Factors associated with learner choice of mathematics at Grade 10 level in a secondary school in KwaZulu-Natal

By

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DECLARATION

I, Visvanathan Marimuthu Govender, declare that this dissertation entitled, *"Factors associated with learner choice of mathematics at the Grade 10 level in a secondary school in KwaZulu-Natal"*, is my own work and that all sources I have used or quoted have been indicated and acknowledged by means of complete references. It has not been submitted before for any degree or examination in any other university.

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ABSTRACT

The purpose of the study was to investigate the factors that are associated with learner choice of mathematics at Grade 10 level at a secondary school in KwaZulu-Natal. It examined learners' experiences of learning and teaching in mathematics in the General Education and Training (GET) phase. The study was a narrative inquiry. The data collection technique focused on learners' stories of their experiences of mathematics teaching and learning. Forty learners participated in this study. Twenty (males = 10; females = 10) of the learners chose mathematics at Grade 10 level and twenty (males = 10; females = 10) did not.

The findings of the study revealed that various factors affect learner choice of mathematics in Grade 10. These factors include: mathematics anxiety; perceptions that mathematics is boring and difficult to understand; classroom pedagogy; teacher attitudes; career aspirations; parental pressure; and course selection limitations. The findings indicate that the decision not to choose mathematics in the Further Education and Training (FET) band is influenced by various intersecting factors. It is impossible to single out a particular factor. The study suggests that there are not many differences in the mathematics learning experiences of boys and girls who chose not to study mathematics in the FET phase. Gender did not emerge as a significant mediating factor in the learners' experiences of learning mathematics, and in their decisions about whether to select mathematics as a subject in grade 10. Learner emotionality in the context of mathematics teaching and learning emerges as a significant factor in the study. The study has implications for teacher professional development and for future research.

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CHAPTER 1: CONTEXTUALISING THE STUDY

1.1 Introduction

The curriculum in secondary schools in South Africa is structured in such a way that learners have a choice in respect of mathematics as a subject in the Further Education and Training (FET) Phase (Grade 10 to Grade 12). Over the years, it has been found that in many schools there has been an increase in the number of learners who do not opt for mathematics at Grade 10 level (Verster, 2009). This obviously results in fewer learners pursuing mathematics in the FET Phase.

I have been a teacher of mathematics for the past 25 years. At the secondary school in KwaZulu-Natal where I teach, I noticed an increase over the years in learners who do not choose mathematics in Grade 10. The following statistics provide insight into the trends between 1992 and 2008 at the school. I began my study in 2008.

The data reflected in Table 1 are also presented in Figure 1, Figure 2 and 3. They follow on in order to make the trends in terms of gender more explicit.

Table 1**:** Mathematics enrolment trends from 1992 to 2008 in respect of Grade 10 learners.

YEAR	**LEARNERS**			**NUMBER OF LEARNERS OPTED FOR MATHEMATICS**	**NUMBER OF LEARNERS WHO DID NOT OPT FOR MATHEMATICS**			**TOTAL % LEARNERS DID NOT OPT FOR MATHEMATICS**	**% BOYS DID NOT OPT FOR MATHEMATICS**	**% GIRLS DID NOT OPT FOR MATHEMATICS**
	TOTALS	**BOYS**	**GIRLS**		**TOTAL**	**BOYS**	**GIRLS**			
2008	239	134	105	115	124	48	76	51.88	35.82	72.38
2007	227	125	102	111	116	54	62	51.10	43.2	60.78
2006	246	135	111	136	110	47	63	44.71	34.81	56,76
2005	235	102	133	169	66	30	36	28.09	29.41	27.07
2004	230	99	131	175	55	17	38	23.91	17.17	29.00
2003	234	135	99	156	78	25	53	33.33	18.52	53.54
2002	225	111	114	140	85	28	57	33.33	25.23	50.00
2001	229	114	115	160	69	29	40	30.13	25.44	34.78
2000	240	128	112	171	69	19	47	28.75	14.84	41.96
1999	207	103	104	174	33	10	23	15.94	9.71	22.11
1998	211	109	102	153	58	16	42	27.48	14.68	41.17
1997	235	82	153	120	115	30	85	48.93	36.59	55.55
1996	192	78	114	120	72	21	51	37.50	26.92	44.74
1995	195	78	117	130	65	23	42	33.30	29.48	35.89
1994	160	89	71	135	25	9	16	15.63	10.11	22.53
1993	162	90	72	146	16	0	16	9.87	0.00	22.22
1992	175	97	78	152	23	0	23	13.14	0.00	29.49

Figure 1: Learners who opted out of mathematics

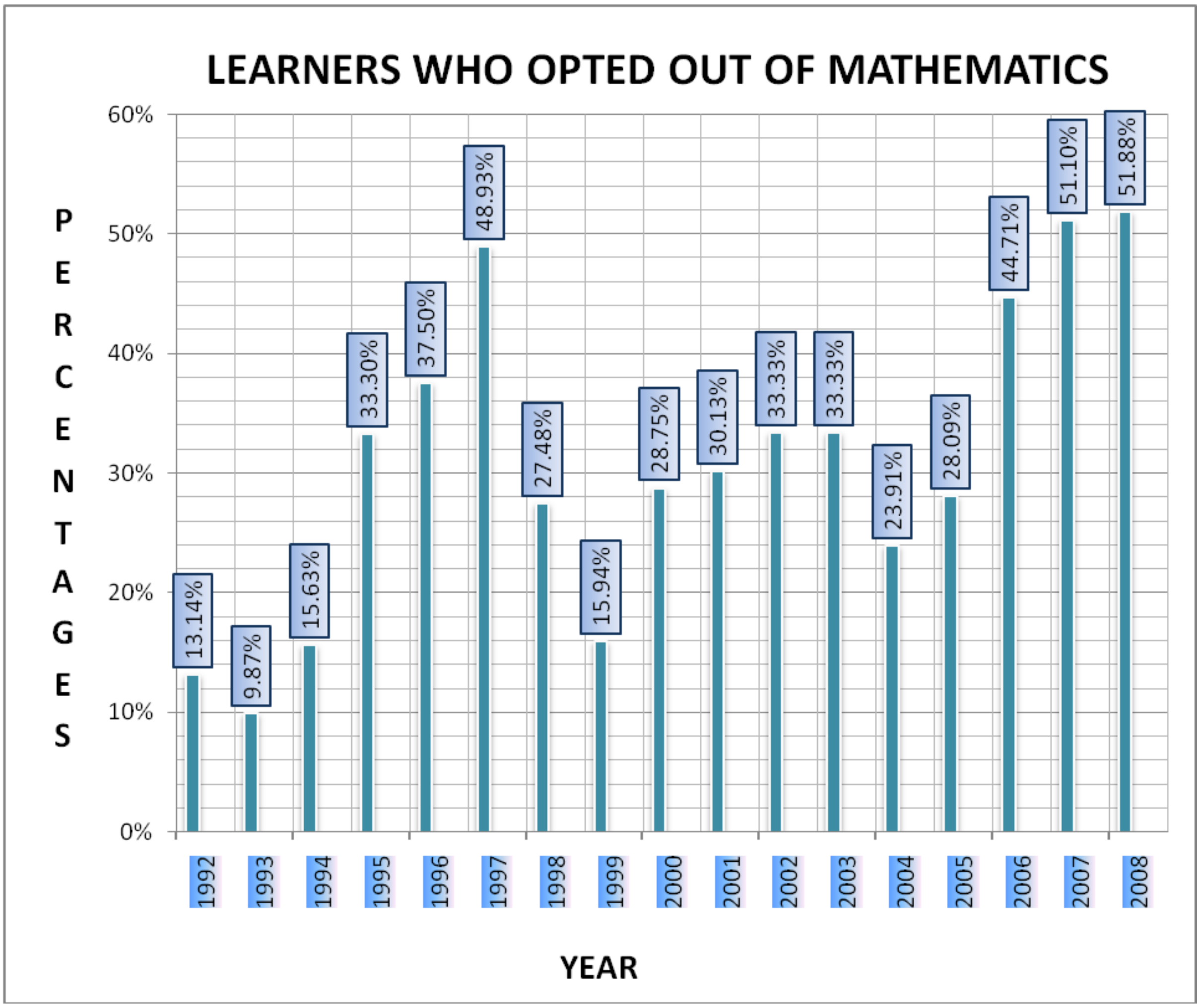


Figure 2: Boys who opted out of mathematics

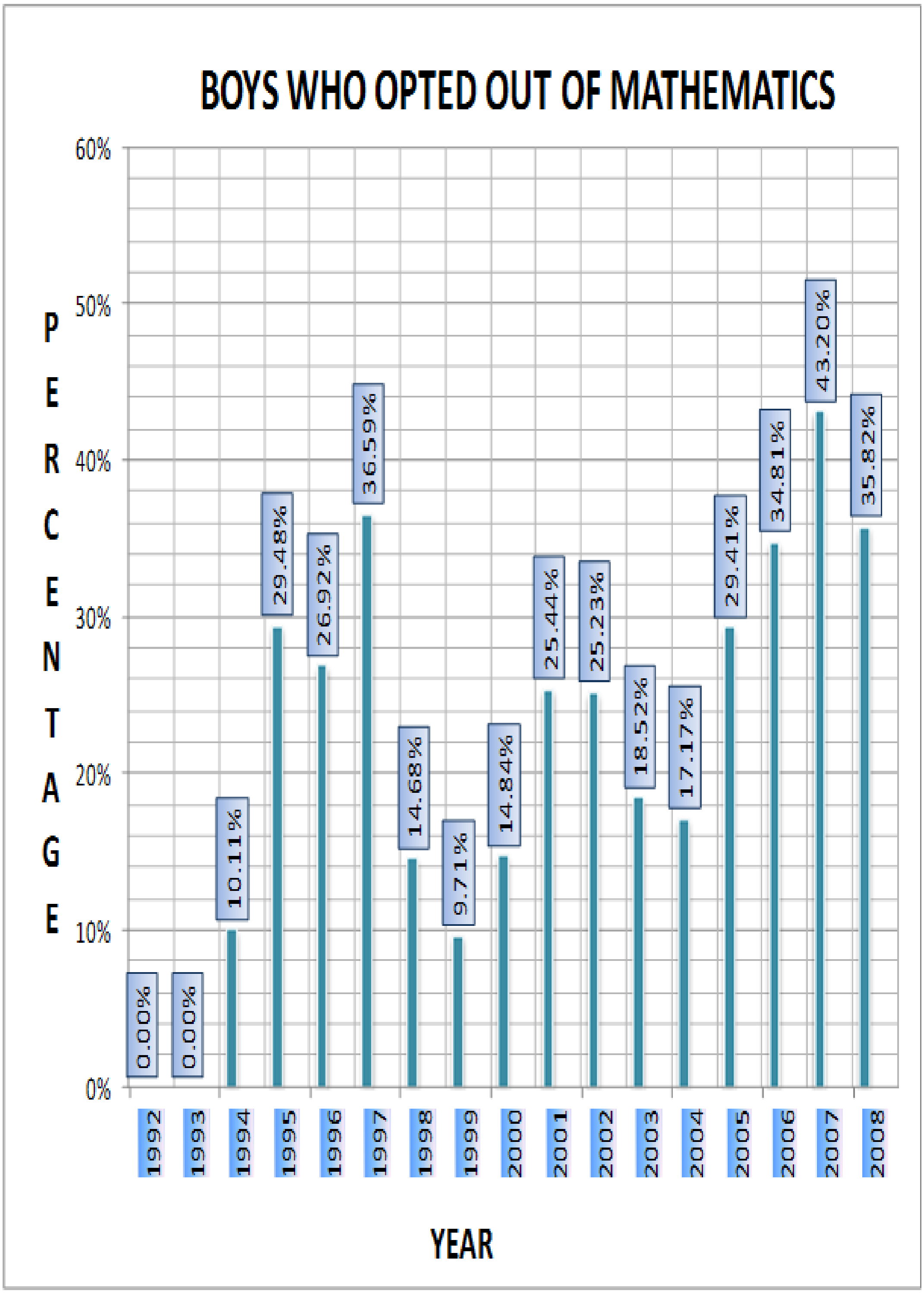
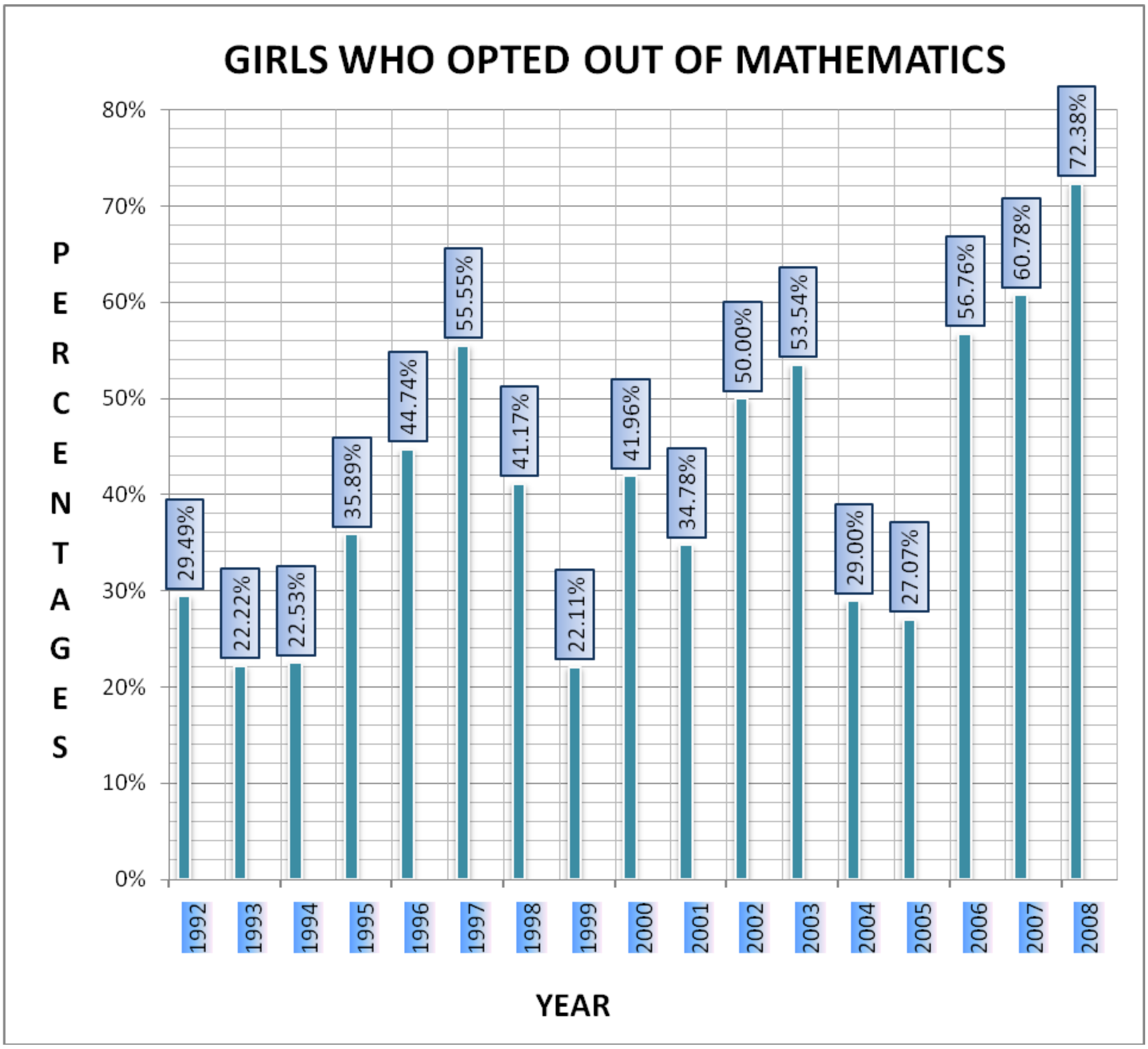


Figure 3: Girls who opted out of mathematics



The tables suggest that, in the period 1992-2008, there was a steady increase in the number of learners who decided not to choose mathematics at grade 10 level. This trend is evident for both boys and girls.

Given the above quantitative picture, I undertook a qualitative study to explore the factors associated with learners not choosing mathematics as a subject at Grade 10 level. It is a concern that from 2006-2008 a much larger percentage of girls compared to boys decided not to choose mathematics in grade 10. Hence I made the decision to explore whether the learners' experiences of mathematics learning and teaching was in any way gendered.

It must be stated that curriculum policy in South Africa has undergone various changes since 1994. In 1997, Curriculum 2005 was introduced (Department of Education, 1997). Prior to 2006, learners could opt out of studying mathematics as a subject. However, in January 2006 mathematical literacy (ML) was introduced in schools in the FET phase (Department of Education, 2006). The subject is an alternative option to mathematics, and all learners entering the FET phase since January 2006 are required to take one or other of these two options. The subject of learner choice and what motivates learner choice of mathematics remains an issue. The findings in this study may inform future studies in South Africa that seek to explore why learners choose mathematics or mathematics literacy as subjects.

1.2 A Brief Perspective on Mathematics Teaching and Learning in South Africa

It has been well documented that the quality and effectiveness of mathematical education in South Africa are inadequate when compared to international standards (Botha, 2000; Reddy, 2006; Reddy, Kanjee, Diedericks & Winnaar, 2007; Kotzé & Strauss, 2007; Moloi, 2005; Motala & Dieltiens, 2010). The reasons for this range from learner characteristics such as aptitude, attitudes, perseverance, gender, prior knowledge, socio-economic background; as well as affective barriers such as math anxiety and negative self-concept; to more general ones such as a shortage of well-trained teachers and inadequate resources in schools (Consortium for Research on Educational Access, Transitions and Equity (CREATE, 2010), 2011; Motala & Dieltiens, 2010). Furthermore, it is argued that the problem may lie in the nature of mathematics teaching (Bayaga, 2010). For example, it has been asserted that learners should be equipped with the necessary mathematical skills and processes to deal with mathematics in a meaningful manner. Instead, the majority of learners are still exposed to memorising mathematical knowledge (Bayaga, 2010). This partially explains the poor quality and lack of effectiveness of mathematics education in South Africa. Botha (2000) suggested that South African learners lack problem-solving abilities and creativity.

Given these debates, I was keen to explore whether the above influences played out in learners' decisions to opt out of mathematics at the Grade 10 level. I was also keen to examine the gender issue in mathematics choice. Mahlomaholo and Sematle (2004), in their study of Black South African learners, reported that girls found mathematics to be too difficult. Many girls claimed that they could not continue with a subject that they were failing. Boys, however, saw mathematics as being of value to them in life and hence pursued the subject. From my experience, mathematics choice at Grade 10 is stressful for many learners, irrespective of gender.

This study investigated the factors that are associated with learners choosing not to study mathematics in the FET phase at a secondary school in KwaZulu-Natal. It also explored whether there are differences in the mathematics learning experiences of boys and girls who opt not to study mathematics at Grade 10. Finally, I have attempted to unravel the hidden assumptions and unanswered questions that may be embedded in learners' decisions to opt out of mathematics in Grade 10.

