section discusses data on students' feelings towards learning mathematics.

5.5.1 Students' feelings toward learning mathematics

Students' feelings towards learning were both positive and negative. Negative feelings are associated with difficulty, laziness and boredom with situations encountered during learning of mathematics. Positive feeling includes interest and enjoyment students have in mathematics.

Students expressed their negative feelings towards learning mathematics. Thirty three students felt that learning mathematics in secondary school was very difficult. As MSU4 stated: "I feel that learning mathematics is such a very difficult subject to understand." Students found difficulties with understanding mathematics topics. This finding supports the finding of Di Martino and Zan (2007), and Pyzdrowski et al., (2013) which revealed that students found mathematics difficulties in understanding concepts.

Secondly, students feel lazy in learning mathematics when mathematics is boring. Most students stated they lack interest in mathematics. More recent literature affirmed that students experience boredom when they lack interest in mathematics and do not see the value of a mathematics course (Hodges & Kim, 2013). Such feeling normally comes to students when the mathematics lesson is not enjoyable (Tahar et al., 2010). This implies that a remedy for such negative attitudes would be to maintain effective teaching where learning is engaging, appropriately challenging, and enjoyable (Anthony & Walshaw, 2007; Beyers, 2011).

Despite the negative feelings towards mathematics, students indicated their positive feelings towards learning mathematics. The majority of the students felt the enjoyment of learning mathematics. In addition, 32 students felt interested in mathematics. Some students stated that learning is interesting when they explore new ideas, conceptualising new rules and formulas. These findings are consistent with the findings of Ashaari et al.,'s (2011) quantitative study that revealed students' interest towards mathematics. Students find mathematics very interesting when lesson activities are incorporated with stimulating tasks (Di Martino & Zan, 2010; Anthony & Walshaw, 2007).

Having developed positive attitudes towards mathematics can simply mean that students enjoy working with mathematics when they have confidence in their ability. However, it does not mean that they will display a positive attitude towards learning of mathematics at all times. Some students have negative attitudes for lack of confidence and understanding to either hate or dislike mathematics (Grootenboer, 2001; Tahar et al., 2010). These finding suggest that students are not only felt positive towards mathematics, but in need of mathematical knowledge and understanding to perform effectively in mathematics.

Several factors have an impact on students' beliefs and attitudes. These factors will be discussed in the next section.

5.6 Factors Impacting on Students' Beliefs and Attitudes

This section discusses three factors that impact on students' beliefs and attitudes towards their mathematics learning as emerged during focus group interviews. These factors are related to students, teacher, and peer group (section 4.5).

5.6.1 Factors associated with students themselves

Factors related to students play major roles in students' mathematics learning. The factors that are associated with students are their affective and cognitive factors (section 4.5.1). The affective factors refer to positive feelings such as enjoyment, interests, preference, confidence and negative feelings such as dislike of mathematics. The cognitive factors are the nature of understanding mathematics, having difficulties due to lack of mathematical knowledge and procedural knowledge. These two factors are discussed below.

Students' affective factors are found to be positive. Students expressed their feelings of enjoyment and interests about learning activities and practical tasks. For instance, FSR22 expressed that "learning activities, practical tasks in mathematics are very interesting for me and I am good at mathematics, and I loved to learn mathematics." These results reflected past studies in which students' enjoyment and their perceptions of learning mathematics have been positively related (Fraser, 2012; Hodges & Kim, 2013). The findings of Winheller et al., (2013), Di Martino & Zan (2010) and Barkatsas et al., (2009) revealed that students who were interested in mathematics were more confident and motivated to perform their mathematics activities well. Students in this study expressed that they are good at mathematics when they have confidence and ability to perform mathematics.

The findings also revealed students having problems with cognitive ability. Students' responses indicated having difficulties understanding mathematics. They expressed their lack of mathematical knowledge and understanding of the procedures to solve mathematics problems. FSR22 said that "I sometimes faced difficulties in mathematics because I did not understand the correct use of formulas and concepts of the particular topic." This finding resonates with the findings of Carroll's (1994) case study that students lack mathematical knowledge and understanding which influences their attitudes to perform well in mathematics. In fact, students who hold very low self-concept about themselves in mathematics will definitely feel an impact on their beliefs and attitudes towards learning mathematics. It seems that students reflected on their learning experiences that were closely linked with strong negative feelings of mathematics because they have a very poor conceptual knowledge of understanding mathematical situation.

5.6.2 Factors associated with the teacher and teaching

Students in this study held negative and positive views towards the teacher and teaching of mathematics. Students expressed two negative aspects about teaching. First, mathematics is not well taught and second, teachers' behaviour is at fault. These two factors are considerably impacting on students' beliefs and attitudes.

Findings (section 4.5.2) revealed that teachers can influence students' beliefs and attitudes from the way they present mathematics to students. Students explained that they were having problems understanding their teacher if the explanation is not clear to them. These findings are consistence with the findings of Pyzdrowski et al., (2013), Ball et al., (2008) and Mansor et al., (2010) that students felt their teacher was the greatest factor that influenced their mathematic learning for lack of clarity in explanations, and not providing proper guidelines for the learning tasks. These findings simply suggest that lack of proper explanations of mathematics concepts can easily induce negative beliefs and attitudes in students when they do not understand the concepts

Another finding revealed that students' beliefs and attitudes toward learning can be affected by teacher's negative interpersonal behavior in the classroom. Students expressed their teacher's behavior for being uncaring, getting frustrated easily and usually grumpy. Literature showed that teacher's hostility, anger and intimidation of students during the course of their learning contribute to more negative attitudes (Jackson & Leffingwell, 1999; Whyte & Anthony, 2012). The expression of frustration and anger against students could adversely impact on students' beliefs and attitudes and affect their mathematics learning

Despite the negative issue about the teacher, students mentioned that their acquisition of mathematical knowledge and understanding inherently comes from teachers who explain mathematics concepts plain and simple. For instance, MSU27 said that “I learn mathematics better from my teacher who can really explains make it simple to the level of my understanding.” This is consistent with Marchis (2011) and Schornick, (2010) finding that teachers that show positive interest in helping students to understand mathematics will implant positive beliefs and attitudes in students. The teaching of mathematics ideas that are clearer and meaningful for students might develop their interest in mathematics.

