

# **Affect and Mathematics Education in Mozambique: Gender, Parents, Social and Economic Factors**

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## **Ethics**

This research project was granted approval by the Monash University Human Research Ethics Committee (MUHREC) on February 3, 2011 (Project no. CF10/2580–2010001437)

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## Abbreviations and Acronyms

|               |   |
|---------------|---|
| <b>UNESCO</b> | United Nations Educational, Scientific, and Cultural Organisation         |
| <b>SACMEQ</b> | Southern and Eastern Africa Consortium for Monitoring Educational Quality |
| <b>TIMSS</b>  | Trends in International Mathematics and Science Study                     |
| <b>HDI</b>    | Human Development Index   |
| <b>TV</b>     | Television Set  |
| <b>WHO</b>    | World Health Organisation   |
| <b>OECD</b>   | Organisation for Economic Cooperation and Development                     |
| <b>APA</b>    | American Psychological Association  |
| <b>CLM</b>    | Confidence in Learning Mathematics  |
| <b>PAM</b>    | Perceived Achievement in Mathematics                                      |
| <b>PUM</b>    | Perceived Usefulness of Mathematics                                       |
| <b>GSM</b>    | Gender Stereotyping of Mathematics  |
| <b>CAM</b>    | Causal Attribution in Mathematics   |
| <b>MVI</b>    | The Mathematics Value Inventory   |
| <b>USA</b>    | The United States of America  |
| <b>MAS</b>    | The Mathematics Attribution Scale   |
| <b>PATM</b>   | Index of Positive Affect towards Mathematics                              |
| <b>PIE</b>    | Parental Involvement in Education   |

|                |  |
|----------------|--|
| <b>SP</b>      | School Parents' Committee                            |
| <b>GI</b>      | Gender Issues' Committee                             |
| <b>HBI</b>     | Home-Based Involvement                               |
| <b>SBI</b>     | School-Based Involvement                             |
| <b>HSC</b>     | Home-School Communications                           |
| <b>NAPLAN</b>  | National Assessment Program on Literacy and Numeracy |
| <b>MMAS</b>    | Ministério para Assuntos da Mulher e Acção Social    |
| <b>SES</b>     | Socio-Economic status                                |
| <b>ALB</b>     | Autonomous Learning Behavior                         |
| <b>W&amp;M</b> | The Who and Mathematics Instrument                   |
| <b>MD</b>      | Mathematics as a Male Domain                         |
| <b>FIQ</b>     | Family Involvement Questionnaire                     |
| <b>FS-MAS</b>  | Fennema-Sherman Mathematics Attitudes Scales         |
| <b>DVs</b>     | Dependent Variables                                  |
| <b>IVs</b>     | Independent Variables                                |
| <b>SPSS</b>    | Statistical Package for Social Sciences              |
| <b>ANOVAs</b>  | Analyses of Variance                                 |
| <b>HSD</b>     | A Tukey Honestly Significant Difference Test         |
| <b>G-H</b>     | A Games-Howell Test                                  |
| <b>SD</b>      | Standard Deviation                                   |

|            |   |
|------------|---|
| <b>KMO</b> | Kaiser-Meyer-Oklin Measure of Sampling Adequacy |
| <b>PCA</b> | Principal Components Analysis                   |
| <b>BD</b>  | Boys Definitely More Likely than Girls          |
| <b>BP</b>  | Boys Probably More Likely than Girls            |
| <b>ND</b>  | No Difference Between Boys and Girls            |
| <b>GP</b>  | Girls Probably More Likely than Girls           |
| <b>GD</b>  | Girls Definitely More Likely than Girls         |
| <b>B</b>   | Boys more likely than Girls                     |
| <b>G</b>   | Girls more likely than boys                     |
| <b>P</b>   | People - Oriented Jobs                          |
| <b>T</b>   | Things - Oriented Jobs                          |