1.3 Research Questions

The study sought to explore the following questions:

i. How did learners experience mathematics over nine years in the General Education and Training phase?

ii. What factors are associated with learners choosing not to study mathematics from Grade 10 level, and to what extent is gender a mediating factor in this choice?

1.4 Overview of the dissertation

Chapter One: Introduction. This chapter provides an overview of the study, and the research questions.

Chapter Two: In this chapter, I discuss the literature review, which informed the research topic. I examine the diverse intersecting factors that affect learner experience of mathematics at school level as evident in studies nationally and internationally.

Chapter Three: In this chapter, I present the research methodology and design of the study. This chapter also discusses the theoretical framework that informs the study.

Chapter Four: This chapter presents the findings of the research.

Chapter Five: This final chapter presents the conclusion and the implications of the study.

CHAPTER 2: INTERNATIONAL DEBATES ON FACTORS ASSOCIATED WITH STUDENT PARTICIPATION IN MATHEMATICS AS A SUBJECT

2.1 Introduction

The nature of student participation in the mathematics class and student attitude towards mathematics has been a major concern to the research fraternity internationally. A review of literature on the subject reveals a complex interplay of factors that affect student participation and attitudes. Sells (1980) drew attention to the perception that mathematics is a powerful subject and is seen to be linked to a person's intelligence. Mendick (2005) argued, from a social justice perspective, that it is important for researchers and educationists to examine why students come to choose mathematics as a subject to study and in what way this process is gendered.

Osborne et al. (1997), from their review of research found that students opted out of mathematics because they perceived it to be difficult, boring and of little use to them. Kyriacou and Golding (2006) report similar findings from their studies. In the U.K., Brown, Brown and Bibby (2008) investigated students' motives for discontinuing with mathematics at 16 years of age. Perceived difficulty and a lack of confidence were factors that influenced students' decision not to choose mathematics. Other factors included a dislike for mathematics and a perception that the subject lacked relevance (Brown et al., 2008). Ercikan, McCreith and Lapointe (2005) claimed that the strongest predictors associated with mathematics achievement and participation are: student attitude towards mathematics; the home environment; parents' expectations; gender differences; teacher expectations and mathematics anxiety. Deficit orientated stereotypes of girls and women lacking mathematical ability persist, and are widely held by parents and teachers, according to Hyde, Lindberg, Linn, Ellis and Williams (2008). Haylock (2003) found that students often admit to not being good at mathematics. This perception could be passed on to them by their parents, argued Furner and Duffy (2002).

A hotly contested debate in many industrialised countries is the transition of mathematics education from a preparation for the elite in society to mass education, which has been argued would achieve the democratisation of education (World Bank, 2005). Gellert, Jablonka and Keitel (2001) and Gates and Vistro-Yu (2003) argue that despite the commitment to promote mathematics, it is still one of those school subjects that evokes strong feelings of anxiety, aversion, incompetence and low self-esteem.

The issues I have raised in this introduction will later be engaged with in more depth. However, my literature search revealed that there are very few studies emanating from the African continent on these issues. Firstly, I examine debates on the gender gap in mathematics. Secondly, I examine literature that focuses on stereotypes associated with mathematics as a subject and mathematics learning. Finally I shift the lens to the mathematics teacher as a factor in mathematics learning.

2.2 The Mathematics Gender Gap?

Examining how gender intersects with mathematics is an educational issue traversed by many a researcher. Recent literature offers interesting additions to the intricate nature of this intersection. Gender differences in mathematics ability have been of major interest to the research community. Researchers have claimed that the role played by gender in mathematics education is multifaceted.

Studies show that the gender issue in mathematics is an active aspect of research in many countries (King & McLeod, 1999; Li, 1999; Abbott, Wallace & Taylor, 2005). Li (1999), in a study conducted in Canada using the British Columbia Mathematics Assessment data, found that girls tended to opt out of mathematics in the latter stages of their schooling career. Researchers have argued that this trend may be related to dominant ideologies of femininity and masculinity in society. Abbott et al. (2005) state that feminists have argued that the education system not only disadvantages girls but also that the very same education system teaches girls to be subordinate and to accept dominant ideologies of femininity and masculinity. Further, girls are indoctrinated to classify themselves as being less able than boys. Fennema (2000a) conceded that she once claimed that teachers should become sex-blind but she had changed her position on this issue. She asserted that “gender is a vital part of each human being that cannot be ignored” (Fennema, 2000a, p. 2).

Some researchers have hypothesised that different cultural and social factors may influence mathematics learning amongst females. It has been documented that teachers and parents hold the belief that boys are better in mathematics and science than girls (Volman &

van Eck, 2001). Kurtz-Costes, Rowley, Harris-Britt & Woods (2008) in their study found that children explicitly endorse gender stereotypes. Studies have shown that children's self-perceptions of ability and decisions related to mathematics education and career are influenced by adult stereotypes (for example, Tiedemann, 2000).

There is a common belief that mathematics is a male-dominated subject (Wadesango, Chabaya, Rembe & Muhuro, 2011). There has been evidence in research that girls are underrepresented in careers that require mathematics (Baine, 2004). Fennema (2000b) found that boys seemed to be more confident about learning mathematics compared to girls. Further, males in these studies believed that mathematics would be more useful and appropriate for them than for females. Goddard-Spear (1989) cited in Abbott et al. (2005) suggested that teachers regarded boys as more intelligent than girls. Drawing from her research undertaken in the United Kingdom, Goddard-Spear found that teachers graded boys' mathematics work more highly than girls. Walkerdine (1990) found that teachers were aware that girls are more able academically than boys, but that the achievements of girls were continuously undermined. Li (1999) asserts that there are various dimensions of schooling that intersect and contribute to gender differences in attitudes to and achievement in mathematics. These dimensions include: stereotypes of mathematics being viewed as a male domain; teachers' expectations of their students; learners' prior experience in mathematics and teachers' gender. Li (1999) states that often teachers mould learners' perceptions of mathematics. Li (1999) found that theoretically, teachers believe that education should be liberating and should promote democracy; however, practices of mathematics teachers often discourage mathematical interest among girls. Fennema (2000b) and Villalobos (2009) agree that the issue of gender inequalities in the mathematics class is complex.

Based on a study undertaken in Botswana, Mwamwenda and Mwamwenda (1989) claimed that learners with female teachers excelled at mathematics, whereas learners taught by male teachers achieved lower scores. It was also observed that there was a significant difference in students' attitudes towards male and female teachers who taught mathematics. Girls who were taught by female teachers demonstrated a positive attitude towards mathematics (Mwamwenda & Mwamwenda, 1989). Male teachers seemed to be more hostile in promoting gender equality. Female mathematics teachers were more positive, served as role models for girls and motivated them to pursue studying mathematics (Mwamwenda & Mwamwenda, 1989). The study by Mwamwenda and Mwamwenda (1989) also found that teachers were intentionally or unintentionally biased towards boys in classroom interactions. Teachers believed that boys were expected to do well in mathematics and move on to university, whereas girls were perceived to need elementary mathematics to enable them to perform simple calculations.

There have been various explanations by scholars and educationists for gender discrepancies observed in mathematics achievement. Benbow and Stanley (1980) in a study conducted in the United States of America with Grade 6 to 12 students, found gender differences in favour of boys, possibly due to greater male ability in spatial tasks. They also contended that gender differences in mathematics are genetic. More recently this claim has been challenged and widely criticised (for example, Neuschmidt, Barth & Hastedt, 2008; Halai, 2009a).

Lim and Hart (2002), in analysing the socio-cultural context of young girls' motivation for learning school mathematics in the USA, suggested that young adolescent girls felt that they do not perform well in mathematics due to them not having a voice in the mathematics class. Girls tended to lack intrinsic motivation for learning mathematics, resulting in them seeing themselves as passive knowledge receivers rather than active constructors of mathematical meanings (Lim & Hart, 2002). These factors prompted girls to drop out of the mathematics class and choose other subjects. Fenema and Sherman (1976) noted that gender differences do influence mathematics performance. Three decades later, Leedy, LaLonde and Runk (2003) reported that these differences do exist and that girls have less confidence in their abilities. Nosek, Banaji and Greenwald (2002), in their study conducted in India, found that relative to men, women reported more negativity toward mathematics, less confidence in learning the subject, and an inability to identify with the subject.

There is substantial evidence that gender differences in achievement are associated with gender differences in participation in the math class. However, the Trends in International Mathematics and Science Study (TIMMS), conducted by the International Association for the Evaluation of Educational Achievement (IEA) from 1995 to 2003, portray a different picture. Given the focus of my study, I will examine mathematic achievement in the TIMMS study. Patterns related to gender discovered in TIMMS 1995 are compared to studies post-1995.

The TIMMS international reports displayed significant gender differences in mathematics achievement. In the 1995 TIMMS report, the following countries reported a significantly higher mathematics performance for males over females: Iran, Japan, Korea and Slovak Republic. The TIMMS 1995 reported that girls outperformed boys in mathematics only in Lithuania (Neuschmidt et al., 2008). However in 2003, TIMMS documented that girls outperformed boys in mathematics in Cypress and Singapore (Neuschmidt et.al., 2008). Halai (2009a) claims that since the 1980s, trends in student performance and achievement in the USA and UK show that girls are closing the gender gap in mathematics or are performing better than boys. Ma (2008) states that this pattern is evident in reports from TIMMS 2003 in many countries.

Meelissen and Luyten (2008) claim that over the past forty years, the gender gap between boys and girls is closing in the Netherlands. They further claim that gender equality in mathematics in Netherlands is far from reality (Meelissen & Luyten, 2008). TIMMS (1995) showed that boys were at a distinct advantage compared to girls in the Netherlands. Eight years later, TIMMS depicted a smaller difference between boys and girls in the Netherlands. The difference was due to a decline in mathematics achievement by boys (Neuschmidt et al., 2008). TIMMS (2003) reported that Israel displayed the largest gender imbalance in grades 7 and 8 (Zohar & Sela, 2003). Crombie, Sinclair, Silverthorn, Byrne, Dubois and Trinneer (2005), in their study conducted with grade 8 learners in the United States of America, found that boys had higher mathematics competence beliefs than girls in. However, in a Dutch study, girls performed better than boys in mathematics tests (Crombie et al., 2005).

Neuschmidt et al. (2008) reported that, in comparing TIMMS 1995 and TIMMS 2003, there were still significant gender differences prevalent in a number of countries. However, some countries in which boys outperformed girls in TIMMS 1995, failed to display similar results in 2003 (Neuschmidt et al., 2008). A decrease in the gender gap in mathematics was observed in Korea, England, Iran and Hong Kong (Neuschmidt et al., 2008). Lee (2009) alludes to the TIMMS report when he states that gender differences in mathematics are evident in Korea. Comparisons of TIMMS 2003 show that many girls in Korea are participating in high-level mathematics at high school level. It is interesting to note that in Cypress, the gender gap increased from 1995 to 2003 in favour of girls (Neuschmidt et al., 2008). According to TIMMS 1995 Iranian boys outperformed girls in mathematics but

TIMMS 2003 reported an inversion in the direction of gender differences, that is, girls outperformed boys in 2003 (Neuschmidt et al., 2008). In the context of the above debates, Mead (2006) warns that we need to take into account that the difficulties boys or girls may have in mathematics learning are connected to larger educational and social problems and are not merely a function of gender

However, despite these often contradictory trends, *gendered mathematics enrolment* is a problem of international concern. Mendick (2005, p. 235) posited that mathematics continues to be perceived as a male-dominated terrain, and that "doing mathematics" is viewed often as "doing masculinity". Hannula (2002) asserts that girls' lack of confidence explains why girls are less likely to choose mathematics. Mendick (2006) suggests that at times girls may reject mathematics in order to affirm their femininity. The American Association of University Women (AAUW) (1998) in their study, conducted in the USA among Grade 9 learners, found the worrying trend of girls becoming less confident in their mathematical abilities and less interested in selecting mathematics later in their school careers. The AAUW (1998) warned that teachers may be contributing to this trend, and stressed the need to recognise and support girls' achievements in mathematics.

Decades ago, Eccles (1987) alluded to the fact that compared to boys, girls in the United States of America tended to display lower self-efficacy in mathematics, which resulted in them not taking mathematics in high school. Results of studies carried out by Kurtz-Costes et al. (2008) among students from a rural district in the southern region of the United States of America, are consistent with these findings, and show that many girls turn away from mathematics by the time they reach high school as they feel that mathematics is not relevant to their lives.

Watt (2005), in her research in the state of New South Wales (NSW) in Australia, found gender differences in enrolment, with fewer girls taking mathematics at high school level. In a study undertaken in New South Wales, Australia, more boys than girls indicated that they liked mathematics (Watt, 2005). This finding was similar to prior research by Benbow and Stanley (1980). This body of research is consistent with that of Fredricks and Eccles (2002) who argued that girls do not choose mathematics because they do not value it as much as boys do. Herzig (2004) and Maple (1996) cited in Watt (2005) admit to a critical shortage of people entering mathematics-related careers but note that it would be counterproductive to discourage boys from participating in mathematics. Rather, the focus should be on actively promoting girls' greater participation in mathematics by targeting their embedded values and perceptions of self (Watt, 2005).

More recently and interestingly, Osborne, Simon and Collins (2003) claim that a major concern in many countries is the decrease in the number of both boys and girls who choose to continue studies in mathematics at high school. Mendick (2006) claims that in society mathematics is a signifier of intelligence and the view is that people who do mathematics are perceived to be "brainy". In schooling contexts, students also develop these perceptions, and opt out of studying mathematics. In further argument, Steele (2003) accuses many institutions of using mathematics as a gatekeeper to elite colleges and universities. Mathematics, therefore, is described as a 'critical filter' (Steele, 2003). Leedy et al. (2003) assert that changing the attitudes of students, parents and teachers is crucial for on-going mathematics reform.

There are some researchers who claim that continents such as Asia and Africa are contexts for gender stereotyping (Juvonen & Graham (2001); Lawrenz & Veach, 2005; Mutemeri & Mugweni, 2005). In sub-Saharan Africa, cultures and societies have been influenced by male domination (Lawrenz & Veach, 2005). Juvonen & Graham (2001) claimed that in Nigeria girls tended to choose subjects such as home economics and biology whereas boys choose chemistry, physics and mathematics. Mutemeri and Mugweni (2005), in their study conducted in Nigeria, found that female learners believed that mathematics was for boys. These researchers argue that it is this belief that widens the gap in mathematics achievement (Mutemeri & Mugweni, 2005). A report by the United Nations Educational, Scientific and Cultural Organization (UNESCO) highlights the fact that poor mathematics performance in Nigeria is further compounded by gender bias within the teaching-learning environments (United Nations Educational, Scientific and Cultural Organization (UNESCO), 2003). Bosire, Mondoh & Barmao (2008) stated that in Kenya, various recommendations have been instituted to address the gender imbalances namely: the use of Integrated Programmed Instruction (IPI) methods; gender-sensitive instructional methods and materials for learning; modes of assessment that are gender-sensitive, and the use of female teachers as role models. Asmeng-Boahene (2006) states that many African countries are experiencing low levels of girls' achievement in mathematics. UNESCO (2001) reported that the gender gap in mathematics in Africa widens from senior secondary to tertiary level. Females tend to opt out of mathematics because it is not compulsory at senior secondary and tertiary level. (UNESCO, 2001). Many girls are not interested in mathematics because they do not see themselves as students who are capable of studying and succeeding in mathematics (Gilbert & Calvert, 2003).

Dovi (2004) states that a common misunderstanding is that African girls fail to achieve or pursue mathematics due to ability, but it is the lack of opportunities that is a key contributing factor. Tuaundu (2009) draws attention to the high dropout rate and low enrolment of girls in mathematics in Namibia. He argues that this phenomenon is attributed to biases in the Namibian education system that prevents girls from choosing mathematics at senior grades.

Pakistan is a highly gender-segregated society where gender issues related to mathematics education are pronounced and play out differently to countries in sub-Saharan Africa and South Asia (Halai, 2009a). Halai (2009a) states that, in Pakistan, institutions are separated into schools with male teachers for male learners and female teachers for female learners. In Pakistan, the cultures of rural schools are mainly responsible for the gender gap in mathematics achievement in favour of boys (Halai, 2009a). However, the results of the National Education Assessment System (NEAS) taken at Grade 4 (ages 8-9 years) in 2005 and then in Grade 8 (ages 12-13 years) in 2008 showed that girls performed better than boys in mathematics at Grade 4 level (Halai, 2009b). In 2008, this achievement was reversed and boys achieved better than girls (Halai, 2009b).

Karimi and Venkatesan (2009), in a study carried out among Grade 8 learners in Karnataka state, India, found no significant differences between boys and girls in mathematics performance. Lee (2009) found that gender differences favouring boys' continue to exist in Korea, where more boys than girls participate in high-level mathematics courses at high school level. This claim is qualified by TIMMS (2003), where boys scored more points than girls. Korea displayed the highest difference compared to the 32 participating countries (Ma, 2008).

Bessoondyal and Malone (2005) reported on the results of national examinations in Mauritius from 1995 to 2004 among children aged between 10 and 11 years. The findings show that girls consistently performed better than boys in the end-of-primary national examination. However, at secondary level, the study shows that girls' performance in mathematics was poorer than boys' (Bessoondyal & Malone, 2005).

In 1998 and 1999, the Third International Mathematics and Science Study-Repeat (TIMMS-R) was conducted in South Africa and 37 other countries (Howie, 2003). It is interesting to note that performance of South African learners was significantly lower than that of other developing countries, namely, Morocco, Tunisia, Chile, Indonesia and the Philippines (Howie, 2003). Howie (2003) warns that South Africa faces a major challenge in providing quality mathematics education for millions of its learners. O'Connor-Petreuso, Schiering, Hayes and Serano (2004), in their study conducted in certain European countries, found that gender differences in mathematics did exist and become apparent at secondary school level. Female learners exhibited less confidence in mathematics and performed lower than males (O'Connor-Petreuso et al., 2004). Sprigler and Alsup (2003), referring to research conducted in the United States of America, claimed that there was no gender difference in mathematical reasoning ability at elementary level. Ding, Song & Richardson (2007) explains that that longitudinal studies, carried out in Iran, display no differences between boys and girls in mathematical performance. Masanja (2003) found that in Tanzania the gender gap in mathematics is huge with girls' performance lagging far behind. Efforts to narrow this gap go back to the early 1960s. Progress is evident in the increase in females enrolling for mathematics at school and tertiary level.

Atweh, Taylor & Singh (2005) argue it is critical for girls to understand that the choices that they make in high school will have a powerful impact on their futures. In many countries in the world, women are under-represented in careers that are related to mathematics, science, engineering and technology. It is therefore imperative to encourage the enrolment of young women in these fields at the tertiary level, and choosing mathematics at high-school level is a step in that direction.