Students believed that learning in a social context by interacting and sharing mathematical ideas, learning from their group or peers is seen as one possible way that could enhance their mathematics understanding. Peer group influences will be discussed in the next section.

5.6.3 Factors associated with the peer group

Findings revealed that the peer group (section 4.5.3) had influenced students' beliefs and attitudes in learning mathematics Students expressed the feelings that help from classmates or friends in sharing mathematics ideas helped their understanding of mathematics. They often resort to their classmates who were mathematically bright for mathematical assistance. For example FSR22 said “I learn better from students…students who were good in mathematics are usually available and willing to help.” In this way students can view their peers as readily available mathematics resources.

The findings suggested the importance of cooperative learning through small group discussion which can help students develop their mathematical knowledge during their active engagement in the mathematical tasks (Lau et al., 2009; Te Maro et al., 2008). It seems more worthwhile for students to communicate mathematical ideas with classmate which in turn, assists less able students to learn from the more able students (Ryan, 2001; Larson et al., 1996). However, this finding contradicts the findings of Hawera et al.,'s (2007) finding in New Zealand on how Maori students view their friend's help in terms of doing mathematics. They revealed that while the majority thought it would be useful to work and learn mathematics from friends, some expressed strong preferences for working on their own task for fear of being accused of cheating, distracted or having their individual progress impeded.

As concurred by Lubienski (2007) not all students can fall within the category of having natural ability to discuss, interact and share ideas with other people. This indicated that while other students disfavour learning mathematics in a socially interactive way, all students in this study see it as an ideal norm for learning mathematics. As said before (section 5.4.1), the culture of togetherness and supporting each other is very prominent in the cultural setting of the Solomon Islands where people are openly share their interests and ideas. This view reflects that learning in social interactions is ideal in the students' learning discourse.

The above factors can also play a very crucial role in affecting students' achievement in mathematics. The next section discusses findings on factors students thought had affected their mathematics achievement.

5.7 Factors Affecting Students' Mathematics Achievement

This section will discuss five factors that students think are affecting their mathematics achievement. These are students' mathematics background, mathematics anxiety, students' attitudes, teacher's influences and parents.

5.7.1 Students' mathematics background

Students' mathematics background will be seen in the aspect of having poor mathematical background knowledge. Students' poor mathematics knowledge is a critical factor that affects students' achievement in mathematics. This section discusses findings from section 4.6.1.

Six students had believed themselves to be very poor at mathematics. As FSR9 stated: "I have lacked knowledge about the subject...I am very poor at mathematics. My performance in mathematics is very poor. I used to get very low marks in tests and exams." This is the typical explanation of students' self-concept belief about their mathematical background. This group of students did not have very strong knowledge to perform better in mathematics. Furthermore, students expressed that when the task was challenging and difficult they just put them off. As FSR11 said, "But for the complicated ones, I just forget them and I don't bothered to attempt them because they are very hard."

These findings are congruent with students in other studies who had poor performance and lacked confidence which affected their mathematics achievement (Dubinsky & Wilson, 2013; Marchis, 2011; Tahar et al., 2010). In addition, lack of mathematical ability may limit students' opportunity to extend their mathematical knowledge and understanding (Barkatsas et al., 2009; Beyers, 2011) to recognize and translate mathematical problems into their sense making (Dubinsky & Wilson, 2013).

One interesting finding revealed students' lack of English proficiency to understand mathematical language (section 4.6.1). Some students had expressed their difficulty understanding and interpreting word problems in English. Malefoasi's (2010) study confirmed that Solomon Islands students had difficulty and confusion over solving word problems in their mathematical tasks. The language barrier is a major factor that most students in our country face. Most of our students can understand English language but to interpret and make meaning out of the context is an issue. Obviously, students had a language barrier because for most of them, English will be their third, fourth or fifth language.

The findings suggest that, students with lack of limited mathematical knowledge and confident may avoid tasks because they feel incompetent to perform them. These students are weak in mathematics so it may affect their ability to manipulate, interpret and make sense of mathematics. The obvious stumbling block encounter by non-native speakers is inadequate acquisition of the English language of instruction to better grasp the meaning.

5.7.2 Students' mathematics anxiety

Students' mathematics anxiety is one of the factors that negatively impacted on mathematics attitudes and achievement. This section discusses two findings from the written survey (section 4.4.3) related to mathematics anxiety: cognitive concerns and fearful experiences.

The findings clearly showed that mathematics anxiety causes some intellectual concerns. Students expressed the feeling that lack of skills and knowledge of understanding mathematical concepts hampered their performance in mathematics. Evans (2000) asserts that anxiety affects intellectual performance. Students who are victims of mathematics anxiety may find mathematics difficult for it affects their thinking and performances (Hoffman, 2010; Tahar et al., 2010; Taylor & Fraser, 2013). This lack of intellectual ability may cause too many difficulties for students to perform well in their assessments. Otherwise, students were worried about getting poor results in tests or exams due to their poor intellectual performance.

Furthermore, fear of failure in mathematics has negative consequences. Students took that view because they were performing poorly in their mathematics. The literature shows that students are facing mathematics phobia, a fearful experience (Burns, 1998; Carroll, 1994; Chinn, 2009; Hoffman, 2010; Taylor & Fraser, 2013). This phenomenon (mathematics phobia) has an adverse impact on students' learning and achievement in mathematics. This implies that fear of mathematics is a natural consequence for students in this study who have no immediate knowledge and skills to perform mathematics at the expected level.

Factors such as students' negative attitudes towards mathematics can also affect achievement. This concept will be discussed below

5.7.3 Students' negative attitudes toward mathematics

Most students in this study held negative views about mathematics for they disliked learning mathematics. Some even mentioned that they hated mathematics. Their attitudes toward class attendance can be another contributing factor that affected mathematics performance.

The difficulty students had in mathematics influenced them to either hate or dislike mathematics. Yılmaz, Altun, and Olkun's (2010) finding revealed that students who lacked adequate mathematical knowledge easily formed negative attitudes towards mathematics. Barkatsas et al., (2009) confirmed that students' achievement will be definitely affected by their established negative attitudes. The effect of negative attitudes may encourage students to spend less time for study, lack motivation in doing their work, and lead to lack of concentration.