## List of Key Terms

| Term                                      | Meaning/Characterisation   | Source                     |
|---|--|----------------------------|
| Sex                                       | “Biological and physiological characteristics that define men and women” (para. 2).  | WHO <sup>a</sup><br>(2010) |
| Gender                                    | “Socially constructed roles, behaviours, activities, and attributes that a given society considers appropriate for men and women” (para. 3).   | WHO<br>(2010)              |
| Gender parity                             | “Equal participation for girls and boys in education” (p. 21).   | UNESCO<br>(2012)           |
| Gender equity/equality in education       | “The right to gain access and participate in education, as well as to benefit from gender-sensitive and gender-responsive educational environments and to obtain meaningful education outcomes that ensure that education benefits translate into greater participation in social, economic and political development of their societies” (p. 21). | UNESCO<br>(2012)           |
| Gender equity in mathematics education    | A tridimensional construct that incorporates equality in opportunity to learn mathematics, in educational treatment, and in educational outcomes (e.g., achievement, beliefs, and attitudes towards mathematics).  | Fennema<br>(1990)          |
| Affective domain in mathematics education | “Beliefs, attitudes, and emotions are used to describe a wide range of affective responses to mathematics” (p. 578). Other researchers also include values, interest, and aspirations.   | McLeod<br>(1992)           |
| Mathematical                              | The individual’s subjective knowledge about  | McLeod                     |

| <b>Term</b>                        | <b>Meaning/Characterisation</b>   | <b>Source</b>          |
|------------------------------------|---|------------------------|
| beliefs                            | mathematics, about the self, about mathematics teaching, and about the social context where mathematics teaching takes place.   | (1992)                 |
| Attitudes                          | Individual's "predispositions to respond positively or negatively to certain objects, situations, concepts, or persons. As such, they possess cognitive (beliefs or knowledge), affective (emotional, motivational) and performance (behaviour or action) components" (p. 2). | Aiken (1980)           |
| Emotions in mathematics            | Refers to moods, worry, anger, arousal, enjoyment, boredom, anxiety, or panic experienced during a classroom mathematics activity or homework.  | Buxton (1981)          |
| Mathematical disposition           | It incorporates a set of aptitude categories that influence mathematics performance (e.g., Mathematical-related beliefs and attitudes, self-regulation skills, metacognitive knowledge, and knowledge of specific-domain.   | De Corte et al. (2000) |
| Academic self-concept              | It is described as the "individual's perception of self with respect to achievement in school" (p. 559).  | Reyes (1984)           |
| Confidence in learning mathematics | It means the same as mathematical self-concept and refers to "how sure a person is of being able to learn new topics in mathematics, perform well in mathematics class, and do well on mathematics tests" (p. 560).   | Reyes (1984)           |
| Perceived usefulness of            | A multidimensional variable that includes intrinsic or interest value, utility value, attainment value, and   | Eccles et al. (1983)   |

| <b>Term</b>                   | <b>Meaning/Characterisation</b>  | <b>Source</b>         |
|-------------------------------|--|-----------------------|
| mathematics                   | cost value.  |                       |
| Attainment value              | Perceived “importance of doing well on the task”... It includes “perceptions of the task’s ability to confirm salient and valued characteristics of the self (e.g., masculinity, femininity, competence), to provide a challenge, and to offer a forum for fulfilling achievement, power, and social needs” (p. 89). | Eccles et al. (1983)  |
| Intrinsic or interest value   | “The inherent, immediate enjoyment one gets from engaging in an activity” (p. 89)  | Eccles et al. (1983)  |
| Utility value                 | “Determined by the importance of the task for some future goal that might itself be somewhat unrelated to the process nature of the task at hand” (89-90).   | Eccles et al. (1983)  |
| Cost value                    | The impact of cost on the value of a task is influenced by perceived effort needed to complete the task, perceived loss of other valued alternative tasks, and the psychological impact of success or failure on the task.   | Eccles et al. (1983)  |
| Expectancy                    | Term used to refer to “probability of success” (p. 81).  | Eccles et al. 1983    |
| Causal attributions           | A construct that refers to the reasons people attribute to their successes and failures in mathematical tasks.   | Fennema et al. (1979) |
| Academic learned helplessness | Term used ‘to describe the behaviors of students who believe they are unable to succeed in school” (p. 104).   | Kloosterman (1990)    |
| Mastery                       | A term opposite to academic learned helplessness. “The term mastery orientation has been used to   | Kloosterman (1990)    |