Penner (2008) explains that there is an under-representation of girls in mathematics and the sciences internationally. Women are under-represented in careers associated with science, technology, engineering and mathematics (STEM) subjects (Penner, 2008). This is a major concern among scientists (National Academy of Sciences, 2006). Guiso, Monte, Sapienza and Zingales (2008) and Reid (2003) assert that the issue of gender inequality is a long-lasting one internationally. Mickelson, Nkomo and Smith (2001) made a comparison of gender inequality in South Africa and Israel. Mickelson et al. (2001) explain that girls are considered inferior and are discriminated against in both countries. Riegle-Crumb (2005) argues that girls allow the opportunities that are available to them later in life to determine whether they would choose mathematics or not. Boys and girls assess the future opportunities that are available to them before making subject choices; therefore, girls respond by not choosing mathematics, as they believe there is a lack of job opportunities for females in careers where mathematics is required (Frank et al., 2008). Gender differences are inextricably linked to cultural variations (Else-Quest, Linn and Hyde, 2010). Hyde et al. (2008) claim that girls' lack of mathematical aptitude is prevalent in many societies even though there is evidence of gender similarities in mathematics performance. The quality of instruction and curriculum contribute to some extent to gender inequality in mathematics achievement. When girls are motivated to succeed they will perform at the same level as boys (Else-Quest et al., 2010). Girls should be given proper educational tools and female role models as these can influence success in mathematics (Else-Quest et al., 2010).

Gender differences in choice of mathematics as a subject can be linked to parental expectations (Bouffard & Hill, 2005), teacher attitude (Heller & Eccles-Parsons, 1981), stereotypical thinking (O'Brien & Crandall, 2003) and other environmental factors (Levine, Vasilyeva, Lourenco, Newcombe & Huttenlocher, 2005). Compared to girls, boys often gain more support from parents, under the guise of homework help, than girls do (Bhanot & Jovanovic, 2005). Gneezy, Niederle and Rustichini (2003) claim that boys outperform girls in mathematics in a co-ed environment. However, this gap fades when the genders are separated.

2.3 Stereotypes in Mathematics

In this section, I shall examine more closely the issue of stereotypes related to mathematics as a subject. Stereotypes can be defined as judgments about the abilities or attributes of individuals based on the social group to which they belong (Ruble, Cohen, & Ruble, 2001). Children in their preschool years have some awareness of traditional gender stereotypes. However, this knowledge becomes more entrenched as they move to middle childhood (Ruble, Martin & Berenbaum, 2006). It is obvious that children to some extent explicitly endorse gender stereotypes (Ruble et al., 2006). Research suggests that many parents and teachers believe that boys are more capable in mathematics and science than girls (Kurtz-Costes et al., 2008).

Bleeker and Jacobs (2004) argue that adult stereotypes to some extent influence children's self-perceptions of their ability, and children's decisions about mathematics related to curriculum choices and careers. Stereotypes of adults often enhance the self-concepts of boys, which favour boys to girls in the USA (Bleeker & Jacobs, 2004). According to Kurtz-Costes et al. (2008, p. 386), studies in western countries have shown that when boys were of the opinion that adults had more traditional stereotypes, they also adopted similar beliefs that girls are less capable and competent in mathematics and science than boys.

A study conducted by Fennema and Sherman (1976) cited by Leder, Forgasz and Solar (1999) in English-speaking countries over a period spanning 25 years showed that gender differences are more prevalent among older students and seemed to increase as they progress through school. In the USA, the Fennema-Sherman Mathematics Attitude Scales were constructed thirty years ago by Fennema and Sherman (1976) for the purpose of measuring the extent to which mathematics is stereotyped as a masculine field (Kloosterman, Tassell, Ponniah & Essex, 2008). In studies by Jones and Dindia (2004) conducted in the USA, the above-mentioned scale showed stereotyping to a certain extent where males stereotyped mathematics as a male domain more than females. However, results from studies conducted in the USA revealed that high-school learners tended not to stereotype mathematics as a male domain (Kloosterman et al., 2008). Interestingly, Forgasz's (2001) report on 820 Australian Grades 7 to 10 learners, indicates that females were stronger in their beliefs than males that mathematics is a neutral domain and not male-orientated.

Kurtz-Costes et al. (2008) used a model to test 302 fourth-, sixth- and eighth-graders from a rural school district in the south eastern parts of the USA. These researchers focused on two goals, namely: (1) to test a model that linked children's perceptions of adult stereotypes, children's own stereotypes, and children's self-concepts and, (2) to determine if these associations differed by grade and gender (Kurtz-Costes et al. 2008). The study found that fourth-grade boys believed that adults held traditional stereotypes about mathematics and science (i.e. boys are better than girls) whereas the other groups (Grades 6 and 8) believed that adults held egalitarian views (Kurtz-Costes et al., 2008). The study revealed that boys throughout all the grades reported a more positive self-concept with respect to their mathematics abilities. Girls, on the other hand, displayed lower self-concept scores across all grades (Kurtz-Costes et al., 2008). Even though girls performed well in mathematics in their respective grades, the study reflected lower perceptions of self-competence of girls when compared to boys. The study also showed that adult stereotypes tended to enhance the self-concepts of boys (Kurtz-Costes et al. 2008).

Differences in attribution beliefs of males and females have also been cited as a factor influencing gender differences in mathematics. Research suggests that these beliefs are socially constructed. For example, Kurtz-Costes et al. (2008) found that, compared to males, females are less likely to attribute mathematical success to ability and failure than to lack of effort, and are more likely to attribute failure to lack of ability.

An important dimension that emerges in research is that teachers still possess old, gender-differentiated views of their students' academic abilities even at elementary school. Tiedemann (2000) conducted a study in Sweden in which mathematics teachers were asked to consider boys’ and girls’ achievement in about fifty elementary school classes. The findings revealed that teachers thought that average-achieving girls were less talented than equally achieving boys (Tiedemann, 2000). Teachers were of the opinion that girls benefited less than boys from additional effort (Tiedemann, 2000). Teachers rated mathematics as being more difficult for average-achieving girls than for equally achieving boys. With regard to girls, teachers attributed failure more to low ability and less to lack of effort than with boys (Tiedemannn, 2000).

An interesting issue of parents' beliefs regarding the issue of competence has also received attention in research. Gibbons (2000), in studies conducted in Sweden, showed that parents may convey information regarding their beliefs about their children's abilities through articulating their views on what they attribute success or failure to. The attributions of parents, related to mathematics, varied with the level of children’s mathematics performance and gender (Gibbons, 2000). Parents claimed that daughters displayed more effort while sons were more talented in mathematics. These beliefs were gender differentiated and subjective, according to Gibbons (2000).

The above studies reveal that stereotypes may exist among students, parents and teachers and learners themselves. Schmader and Johns (2003) claim that stereotypes can harm performance whether or not they are explicitly endorsed. Kurtz-Costes et al. (2008) claim that traditional stereotypes have an impact on children's beliefs about boys' and girls' performance in mathematics.

2.4 Shifting the Lens to the Mathematics Teacher

In this section, I shift the focus to the mathematics teacher in the classroom. Literature reviewed indicates that the mathematics teacher plays a pivotal role in the classroom by overtly or covertly influencing the attitudes of learners towards mathematics. Dent and Harden (2001) state that the teacher plays an important role in constructing a supportive and educationally effective environment in the classroom. Jacobs and Harvey (2010, p. 205) hold the view that "teacher perceptions, attitudes and expectations do contribute significantly to student academic achievement".

Studies have shown that a teacher of mathematics holds certain values and articulates these values through classroom enactments (for example, Becker, 1981; Eccles, 1987; Hannula, 2002). This body of research indicates that teachers hold both implicit and explicit values and beliefs that are evident in the messages they send to learners. These messages can lead to children either liking or disliking mathematics. Hannula (2002) asserts that teachers often send out problematic messages to learners which may convince learners that they are not good in mathematics, resulting in children opting out of mathematics. Jussim and Eccles (1992) in a study conducted in the USA found that teachers believed that girls were successful in mathematics due to hard work, while boys performance in mathematics was attributed to talent . Becker (1981) found that teachers behaved differently towards learners of different genders and responded preferentially to boys in the mathematics class. In an interesting study conducted in the USA, Li (1999) highlighted teacher gender as a factor that has an impact on learner beliefs and behaviour. Female teachers tended to promote gender equality (Li, 1999). Li (1999) found a significant difference between attitudes towards mathematics by the female students who were taught by female teachers. Girl students in these classes seemed to display a positive attitude and were willing to participate in mathematics-related activities.

Bansilal (2002) stresses a key facet of any educational process is well-trained teachers. She explained many high-school mathematics teachers in South Africa were unqualified or under-qualified. There were many teachers who had not received any formal teacher training qualification (Bansilal, 2002). There are strong assertions within the field of mathematics education that differences in learners' mathematics abilities and attitudes towards mathematics may be a reflection of teacher content knowledge, teaching methods and pedagogies (Ross, McDougall, Hogaboam-Gray & Lesage, 2003; Wilkins, 2008).

Brumbaugh, Ashe, Ashe & Rock (1997) argue that a successful teacher of mathematics must be effective and competent in mathematics. Further, they state that besides mathematics teachers being competent, they must also be confident about teaching the subject of mathematics. Effective teachers generally, in an on-going way, investigate new mathematical knowledge and relevant strategies of effective teaching. Thisin turn may influence learner motivation, self-efficacy and attitudes towards maths as a subject (Brumbaugh et al., 1997). The beliefs and values that teachers hold also influence key classroom practices (Furinghetti & Pehkonen, 2002; Ross et al., 2003). Teacher knowledge of the subject matter has a positive effect on the teacher's practice, according to Wilkins (2008). Stein, Remillard & Smith (2007) claim that many researchers believe that knowledge of the mathematics teacher is of paramount importance to his or her success in the classroom. Wong and Lai (2006) contend that there is no doubt that the mathematics knowledge of the teacher is a basic prerequisite for successful student achievement and positive attitudes towards the subject.

In support of the above views, research has shown that the way teachers teach can influence students' decisions to choose mathematics as a subject, as well as students' achievement in the subject. For example, Nardi and Steward (2003) accuse teachers of reducing mathematics to a list of rules, which results in learners being deprived of obtaining a deep and firm understanding of concepts. At the same time, learners are not intellectually stimulated (Nardi & Steward, 2003).

Willis (1998) highlights another dimension of teaching mathematics asserting that school mathematics is generally taught in a narrow context. Flores (2006) claims that many school learners seldom question the mathematics taught to them because they trust the mathematical knowledge and competence of their teachers. Thus, misconceptions and faulty understandings remain unchallenged (Flores, 2006). Flores (2006) further stresses that children should be encouraged to share their mathematical ideas with their peers and teachers, and that many a teacher of mathematics does not practise this. Brown and Walter (2005) described a classroom in which students were merely 'fed' information by the teacher with no space for critical engagement. These researchers found that this results in a poor understanding of concepts and limited independent thinking in mathematics (Brown & Walter, 2005). Ensign (2003) and Martin (2007) stress that mathematics instruction must be linked to children's prior knowledge and to the contexts from which they come. Matthews (2003) elaborates that the teacher should allow students to make meaning of their own individual ideas and conceptions by linking prior knowledge to new knowledge. This suggests that creating a classroom environment in which meaning-making is valued and encouraged can motivate learners in mathematics classrooms.

Willis (1998) argues that classroom pedagogy reinforces the contention that school mathematics is a significant factor that segregates the powerless from those who are in a position of power. This stratification is carried through the divisive nature of mathematics teaching. Willis (1998) suggests that when one is categorised as not being good in mathematics, the implication is that one lacks intellectual capability and will be unsuccessful. Haylock (2003) asserts that authoritarian teaching styles in mathematics classes can have a negative effect on learners and result in anxiety. In many classes, learners are afraid of being questioned by a teacher and to question someone in authority. Teachers hold power in the educational milieu through rewards and sanctions (Berends, Bodilly & Kirby, 2002). Teachers have the power to implement a particular curriculum delivery mode irrespective of whether it provides curriculum access to learners (Berends et al., 2002).

There are studies that indicate that the achievement gap is widening between students from different social groups, and that various systemic processes and practices in schools reinforce differences in achievement in mathematics (Geist, 2009; Manoah, Indoshi & Othuon, 2011; Popham, 2008). Bol and Berry (2005) argue that in many classrooms, teachers form different expectations of students related to race, gender and social class. These expectations are established in different ways. Bol and Berry (2005) argue that the impact of teacher expectations can be significant in the mathematics classroom and can accumulate from preschool to high school. Ferguson (1998), in research conducted in the USA, found that teachers' perceptions, expectations and behaviour are responsible for the achievement gap between Black and White learners. Lubienski (2001) claims that race, not socio-economic differences, is the factor associated with the gaps between Black and White students in schools. To add another dimension, Moore (2003) explains that many African-American students attend schools that are underperforming in the public education system. Furthermore, teachers and school counsellors in these institutions often discourage learners from choosing mathematics as a subject (Brown-Wightman, 2002). Moore (2006) emphasises that effective, positive and quality learning experiences may shift learners' choice towards subjects such as mathematics.

Oakes and Lipton (1996) highlighted how tracking in mathematics education, that is, monitoring learners at different levels through the mathematics curriculum, led to the separation of students for instruction based on perceived needs, potential, and academic performance. The goal of tracking is for students in low-track groups to catch up with their colleagues. However, often in these groups more time is spent on learning facts and skill building (Oakes & Lipton, 1996). Thompson and O'Quinn (2001) argue that the gap begins to widen because learners in the high-track groups progress with the curriculum and focus on problem-solving and deep level mathematical analyses.

Given the above empirical studies, teacher expectations and teaching practices can affect learners' decisions to choose or not choose mathematics as a subject. In the USA, African-American students tend to adopt a negative view of mathematics when they are not positively encouraged (Martin, 2006). However, positive encouragement and reinforcement of students' academic performance and potential by teachers can increase these students' educational aspirations (Martin, 2006). Ford and Moore (2004) urge that classroom practitioners in the USA should use and develop innovative and relevant pedagogical strategies to convince students, in particular, African-American students, to follow career aspirations related to mathematics.

Keck-Staley (2010) asserts that students can use mathematics to get a firm hold of the social and personal contexts of their lives. Learners can strengthen their concepts and proficiency in mathematics by studying their own social realities and linking these to mathematical principles (Keck-Staley, 2010). The argument is that classroom pedagogy often does not capitalise on students' social realities. Gutstein (2006) states that teachers can support this goal by engaging students in mathematical investigations and problem solving tasks that are related to their social and physical world to make mathematics more meaningful. Keck-Staley (2010) believes that the personal identities of students affect their development of a mathematics identity. The personal identity of a student interacts with what happens in the mathematics class. Cobb and Hodge (2002) explain that teacher interactions in the mathematics class tend to affect the ways in which students see themselves as learners of mathematics. Reed and Oppong (2005) argue that the issue of equity in the mathematics class needs to be constantly monitored to ensure that all learners can access the curriculum and develop positive attitudes towards the subject.

2.5 Conclusion

The literature reviewed in this chapter served to illuminate my study focus in various ways. I was able to examine factors associated with learners' experience of mathematics in various contexts. My study explored whether these factors and other influences affect learner choice of mathematics as a subject in Grade 10. The review of literature made me aware that I was researching a complex issue which was multi-dimensional in nature. I was, therefore, open to engaging with new insights and perspectives that may emerge in my study.

CHAPTER 3: RESEARCH METHODOLOGY AND DESIGN

3.1 Introduction

An important aspect of any research is the methodology, design, procedures of inquiry, and methods of data collection, analysis and interpretation, which are the focus of this chapter. Research designs are processes and procedures that give one insight into how the research questions are turned into a plan of action for the investigation (Stake, 1995). This study was largely qualitative in nature. Qualitative research uses what researchers term 'soft data', which may include impressions, words, sentences, photos and symbols (Cohen, Manion & Morrison, 2007; Cresswell, 1998). Neuman (2000) states that qualitative research involves documenting authentic occurrences and what people have to say about them; observing particular behaviours as well as analysing relevant documents and visual images.

Qualitative researchers examine cases that are a part of everyday life, and generally focus on the human factor in a particular setting (Cresswell, 1998; Bogdan & Biklen, 1992). The aim is to explore personal insight, feelings and human perspectives to make sense of social life. Neuman (2000) explains that in a qualitative study, the aim is to assess what people say, to search for evidence, to confirm interpretations, and to assess internal consistency in the data (Neuman, 2000).

Qualitative research adopts a language of interpretation (Cohen, et al., 2007). A qualitative researcher interprets data by giving them meaning, translating them or making them understandable (Cohen et al., 2007). It is important to note that meaning begins with the point of view of subjects being studied (Neuman, 2000). Data are interpreted by finding out how the subjects see the world (Cresswell, 1998; Bogdan & Biklen, 2003).

Atkinson, Coffey and Delamont (2001, p. 7) assert that qualitative research is an "umbrella term". Qualitative research consists of a number varying approaches within its wider framework. However, it is important to note that these approaches have a common aim, namely, to understand the social reality of individuals, groups and cultures (Denzin & Lincoln, 2000). Researchers also use qualitative research to investigate human behaviour, perspectives and experiences (Cohen at al., 2007).

One of the hallmarks of qualitative research is that it is carried out in a natural setting (Atkinson et al., 2001). In other words, the environment is not intentionally manipulated. Patton (2002) concurs with Atkinson et al. (2001) by asserting that qualitative research adopts a naturalistic approach, that is, it seeks to understand phenomena in context-specific settings, where the researcher does not alter the environment. Qualitative research is related to rich descriptions of human behaviour and opinion (Cohen at al., 2007). Bryman (2004) claims that qualitative research is a process whereby the researcher tries to understand the context in which actions and events happen.

This study is located in an interpretivist paradigm as its central aim is to understand the subjective world of human experience (Cohen et al., 2007). Cresswell (1998) defines a paradigm as a worldview; a framework of beliefs, values and methods within which research takes place. The interpretive approach focuses on action, and the assumption is that Human behaviour is intentional (Cohen et al., 2007). Research findings and knowledge are created through dialogue with research participants (Angen, 2000). The interpretivist paradigm posits that the researcher's values are inherent in all phases of the research process. For example, conflicting interpretations may be negotiated between the researcher and the relevant subjects (Angen, 2000). Rubin and Rubin (2005) argue that the interpretive approach allows for the acknowledgement of subjectivity in research.

Research located within the interpretivist paradigm aims to examine the way in which people experience the world, the ways they interact together, and the settings in which these interactions take place (McCotter, 2001). Interpretive researchers begin with the relevant subjects and then aim to understand the subjects' interpretations of the world around them (McCotter, 2001). Theory is built on experience and understanding. Data collected would reflect the meaning and purpose of individuals' behaviours and actions (Denzin & Lincoln, 2000). Interpretivists assume that knowledge and meaning are acts of interpretation. Thus, there is no objective knowledge which is independent of an individual's thinking (Cohen at al., 2007). Schwandt (1994) claims that proponents of the interpretivist viewpoint share the goal of understanding the complex world of lived experiences from the point of view of those who live it. This is because interpretivist research come with the assumption that knowledge is always local, situated in local culture (Denzin & Lincoln, 2000).