5.7.4 Teachers' influences

The finding shows that most critical factor that affects students' mathematics attitudes and achievement is the teacher (section 4.6.3). The minimal amount of confidence, effort and support the teacher gives to the students have a great impact on students' mathematics achievement.

Findings from semi-structured interviews revealed that mathematics teacher also affected students' opportunity to know and understand mathematics. The effect of teachers not explaining and synthesising mathematics lesson permit students to have misconceptions of understanding mathematical concepts and processes. This findings is congruent with the findings of Mapolelo (2009) that students are affected performance is affected when the teacher is not properly explaining processes, concept of mathematics in solving mathematics problem in preparing students for tests or exams (Mapolelo, 2009).

Another notable finding revealed that mathematics subject was taught by some untrained professionals whom teaching is not their field of training, but major in science areas. It may be assumed that teacher's background qualification or teaching experiences can affect student achievement. However, one previous study showed that there is little or no evidence on conventional teacher's background qualification that matters to students' achievement (Boonen, Damme, & Onghena, 2013). Base on this claim, Wayne and Youngs (2003) affirm that "teacher differ greatly in their effectiveness, but teachers with and without different qualification differ only a little" (p. 108). In other words, teachers that have no teaching qualification can still be effective in what they do in mathematics classroom. This finding is from Solomon Islands contexts, and it is prevalent in various schools to have teachers who do not hold any formal training and still teach in the primary school (Alamu, 2010; MEHRD, 2007).This is a common practice in most schools because of shortage of qualified subject teacher (MEHRD, 2007).

5.7.5 Parents' lack of support

Parents' lack of support towards students' mathematics learning (section 4.5.4) can affect mathematics achievement. The findings indicated two aspects about parents in the Solomon Islands. Firstly, some parents may not be very supportive towards their children's mathematics learning. Secondly, parents of students' interviewed have low level of educational background, with few reaching higher education.

The findings revealed that students had not received mathematics assistance from parents. MSR2 said that "for this level of mathematics, parents could not handle them. So all I could say is there is little support from parents in my learning of mathematics." Research revealed that parents' lack of confidence and self-esteem arising from their poor or negative school experiences (Gorinski & Fraser, 2006) diminished parents' effort to help students with their mathematics learning. This creates barriers to their engagement and involvement in supporting their children's mathematics learning (Gorinski & Fraser, 2006; Sharma, 1993). This seems to suggest that students hardly get any learning support from their parents and do not interact with parents about mathematics. One point can be noted as well is that mathematics at senior level is quite challenging for students and the parents to handle.

Parents who have a low level of education could not help support students with mathematics work. MSU17 said that "My parents have very low level of education so I have very little or no support in my learning mathematics. I have to work on my own at home." Parental involvement in supporting children's homework, assignments and other related mathematics tasks in the Solomon Islands is minimal. Many parents in developing countries, especially in the Solomon Islands, are unlike parents in developed countries like the US, Australia and New Zealand who may be well educated to engage in school programs to help support their children's success in learning mathematics (Hawera et al., 2007; Hoover-Dempsey & Sandler, 1997). For instance, Hawera et al.,'s (2007) study revealed that Maori students received strong support at home from families [parent] or relatives to help with their mathematics learning. The findings suggest two possibilities that hinder parents from being involved in students' mathematics learning. The first is parents' lack of knowledge in year-12 mathematics. Secondly, most students in year-12 are enrolled in boarding schools that detach them from parental connection; thus, parents may not have chances to discuss school related work with students.

5.8 Gender Differences

Gender differences related to aspects of beliefs, attitudes, mathematics anxiety and achievement in mathematics are very common in this study. These aspects will be discussed below.

5.8.1 Gender and beliefs about learning mathematics.

The findings in section 4.3.4 revealed that the majority of students (n=83, 78%) disagreed with the perspective that men are better at mathematics than women. Another statement asked students if they were good at mathematics and enjoyed the challenges (section 4.3.5, statement 1). More than three-quarters of the boys (87%) and just 59% of the girls believed that they were good at mathematics. Other findings in this study revealed that boys and girls had similar high self-efficacy about learning mathematics (section 4.3.5). For instance, 98% of the boys and 93% of the girls thought that to be good at mathematics they must have confidence (statement 17). The findings are consistent with the findings of Ganley and Vasilyeva (2011) that both boys and girls had similar levels of mathematics performance. This view contradicts findings from previous studies that revealed boys had greater confidence in their mathematical abilities than girls (Hyde et al., 2008; Linn & Hyde, 1989).

5.8.2 Gender and attitudes towards learning mathematics

General attitudes towards mathematics such as liking, enjoying, disliking or hating are associated with gender differences (section 4.4). Main findings are discussed below.

More boys tended to respond very positively towards learning mathematics. Findings in section 4.4.1 revealed that boys seemed to be more interested (n=20) than girls (n=12) in learning mathematics. The findings are consistent with the findings of Linn and Hyde (1989) and Barkatsas et al., (2009) that revealed boys expressed more positive interest towards mathematics. In addition, more boys (n=21) tended to enjoy learning mathematics than did girls (n=8) when they understood the mathematics concepts and learning tasks. This view favoured most urban boys were mostly interested and enjoyed learning mathematics.

Next, more girls (n=19) than boys (n=14) reported negative views that learning mathematics in secondary school is very difficult (section 4.4.1). For instance, most rural high school girls (n=13) indicated mathematics is mind wrenching – too difficult. This finding is consistent with studies that showed girls had more negative views such as difficulty and lack of mathematical confidence than boys did (Barkatsas et al., 2009; Gunderson et al., 2012). However, it is important to remember that not all girls are created the same to all have difficulties in mathematics and to disengage in learning mathematic. Most likely girls perceived themselves as having talents, confidence and abilities, and performed similarly as boys.

5.8.3 Gender, mathematics anxiety and achievement

Students' mathematics anxiety such as feelings of tension, worried, fear and apprehension revealed gender differences. Gender differences with respect to mathematics anxiety had been revealed in section 4.4.3.