The underlying assumption of interpretivism is that the whole needs to be examined in order to understand phenomena (McCotter, 2001). Interpretivism seeks to collect and analyse data from parts of phenomena, emphasising significant aspects of comprehensive understanding of the whole (McCotter, 2001). Myers (2000) claims that an interpretivist researcher would believe that there are multiple realities, and that realities can be constructed in diverse ways across time and place.

Taylor (2008) claims that the interpretive paradigm allows the researcher to understand and make sense of others' socially constructed perspectives. This kind of research enables an understanding of the meanings of human action (Bryman, 2008). However, Ruben and Ruben (2005) explain that interpretivist research is not only about subjectivity and complexity. It aims to explore the rich, nuanced subjective experiences of participants (Ruben & Ruben, 2005).

3.2 The Theoretical Framing

I selected socio-constructionist theory as a framework for the study. Socio-constructionism is a sociological concept that relates to ways in which social events happen and exist (Sahlin, 2006). The basic contention of socio-constructionism is that reality is socially constructed, that is, what we perceive as reality has been shaped through a system of social, cultural and interpersonal processes (Parker, 1998). In other words, knowledge is constructed through social interpretation. Hoffman (1990) explains that from this theoretical position, the development of knowledge is a social phenomenon, a fluid process that evolves within dialogue. For example, Willis (1998) claimed that even the school mathematics curriculum mirrors the constructs, values, priorities and lifestyles of a dominant culture. Children from non-dominant groups are often coerced into learning mathematics in ways that may not be consistent with their socially constructed realities, interests, social and cultural backgrounds (Willis, 1998). A school mathematics curriculum that operates in the best interest of the dominant social group may disadvantage the non-dominant social group. Therefore, when given the choice of mathematics, many learners from the non-dominant social group may choose to opt out of mathematics (Willis, 1998).

The aim of research that draws on socio-constructionism is to account for the multiple and complex ways in which phenomena are socially constructed. The focus of socio-constructionism is on exploring the meanings that are created through individuals' interactions with one another (Hoffman, 1990). Berger and Luckmann (1966) assert that all knowledge is derived from and maintained by social interactions (Hoffman, 1990).

Social constructionists challenge the idea of one truth and question the validity of objective research (Hoffman, 1990). Hoffman (1990, p. 9) explains that socio-constructionists argue that "we cannot ever really know what 'social reality' is". A key goal of social-constructionism is the eradication of objectivity (Berger & Luckmann, 1966). Since reality is constructed through social discourse, it cannot be known through objective ways. (Hoffman, 1990).

Hoffman (1990) explains that social-constructionism is a sociological theory of knowledge that examines how social phenomena or objects of consciousness evolve in social contexts. Berger and Luckmann (1966, p.159) explain the basic assumptions underlying the theory:

> *Every individual is born into an objective social structure within which he encounters the significant others who are in charge of his socialization. These significant others are imposed on him. Their definitions of his situation are posited for him as objective reality. He is thus born into not only objective reality but also an objective social world. The significant others who mediate this world to him modify it in the course of mediating it. They select aspects of it in accordance with their own location in the social structure and by virtue of their individual, biographically rooted idiosyncrasies. This suggests that our social experiences and interactions shape what we take to be reality and what we regard as truth.*

Social-constructionism promotes the thinking that language is central to our experiences of social reality, and that these experiences are inter-personal (Held, 1995). In other words, linguistic and social processes impact the meanings we construct through social interaction. Held (1997) also states that our inter-personal linguistic interactions construct our understandings of our social environment and how we respond to our environment. Social-constructionism argues that in order to understand a social environment, we must study the interpersonal and linguistic interactions of people located within that environment (Berger and Luckmann, 1966). Held (1997) suggests that a key argument of social-constructionism is that language is a shared system, and it operates as a coercive force in social interactions. However, Berger and Luckmann (1966) explain that language and discourse do not merely mirror social reality in a neutral manner. Rather, language has the power to structure social reality, and it influences how one makes sense of the world. In other words, the way in which individuals talk about their experiences determines their experiences (Berger and Luckmann, 1966). If one considers mathematics teaching and learning, Willis (1998) claims that the mathematics curriculum and its underlying discourse influences what and how mathematics is to be taught, perceived, experienced and learned. In many contexts internationally research has shown that the mathematics curriculum and the way it is mediated produces and reproduces social inequality by entrenching the values of the dominant culture (Willis, 1998).

Another important issue is that socially constructed meanings are contingent upon aspects of our social lives. Hacking (1999) elaborates on this in his analysis that society's pillars such as the family, the self, race, class and gender are social constructions. One can argue that many aspects of the mathematics curriculum are socially constructed. Sukthankar (1998), in her research in Papua New Guinea, found that that participation among females in mathematics is deeply influenced by cultural values and sex stereotyping. The study found that teachers influence female learners' attitudes towards mathematic and these attitudes are strongly based on social and cultural values (Sukthankar, 1998). This suggests that our knowledge of self and others is also socially constructed. For example, the way in which a mathematics student perceives himself or herself as a learner is socially constructed.

Hoffman (1990) explains that as we experience the world, we construct our ideas and perspectives about issues in conversation with others. Gergen (1985, p. 4) states that the ways in which the world is known "are products derived from historically situated interchanges among people". Thus, the emphasis is on the historical, contextual and cultural specificity of knowledge. Further, how an individual's knowledge is constructed may lead to different kinds of action from the individual. In other words, knowledge and social action go together (Hoffman, 1990). Thus, a learner's action to choose or not choose mathematics as a subject to study should be viewed as socially constructed and socially mediated. This is the issue I intended examining in my study.

Using a socio-constructionist lens, I explored the question of what kinds of socially constructed knowledge influenced learner choice of mathematics in Grade 10. The questions I was interested in were: What dominant meanings influenced learners' experiences of mathematics teaching and learning as a phenomenon? What contextual, historical and cultural influences shaped these meanings? What are the power relations in the mathematics classroom? Learners construct these meanings through their environment, and the knowledge that circulates about mathematics learning is perpetuated and sustained by the culture of the school as an institution. This suggests that understandings and interpretations of phenomena may be viewed as a political process.

3.3 The Design of the Study.

3.3.1 The research site

The research site was an urban secondary school located in KwaZulu-Natal. I was a teacher at the school. At the time of the study, the school had a learner population of 950. Learners were from three historically constituted racial groups in South Africa: African, Indian and Coloured. The learner population consisted of 489 girls and 461 boys. The school was established in 1985 and is situated in a densely populated area. The socio-economic backgrounds of the learners were diverse, ranging from middle-class to working-class. Many of the parents, guardians and caregivers work in factories located in the nearby industrial area. However, there are parents, guardians and caregivers who are unemployed.

The school had a teaching staff of 34, and the principal, two deputy principals and five Heads of Departments (HOD). The responsibility of the HODs was to manage their respective departments. The mathematics, sciences (physical, life, natural) and computer sciences departments were managed by one HOD. This department comprised one physical science educator, two life sciences educators, one computer science educator and four mathematics educators (including the HOD). Teachers were classroom-based. The mathematics teaching load was split among the four mathematics educators, all of whom taught mathematics in Grade 9. The physical science educator also taught two classes of mathematics. Learners generally had the same mathematics educator from Grades 10 to 12.

3.3.2 The participants

Cohen et al. (2007) explain that four key factors must be considered in sampling namely: the sample size; the representativeness and parameters of the sample; access to the sample and the sampling strategy to be used. I shall explain the process that I followed, below.

Forty learners participated in the study. They constituted two groups: 20 learners who chose mathematics at the Grade 10 level, and 20 who did not. Learners' ages ranged from 15 to 19. Participation was voluntary. The groups comprised ten male and ten female learners of different races: African, Coloured and Indian.

Before I initiated this study, I met with the Grade 10 learners at the school. During this meeting, I explained to learners the aim and nature of my study. Learners were requested to volunteer to participate in this study. Sixty-seven learners (48 girls and 19 boys) from the mathematics group volunteered to participate in this study. Thirty-three learners (19 girls and 14 boys) from the non-mathematics group volunteered to be part of the research. Thereafter, I randomly (stratified by gender) chose participants within each of the groups. This formed the final composition of the two groups with 20 learners (10 girls and 10 boys) in each of them.

3.3.3 Data generation

Data collection took place over a period of six months. In the first phase of the study, I obtained quantitative data that reflected trends in student choices of mathematics at the school over a period of time. The data were accessed from school records and are depicted in Chapter 1. These data provided the context of my study.

In the second phase of the study, qualitative data were obtained from the 40 participants. I conceptualised this phase of my study as a *narrative inquiry* since its focus was on learners' stories of their experience of mathematics learning and teaching. Heikkinen (2002) states that the Latin noun *narrais* translates to a *narrative* or a *story*; the word 'narrative' means 'to tell' or 'to narrate'. A narrative relates to a story that depicts a sequence of events that are of significance to the narrator or the relevant audience (Richmond, 2002). The narrative must capture both the individual and the context. Czarniawska (2004, p. 17) claims that "Narrative is understood as a spoken or written text giving an account of an event/action or series of events/actions, chronologically connected".

Moen (2006) identifies three basic assumptions that underlie a narrative research approach: firstly, humans view storytelling to be a natural way of recounting experiences. Storytelling helps the teller to create some kind of order out of experience. Secondly, stories told are related to the individual's experiences and values, and the place and time at which the story is being told. Thirdly, many voices can be heard in a story.

Polkinghorne (1988) claims that the narrative is important as it constructs human existence as meaningful. The key focus of narrative research is on how humans use stories to give meaning to their experiences. The narrative researcher has a variety of data collection methods to choose from, which include: filed notes, journal records, interview transcripts, observations, storytelling, letter writing, autobiographical writing, documents, newsletters and pictures (Connelly & Clandinin, 1990). In my study, I believed that learners' written narratives would give me insight into the meanings of their experiences of mathematics learning in their educational lives, both formal and informal. Many participants in the study began their narrative from infancy (years of informal education) through to primary school education, progressing into high school.

Bruner (1984) claims that stories are not abstract representations distinct from culture in which they are embedded. Narratives are rooted in society. Bruner (1984) explains that these narratives are performed and experienced by individuals in the context of culture. Narratives are personal stories shaped by the knowledge, experiences, values and feelings of the person who is relating the story. Elbaz-Luwisch (2002) explains that in many ways stories are collective, influenced by the storyteller and the historical, institutional and cultural settings in which they take place.

An invitation to attend a meeting was extended to all Grade 10 learners. Learners were informed from the outset that attendance was voluntary. This meeting took place during the lunch break at the school. The meeting was held in the multipurpose room which could accommodate all the learners. The majority of the learners attended. In my address to the learners, I informed them of my intended research, which was to examine the factors associated with learner choice of mathematics at Grade 10 level. Interested learners were requested to meet with me the following the day. These learners were then separated into those who chose mathematics (67) and those who did not choose mathematics (33) at Grade 10 level. The composition of learners in the two groups that emerged is mentioned above.

I explained to learners that they were going to write a story about their experiences in mathematics. Many of the learners seemed to be confused. This was understandable, as these learners were doing this for the first time. Some students displayed emotions of anguish and tension. Their feelings of tension and anxiety seemed to have been allayed once I explained to them what was required. Learners were handed their respective instructions (see Appendices 3 and 4). I explained to them that they needed to describe their feelings and experiences in mathematics and eventually qualify their choice or not of mathematics. Learners were assured that they could consult with me at any time regarding their stories.

Heikkinen (2002) claims that time and space are vital in developing a conducive environment in which the researcher could interact with the research subjects. Both parties must be comfortable. A non-judgmental attitude must prevail (Fetterman, 1998). Further, Hitchcock and Hughes (1989) assert that a vital question concerns how trust can be developed and maintained during the research process. In my study, participants were given the opportunity to write their narratives at a venue of their choice (either at home or school). Most participants chose to write in the comfort of their homes. The timeframe for handing in their stories was negotiated with the learners. Learners agreed that a week was ample time to complete their narratives. There was no pressure on participants with respect to deadlines. In other words, I accepted submissions handed in after a week. As usual with children, a few handed in their narratives days later. Learners were told that there was no right answer, and that the work was not for assessment purposes. However, I did indicate to the respondents that the experiences and feelings expressed must be their own. I pleaded with participants to be original and to write their own narratives. Judging from their responses – the styles of writing, presentation and format – the narratives seemed to be the original submissions of the learners. I admit that I could not authenticate the written responses of the participants.

3.3.4 Data Analysis

The narratives of the participants were about the relating of experiences or events. They had a temporal and spatial orientation. Data analysis began with close readings of the written stories told by participants. My aim was to understand a particular human experience through the form and content of stories, as suggested by Taylor-Powell and Renner (2003). I was guided in this process by my key research questions.

In phase 1 of the data analysis, I examined what was conveyed in the written stories and searched for categories of meaning, for example: family support; maths was fun; I hated maths. These categories were systematically coded as shown in Table 2 in the next chapter.

In phase 2, I asked the question: what were the key ideas or issues mentioned within a category and between categories? Finally, I searched for themes and patterns both within and between categories (Bazeley, 2009). I did not use pre-conceived themes or categories. As I read through the text I found recurring themes and categories that emerged from the data.

3.3.5 Ethical Issues

Any empirical study should be underpinned by the following ethical principles: fairness, justice, honesty, confidentiality and privacy (Cohen et al., 2007). These principles are vital for the recognition, authenticity and legitimacy of the research. Hitchcock and Hughes (1989) claim that researchers do have to engage with the following ethical questions: How far can research go when investigating the subjects? What rights do participants have and how can these be protected? How can trust be established? How can confidentiality and anonymity be assured? I worked to negotiate these issues during my study.

Neuman (1997) stressed that one of the fundamental principles of social research is that participation should be voluntary. A researcher should not try to coerce individuals into participating. In my study, learners were told that participation was voluntary. Informed consent was obtained from the learners (refer to Appendix 1). The consent letter explained the purpose of the study and the importance of their participation. Participants were given the assurance of confidentiality and anonymity. The learners were constantly made aware that this study was not part of the curriculum of the school, and that it was in no way going to be used for assessment purposes. Many learners who participated in this research were English-second-language learners. Therefore, learners were assured that they could write their stories in a language of their preference. However, all learners responded in English. Learners were further assured that the research did not require grammatically correct written language and spelling. The aim was to share their experiences and ideas in a way that I could understand them.

I then followed the channels of protocol by requesting permission from the principal and school governing body to conduct this study. The respective authorities were informed of the nature of my research and its aim (refer to Appendix 1). Learners who indicated their willingness to be part of my research were given consent letters for their parents, guardians or caregivers to complete (refer to Appendix 2).

Ethical clearance was obtained from the Research Office, University of KwaZulu-Natal. The ethical clearance number is HSS/0148/011M.

3.3.6 Validity and Reliability

During my study, I was cognisant of the importance of reliability (the extent to which the findings are replicable by other researchers) and validity (the credibility of the results). Cohen et al. (2007) claim that validity is one of the basic tenets of research, in the case of both quantitative and qualitative research. They explain that issues of depth, honesty and richness must underpin the validity of qualitative data.

Researchers can use a variety of procedures to verify the quality of qualitative research. For example, the participants, researcher-participant relationship and the environment of the study must be described in detail. Being a teacher at the school, my engagement with the participants began three years prior to this study. During this period, I developed a relationship of trust with my learners. I was involved in various activities organised by the school and myself to engage with parents and community organisations in the school community over the years. This strengthened my relationship with learners at the school. During this period, I allowed myself to understand and learn more about the different cultures and backgrounds of the learners.

Denzin (1989) draws attention to the issue of implementing 'thick' description in a qualitative study. In my study, a narrative approach, that is, the written stories of the learners enabled such thick description. Most learners were eager to write and share their experiences of mathematics learning and teaching. The narrative approach incorporated the context of mathematics learning and inter-connected social relationships.

3.3.7 Conclusion

This chapter captures the research design and methodology of the study. My study was largely a qualitative one despite the fact that I undertook a quantitative analysis of trends in student choice of mathematics, presented in Chapter 1. This analysis merely provided the background to my study. Therefore, I would not categorise my study as a mixed-methods design since the greater part of the study was qualitative in nature, and involved learner written narratives.

The next chapter presents the findings of the study.

CHAPTER 4: DISCUSSION OF FINDINGS

4.1 Introduction

In this chapter, I present and discuss the findings of the study. In this study, using the theoretical framing of social-constructionism, I explored the research questions: How did learners experience mathematics over nine years in the GET phase? What factors are associated with learners choosing or not choosing to study mathematics from Grade 10 level and, to what extent is gender a mediating factor in this choice?

I drew on learners' written narratives of their experience of mathematics. As discussed in Chapter 3, the participants were categorised into two groups. Participants were numbered from 1 to 40; 1 to 20 were from the group that chose mathematics, and 21 to 40 from the group that did not choose mathematics. The group that chose mathematics is categorized as C1, and the group that did not choose mathematics is categorized as C2.

This chapter is structured in three broad sub-sections. In the first sub-section (4.1), I examine in more a descriptive way the *categories of responses* within the written responses of learners that I was able to identify in relation to the two research questions. The data in captured in Table 2.

The second sub-section (4.2) examines in a more qualitative manner learners' storied *experiences of mathematics* in the GET phase. This section explores the first research question stated above.

The third sub-section (4.3) deals with an issue: *Choosing mathematics in grade 10 – a socially constructed decision?* This section examines more closely key factors associated with learner choice of mathematics in grade 10, drawing on the written stories of learners. The key themes or issues discussed are: pressures on student decision making; gender, race, class and mathematics choice; the teacher and teaching methodologies; the question of a love of mathematics

4.2 Examining Categories of Responses in Learner Narratives

Table 2 depicts the key categories that emerged in the data. It gives a picture of the learner experiences of mathematics in their first nine years of schooling. I will begin by examining feelings and attitudes towards mathematics as a subject. In group 2 (learners who did not choose maths), a number of learners indicated in their stories that they struggled with mathematics (12 out of 20). Fourteen (14) stated they disliked mathematics. Only (5) stated that maths was fun. Seven (7) learners felt that they were good at the subject. In group 1, none of the learners stated that they disliked maths, and 14 experienced maths as fun. It is interesting that 6 of the learners who chose maths stated that they struggled with the subject. Only 7 stated that they liked maths which does seem a contradiction in the data. It is likely that they did not explicitly state it in their stories, and that their love of maths is implicitly present. There was no evidence from their written narratives that they disliked maths. Overall, the data suggests that the group that chose maths had more positive experiences with learning mathematics as a subject in their first nine years of schooling when compared with learners in group two.

Seven learners (Group 1 = 3; Group 2 = 4) experienced math anxiety, and eight (8) learners wrote about fears they had of failure. There were students from both groups who expressed their stress (8) and anger (6) at failure in mathematics. The 'teacher factor' (positive and negative) did surface as an issue in learner narratives. It was surprising to note that 10 learners from the mathematics group expressed a negative teacher factor. However, these learners still went on to choose mathematics at Grade 10 level. In the non-mathematics group, 8 learners expressed a negative teacher factor. This analysis seems to suggest some level of contradiction. However, 12 learners in Group one experienced the teacher factor as positive, compared with only 3 in Group 2.

The above findings point to the importance of developing in learners a love of mathematics as a subject. Nicolaidou & Philippou (2001) suggest that learners who develop a love and enjoyment of mathematics, increase their intrinsic motivation to learn, and vice-versa. They urge that teachers should pay ongoing attention to creating positive learning experiences and to reinforcing positive attitudes towards any subject of the curriculum.

It was interesting to note that few learners reported experiencing racism and gender bias in their stories across the two groups. Yet numerous studies in the literature reviewed have documented the gendered experiences of learners in mathematics classrooms internationally (for example, Leedy et al., 2003; Nosek, Banaji & Greenwald, 2002). Race did not emerge as in issue in this desegregated school. Studies internationally have revealed often that teachers' perceptions, expectations and behaviour are responsible for the achievement gap between learners from different race groups or learners from minority groups (Bol & Berry, 2005; Ferguson, 1998). The study suggests that race and gender in the mathematics class are areas for further research, utilizing different research methodologies...

Learners from both groups alluded to the influence of early socialisation on their interest in mathematics. Twelve (12) of the 20 learners in the group that chose mathematics indicated the impact of early socialisation on their love for mathematics. This impact could have been sustained in the nine years of their schooling career and may be associated with their decision to choose mathematics at Grade 10 level.

An interesting finding in the study is that the language of teaching and learning did not emerge as an issue in this study. Only one learner mentioned language as being a barrier to learning, which research indicates is the experience of many learners in schools in South Africa (Chisholm, 2004; Reddy, 2006; Sepeng, 2010; Setati, 2005). It is likely that the Black African learners (30), for whom English is a second language, have had their entire schooling in this desegregated, former Indian school settings, and have acquired good English language proficiency (the school in this study is a desegregated, former Indian school). However, many students stated that mathematics was difficult because they did not understand it or that it did not have meaning for them. This does not seem to be associated with the language issue and may be the result of the nature of teaching and mediation of topics to learners.

Research question	Categories of responses	Number of learners Expressed category (n= 40)			
		Group 1 (n= 20) Learners who chose mathematics		Group 2 (n= 20) Learners who did not choose mathematics	
		Male (n=10)	Female (n=10)	Male (n=10)	Female (n=10)
How did learners experience mathematics over nine years in the General Education and Training Phase (GET) phase?	maths fun	6	8	3	2
	I was good at maths	6	7	4	3
	I struggled with maths	3	3	5	7
	liked maths	4	3	0	0
	disliked maths	0	0	6	8
	support from family	4	4	3	3
	anxiety	2	1	1	3
	fear of failure	1	1	2	4
	stress in math class	1	2	1	4
	anger at failure	0	3	2	1
	teacher factor – negative	5	5	4	4
	teacher factor – positive	6	6	1	2
	curriculum change	3	4	0	2
	language of instruction	0	1	0	0
	Racism	1	0	1	1
	gender bias	0	1	1	1
	family pressure	1	1	2	5
	language of instruction	0	1	0	0
	early socialisation about maths	7	5	3	3
What factors are associated with learners choosing/not choosing to study mathematics from Grade 10 level, and to what extent is gender a mediating factor?	future career plans	7	9	3	5
	parent pressure	4	6	4	5
	course selection limits	4	4	6	6
	peer influence	3	1	2	2
	poor teaching	1	3	3	1
	teacher attitudes to learners	8	4	5	4
	Gender	3	1	0	0
	Racism	2	1	1	1
	gender stereotypes	3	1	2	1

Table 2: Categories in the data and number of learners who expressed them

4.3 Experiencing Mathematics in the GET Phase

The first research question examined how learners experienced mathematics teaching and learning in their first 9 years of schooling. I sought to examine whether these issues were in any way *associated* with learner decision to choose or not choose maths at grade 10 level. However, it must be stressed that this qualitative study could not make any causal links from the data.

The data analysis involved a search for key issues within a category, between and across categories. From this process, four key themes related to how learners experienced mathematics emerged:

- classroom ethos and culture; exclusionary vs exclusionary;
- mathematics and student emotionality;
- early experiences of mathematics as a subject;
- the teacher factor in mathematics learning.

These are discussed in the sections below.

4.3.1 Classroom ethos and culture: inclusionary vs exclusionary

The data in this study revealed that in general learners experienced the mathematics class as having an inclusive culture and ethos. The majority of learners' stories indicated that they were treated on equal terms irrespective of competence in mathematics, gender, race and language differences. Yet, there were stories of learners experiencing difficulty with mathematics learning and teaching, math anxiety and stress, fear of failure, negative experiences with teachers of mathematics and the challenges of curriculum change. It is likely that these experiences stem from the nature of curriculum delivery. Twenty one (21) students mentioned the importance of teacher attitudes towards learners in their written stories, suggesting that they valued supportive and caring teachers who motivated and affirmed them.

Many researchers have claimed that race and gender play a vital role in learners' experiences in mathematics (Sukthankar, 1998; Erickan et al., 2005; Martin, 2006). Erickan et al. (2005) concluded that there were large differences in mathematics participation of males and females. This is affirmed by research conducted by Sukthankar (1998), who concluded that female participation in mathematics is influenced by stereotyping. Fennema

(2000a) asserted that in many studies, females are portrayed as being inadequate in mathematics. There have been international studies that have found that, for many learners, the experiences of school mathematics are racialised (for example, Nasir & Shah, 2011). Martin (2006) found that African-American parents formed personal theories about how the socially constructed meaning for race comes to be a deciding factor in which students get to do mathematics or not. The parents viewed mathematics learning and the struggle for mathematics literacy as racialised forms of experience for themselves and their children (Martin, 2006).

In my analysis, I found no significant evidence of gender and race as a mediating factor in how learners experienced mathematics, and in particular their achievement in mathematics. Some learners in fact stated that every scholar could perform well in mathematics irrespective of race and gender.

On closer examination of the data some gender issues did emerge but they were not significant in the larger part of the data set. For example, a few learners expressed an interest in mathematics because of the teacher's gender. There were a few female learners who indicated that they had more positive experiences with female mathematics teachers. A few learners claimed they had more respect for male mathematics teachers. This respect for male teachers seemed to be influenced by a notion that the male teacher teaches better than female teachers. Below are responses that illustrate these responses of learners:

> *Anyone can do maths, you don't have to be African or Indian, anyone can do it. It depends on your brain and if you are willing to work as hard as needed.* (P5; C1)

> *I used to be very interested because the teacher was a female and from my same race group.* (P13; C1)

> *But to every teacher which taught me maths I enjoyed it, there was no racism, or description of choosing the brighter ones and treating others differently.* (P14; C1)

> *My maths teacher was not a racist. She treated us equal and was very kind so that is why I loved maths. (P38; C2)*

However, as stated it is interesting that race and gender did not emerge as a significant mediating issue in learner's experience of mathematics learning and teaching in this desegregated school. .

4.3.2 Mathematics and student emotionality

The issue of student emotionality and mathematics learning and teaching emerged as one of the key issues in my study. In the last two decades, there has emerged a body of research on emotions and emotional spaces in the everyday lives of teachers (Brunker, 2007; Hargreaves, 2001; Zembylas, 2003; 2006). Much of this research undertaken in schooling contexts has focused on teacher emotionality (Hargreaves, 1998; 2001; Zembylas, 2003). The argument is that teaching and learning not only involve knowledge, cognition, and skill but emotions as well (Brunker, 2007; Zembylas, 2003; 2006). Hargreaves (1998) contended that teaching and learning are emotional practices and that teacher emotionality can be experienced in personal, psychological and individual terms (Hargreaves, 2001). Zembylas (2003) argued that emotional rules form an integral part of teaching practice, and that teachers learn to engage with emotions of anger, anxiety and vulnerability, and empathy. Hargreaves (2001) further introduced the concept of 'emotional geographies' in educational research. According to Hargreaves (2001, p. 1061), emotional geographies consist of "the spatial and experiential patterns of closeness and/or distance in human interactions and relationships that help create, configure and colour the feelings and emotions we experience about ourselves, our world and each other."

Emotional geographies are linked to the culture and context of individuals, that is, they are embedded in situated spaces and the interactions in these spaces (Zembylas, 2006). Hargreaves (2001) suggested that the emotional experiences of individuals influence their identities as well as their relationships with others. Zembylas (2006, p.251) explains that emotions are "an individual's positive or negative type of experience and are constructed through the interplay of both psychological-physiological conditions and social-cultural patterns". Zembylas (2006) further states that emotions arise in the context of social relations and in various social spaces. In the context of my study, there are complex places and spaces in mathematics teaching and learning that give rise to various emotions.

In the analysis of the data in my study, I found that the body of research on emotionality and teacher emotionality helped me to make sense of the emotionalities of learners in the mathematics class. Learners' responses gave me insight into the complex emotions that they experienced at various stages and spaces in their learning of mathematics.

> *In Grade 1 we learned maths. It was a bit confusing but I got [the] hang of it. I loved learning about different shapes and their properties.* (P19; C1)
>
> *In junior primary I was really good at the subject. My teachers loved me.*
>
> *My experience with mathematics was like a journey every year as it became more challenging with different and exciting things at every corner making the subject more interesting.* (P6; C1)
>
> *I started to enjoy maths. I understood my teacher and I enjoyed in his class because I wasn't terrified of him, I knew that I could speak to him and he would help me if I had a problem.* (P2; C1)
>
> *I was depressed and suddenly lost interest in maths. But my blame is on the teacher because I never understood her.* (P35; C2)
>
> *I really felt it hard to study a subject as maths. For me I really found it confusing, misunderstanding and very stressful.* (P24;C2)
>
> *I hate maths and I will never ever think about doing maths ever again it was my worst subject. I never understood maths. When I think of maths nothing comes to mind. Maths sucks.* (P23; C2)
>
> *I started to hate maths in my first year at school that time I didn't enjoy it and I also started failing it because I didn't understand and the teacher who was teaching boring.* (P22; C2)

The above responses of learners reveals that students' emotionality vary from one of enjoyment and love of the subject to aversion, anxiety, feeling stressed and hatred. The group that chose mathematics (students P1; C1 to P20; C1) generally experienced positive emotions and were affirmed by their mathematics teachers. Analysis of their narratives showed that positive emotions were related to factors such as caring and patient teachers; a warm, encouraging and inclusive learning environment; positive interactions in the classroom; support for learning, and their early experiences with mathematics. A key finding was that positive emotions were linked to understanding and being make to make sense of mathematics.

Many participants in the group that did not choose mathematics voiced emotions of fear of failure, hatred for the subject, and experiencing depression and anger. Teachers were constructed as ‘strict’. In some cases, corporal punishment was inflicted. Some students recounted that failure experiences in the early years led to their negative attitudes towards mathematics.

This study shows that the emotional geographies of learners in mathematics classes cannot be ignored. There are clearly places and spaces in mathematics learning that can provoke powerful emotional reactions in learners.

Teachers need to recognise the emotions that arise during mathematics learning and teaching. . Understanding the emotions of learners and developing empathy is a fundamental interpersonal skill that all teachers need to develop. Teachers need to have skills to help learners deal with and manage their emotions. Steiner and Perry (1997) use the term ‘emotional literacy’ for such a process. These researchers suggest that emotional literacy has three dimensions: the ability to understand one’s own emotions; the ability to listen to others and empathise with their emotions and the ability to express emotions in a productive manner (Steiner & Perry, 1997). Teachers also need to understand that often learners’ negative emotions are associated with a lack of understanding of mathematics. Helping learners to experience mathematics topics, problem solving and processes as a meaningful, has to be a priority.

4.3.3 Early experiences of mathematics as a subject

The influence of the family on a child’s development is well studied, and is of particular significance in early mathematics learning (Kurtz-Costes, Rowley, Harris-Britt & Woods (2008). Parental influence shapes the early development of children in mathematics. Khoon and Ainley (2005) claim that initial educational and socialisation experiences are important to children’s learning and their participation in education in later years. Vygotsky (1935; 1978) cited in Tudge and Doucet (2004) drew attention to the fact that before attending a formal institution, children develop a concept of preschool arithmetic. This so-called preschool arithmetic is developed during interaction with others, and exposes children to the basic operations of mathematics. The narratives of the learners showed that they fore-grounded parental or family influence on mathematics learning in their early years prior to formal schooling. They believed that their early socialisation experiences impacted their attitudes towards mathematics in the formal school years. Haith and Benson (1998) revealed that mathematical knowledge and attitudes are initiated during infancy and developed over the first five years of the individual's life - a finding supported by Ginsburg, Klein and Starkey (1998). Many participants in my study indicated that family members exposed them to mathematics during their infant years. This exposure occurred through informal game-playing and the use of various stimuli such as objects for counting, puzzles and colouring activities. Many of these learners had positive experiences of early mathematics.

Most learners stated that difficulties in mathematics learning began to appear at high-school level. The narratives of many learners indicated that mathematics was fun and exciting in the early years as they enjoyed experimenting with numbers. However, at high-school level, mathematics was experienced as being boring, difficult to understand, meaningless, anxiety-provoking and stressful. Many learners in the group that chose mathematics indicated that a love of mathematics was instilled in them in their early years, both in the home and at preschool level. The responses below provide some insight into how learners experienced early mathematics:

> *Mathematics has been my favourite subject since preschool. Starting off by using wooden blocks to learn how to count was fun.* (P1; C1)

> *I enjoyed maths because singing songs to learn numbers and experimenting with different objects to add, subtract etc. was a lot of fun.* (P2; C1)

> *As a toddler when growing up, my mum always bought me educational toys, that had beads etc. that I should learn to count on, so when I got to preschool, I already knew how to count.* (P3; C1)

> *Since my preschool years I enjoyed doing maths. We brought different objects into class e. g. bottle caps so that we could understand the sums.* (P14; C1)

The study suggests that in the early years of a child's development, adults need to build positive experiences and attitudes and most of all, the subject should be meaningful to children. In many contexts, it has been documented that children associate mathematics with boring work that often does not relate to their everyday lives (Geist, 2009; Lewis, 2005). Popham (2008) explains that children often have a positive mathematical experience in their early years, but in later years the approach to learning and teaching mathematics is often very different to what they experienced before. Many students in this study indicated that mathematics was boring, and that was one of the reasons they opted out of it at Grade 10.

4.3.4 The teacher factor in mathematics learning

The mathematics teacher plays a very important role in the classroom. The mathematics teacher can overtly or covertly affect children's beliefs about and attitude towards mathematics (Furinghetti & Pehkonen, 2002; Yara, 2009).

Stuart (2000) claims that teachers are often responsible for positive or negative attitudes towards learning in children. In my analysis, I found that learner attitudes towards mathematics, whether positive or negative, were associated with the kind of mathematics teacher and the teaching style they had experienced. There were learners who mentioned how teachers motivated them, encouraged and gave them support. However, there were also learners who expressed dissatisfaction with mathematics teachers who were critical of learners' poor performance, were discouraging and non-supportive. Lack of commitment by teachers, lack of interpersonal skills, and poor subject knowledge and pedagogical skills were factors that emerged from the narratives of learners. However, a key issue that emerged was that learners could not see mathematics as meaningful. There was little focus on meaning making and meaning construction. The excerpts below provide some insight into these issues:

> *I did not* ***know*** *maths, it's just the teacher that did not know maths and how to teach. If maths was explained properly to me, maybe I would enjoy it.* (P32; C2)

> *The teacher played an important role in this subject as some my mathematics teachers tried to make every lesson as exciting as possible. But there was always an exception as [each] teacher is different. This particular teacher would make mathematics a nightmare. She would just teach you mathematics and that was it. She would never smile, laugh with the class therefore becoming a boring teacher*

which every pupil hates, and due to hating the teacher most of the students hated mathematics including me. (P6; C1)

This study affirms that the way teachers represent mathematics, structure the culture and ethos of the classroom, and the kind of support they provide may be associated with learner attitudes towards mathematics and their decisions to take on mathematics as a subject, as indicated by other empirical studies (Manoah et al., 2011; Yara, 2009).

Internationally, numerous studies have analysed how the gender of the teacher can influence learner achievement in mathematics and student attitudes towards the subject. Li (1999) concluded that the gender of teachers influenced their beliefs and behaviour. This in turn has a major influence on learners' attitudes and experiences. In Mwamwenda and Mwamwenda's study (1989), students of female teachers scored higher in mathematics than students taught by male teachers. The study found that girls who are taught by female teachers display a positive attitude towards mathematics. An analysis of learner narratives in this study revealed contradictory findings regarding the issue of the gender of the teacher. There were learners who preferred to be taught by male teachers, and believed that they did well in mathematics because they had a male teacher. Some participants claimed that male teachers have better mathematics content knowledge and they were assertive with their students. However, there were other learners who felt female teachers were supportive, caring, affirming and focused on helping students to grasp the content by carefully mediating it to them.

I started enjoying it [mathematic] more and more and I could say that it is the female teacher that taught me, because she was always encouraging and very understanding. She took each step of each section we did in a very patient way and she was also often very clear and loud. She had time for us to come at break times and practice maths. (P11; C1)

It's wonderful to be taught by a male teacher as the children respect male teachers more than females. It's easy for male teachers to explain, and more of us understand. And we don't get scared asking the teacher for assistance. (P13; C1)

Levpuscek and Zupancic (2009) argue that teachers should serve as mentors and role models to learners. They have a responsibility to uphold the image of a good, caring teacher to the children since their attitudes can influence learners. One learner summed this up quite succinctly:

> *I've come to a conclusion that the teacher really impacts on my performance in maths, especially if you are afraid of a teacher you can't really learn well because you feel uncomfortable and unhappy. If the teacher is anxious then you become anxious.*

Gates & Vistro-Yu (2003) state that authoritarian teaching styles position the teacher as an expert in mathematics. Such a style of teaching may stifle the creativity of students, restrict their freedom of learning and hamper social interactions. In my analysis, many learners claimed that they had experienced teachers' authoritarian teaching styles. In addition, some teachers created elitism about mathematics – the thinking that mathematics was for bright learners. The learners were of the view that this attitude created a negative attitude in children towards mathematics to some extent.

> *We had this really cheeky teacher who really always expected us to get all our homework right and when we didn't, he would give us one shot for each sum we gotten wrong.* (P1; C1)
>
> *The teacher made it seem that maths is for the intelligent students.* (P3; C1)
>
> *Many teachers are strict and frightened the students. That's why many students don't approach the teacher when they have problems and in the end fail the subject. I did well in maths with* ***certain*** *teachers.* (P7; C1)

4.3.5 Concluding thoughts

This study shows that learner experiences in mathematics in the GET phase impacted by intersecting factors. In the majority of written narratives learners were of the opinion that their experiences in mathematics classrooms influenced their decision to choose or not choose mathematics at Grade 10 level. Parents, peers, teachers and other individuals whom learners interact with, either formally or informally, influence learners' perceptions, beliefs and attitudes about the subject, and the emotions teaching and learning generated. The study suggests that the mathematics teacher plays a pivotal role in the learners' experience of mathematics.