The findings revealed that more boys than girls had been affected by mathematics anxieties. More boys seemed to have expressed negative attitudes due to developing of mathematics anxiety. These findings contrast the finding of Devine et al., (2012) that explored the relationship between mathematics anxiety and performance. They found that girls tended to have higher levels of mathematics anxiety than do boys. Girls who have higher mathematics anxiety are negatively affected by their gender ability beliefs which significantly affects their mathematics achievement (Beilock, Gunderson, Ramirez, & Levine, 2010).The negative consequence can be an impediment to girls' mathematics achievement (Beilock et al., 2010).This view suggests that girls may exhibit less interest in mathematics, experience less enjoyment, and be less determined to pursue mathematics career at higher level (Witt, 2012).

5.9 Chapter Summary

The chapter enlightened that students' beliefs about the nature of mathematics in terms of mathematical content referred to aspect of number, calculations, formulas and topics. Students' beliefs about the mathematical processes revolved around the ideas of problem solving using procedures and steps. Moreover, beliefs of the nature of mathematics in terms of cognitive processes aligned to general thinking and learning. Students' beliefs and attitudes towards the utility of mathematics were positive in that students used mathematical ideas learnt in school and made connections to practical situations in their everyday life.

The findings highlighted that students still have well-formed attitudes towards learning mathematics. The association of negative attitudes interfere with students' mathematics learning. This showed in the research that most students find mathematics difficult. However, positive attitudes develop when students have understood mathematics better.

Factors such as the student themselves, teachers and peers play major roles that impact on students' beliefs and attitudes in both positive and negative ways. Similarly, students and teachers are seen as very crucial factors in affecting students' mathematics achievement, along with lack of parental support.

In terms of gender differences more boys than girls hold more positive beliefs and attitudes. With regards to the issue of mathematics anxiety this study found that boys developed more anxiety than girls. In the next chapter, the summary, limitations, implications and conclusions are discussed.

CHAPTER SIX: SUMMARY, LIMITATIONS, IMPLICATIONS AND CONCLUSIONS

6.1 Introduction

This study was designed to investigate the beliefs and attitudes of secondary school students in the Solomon Islands towards learning mathematics. A mixed-method approach was used to generate data through a written survey, focus groups and semi-structured interviews. This chapter provides a brief summary of the findings discussed in chapter five, the limitations, and implications for teaching and future research. The chapter ends with a brief conclusion.

6.2 Summary of the Key Findings

The summary is based the students' beliefs towards the nature of mathematics, the utility of mathematics, and beliefs and attitudes towards learning mathematics. It also briefly discussed factors that had impacted on their beliefs and attitudes, and factors that affected their mathematics achievement. Next, it states the findings of gender differences in relation to beliefs and attitudes, and mathematics anxiety.

The students thought about mathematics in terms of its content (section 5.2.1: calculation of number, rules, formulas and steps), processes (section 5.2.2: using rules and procedures, problem solving, investigating and analysing), and cognitive processes (section 5.2.3: learning and thinking). In addition, students had positive beliefs and attitudes towards the utility of mathematics (usefulness and relevance) which is an important subject for solving problems in the real world (section 5.3).

Students' positive beliefs about learning mathematics were associated with their beliefs about knowing and doing mathematics, and self-efficacy. Most students strongly believed that mathematics involves more thinking than remembering, and doing mathematics means working logically with mathematical processes and using a range of strategies. Students' self-efficacy beliefs involve their ability to gain confidence to learn or do mathematics.

Most students had both negative and positive attitudes towards learning mathematics. They expressed that learning mathematics was difficult. The difficulty with mathematics resonates with their well-established negative attitudes. Despite the negative attitudes, positive attitudes developed from their enjoyment of mathematics. Having developed positive attitudes towards mathematics meant students enjoyed and were interested in working with mathematics and had confidence in their ability.

Several factors impacted on students' beliefs and attitudes towards learning mathematics. Firstly, factors associated with the students themselves impacted on their beliefs and attitudes. Students with positive attitudes to mathematics seemed to be committed to learning. Generally, students who had negative attitudes tended to perform very poorly in mathematics. Secondly, the factors associated with teacher and teaching had positively and negatively impacted on students' beliefs and attitudes. Students developed negative attitudes when mathematics was not well taught by the teacher and teacher displayed negative behaviours. This meant that students had negative views about their mathematics when mathematics concepts, steps and procedures were not clearly explained. Thirdly, peer group support was believed to impact on students to develop positive beliefs and attitudes towards their mathematics learning.

Students also thought of factors that affected their mathematics achievement. Firstly, having poor mathematics background was a crucial issue that affected their achievement. Students who have developed academic self-concept beliefs of being poor at mathematics found themselves in a difficult situation to understand mathematics concepts. These negative beliefs and attitudes affect mathematical ability which hampers students' academic achievement. Secondly, students' mathematics anxieties affected their mathematics achievement. Students with insufficient cognitive skills to perform mathematical tasks could face mathematics anxiety. Thirdly, students considered that their mathematics achievement had been affected by lack of teacher's support in their learning. The effect of teacher's lack of content knowledge and inappropriate pedagogical practice paved more paths for students' misconceptions and lack of mathematical understanding. Furthermore, lack of parental support had affected the students' mathematics achievement.

There were few differences found in gender with respect to mathematical-related beliefs. Both genders held similar views with regards to the belief that men are better at mathematics than women. A good number of boys and girls opposed this view. With respect to beliefs about their self-efficacy, both boys and girls shared similar views. In terms of mathematics anxiety, more girls in the rural school were worried about mathematics so it affected their achievement. However, the sample affects the rate of response because more boys than girls participated in the study. Most beliefs about mathematics were favoured by the majority of boys.

Gender differences in terms of students' attitudes towards learning mathematics revealed differences in data from the two schools. This study revealed that more boys tended to have positive attitudes towards learning mathematics. They seemed to be more interested and enjoyed mathematics more than girls did. In addition, most boys from the urban high school enjoyed learning mathematics. Similarly, more girls than boys had negative views that learning mathematics in secondary school was very difficult. Moreover, many rural students than urban students were more anxious about learning mathematics. In addition, most girls from the rural high school had negative feelings towards mathematics because of difficulties they encounter in mathematics.