4.4 Choosing Mathematics in Grade 10 - A Socially Constructed Decision?

The findings in this study indicate that the decision of learners to choose or not choose mathematics as a subject in Grade 10 is a socially constructed one. Saxe, Gearheart, Note & Paduano (1993) argue that social-constructionism emphasises that the construction of knowledge and meaning takes place in a social, institutional and cultural context. For example, learners' experience and participation in the mathematics classroom are influenced by their own socially acquired knowledge of mathematics, their beliefs about the subject, their social competence in the classroom, and their knowledge of how others understand and view them (Lo, Wheatley & Smith, 1994). Social-constructionism emphasises that knowledge is actively constructed within a social and cultural environment. Social-constructionism focuses on power and meaning, and accounts for the ways in which phenomena such as attitudes towards mathematics as a subject are socially constructed.

In the sub-sections below, I present some of the themes that emerged when I looked more closely at what learners felt were the reasons they chose or did not choose mathematics in Grade 10.

4.4.1 Pressures on student decision making

Numerous studies have indicated that parents have the potential to influence children's attitudes, dispositions and achievement in mathematics (Awad, 2008; Desforges, 2003; Fan & Chen, 2001; Kleanthous & Williams, 2011; Ma, 2001). Fan and Chen (2001) suggest that parental involvement influences students' achievement in mathematics. (Ma, (2001) argued that students' participation in mathematics is influenced by parental involvement. The present study suggests that parents may influence whether their children choose mathematics in Grade 10 or not.

Campbell and Mandel (1990) identified four elements of parental influence: parental pressure, psychological support, parental help and parental monitoring. Many learners in the present study indicated that their parents were of the opinion that their future success in life was dependent on them taking mathematics as a subject.

I guess my brother and sister were also lovers of mathematics because they did the same course when they were in school. My parents expect me to be a very very successful member in our family. I know my mom loves me and she wants the best for me and that's why I will always try my best in the most important subject. (P12; C1)

My parents' expectations in maths were very high, because they wanted me to be a doctor or a scientist but unfortunately I won't be able to be that. (P11; C1)

I told my mom that I can't choose maths in Grade 10 but she forced me. (P10; C1)

My parents liked me to do maths because they wanted me to get a nice job when I leave school. (P36; C2)

Data in this study also showed that some parents encouraged their children not to choose mathematics. These parents were realistic in admitting that their children are not functioning at their optimum in mathematics. There were parents who clearly did not want their children to have failure experiences in mathematics, and supported their children's decision to opt out of mathematics.

My parents say don't do mathematics because I don't know mathematics - so I choose to leave it because I will get failed. (P26; C2)

Mathematics has been labelled a 'critical filter' for many career choices (Sells, 1980). Mathematics is seen as important in the pursuit of high status careers (Stinson, 2004). The narratives of the learners in this study revealed their views, and those of their parents, on this issue. Many learners chose mathematics so that they can gain entry into university to pursue careers in science and mathematics. A qualification in mathematics is viewed as being vital for many careers. Therefore, learners chose mathematics. These narratives below reflect the career aspirations of learners and their parents.

I feel if you want a good job, you need maths skills, I am planning on studying after school. (P3; C1)

The thought of me being a chemical engineer without learning maths is a driver without licence. (P19; C1)

In contrast, the data indicated that there were learners who believed that I mathematics is of no importance to them in their career choice. These learners argued that careers of their choice did not need mathematics.

I didn't choose maths because I firstly don't like it and I don't see where it is going to help in my acting career. (P32; C2)

I am doing drama I really want to be an actress or an artist I do not need maths and I don't like maths at all. (P23; C2)

The reason being for me not choosing maths is because I want to be a nurse and with this you don't really need it. (P21; C2)

The study revealed that there were 10 learners in the group that chose mathematics who indicated that they experienced pressure from parents to choose maths. There were also a few in Group 2 who were pressured to choose mathematics by their parents but they resisted. Research on the issue of parent pressure suggests contradictory findings, which are context dependent. For example, Kleanthous and Williams (2011) explored perceived parental influence on learners' performance in mathematics, their aptitude towards mathematics and dispositions to study further mathematics among 563 secondary school students in Cyprus. This study found that perceived parental influence had a statistically significant effect on students' inclination to mathematics. However, it did not have a statistically significant effect on students' mathematics achievement and dispositions to study mathematics at a higher-education level (Kleanthous & Williams, 2011). My study points to the need for further research in this area in South Africa. I have not been able to locate any studies on parental aspirations and their impact on students' dispositions towards mathematics in a South African context.

Having to select a course in grade 9 is the highlight of a prospective Grade 10 learner's life. In the South African education system, a cluster of subjects makes up a course. Generally, the mathematics and science courses are clustered together, and commerce subjects form another cluster. Learners will then choose a course, given the limits of choice. This in turn impacts on career choice. Eight (8) learners in Group 1 and 12 learners in Group 2 indicated that their decision about the selection of mathematics was associated with course selection and limitations in course clusters. The narrative below provides insight into this issue:

> *I never did Accounting. I am from Eastern Cape Province. So I was going to find it hard to choose a course. I would only get a course with no maths.* (P32; C2)

The narratives showed that learners' choice was often limited because of the ways in which subjects were clustered. The learner above had to choose a course without mathematics because accounting is clustered with mathematics. In other instances, certain children could not select computer science because it is grouped with physical science, as alluded to by learner P35 above. Many of the learner narratives reflected emotionality around the issue of choice and the limitations and exclusions they experienced. Drawing from Zemblyas (2003) and based on the findings of this study, one can argue that making choices in respect of the mathematics curriculum can generate emotions of anger, anxiety and vulnerability. The issue of learner emotionality in mathematics learning is an area for further study.

4.4.2 The teacher and teaching methodologies

Mathematics teachers and researchers agree that the teaching and learning of mathematics must extend students' ways of thinking and provide them with applicable mathematics knowledge, experience and skills for future needs (Wang, 2001; Flores, 2006); Wang (2001) states that students must do mathematics, that is, be what Brown and Walter (2005) describe as being active and critical learners in the mathematics class. Students should not merely be made to listen and observe what the mathematics teacher is doing. Students must be excited about doing mathematics.

Oliver and Omari (2001) claim that traditional teaching methods are largely teacher-centred, and that students' active and critical engagement in learning is often decreased in such classrooms. Oliver and Omari's (2001) study revealed that that majority of the learners in the study had experienced the conventional teaching styles of 'chalk and talk', and meaningless learning of mathematics at some time in their schooling careers. The narratives below from two students who did not choose mathematics, points to the critical importance meaning-making in the mathematics classrooms.

> *I lost interest in mathematics. But I blame the teacher because I never understand her.* (P35; C2)

> *I did not understand the mathematics teacher, she was boring and sometimes did not explain.* (P22; C2)

Mathematics lessons need to be planned creatively by teachers to prioritise the need for students to understand concepts and processes, according to Brown & Walter (2005). Teachers need to have good content and pedagogical knowledge and build learners who respect and enjoy mathematics (Bansilal, 2002; Wilkins, 2008).

4.4.3 Attitudes towards mathematics

Learners in the present study displayed diverse feelings and attitudes towards mathematics as a subject that have been developed through their schooling careers. The majority of participants from the C1 group displayed an affinity for mathematics while the majority of those in the C2 group detested mathematics. One can draw the conclusion that an enjoyment of mathematics is associated with choice of mathematics at Grade 10.

A dislike for mathematics seems to be associated with opting out of mathematics at Grade 10. The narratives below provide insight into learner experiences:

> *My experience in mathematics was really hard and I found it difficult to try and manage.* (P21; C2)

> *I am happy I did not choose maths. Because it sucks.* (P27: C2)

> *From all the people I came across I've never heard of a student who really liked maths. Sorry to just give it as it is but it is the truth - math sucks.* (P23; C2)

> *I love maths that's why I will always try my best in the most important subject mathematics.* (P12; C1)

I enjoy math and I will pursue it to my greatest potential. (P19; C1)

Maths is also very exciting as it challenges you to do things you never could do. Maths also encourages us to use our heads and if [we] use our heads we will be successful. (P5; C1)

The narratives of those students who enjoyed mathematics pointed to them experiencing challenging lessons, critical thinking and active learning, and understanding and meaning-making in lessons. Numerous teachers and researchers internationally propose that motivation in mathematics and positive dispositions of learners are associated with the nature of the learning environment (Maaß & Schlöglmann, 2009).

4.5 Conclusion

This study brought to light the many intersecting factors that seem to be associated with learner choice of mathematics at a Grade 10 level. However, I wish to stress that no causal conclusions could be made in this small-scale qualitative study. Having said that, I wish to add that many of the trends in this study have been documented in other studies internationally, as is evident in my discussion above.

The final chapter in this dissertation will focus on the conclusion and implications of the study.

CHAPTER 5: CHAPTER 5: CONCLUSION AND IMPLICATIONS

5.1 Introduction

The study presented in this dissertation investigated the factors that are associated with learner choice of mathematics at Grade 10 level at a secondary school in KwaZulu-Natal. The study was motivated by a trend I observed at the school for the period 1992-2008 which showed that there was a steady increase in the number of learners who decided not to choose mathematics at grade 10 level. Forty (40) learners participated in this study on a voluntary basis. Twenty (20) of the learners chose mathematics at Grade 10 level, and 20 learners did not. The research questions were: How did learners experience mathematics over nine years in the General Education and Training phase? What factors are associated with learners choosing not to study mathematics from Grade 10 level, and to what extent is gender a mediating factor in this choice?

In this chapter, I firstly, summarise the key findings in the study. Secondly, I reflect upon the methodological approach I used in the study. Thirdly, I highlight some of the implications of the study for the teaching and learning of mathematics and for future research. Finally, I discuss some of the limitations of the study. Since this is a small scale qualitative study I have decided not to cite any far reaching recommendations but rather explore some implications for mathematics teaching and learning and for research.

5.2 Key Findings of the Study

The findings of the study indicate that learners' decision to choose or not choose mathematics at grade 10 is socially constructed. Learner narratives show how learners experienced mathematics in their first nine years of schooling was shaped through a system of social, cultural and interpersonal processes. Learners indicated these experiences impacted their decisions about choice of mathematics as a subject. A number of factors seem to be associated with learner choice. Eighteen (18) learners across both the groups stated that they struggled with maths. Twenty one (21) learners cited teacher attitudes as a factor that had a bearing on how they experienced mathematics teaching and learning. The nature of curriculum delivery was an issue that many learners foregrounded. In particular they cited the fact that they had difficulty understanding the subject and that often mathematics was not meaningful to them.

A significant issue that emerged in the study is learner emotionality in the context of mathematics teaching and learning. The narratives reflect emotions of anxiety, fear of failure, stress, and hatred for the subject amongst others. The narratives suggest that these emotions are linked to the nature of learning and teaching.

An interesting finding is that gender and race did not emerge as a significant issue in learner narratives. Only 7 learners mentioned their experience of gender stereotypes. This finding is interesting in view of the large body of research internationally on race and gender in the context of the mathematics classroom.

The study also revealed that most learners had positive experiences of mathematics learning at the primary school level. They alluded to the fact that at primary school mathematics was fun and that teaching and learning was affirming, exciting and meaningful. However, at the secondary school level the situation seemed to change. Generally, learners struggled with understanding and sense-making in mathematics. Learners across the groups stated that maths was boring. Studies have pointed to this trend in many schools internationally (for example, Popham, 2008).

5.3 Methodological Reflections

The study was a narrative inquiry and the key facet was the study of written stories by learners about their experiences of learning mathematics in the GET phase. Learners were able to reflect on their experiences and tell their stories – a process that allowed them an opportunity to both create and recreate their storied lives in the mathematics classroom. I was encouraged by the openness with which learners shared their subjective, inner experiences with me – in particular as parts of the story caused them to re-live some emotive memories.

A concern in the study of stories relates to the idea of validity. The issue of validity is about how believable is a statement or knowledge claim or interpretation by the researcher Polkinghorne, 2007). A question a researcher should ask is: Is there strong enough evidence to support the interpretation a researcher makes about human behaviour, actions, and about how people make sense of events, situations and interactions in their everyday lives? On reflecting on my data analysis and interpretation, I acknowledge that I faced challenges when my interpretations were questioned and placed under scrutiny by my supervisor and peers. I tended to make value judgements that clearly emanated from my own life experiences as a teacher and a student of mathematics. I realised that I had to constantly ask myself whether other interpretations were possible. I learned through the process that my interpretations had to be grounded in evidence, as suggested by Polkinghorne (2007).

A concern I had about learner stories was about whether the learners were selective in their accounts, and whether there were parts of the story that they deliberately omitted or decided to be silent about. Polkinghorne (2007, p. 9) helped me to deal with this dilemma when he argued that "Storied texts serve as evidence for personal meaning, not for the factual occurrence of the events reported in the stories." He explains that storied accounts are not necessarily factual accounts of events but are personal meanings constructed about life events. He argues that narratives should not be taken at face value, as they may never be completely authentic representations of reality. The fact that the narratives in the study were learners' memories of events, they represent a great deal of individual creativity in the selection of what accounts to include in their stories. Polkinghorne (2007) also draws attention to the fact that language, in particular written language in the case of the learners in my study, can create limits in that it may not capture meaning in all its complexity. Another limit may relate to the fact that the writing of narratives in this study required reflection by the learners (Polkinghorne, 2007). It is questionable whether the depth of meaning was in fact fully captured, and whether the learners were able to record in writing all the complex meanings they were able to access through reflection.

5.4 Implications of the Study

The study has implications for the teaching and learning of mathematics and for future research on the topic. It draws attention to how the teacher and teaching practices, that is, the ethos and cultures of classrooms can impact students' experiences and attitudes towards mathematics. However, it must be stated that identifying and adopting teaching approaches that affirm all learners is a challenge for teachers. Many learners' narratives alluded to the fact that mathematics at secondary school level was boring and difficult to make sense of. The study points to the need for a focus on making mathematics meaningful as this could be the key to motivating learners and to addressing the strong negative emotions that the mathematics class seems to generate in learners.

Professional teacher education programmes need to develop reflective practices that examine the diverse needs and attitudes of students, the impact of curriculum delivery on different learners in the classroom, and to improve mathematical content knowledge and pedagogical knowledge to enable the development of classrooms that are exciting environments and where the emphasis is on understanding and meaningful learning.

The findings suggest that an area for future research is learner emotionality in the mathematics class and an investigation of the gap between mathematics achievement and the affective dimension of learner lives.

5.5 Limitations of the study

As explained above, this was a small scale study in one school context. It involved a unique school context, a particular permutation of a desegregated school in South Africa, in terms of its history, learner population and context. The findings may not generalise to learners with different characteristics and to a different school context. However, Morrow (2007) reminds us that of the fact that a social constructionist perspective foregrounds an ontology that is relativist. The assumption is that there are many or multiple realities.

REFERENCES

Abbott, P., Wallace, C., & Taylor, M. (2005). *An introduction to sociology: feminist perspectives*. New York: Routledge.

American Association of University Women (AAUW). (1998). *Gender gaps: where schools still fail our children.* Washington, DC: AAUW.

Angen, M.J. (2000). Evaluating interpretive inquiry: reviewing the validity debate and opening the dialogue. *Qualitative Health Research, 10*(3), 378-395.

Asmeng-Boahene, C. (2006). *Gender inequity in science and mathematics education in Africa: the cause, consequence, and solution*. London: Allyn and Bacon.

Atkinson, P., Coffey, A., & Delamont, S. (2001). A debate about canon. *Qualitative Research, 1*(1), 5-2.

Atweh, B., Taylor, S., & Singh, P. (2005). *School curriculum as cultural commodity in the construction of young people's post-school sspirations.* Retrieved May 15, 2009 from: http://eprints.qut.edu.au/5715/1/5715_1.pdf

Awad, F. (2008). *The influence of parents' culture on students' choice of mathematics study in senior years*. (Unpublished B.Ed Honours thesis, School of Education and Social Work, Universty of Sydney).

Baine, C. (2004). Is *there an engineer inside you? A comprehensive guide to career decisions in engineering*. Belmont, CA: Professional Publications, Inc.

Bansilal, S. (2002). An investigation into teachers' knowledge in algrebra. In C. Malcom, & C. Lubisi (Eds.), *Proceedings of the 10th Annual Conference of the SAARMSTE* (pp. 22 – 27). Durban: University of KwaZulu-Natal.

Bayaga, A. (2010). Effective practice of mathematics teaching: through the lesson stury model. *The Journal of International Social Research, 3*(11), 115-124.

Bazeley, P. (2009). Analysing qualitative data: more than 'identifying themes'. *Malaysian Journal of Qualitative Research, 2*, 6-22.

Becker, J. (1981). Differential treatment of females and males in mathematics classes. *Journal for Research in Mathematics Education, 12* (1), 40–53.

Benbow, C. P., & Stanley, J. C. (1980). Sex differences in mathematical ability: fact or artifact? *Science, 210*, 1262-1264.

Berends, M., Bodilly, S., & Kirby, S. (2002). *Facing the challenges of whole-school reform: New American Schools after a decade*. Santa Monica, CA: RAND.

Berger, P. L., & Luckmann, T. (1966). *The social construction of reality: A treatise in the sociology of knowledge*. Garden City, NY: Anchor Books.

Bessoondyal, H. & Malone, J. (2005, August). *Gender issues and mathematical performance at the secondary Level: A Mauritian experience.* Paper presented at the Proceedings of the Fourth International Conference on Science, Mathematics and Technology Education. Victoria, Canada.

Bhanot, R. T. & Jovanovic, J. (2005). Do parents' academic gender stereotypes influence whether they intrude on their children's homework? *Sex Roles, 52*(9/10), 597-607.

Bleeker, M. M., & Jacobs, J. E. (2004). Achievement in math and science: Do mothers' beliefs matter 12 years later? *Journal of Educational Psychology, 96,* 97–109.

Bogdan, R. G., & Biklen, S. K. (1992). *Qualitative research for education* (2nd ed). Boston, MA: Allyn and Bacon.

Bogdan, R. C., & Biklen, K. S. (2003). *Qualitative research for education: an introduction to theory and methods.* Boston: Allyn and Bacon.

Bol, L., & Berry, R.Q. (2005). *Secondary mathematics teachers' perceptions of the achievement gap*. North Carolina. The University of North Carolina Press.

Bosire, J., Mondon, H., & Barmao, A. (2008). Effect of streaming by gender on student achievement in mathematics in secondary schools in Kenya. South African Journal of Education, 28, 595-607.

Botha, R. J. (2000). Quality and effectiveness in mathematics education: the role of the professional mathematics teacher/educator. *South African Journal of Education, 20*(2), 135-142.

Bouffard, S.M., & Hill, N.E. (2005). Maternal perceptions of competence and children's academic adjustment: longitudinal relations across early elementary school. *Social Psychology of Education, 8*(4), 441-463.

Brown, M., Brown, P., & Bibby, T. (2008). *"I would rather die": reasons given by 16-year-olds for not continuing their study of mathematics*. Department of Education and Professional Studies, King's College London; Institute of Education, University of London, London

Brown, S., & Walter, M. (2005). *The art of problem posing* (3rd ed.). New York, NY: Lawrence Erlbaum.

Brown-Wightman, S. (2002). Hispanic students majoring in science or engineering what happened in their educational journeys. *Journal of Women and Minorities in Science and Engineering, 8,* 123-148.

Brumbaugh, D. K., Ashe, D. E., Ashe, J.L., & Rock, D. (1997). *Teaching Secondary Mathematics*. Mahwah, NJ: Lawrence Erlbaum & Assoc.

Bruner, E. M. (1984). *Life as narrative.* Retrieved May 11, 2009 from: http://ewasteschools.pbworks.com/f/Bruner_J_LifeAsNarrative.pdf

Brunker, N. (2007). *Primary schooling and children's social emotional wellbeing: A Teacher's Perspective.* Retrieved August 10, 2011, from: http://www.aare.edu.au/07pap/bru07322.pdf

Bryman, A. (2004). *Social research methods*. New York: Oxford University Press.

Bryman, A. (2008). *Social research methods* (3rd ed.). New York: Oxford University Press.

Campbell, J., & Mandel, F. (1990). Connecting math achievement to parental influences. *Contemporary Educational Psychology*, *15*, 64-74.

Chisholm, L. (2004). *The quality of primary education in South Africa: background paper*. Retrieved April 10, 2011 from: http://www.hsrc.ac.za/research/output/outputDocuments/2872_Chisholm_Thequalityofprimary.pdf

Cobb, P., & Hodge, L. L. (2002). A relational perspective on issues of cultural diversity and equity as they play out in the mathematics classroom. *Mathematical Thinking and Learning, 4,* 249-284.

Cohen, L., Manion, L., & Morrison, K. (2007). *Research methods in education*. London and New York: Routledge.

Connelly, M. F., & Clandinin, J. D. (1990). Stories of experience and narrative inquiry. *Educational Researcher*, *19*(5), 2-14.

Consortium for Research on Educational Access, Transitions and Equity (CREATE). (2010). *South Africa policy brief 3: access to learning - mathematics performance in schools in Gauteng and Eastern Cape.* Johannesburg: CREATE.

Cresswell, J. W. (1998). *Qualitative inquiry and research design: Choosing among the five traditions*. Thousand Oaks, CA: Sage.

Crombie, G., Sinclair, N., Silverthorn, N., Byrne, B. M., Dubois, D. L., & Trinneer, A. (2005). Predictors of young adolescents' math grades and course enrolment intentions: gender similarities and differences. *Sex Roles*, *52*(5–6), 351–367.

Czarniawska, B. (2004). *Narratives in social science research*. London: Sage.

Dent, J.A. & Harden, R.M. (2001). *A practical guide for medical teachers.* London: Churchill Livingstone.

Denzin, N. K. (1989). *Interpretive interactionism*. Newbury Park, CA: Sage.

Denzin, N. K., & Lincoln, Y. S. (Eds). (2000). *Handbook of qualitative research* (2nd ed.). Thousand Oaks: Sage.

Department of Education. (1997). *Curriculum 2005: lifelong learning for the 21st century. A user's guide*. Pretoria: Department of Education.

Department of Education. (2006). *National Curriculum Statement Grades 10 to 12:*

Mathematical Literacy. Pretoria: Department of Education

Desforges, C. (2003). *The impact of parental involvement, parental support and family education on pupil achievements and adjustment: a literature review*. Retrieved July

12, 2011 from: http://bgfl.org/bgfl/custom/files_uploaded/uploaded_resources/18617/Desforges.pdf

Ding, C. S., Song, K., & Richardson, L. I. (2007). Do mathematical gender differences continue? *Educational Studies, 40,* 279 – 295.

Dovi, J. C. (2004). *Equality and gender education in the work place*. California: Jossey-Bass Inc.

Eccles, J. S. (1987). Gender roles and women's achievement-related decisions. *Psychology of Women's Quarterly, 11,* 135-172.

Elbaz-Luwisch, F. (2002). Writing as inquiry: storying the teaching self in writing workshops. *Curriculum Inquiry, 32*(4), 403-428

Else-Quest, N. M., Linn, M, C., & Hyde, J. S. (2010). Cross-national patterns of gender differences in mathematics: a meta-analysis. *Psychological Bulletin, 136*(1), 103–127.

Ensign, J. (2003). Including culturally relevant math in an urban school. *Educational Studies, 34,* 414-423.

Ercikan, K., McCreith, T., & Lapointe, V. (2005). Factors associated with mathematics achievement and participation in advanced mathematics courses: an examination of gender differences from an international perspective. *University of British Columbia, 105*(1), 5-14.

Fan, X., & Chen, M. (2001). Parental involvement and students' academic achievement: a meta-Analysis. *Educational Psychology Review, 13*(1), 1-22.

Fennema, E. (2000a*). Gender and mathematics: What is known and what do I wish was known?* Paper presented at the Fifth Annual Forum of the National Institute for Science Education. Detroit, Michigan.

Fennema, E. (2000b). *Gender equity for mathematics and science*. Retrieved August 16, 2009 from: http://www.woodrow.org/teachers/math/gender/02fennema.html

Fennema, E., & Sherman, J. A. (1976). Fennema-Sherman Mathematics Attitude Scales. *Catalog of Selected Documents in Psychology, 6*, 31.

Ferguson, R. F. (1998). Teachers' perceptions and expectations and Black-White test score gap. In C. Jencks .,& M. Phillips (Eds.), *The Black-White test score gap* (pp.373-317). Washington DC: Brookings Institution Press.

Fetterman, D. (1998). *Ethnography: Step by step*. Newbury Park, CA: Sage.

Flores, A. (2006). How do students know what they learn in middle school mathematics is true? *School Science and Mathematics, 106,* 124-132.

Ford, D.Y., & Moore, J.L., III. (2004).The achievement gap and gifted students of color: Cultural, social, and psychological factors. *Understanding Our Gifted*, 16, 3-7.

Forgasz, H. J. (2001). *Mathematics: still a male domain? Australian findings*. Paper presented at the Annual Meeting of the American Educational Research Association. Seattle.

Frank, K., Muller, C., Schiller, K., Riegle-Crumb, C., Mueller, A., Crosnoe, R., & Pearson, J. (2008). The social dynamics of mathematics course-taking in high school. *American Journal of Sociology, 113*(6), 1645–1696.

Fredricks, J. A., & Eccles, J. (2002). Children's competence and value beliefs from childhood through adolescence: growth trajectories in two male-sex-typed domains. *Developmental Psychology*, *38*, 519–533.

Furinghetti, F., & Pehkonen, E. (2002). Rethinking characterizations of beliefs. In G. Leder, E. Pehkonen, & G. Toerner (Eds.), *Beliefs: a hidden variable in mathematics education?* (pp. 39-58). Dordrecht: Cuwer Academic Publishers.

Furner, J. M., & Duffy, M. L. (2002). Equity for all students in the new millennium: disabling math anxiety. *Intervention in School & Clinic, 38*(2), 67-74.

Gates, P., & Vistro-Yu, C. (2003) 'Is mathematics for all?' In A.J. Bishop, M.A. Clements, C. Keitel, J. Kilpatrick, & F.K.S. Leung (Eds.), *Second international handbook of mathematics education part one* (pp. 31-73). Dordrecht: Kluwer Academic Publishers.

Geist, E. (2009). *The anti-anxiety curriculum: combating math anxiety in the classroom*. Retrieved December 9, 2011, from: http://www.andrews.edu/sed/ecp/resources/faculty-research/montagano-research/the-anti-anxiety-cur.pdf

Gellert, U., Jablonka, E., & Keitel, C. (2001). Mathematical literacy and common sense in mathematics education. In H. F. Bill Atweh (Ed.), *Socio-cultural research on mathematics education* (pp. 57-73). Mahwah: Lawrence Erlbaum.

Gergen, K.J. (1985). The social constructionist movement in modern psychology. *American Psychologist*, *40*(3), 266-275.

Gibbons, J. L . (2000). Gender development in cross-cultural perspective. In T. Eckes, & H.M. Trautner (Eds.), *The developmental social psychology of gender* (pp. 389-415). Mahwah: Lawrence Erlbaum Ass.

Gilbert, J., & Calvert, S. (2003). Challenging accepted wisdom: looking at the gender and science education question through a different lens. *International Journal of Science Education*, *25*(7) 861-878.

Ginsburg, H. P., Klein, A., & Starkey, P. (1998). The development of children's mathematical thinking: connecting research with practice. In W. Damon, I. E. Sigel, & K. A. Renninger (Eds.), *Handbook of child psychology, Vol. 4: child psychology in practice* (5th ed.) (pp. 401–476). New York: Wiley.

Gneezy, U, Niederle & Rustichini, A. (2003). Performance in competitive environments: Gender differences, *Quarterly Journal of Economics*, 118, 1049-1074.Hacking, I. (1999). *The social construction of what?* Cambridge, MA: Harvard University Press.

Graham, M. (2001). *Increasing participation of female students in physical science class*. (Unpublished Master's thesis, Saint Xavier University).

Guiso, L., Monte, F., Sapienza, P., & Zingales, L. (2008). Culture, gender, and math. *Science,* 320, 1164–1165.

Gutstein, E. (2006). *Reading and writing the world with mathematics:toward a pedagogy of social justice*. New York, NY: Routledge.

Haith, M. M., & Benson, J. B. (1998). Infant cognition. In W. Damon (Series Ed.), D. Kuhn, & R. S. Siegler (Vol. Eds.), *Handbook of child psychology: Vol. 2:cCognition, perception and language* (5th ed.) (pp. 199–254). New York: Wiley.

Halai, A. (2009a). Gender and mathematics education in Pakistan: a situation analysis. *The Montana Mathematics Enthusiast*, *7*(1), 47- 62.

Halai, A. (2009b). *Comparative perspectives in creating gender awareness: stories from elementary mathematics classrooms in Pakistan*. Paper presented at the 10th UKFIET International Conference. Oxford, University of Oxford.

Hannula, M. (2002). Attitude towards mathematics: emotions, expectations and values. *Educational Studies in Mathematics, 49*, 25-46.

Hargreaves, A. (1998). The emotional practice of teaching. *Teacher and Teacher Education. 14*(8), 835-854.

Hargreaves, A. (2001). Emotional geographies of teaching. *Teachers College Record, 103*(6), 1056-1080.

Haylock, D. (2003). *Mathematics explained for primary teachers* (2nd ed.). London: Paul Chapman.

Heikkinen, H. L. T. (2002). Whatever is narrative research? In R. Huttunen, H. L. T. Heikkinen, & L. Syrjälä (Eds.), *Narrative research: Voices from teachers and philosophers* (pp. 13-25). Jyväskylä, Finland: SoPhi.

Held, B. (1995). The real meaning of constructivism. *Journal of Constructivist Psychology, 8*, 305-315.

Heller, K.A., & Eccles-Parsons, J. (1981). Sex differences in teacher's evaluative feedback and students' expectancies for success in mathematics. *Child Development*, *52*, 1015-1019.

Hitchcock, G., & Hughes, D. (1989). *Research and the teacher: a qualitative introduction to school-based research.* London: Routledge.

Hoffman, L. (1990). Constructing realities: An art of lenses. *Family Process, 29,* 1-12.

Howie, S. J. (2003). Language and other background factors affecting secondary pupils' performance in mathematics in South Africa. *African Journal of Research in Mathematics Science and Technology Education*, 7, 1-20.

Hyde, J. S., Lindberg, S. M., Linn, M. C., Ellis, A., & Williams, C. (2008). Gender similarities characterize math performance. *Science,* 321, 494–495.

Jacobs, N., & Harvey, D. (2010). The extent to which teacher attitudes and expectations predict academic achievement of final year students. *Educational Studies*, *36*(2), 195-206.

Jussim, L., & Eccles, J. (1992). Teacher expectations 11: construction and reflection of student achievement. *Journal of Personality and Social Psychology, 63*, 947-961.

Juvonen, J. & Graham, S. (Eds.) (2001). *Peer harassment in school: the plight of the vulnerable and victimized*. New York: Guilford Press.

Karimi, A., & Venkatesan, S. (2009). Mathematics anxiety, mathematics performance and academic hardiness in high school students. *International Journal of Education Science, 1*(1), 33-37.

Keck-Staley, T. L. (2010). The role of human resource capital of Black and Latino middle schoolers' mathematics identities. *The Negro Educational Review, 61*(1-4), 7-40.

Khoon, S., & Ainley, J. (2005). *Longitudinal surveys of Australian youth. Research report 41: Attitudes, intentions and participation.* Melbourne: ACER

Kleanthous, I., & Williams, J. (2011). *Perceived parental influence on students' mathematical achievement, inclination to mathematics and dispositions to study further mathematics*. Retrieved October10, 2011, from: http://www.bsrlm.org.uk/IPs/ip30-1/BSRLM-IP-30-1-17.pdf

King, K., & McLeod, D. (1999). Coming of age in academic a review of mathematics education as a research domain: a search for identity. *Journal for Research in Mathematics Education,* 30(2), 227-34.

Kleanthous, I. & Williams, J. (2011). *Students' dispositions to study further mathematics: the effect of students' mathematics self-efficacy*. Paper presented at the Seventh Congress of European Society for Research in Mathematics Education (CERME7), 9-13 February, Rzeszow, Poland. Retrieved October 10, 2011, from http://www.cerme7.univ.rzeszow.pl/WG/8/CERME%207_WG8_Kleanthous.pdf

Khoon, S., & Ainley, J. (2005). *Longitudinal surveys of Australian youth; research report 41: attitudes, intentions and participation*. Camberwell, Victoria: Australian Council for Educational Research

Kloosterman, P., Tassel, J. H., Ponniah, A. G., & Essex, N. K. (2008). Perceptions of mathematics and gender. *School Science and Mathematics, 108,* 149-162.Kotzé, G. S., & Strauss, J. P. (2007). An investigation into the mathematics performance of grade 6 learners in South Africa. *Pythagoras, 65,* 24-31.

Komle, L. J. (2009). *Determinants of grade 9 learners' intention to select science/applied sciences as curriculum stream for grade 10: an exploratory study of selected secondary schools in amathole district*. (Unpublished master's thesis). University of Forte Hare.

Kotzé, G. S., & Strauss, J. P. (2007). An investigation into the mathematics performance of grade 6 learners in South Africa. *Pythagoras*, *65*, 24-31.

Kurtz-Costes, B., Rowley, S, J., Harris-Britt, A., & Woods, T. A. (2008). Gender stereotypes about mathematic and science and self-perceptions of ability in late childhood and early adolescence *Merrill-Palmer Quarterly*, *54*(3), 386-409.

Kyriacou, C., & Goulding, M. (2006). *A systematic review of strategies to raise pupils' motivational effort in Key Stage 4 mathematics*. London: EPPI Centre, Institute of Education.

Lawrenz, F., & Veach, P. M. (2005). Investigating perceptions of gender education by students and teachers in Taiwan. *Journal of Educational Research, (98), 3,* 430-446.

Leder, G.C., Forgasz, H.J., & Solar, C. (1996). Research and intervention programs in mathematics education: a gendered issue, in A. Bishop, K. Clements, C. Keitel, J. Kilpatrick, & C. Laborde (Eds.), *International Handbook of Mathematics Education, Part 2* (pp. 932-961). Kluwer: Dordrecht.

Lee, K. H. (2009). *Discovering the potential of gifted females in mathematics*. Retrieved 9 July, 2011 from: http://www.pme32-na30.org.mx/ws1/PME-KyunghwaLee.pdf

Leedy, M.G., LaLonde, D., & Runk, K. (2003). Gender equity in mathematics: beliefs of students, parents, and teachers. *School Science and Mathematics*, *103*, 285-292.

Levine, S.C., Vasilyeva, M., Lourenco, S.F., Newcombe, N.S., & Huttenlocher, J. (2005). Socioeconomic status modifies the sex difference in spatial skill. *Psychological Science, 16*, 841.

Levpuscek, M. P., & Zupancic, M. (2009). Math achievement in early adolescence: the role of parental involvement, teachers' behavior, and students' motivational beliefs about math. *Journal of Early Adolescence*, *29*(4), 541-570.

Lewis, T. (2005). Facts + fun = fluency. *Teaching Children Mathematics*, *12*(1), 8-11.

Li, Q. (1999). Teachers' beliefs and gender differences in mathematics: a review. *Educational Research, 41*(1), 63-76.

Lim, J. H., & Hart, L. E. (2002, April). *Sociocultural context of young adolescent girls' motivation for learning school mathematics: An ethnographic case study.* Paper presented at the annual meeting of American Educational Research Association. New Orleans, LA.

Lo, J. J., Wheatley, G. H., & Smith, A. C. (1994). The participation, beliefs, and development of arithmetic meaning of a third-grade student in mathematics class discussion. *Journal of Research in Mathematics Education, 25*(1), 30–49.

Lubienski, S.T. (2001). *A second look at mathematics achievement gaps: Intersections of race, class and gender in NAEP data.* Paper presented at the American Educational Research Association. Seattle, Washington.

Ma, X. (2001). Participation in advanced mathematics: Do expectation and influence of students, peers, teachers and parents matter? *Contemporary Educational Psychology, 26,* 132-146.

Ma, X. (2008). Within school gender gaps in reading mathematics and scientific literacy. *Comparative Education Review*, *52*(3), 437-460.

Maaß, J., & Schlöglmann, W. (2009). *Beliefs and attitudes in mathematics education: new research results*. Rotterdam: Sense Publishers.

Mahlomaholo, S., & Sematle, M. (2004). *Gender differences and black learners' attitudes towards mathematics in selected high schools in South Africa*. Paper presented at the 10th International Congress on Mathematical Education. Denmark, Copenhagen.

Manoah, S. I., Indoshi, F. C., & Othuon, L. O. A. (2011). Influence of attitude on performance of students in mathematics curriculum. *Educational Research, 2*(3), 965-981.

Martin, D. B. (2006). Mathematics learning and participation as racialized forms of experience: African-American parents speak on the struggle for mathematics literacy. *Mathematical Thinking and Learning*, *8(*3), 197–229.

Martin, D. B. (2007). Mathematics learning and participation in the African-American context: the construction of identity in two intersecting realms of experience. In N. S. Nasir, & P. Cobb (Eds.), *Improving access to mathematics: diversity and equity in the classroom* (pp. 51-68). New York, NY: Teachers College Press.