6.3 Limitations of the Study

There are several limitations encountered in this study. Yet, sufficient data were received to fulfil the purpose of this study.

6.3.1 Limitation of the sample size

There were only two schools chosen for this study with a small sample (n=107) of participants involved in the written survey. There were 52 students from the rural high school and 57 students from the urban school. It is suggested that the sample size could have been increased in order to cover students with a wider range of responses. Further, despite the limited sample, rich data was collected which outweighed the setbacks.

Obviously, a gender gap emerged from the written survey. More boys (n=61) than girls (n=46) participated in the written survey. This may have affected the number of responses in the results. For instance, more boys will respond higher in other aspects than girls. It could be better to have gender balance in the survey. The researcher did not consider this in the first instance; however, the study proceeded to generalise all year-12 classes in both schools.

6.3.2 Conducting interviews

Another limitation is the students were not very comfortable having conversation with the researcher. However, a little chat and introduction about the study commenced each session of the interview to make the participants feel they were part of the study. The purpose was to get to know them briefly and make them feel welcomed. These students were encouraged to share if they wanted to, but were not forced to comment. At times students just provided brief explanations, or provided yes or no answers. A probe for more answers was encouraged students to provide more details in their responses. Culturally, some students may not had felt confident talking with an adult in a private place. The researcher made things clear and friendly to the participants especially in a semi-structured interview.

One of the setbacks was lack of research skills. The researcher had inexperienced training and should have piloted the interview before conducting the actual research. At times the researcher quickly moved to the next question, rather than probing for more responses. The researcher, in some cases provided clues for students if they did not know how to answer the questions.

6.3.3 Time factor

Time constraint was another limitation of this study. The time limit set for the interview scheduled was not followed when interviewing students. The researcher had to interview four students during break time, which is a limited time to cover the semi-structured interview questions. Permission was sought from the teachers so that the students could be excused from their class period while the interview proceeded. Due to limited time, this study was conducted only on two schools rather than extending to other schools.

6.3.4 Relationship between researcher and students

One constraint often faced when executing this study in both schools was the relationship between the researcher and the student participants. The study was the first of its kind in both schools for a researcher to conduct a research inquiry with students. Therefore, students and the school considered the researcher as an outsider, which made the interview quite difficult. Coming from a cultural perspective where students were not used to explaining things clearly with adults, even in class or at home when they were asked to share, may have affected the data from the interviews. It was sensed through the interviews that students did not have the confidence to express ideas openly with the researcher. However, there were students who confidently expressed themselves fully during the interviews. Solomon Island’s national language, pijin was the only means of communication used in this study. Even though the research questions were written in English and explained to students in pijin, they may not have been well understood. As much as possible clear and simple terms were used during the interviews.

6.4 Implications of the Study

The findings provide valuable insights about students' beliefs and attitudes towards learning mathematics. They also provide important implications for teachers, teacher educators, parents and for scholars who are interested in further research.

6.4.1 Mathematics teachers

Findings from this study revealed that teachers were the most significant factors that impacted on students' mathematical beliefs and attitudes. It was identified that students had negative attitudes towards their teacher for lack of clarity in the way teachers presented mathematics in class. Thus, mathematics teachers must ensure they are pedagogically sound with strong mathematical knowledge background to properly represent mathematics at the students' level of understanding.

Importantly, there must be an awareness of the importance of beliefs and attitudes; teachers need to address these issues in the classroom. Students should, therefore, be encouraged to make personal reflections on their beliefs and attitudes when learning mathematics, using a log book or journaling. From time to time they can review their progress and make improvements where appropriate, and to take necessary actions that foster effective and worthwhile learning of mathematics.

Further, teacher's training development needs to be sought alongside with students' responses about the teacher to develop their mathematical knowledge. Moreover, teachers must provide the utmost care and support for students to feel that they are part and parcel of mathematics learning.

6.4.2 Teacher educators

The findings of this study provide relevant information for reflection on teacher educators to train and equip mathematics teachers with relevant skills and knowledge to effectively teach mathematics at higher secondary level in the Solomon Islands.

It is of great importance that those untrained teachers who still teach mathematics in rural or urban schools at both primary and secondary levels must pursue professional teacher training to develop a strong mathematics content knowledge to teach mathematics. Training must be taken for teaching mathematics at an expected level where it promotes conceptual understanding for students and impacts positively on students' beliefs and attitudes about mathematics learning.

6.4.3 Parents

Parental support in students' learning must be established first at home. Parents are the first teachers for the children at home in supporting and shaping their mathematics learning. Parents, as much as possible must see the needs of their children in mathematics to provide learning support by assisting in any mathematics related task. As early as possible, parental involvement should be enacted in whatever way possible to develop and maintain positive beliefs and attitudes of students in their mathematics learning.

6.4.4 Research Implications

This study has an important place in the education system of the Solomon Islands. It is of great concern that a large number of poor attitudes has been observed in many students regarding mathematics learning. Many students find mathematics difficult, lack interest and enjoyment, hate mathematic and, as a result, perform poorly. A further study could be conducted to explore students' beliefs and attitudes towards learning mathematics at the elementary or primary schools in the Solomon Islands.

In addition, study also partially revealed gender differences in mathematics being favoured by males than females. The findings were just limited to two schools that could represent the whole country; however, it is recommended that the same study could be extended to other schools in the country on gender affects in the context of learning mathematics. Additionally, this study used only one statement about gender difference in the written survey. Future research studies should have more statements, and then use interviews to explore ideas in more depth.

It is suggested there could be ways to improve research questions and interview questions for future research to gather specific data about the issue to be investigated. For instance, when asking about factors affecting students' mathematics achievement, at least some word problems or written tests might be provided for students to do. Then, follow-up by using semi-structured interviews to gain more information about the issue.

Furthermore, it could be much better that the future research be extend to interview teachers to further reinforce what factors students believed had impacted on their beliefs and attitudes. It is anticipated that rich data could be obtained from teachers as well once they were interviewed. In addition, it would be great if observation could be employed in future research to observe students' attitudes towards teaching and learning in the classroom.

6.6 Conclusion

This research is ground breaking in that it investigated the beliefs and attitudes of students towards learning mathematics in the context of the Solomon Islands. The study itself provided avenues for students to voice their concerns, interests and feelings. The findings in this study were anticipated to inform teachers and other stake holders about the affective issues in learning mathematics. Furthermore, it informs mathematics teachers to review, reflect, and re-examine their teaching practices to seek for new approaches to improve teaching and learning of mathematics now and in the future. The study identified that effective and worthwhile teaching support to meet learners' mathematical needs will boost students' beliefs and attitudes towards their mathematics learning. In addition, there must be an awareness of the importance of beliefs and attitudes needed to address these issues in the mathematics classroom. This is the beginning to open up research and to unpack what is in the mind of students sitting with unheard voices in the corner of the classroom.

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APPENDICES

Appendix A: Solomon Islands Research Application Form

SOLOMON ISLANDS

FORM RA

RESEARCH APPLICATION

1. NAME ……………………………………….... (Underline Surname)
2. ADDRESS(es) (if more than one give all)
3. Curriculum Vitae – (attach separately and include previous research work)
4. Subject(s) to be studied. (brief synopsis, detail should be on the research proposal)
5. Areas/locality where research work is to be conducted.
6. Funding
   (a) Who is funding this Research?
   (b) What is the level of funding?
7. Method of Research
8. My Research will involve …………………….. Please tick

Filming		Collecting Sample/Specimen	
Recording			
Photographing		Others (Please specify)	

Others

9. Arrangements for Accommodation in the place(s) of Research
10. How will the research results be used? List
11. List benefits of Research to Solomon Islands.
12. Name and Address of any person/organization/institution who is willing to assist you while you are doing your research. (A letter from local host will be useful)
13. How long will the research take? Specify dates if possible.
14. Any additional specific information you consider useful for our perusal of your application may be described below.
15. Give us two referees certifying your research application and background. (Two separate statements expected

    Name ______________________
    Address ______________________
    ____
    ____
    ____

    Name ______________________
    Address ______________________
    ____

16. Applicants signature: ________________ Date ______________

Appendix B: Letter to Permanent Secretary

Address omitted

Dear Sir/Madam,

SUBJECT: PERMISSION TO DO RESEARCH IN THE SOLOMON ISLANDS

I am Andriane Kele, ~~and I~~ a current student of Waikato University undertaking Master of Education (Mathematics Education) study. As part of my master's thesis, I am required to complete a research project in mathematics education. My research project is entitled: "An investigation of secondary school students' beliefs and attitudes towards learning mathematics in the Solomon Islands."

This study was motivated from my teaching experiences over the last five years during which time I have noticed a decline in students' performance in mathematics. Also, I have noticed their mathematics achievement has been affected by their established negative beliefs ~~attitudes~~ and attitudes. ~~beliefs~~The outcome of this study could improve mathematics teaching pedagogies and develop more positive attitudes and beliefs to students' learning of mathematics in high school.

The ethical approval has been granted by the Faculty of Education Research Ethics Committee at the University of Waikato for me to conduct my research in the Solomon Islands.

I am writing to seek permission to conduct research inquiry with students in the two selected schools namely: Kukudu Adventist College in Western province and Honiara Senior Secondary High School in the capital, Honiara. This research will be implemented at the beginning of the fourth week of April, 2013. I will patiently await your response before contacting the respective education authorities and school principals for the two schools.

Should you need further information and clarification, you are welcome to contact my supervisor in this study, Dr. Sashi Sharma, Department of Maths, Science and Technology Education, University of Waikato, New Zealand. She can be contacted on: phone (+64) 7 8384466 ext 6298 or email: sashi@waikato.ac.nz

Thank you for considering my request. I look forward to receiving your response.

Yours faithfully,

Andriane Kele

Appendix C: Letter to Education Authority

Dear Sir,

SUBJECT: PERMISSION TO DO RESEARCH IN YOUR EDUCATION AUTHORITY

I am Andriane Kele from Western province, currently on study leave undertaking Master of Education (Mathematics Education) study at the University of Waikato, New Zealand. As part of my master's thesis requirement, I am required to complete a research project in mathematics education. My research project is entitled "An investigation of high school students' beliefs and attitudes towards learning Mathematics in the Solomon Islands".

This study has been influenced from what I have observed during my teaching experiences for the past 5 years specifically on the decline of students' performances in mathematics. Furthermore, students' mathematics achievement has been affected by their established negative attitudes and beliefs. My intention for this study is to investigate what sorts of beliefs and attitudes do students have towards learning mathematics. The outcome of this study may elicit mathematics teaching pedagogies to develop more positive impacts on students learning of mathematics in high school.

I have received permission from the Ministry of Education Human Resources and Development to conduct research in the Solomon Islands. While the study is intended to be conducted in one of your schools, I am seeking your official approval for me to visit and collect data from the school.The target group in this study will be year-12 students/

I am planning to begin my data collection in the second week of May, 2013. I intend to spend approximately two weeks in this school.

Should you need further information and clarification, you are welcome to contact my supervisor in this study, Dr. Sashi Sharma, Department of Maths, Science and Technology Education, University of Waikato, New Zealand. She can be contacted on: phone (+64) 7 8384466 ext 6298 or email: sashi@waikato.ac.nz

Thank you for considering my request. I look forward to receiving your response as soon as possible.

Yours faithfully,

Andriane Kele

Appendix D: Letter to School Principal

Dear Principal,

SUBJECT: INFORMATION AND INVITATION

My name is Andriane Kele and I am currently on study leave undertaking Master of Education (Mathematics Education) at the University of Waikato, New Zealand. As part of my master's thesis, I am required to complete a research project in mathematics education. The title of my project is entitled: "An investigation of highs school students' beliefs and attitudes towards learning mathematics in the Solomon Islands".

My research will focus on students' attitudes and beliefs as well as exploring factors students believe have impacted on their beliefs and attitudes towards learning mathematics. The outcomes of this study may improve students' mathematics achievement and teaching pedagogies which might have more positive impacts to students learning of mathematics in the high school.