Masanja, V. (2003). *Bridging the gender gaps in science and mathematics education.* HakiElimu working paper Series No. 2003.10. Dar Es Salaam, Tanzania: HakiElimu

Matthews, L. (2003). Babies overboard! The complexities of incorporating culturally relevant teaching into mathematics instruction. *Educational Studies in Mathematics, 53*, 61-82.

McCotter, S. S. (2001). The journey of a beginning researcher. *The Qualitative Report*, *6*(2). Retrieved September 12, 2009 from: http://www.nova.edu/ssss/QR/QR6-2/mccotter.html

Mead, S. (2006). *The truth about boys and girls*. Retrieved September 12, 2011 from: http://www.cpec.ca.gov/CompleteReports/ExternalDocuments/ESO_BoysAndGirls.pdf

Meelissen, M. & Luyten, H. (2008). The Dutch gender gap in mathematics: small for achievement, substantial for beliefs and attitudes. *Studies in Educational Evaluation, 34,* 82–93.

Mendick, H. (2005). Mathematical stories: why do more boys than girls choose to study mathematics at AS-level in England. *British Journal of Sociology of Education, 26*(2), 235-251.

Mendick, H. (2006). *Masculinities in mathematics*. Maidenhead: Open University Press.

Mickelson, R.A., Nkomo, M., & Smith, S.S. (2001). Education, ethnicity, gender, and social transformation in Israel and South Africa. *Comparative Education Review*, *45*(1), 1-35.

Moen, T. (2006). Reflections on the narrative research approach. *International Journal of Qualitative Methodology*, *5*(4), Article 5. Retrieved October 5, 2011 from: http://www.ualberta.ca/~iiqm/backissues/5_4/pdf/moen.pdf

Moloi, M.Q. (2005). Mathematics achievement in South Africa: a comparison of the official curriculum with pupil performance in the SACMEQ II Project. Retrieved October 11, 2011 from: http://www.jet.org.za/events/conferences/School%20quality%20research%20seminar%202/testing-programmes-1/Moloi.pdf

Moore, J. L. III. (2003). Introduction. *The High School Journal, 87,* 1-3.

Moore, J. L. III. (2006). A qualitative investigation of African-American males' career trajectory in engineering: implications for teachers, school counselors, and parents. *Teachers College Record, 108, (2),* 246-266.

Morrow, S.L. (2007). Qualitative research in counselling psychology. Conceptual foundations. *The Counseling Psychologit*, 35(2), 209-235.

Motala, S., & Dieltiens, V. (2010). *Educational access in South Africa: country research summary*. Johannesburg: Consortium for Research on Educational Access.

Mutemeri, J., & Mugweni, R. (2005). The extent to which mathematics instructional practices in early childhood education in Zimbabwe relates to or makes use of children's experiences. *African Journal of Research in Mathematics, Science and Technology Education*, *9*(1), 49-54.

Mwamwenda, T.S. & Mwamwenda, B.B. (1989).Teacher characteristics and pupils' academic achievement in Botswana primary education. International *Journal of Educational Development, 9*(1),31-42.

Myers, M. (2000). Qualitative research and the generalizability question: standing firm with Proteus. *The Qualitative Report*, *4*(3/4). Retrieved September 7, 2011, from: http://www.nova.edu/ssss/QR/QR4-3/myers.html

Nardi, E. & Steward, S. (2003). Is mathematics T.I.R.E.D? A profile of quiet disaffection in the secondary mathematics classroom. *British Educational Research Journal, 29*(3), 345-367.

Nasir, N. S., & Shah, N. (2011). On defense: African-American males making sense of racialized narratives in mathematics education. *Journal of African-American Males in Education,* 2(1), 24-45.

National Academy of Sciences. (2006). *Beyond bias and barriers: Fulfilling the potential of women in academic science and engineering*. Washington, DC: National Academies Press.

Neuman, W. (2000). *Social research methods. (*4th ed). Boston. Allyn and Bacon.

Neuman, W. (Ed.). (1997). S*ocial Research Methods: qualitative and quantitative approaches.* London: Allyn and Bacon.

Neuschmidt, O., Barth, J. & Hastedt, D. (2008). Trends in gender differences in mathematics and science (TIMSS 1995–2003). *Studies in Educational Evaluation, 34*, 56–72.

Nicolaidou, M., & Philippou, G. (2001). *Attitudes towards mathematics, self-efficacy and achievement in problem-solving*. Retrieved October 12, 2011, from: http://ermeweb.free.fr/CERME3/Groups/TG2/TG2_nicolaidou_cerme3.pdf

Nosek, B. A., Banaji, M. R., & Greenwald, A. G. (2002). Math = male, me = female, therefore math ≠ me. *Journal of Personality and Social Psychology, 83*, 44–59.

O'Connor-Petruso, S., Schiering, M., Hayes, B., & Serrano, B. (2004). Pedagogical and parental influences in mathematics achievement by gender among selected European countries from the TIMSS-R study. In C. Papanastasiou (Ed.), *Proceedings of the IRC-2004 TIMSS Vol. II* (pp. 69-84). Nicosia: Cyprus University.

Oakes, J., & Lipton, M. (1996). Developing alternatives to tracking and grading. In L. I. Rendon, & R. O. Hope (Eds.), *Educating a new majority: transforming America's educational system for diversity.* San Francisco: Jossey-Bass.

O'Brien, L.T., & Crandall, C.S. (2003). Stereotype threat and arousal: effects on women's math performance. *Personality and Social Psychology Bulletin, 29*, 782-789

Oliver, R., & Omari, A. (2001). Student responses to collaborating and learning in a web based environment. *Journal of Computer Assisted Learning*, *17,* 34-47.

Osborne, J., Black, P., Boaler, J., Brown, M., Driver, R., & Murray, R. (1997). *Attitudes to science, mathematics and technology: a review of research.* London: King's College, University of London.

Osborne, J., Simon, S., & Collins, S. (2003). Attitudes towards science: a review of literature and its implications. *International Journal Science Education. 25*(9), 1049-1079.

Parker, I. (1998). Realism, relativism, and critique in psychology. In I. Parker (Ed.), *Social constructionism, discourse and realism* (pp. 1-9). California*:* Sage.

Patton, M. Q. (2002). *Qualitative evaluation and research methods* (3rd ed.). Thousand Oaks, CA: Sage Publications, Inc.

Penner, A. M. (2008). Gender differences in extreme mathematical achievement: an international perspective on biological and social factors. *AJS*, *114*, S138–S170.

Polkinghorne, D. E. (1988). *Narrative knowing and human sciences*. New York: State University of New York Press.

Polkinghorne, D. E. (2007). Validity issues in narrative research. *Qualitative Inquiry.* Retrieved December 11, 2011, from: http://web.media.mit.edu/~kbrennan/mas790/07/Polkinghorne,%20Validity%20issues%20in%20narrative%20research.pdf

Popham, W. J. (2008). Timed tests for tykes? *Educational Leadership, 65*(8), 86-87.

Reddy, V. (2006). *Mathematics and science achievement at South African schools in TIMMS 2003*. Cape Town: HSRC Press.

Reddy, V., Kanjee, A., Diedericks, G., & Winnaar, L. (2007). *Mathematics and science achievement at South African schools in TIMSS 2003*. Pretoria: Human Sciences Research Council.

Reed, R. J., & Oppong, N. (2005). Looking critically at teachers' attention to equity in their classrooms. *The Mathematics Educator, 1*(1), 2–15.

Reid, N. (2003). Gender and physics. *International Journal of Science Education, 25* (4), 509-536.

Richmond, H. J. (2002). Learners' lives: a narrative analysis. *The Qualitative Report, 7*(3). Retrieved July 9, 2011, from: http://www.nova.edu/ssss/QR/QR7-3/richmond.html

Riegle-Crumb, C. (2005). The cross-national context of the gender gap in math and science. In L.V. Hedges, & B. Schneider (Eds.), *The social organization of schooling* (pp. 227–43). New York: Russell Sage Foundation.

Ross, J. A., McDougall, D., Hogaboam-Gray, A., & LeSage, A. (2003). A survey measuring elementary teachers' implementation of standards-based mathematics teaching. *Journal for Research in Mathematics Education, 34,* 344-363.

Rubin, H., & Rubin, I. (2005) *Qualitative interviewing: the art of hearing data* (2nd ed.). London: Sage.

Ruble, D. N., Martin, C. L., & Berenbaum, S. A. (2006). Gender development. In W. Damon, & R. M. Lerner (Series Eds.), & N. Eisenberg (Vol. Ed.), *Handbook of child psychology, 6*(3), 858-932.

Ruble, T. L., Cohen, R., & Ruble, D. N. (2001) Sex stereotypes. *American Behavioral Scientist, 27,* 339-356.

Sahlin, I. (2006). Book review: social constructionism in housing research. *Housing, Theory and Society, 23*(3), 176-180.

Saxe, G.B., Gearhart, M., Note, M., and Paduano, P. (1993) Peer interaction and the development of mathematical understanding: a new framework for research and educational practice. In H. Daniels (Ed.), *Charting the agenda: Educational activity after Vygotsky* (pp. 107-144). London: Routledge.

Schmader, T., & Johns, M. (2003). Converging evidence that stereotype threat reduces working memory capacity. *Journal of Personality and Social Psychology, 85,* 440-452.

Schwandt, T.A. (1994).Constructivist, interpretivist approaches to human inquiry. In N.K. Denzin, & Y.S. Lincoln (Eds.), *Handbook of qualitative research* (pp.189-213). Newbury Park, CA.

Sells, L. W. (1980). Mathematics: the invisible filter. *Engineering Education*, *70*, 340-341.

Sepeng, J. P. (2010). *Grade 9 second-language learners in township schools: issues of language and mathematics when solving word problems*. (Unpublished PhD thesis, Nelson Mandela Metropolitan University).

Setati, M. (2005). Teaching mathematics in a primary multi-lingual classroom. *Journal for Research in Mathematics Education, 36*(5), 447-456.

Sprigler, D. M., & Alsup, J. K.(2003). An analysis of gender and the mathematical reasoning ability sub-skill of analysis-synthesis. *Education, 123* (4), 763-769.

Stake, R. E. (1995). *The art of case study research*. Thousand Oaks: Sage Publications, Inc.

Steele, J. (2003). Children's gender stereotypes about math: the role of stereotype stratification. *Journal of Applied Social Psychology, 33*(12), 2587-2606.

Stein, M., Remillard, J., & Smith, M. (2007). How curriculum influences student learning. In F. Lester Jr. (Ed.), *Second handbook of research on mathematics teaching and learning* (pp. 319-369). Charlotte: Information Age Publishing.

Steiner, C., & Perry, P. (1997). *Achieving emotional literacy.* London: Bloomsbury.

Stinson, D. W. (2004). Mathematics as "gate-keeper": three theoretical perspectives that aim toward empowering all children with a key to the gate. *Mathematics Educator, 14*(1), 8-18.

Stuart, V. (2000). Math curse or math anxiety? *Teaching children mathematics, 6*(5), 330–335.

Sukthankar, N. (1998). Perspectives on social justice, disadvantage, and the mathematics curriculum. In C. Keitel (Ed.), *Social Justice and Mathematics Education* (pp1-19). Berlin: Freie Universitat Berlin.

Taylor, P. C. (2008). Multi-paradigmatic research design spaces for cultural studies researchers embodying postcolonial theorizing. *Culture Studies of Science Education, 4*, 1-8.

Taylor-Powell, E., & Renner, M. (2003). *Analysing qualitative data*. Retrieved August 12, 2011, from: http://learningstore.uwex.edu/assets/pdfs/G3658-12.pdf

Thompson, C. L., & O'Quinn, S. D. (2001). *Eliminating the Black-White achievement gap:aA summary of research.* Chapel Hill: The North Carolina Education Research Council.

Tiedemann, J. (2000). Parents' gender stereotypes and teacher's beliefs as predictors of children's concept of their mathematical ability in elementary school. *Journal of Educational Psychology, 92,* 144 – 498.

Tuaundu, C. (2009). *Gender stereotypes about mathematics and science and self-perceptions of ability in late childhood and early adolescence.* (Unpublished Master of Education thesis, University of South Africa).

Tudge, J.R.H., & Doucet, F. (2004). Early mathematical experiences: observing young Black and White children’s everyday activities. *Early Childhood Research Quarterly, 19,* 21–39.

United Nations Educational, Scientific and Cultural Organization (UNESCO). (2001). *UNESCO annual report 2001*. Washington: United Nation Press.

United Nations Educational, Scientific and Cultural Organization (UNESCO). (2003). *Gender and education for all: the leap for equality. global monitoring report 2003/2004*. Retrieved July 11, 2011, from: http:// www.unesco/oc.unesco.org/education/eta-report/2003-pdf/chapter3.pdf.

Verster, M. (2009). Creating an online learning ecology in support of mathematical literacy teachers. *International Journal of Education and Development Using Information and Communication Technology, 5*(5), 85-100.

Villalobos, A. (2009). The Importance of breaking set: socialized cognitive strategies and the gender discrepancy in mathematics. *Theory and Research in Education, 7*(27), 27-45.

Volman, M., & van Eck, E. (2001). Gender equity and information technology in education: the second decade. *Review of Educational Research, 7*(14), 613-634.

Wadesango, N., Chabaya, O., Rembe, S., & Muhuro, P. (2011). Assessment of first-year female students’ experiences in historically male dominated subjects in higher education from a cultural capital perspective. *Journal of Social Sciences, 27*(1), 7-14.

Walkerdine, V. (1990). *Schoolgirl fictions*. New York: Verso.

Wang, Y. (2001). The changing education framework for the teaching of mathematics in China. *The China Papers, 5,* 6-17.

Watt, H.M.G. (2005). Explaining gendered math enrollments for NSW Australian secondary school students. *New Directions for Child and Adolescent Development, 110* (winter), 15-29.

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

Willis, S. (1998). Perspectives on social justice, disadvantage, and the mathematics curriculum. In C. Keitel (Ed.), *Social Justice and Mathematics Education* (pp. 1-19). Berlin: Freie Universitat Berlin

Wong, T., & Lai, Y. (2006). *Exploring factors affecting mathematics teaching effectiveness among pre-service primary mathematics school teachers.* Paper presented at the annual meeting of the Australian Association for Research in Education. Adelaide, South Australia. Retrieved July 1, 2011, from: http://www.aare.edu.au/06pap/won06754.pdf

World Bank. (2005). *Expanding opportunities and building competencies for young people a new agenda for secondary education*. Washington: The World Bank.

Yara, P. O. (2009). Students' attitudes towards mathematics and academic achievement in some selected secondary schools in South-western Nigeria. *European Journal of Scientific Research*, *36*(3), 336-341.

Zembylas, M. (2003). Interrogating teacher identity: emotion, resistance and self-formation. *Educational Theory, 53,* 107-127.

Zembylas, M. (2006). Challenges and possibilities in a postmodern culture of emotions in education. *Interchange*, *37*(3), 251 - 275.

Zohar, A., & Sela, D. (2003). Her physics, his physics: gender issues in Israeli advance placement physics classes. *International Journal of Science Education*, *25*(2), 245-268.

Appendix 1: Letter of consent: School principal and school governing body

The School Governing Body/Principal

Dear Sir/Madam

I am presently reading towards a Masters Degree in Social Justice Education. The course structure requires me to complete a research project. My study focuses on factors associated with learner choice of mathematics at Grade 10 level.

I hereby request permission to conduct this study with Grade 10 learners at your school. The study will not impinge on teaching time or in any way disrupt teaching and learning at the school. The data collection time will be negotiated with participants. I am hoping it will occur during the breaks and in the the afternoons.

I also bring to your attention, that permission from the respective parents, guardians and caregivers will be sought. Participants' identity will be protected at all times. Participation in this project is voluntary and participants can withdraw the project at any time.

This research is conducted under the supervision of Prof. A. Muthukrishna.

Yours in education

____

Vince M Govender

Appendix 2: Consent form - Parents, guardians and caregivers

Date

Dear ______

I am presently engaged in research as part of my Masters Degree in Social Justice. My study focuses on learner choice of mathematics at Grade 10 level. Participation of learners in this project is vital for me to gain relevant information. It is for this reason; I request permission for your child/ward to participate in this project.

This research is conducted with the consent of the principal and the school governing body.

Please complete the form below and return it to the school.

____

Researcher

Mr V. M. Govender

CONSENT FORM

I, _________________________parent/guardian of ____________________in Grade 10___ grant/do not grant permission for my child/ward to participate in this study.

____

Parent's/Guardian's signature

____

Date

Appendix 3: Data collection: Learner written stories

NARRATIVE RESEARCH

Dear learner,

This research is presently being carried out by Mr V. M. Govender , presently studying for his Masters degree in education. He wants to find out:

- How did you experience mathematics from a little child to a scholar in Grade 9
- What are your feelings/perceptions about mathematics teaching and learning
- What factors are associated with you choosing mathematics at Grade 10

Your co-operation is highly appreciated. Please remember that all information is strictly confidential. You are guaranteed that your identity will be protected at all times**.**

Write an essay of approximately 1½ - 2 pages, about your experiences in mathematics. In your essay, mention your experiences from childhood to preschool to primary school and then high school. Discuss how you experienced mathematics with different teachers (do not mention names). Mention your expectations, your parents' and teachers' expectations in mathematics. Also discuss other factors (eg: race, gender, culture, etc) that has influenced you studying mathematics at grade 10. Please feel free to discuss your feelings about mathematics. Do not be afraid to discuss any other issues about mathematics (eg: parental expectations, career choice, influence by others, your choice of subjects).

Once again a big THANK YOU for your participation in this study.

Appendix 5: Ethical Clearance

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

Research Office, Govan Mbeki Centre
Westville Campus
Private Bag x54001
DURBAN, 4000
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mohunp@ukzn.ac.za

8 April 2011

Mr VM Govender (982195492)
School of Education and Development
Faculty of Education
Pietermaritzburg Campus

Dear Mr Govender

PROTOCOL REFERENCE NUMBER: HSS/0148/011M
PROJECT TITLE: Factors associated with learner choice of mathematics at the grade 10 level in a secondary school in Pietermaritzburg, KwaZulu-Natal

In response to your application dated 29 March 2011, the Humanities & Social Sciences Research Ethics Committee has considered the abovementioned application and the protocol has been granted **FULL APPROVAL.**

Any alteration/s to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through the amendment /modification prior to its implementation. In case you have further queries, please quote the above reference number.
PLEASE NOTE: Research data should be securely stored in the school/department for a period of 5 years.

I take this opportunity of wishing you everything of the best with your study.

Yours faithfully

....

Professor Steven Collings (Chair)
HUMANITIES & SOCIAL SCIENCES RESEARCH ETHICS COMMITTEE

cc. Supervisor: Prof A Muthukrishna
cc. Mr N Memela/Ms T Mnisi

1910 - 2010
100 YEARS OF ACADEMIC EXCELLENCE

Founding Campuses: Edgewood Howard College Medical School Pietermaritzburg Westville