I have received approval from the MEHRD and EA to conduct this research. I have selected your school in which to conduct research inquiry with students. This study will mostly involve year-12 students to participate in written survey and interviews. They will be involved in the following activities: 1) 10 – 15 minutes whole class written survey. The survey will be conducted during their maths class period for about 15 minutes. 2) Individual student interview (10 students will be selected for approximately 20 minutes), and 3) Focus group interview (4 students will be chosen) for approximately one hour. The interview will be done in students' free time so that it will not interfere with their school program.

Therefore, prior to undertaking this project I wish to seek official approval from you as the principal of this school to involve your students in my study. It is much appreciated if I may ask your permission to conduct a meeting with the teachers responsible for year-12 students where I will be surveying and interviewing the students. I am planning to begin my data collection in the second week of May 2013. I intend to spend 2-3 weeks at your school to conduct my research.

Should you need further information and clarification, you can contact my supervisor in this study, Dr. Sashi Sharma, Department of Maths, Science and Technology Education, University of Waikato, New Zealand. She can be contacted on: phone (+64) 7 8384466 ext 6298 or email: sashi@waikato.ac.nz.

Thank you for considering my request. I look forward to receiving your response as soon as possible.

Yours faithfully,

Andriane Kele

Appendix E: Information sheet for Student Participants

Dear student,

SUBJECT: INVITATION TO PARTICIPATE IN A RESEARCH PROJECT

My name is Andriane Kele from Western province. I am currently on study leave undertaking Master of Education (Mathematics Education) study at the University of Waikato, New Zealand. As part of my master's thesis, I am required to complete a research project in mathematics education. The research that I am going to conduct is to investigate high school students' attitudes and beliefs, factors affecting attitudes and how attitudes affect mathematics achievement in the learning of mathematics.

All information gathered during this study will be kept confidential. Students who participate in this research study will not be identified, nor will the school in any report. Their right to decline or withdraw from participating from the study if they do not wish to continue further in the research process will be adhered to.

My purpose in writing is to seek permission for your willingness to participate in my study. This study will require you to complete a written survey, for approximately 10-15 minutes during class time. You are to provide answers to the statements or questions in the written survey. After you have completed the survey, you may be chosen to be involved in an individual interview with the researcher for half an hour or less. If you are not chosen, do not worry because it will not affect you and your well-being at all. You may also be selected to be interviewed with a group of students for about an hour. The interview will require you to answer short questions about your learning of mathematics. It is anticipated that the interview will only be done during your free time. The interview will be done in either English or Pijin. The venue will be in the mathematics department office or a place where you prefer to be interviewed.

Formatted: Justified, Line spacing: single

If you are willing to participate in this research please indicate by signing the consent form attached.

If you have any questions or require further clarification, please feel free to contact me at the above address.

Thank you in advance for your participation.

Yours faithfully,

Andriane Kele

Appendix F: Consent Form for Student Participants

Giving consent

I ………………………….. of ………………………………. High School have read the introductory statement, have asked questions about the research project and understand that:

i. The researcher will not identify me personally in any presentations or publications reporting the research
ii. The researcher will remove all electronic files after transcription
iii. The researcher will only keep textual data (transcripts and any written documents) for the required period of five years.

I understand that I have the right to:

- Withdraw from the research at any time, and also withdraw my data up until I have approved my transcript.
- Remove, or add to the transcripts that record my contributions during the survey and interviews

I understand who I can contact if I have any concerns that I feel are unable to be resolved by speaking with me directly.

I consent to:

☐ Having my contributions during the survey and interviews documented, transcribed and analysed

☐ Having the researcher collect and analyse any documents necessary for the study.

Name: ______________________________________

Signature: ______________________________________

Date: ______________________________________

Appendix G: Written Survey

Research question 1: What beliefs and attitudes do selected senior high school students have toward learning mathematics?

Demographic Information
Name:…………... Gender: Male / female (circle one)
School:…………………………………………………..
Age:..……………. yrs

Instructions:

The statements below are designed to identify your beliefs and attitudes about learning mathematics. Each item has 4 possible responses. The responses are strongly disagree (SD), disagree (D), agree (A) and strongly agree (SA). Please read each statement carefully. Tick a response beside each statement that most clearly represents your degree of agreement or disagreement with that statement. Only tick one response in each statement. Record your answer and move quickly to the next statement. Please respond to all of the statements.

Part A: Beliefs about learning mathematics

Statement	Strongly Disagree	Disagree	Agree	Strongly Agree
1. I am good at mathematics and I enjoy the challenge of it.				
2. Learning mathematics is interesting. I have the kind of mind needed to do advance mathematics.				
3. I feel okay about making mistakes in mathematics. While I am not especially strong at it, I am not fearful of it either				
4. Doing mathematics is usually a matter of working logically in a step-by-step fashion				
5. Maths is difficult for me so I avoid it whenever possible.				
6. Doing mathematics allows room for original thinking and creativity				
7. It is okay for learners to come up with their own ways of solving maths problems.				
8. Knowing why an answer is correct in mathematics is just as important as getting the				

right answer.

9. When working on mathematics problem, it is important that your answer makes sense to you.
10. When my work in mathematics is hard I don't give up.
11. Learning mathematics involve more thinking than remembering
12. I am very poor at doing mathematics
13. Mathematics helps me learn to think better.
14. Mathematics is needed for many jobs and careers
15. To succeed in school, you need to be good in mathematics.
16. Men are better at mathematics than women.
17. To be good at mathematics you need to have confidence you can do it.
18. To be good at mathematics, you need to remember formulas, procedures and rules.
19. To be good at mathematics you need to work hard at it.
20. It is important to explain how I solved a problem to other pupil in class.
21. To be good at mathematics you need to have a kind of "mathematical mind".

Part B: Attitudes towards learning mathematics

Answer the following questions in your own words. Please attempt all questions.

1. How do you feel about learning maths in secondary school?
2. Have your attitudes to mathematics changed during learning mathematics in secondary school? How?
3. Have you felt anxious (worry, fear, concern, uneasy, boring) about mathematics? Why?
4. How do you use mathematics in your everyday life? (Any situation you apply mathematics)

Appendix H: Overall Data

Table 4.2. Number of students who agreed or disagreed with each statement of the overall sample (n=107)

Statement	Overall (n=107)				
	SD	D	A	SA	*NR*
A. Students' beliefs about doing and knowing mathematics					
4. Doing mathematics is usually a matter of working logically in a step-by-step fashion			46	60	*1*
6. Doing mathematics allows room for original thinking and creativity		4	52	48	*3*
7. It is okay for learners to come up with their own ways of solving mathematics problems.	6	18	57	26	
8. Knowing why an answer is correct in mathematics is just as important as getting the right answer.	1	6	58	36	*6*
9. When working on mathematics problems, it is important that your answer makes sense to you.	2	3	36	65	*1*
11. Learning mathematics involves more thinking than remembering.	3	15	32	56	*1*
20. It is important to explain how I solved a problem to other pupils in class.	1		50	56	
B. Students' beliefs about utility of Mathematics					
13. Mathematics helps me learn to think better.	1	7	37	61	1
14. Mathematics is needed for many jobs and careers.	2	2	46	55	2
15. To succeed in school, you need to be good in mathematics.	10	23	54	18	2
C. Student's beliefs about gender differences					
16. Men are better at mathematics than women.	43	41	12	10	1
D. Students' beliefs about their self-efficacy					
1. I am good at mathematics and I enjoy the challenge of it.	4	21	57	23	2
2. Learning mathematics is interesting. I have the kind of mind needed to do advanced mathematics.	1	10	45	49	2
3. I feel okay about making mistakes in mathematics. While I am not especially strong at it, I am not fearful of it either.	6	15	41	43	2
5. Maths is difficult for me so I avoid it whenever possible.	31	47	19	8	2
10. When my work in mathematics is hard I don't give up.	3	8	31	65	
12. I am very poor at doing mathematics.	24	43	28	11	1
17. To be good at mathematics you need to have confidence you can do it.	2		25	78	2
18. To be good at mathematics, you need to remember formulas, procedures and rules.	1		19	87	
19. To be good at mathematics you need to work hard at it.	1	5	20	81	
21. To be good at mathematics you need to have a kind of "mathematical mind".	2	6	39	58	2

Appendix I: Semi-structured Interview Questions

Research question 3: How do students think their mathematics achievement has been affected by their beliefs and attitudes?

A. Students mathematics background, attitudes towards mathematics

1. What is mathematics?
2. Are you good at mathematics? Why? [Prob: Did you get good marks in your tests or assignment?]
3. Do you find mathematics interesting or not? Explain. [Prob: How about study for your tests?]
4. What makes you think that you do not like solving mathematics problems
5. Can you tell me why sometimes mathematics is so difficult?
6. How do you feel when you do poorly in your mathematics tests and exams? Why are you affected by your achievement?

B. Mathematics teacher and teaching

1. Do you like your teacher? What are some of the things you like about your mathematics teacher?
2. Do you like/dislike how your teacher teaches you mathematics? Did he/she help you with your maths task? Can you further explain?
3. Do you understand the teaching approach? Explain how you understand your mathematics teacher.
4. Are you able to ask your teacher if some part of the teaching is not being fully understood? What sorts of things are not helpful to you in the teaching of mathematics in the classroom? Explain.

Parental support

1. One can learn mathematics by seeking help from others e.g. parents, teacher or others. Do you usually get help from your parent with your mathematics? Explain why?
2. Do you sometimes discuss mathematics together with your parents? Explain these further.

Appendix J: Focus Group Interviews

Research questions 2: What factors do students believed have impacted on their beliefs and attitudes toward learning mathematics?

i. Personal factors

1. How do you feel about learning mathematics? [prob: what is your personal view about learning mathematics?]
2. What are some of the factors that affect your learning in mathematics? [Prob: Or do you sometimes come across problems in learning mathematics? What are some of the problems?]
3. Why do you find mathematics very difficult? Can you please explain?
4. What are some difficulties you face in learning mathematics?

ii. Peer support

1. Do you feel wanting to seek help from your classmates?
2. Have you felt wanting to learn from others offering you their help in solving mathematics problem?
3. Do you like to share mathematics ideas with your sit mate? [Prob: Explain how is this important]

Any other comments that you might like to share

iii. Teachers influences

1. Do you like the way mathematics is being taught?
2. Did your teacher teachers you good mathematics? Explain
3. Did he/she explain mathematics well to you? How do you see this?
4. Is your teacher very friendly when teaching you mathematics?

Is there any factor(s) or issue(s) of concerns that influence your learning of mathematics? Can you explain some of them?

Appendix K: Survey Participants for both High Schools

Urban school		Rural School	
Female	*Male*	*Female*	*Male*
FSU1	MSU1	FSR1	MSR1
FSU2	MSU2	FSR2	MSR2
FSU3	MSU3	FSR3	MSR3
FSU4	MSU4	FSR4	MSR4
FSU5	MSU5	FSR5	MSR5
FSU6	MSU6	FSR6	MSR6
FSU7	MSU7	FSR7	MSR7
FSU8	MSU8	FSR8	MSR8
FSU9	MSU9	FSR9	MSR9
FSU10	MSU10	FSR10	MSR10
FSU11	MSU11	FSR11	MSR11
FSU12	MSU12	FSR12	MSR12
FSU13	MSU13	FSR13	MSR13
FSU14	MSU14	FSR14	MSR14
FSU15	MSU15	FSR15	MSR15
FSU16	MSU16	FSR16	MSR16
FSU17	MSU17	FSR17	MSR17
FSU18	MSU18	FSR18	MSR18
FSU19	MSU19	FSR19	MSR19
FSU20	MSU20	FSR20	MSR20
FSU21	MSU21	FSR21	MSR21
	MSU22	FSR22	MSR22
	MSU23	FSR23	MSR23
	MSU24	FSR24	MSR24
	MSU25	FSR25	MSR25
	MSU26		MSR26
	MSU27		MSR27
	MSU28		
	MSU29		
	MSU30		
	MSU31		
	MSU32		
	MSU33		
	MSU34		