| <b>Term</b>                                    | <b>Meaning/Characterisation</b>  | <b>Source</b>                    |
|--|--|----------------------------------|
| orientation                                    | categorize the disposition of persons who are confident of their ability and thus are not worried about failure” (p. 104).   |                                  |
| Stereotype of mathematics as a gendered domain | “The extent to which they [individuals] believe that mathematics may be more suited to males, to females, or be regarded as gender-neutral domain” (p. 3).                               | Leder and Forgasz (2002a)        |
| Stereotype mathematics as a male domain        | To hold the views in regard to mathematics learning for males and females that are consistent with the early findings <sup>b</sup> (see Fennema & Sherman, 1976; Leder & Forgasz, 2002a) | Leder and Forgasz (2002a)        |
| Parent involvement in education [PIE]          | Refers to home-based involvement, school-based involvement, and home-school communications.  | Manz, Fantuzzo, and Power (2004) |

Note.

<sup>a</sup> World Health Organisation;

<sup>b</sup> In the western society, historically, mathematics has been viewed as a domain of white and middle-class males (Leder & Forgasz, 2008);



# **Abstract**

The aim of this study was to investigate the relationships between Grade 7 boys' and girls' beliefs and attitudes towards mathematics learning and parents' views, and family circumstances (e.g., parental education and occupation, home language, number of siblings, and economic resources) in Mozambique.

The study was inspired by on-going concerns about persistent patterns of gender differences in mathematics achievement favouring boys among grade 6 pupils in Mozambique (Saito, 2004, 2010). Although gender issues and affective factors in mathematics education have received considerable attention in the western countries, a review of the literature revealed that there is a lack of research in this field in primary schools in Mozambique. Thus, this study was aimed at filling this gap.

A convenience sample composed of 300 Grade 7 pupils (134 boys and 166 girls), 225 parents or guardians of these children (98 fathers, 96 mothers, and 31 guardians), and five principals (3 males and 2 females) from participating schools took part in the study. The ages of the children varied from 11 to 16 and the mean age was 12.9.

The dependent variables examined included: perceived achievement; occupational aspirations; confidence in learning mathematics; perceived usefulness of mathematics; causal attributions for success and failure in mathematics; gender stereotyping of mathematics; and parent involvement in education. These variables were examined due to their relationships with task-choices, persistence, and achievement (Eccles et al., 1983).

Pen-and-paper surveys and interviews were used to gather quantitative and qualitative data.

The main findings of the study were:

- Boys and girls viewed mathematics as the most difficult subject. Similarly, parents believed mathematics was the worst subject for their children.

- The children's perceived usefulness of mathematics was strongly associated with age, education of parent, geolocation, and number of siblings. Having electricity, piped water, television set, computer, and internet access were positively associated with perceived usefulness of mathematics and confidence, but not with perceived achievement in mathematics.
- Having calculators, cell phones, textbooks, and language spoken at home were not associated with children's affect towards mathematics.
- Boys and parents tended to view mathematics learning as a male domain reflecting the traditional belief, identified in the 1970s, that mathematics is a male preserve (Fennema & Sherman, 1976). In contrast, girls tended to view mathematics learning as a gender-neutral domain.
- Boys' and girls' attributions for success and failure in mathematics were not functional (Meyer & Koehler, 1990) as they believed that the most plausible cause for their success was environment (e.g., teacher, help) and for their failure it was task difficulty (e.g., hard mathematics). Parents' attributions in regard to failure were consistent with those of their children but for success were not. Parents believed success in mathematics is achieved through effort.
- Consistent with the literature, girls preferred to engage in 'people-oriented' occupations and boys preferred 'things-oriented' occupations. Parents' occupational aspirations for their daughters and sons followed the same pattern.

This study was conducted only in one province in Mozambique. Thus, further research is necessary to substantiate the findings from this study in other Mozambican Provinces. However, the results reported have implications for mathematics teaching to children from low-income parents.

# **Chapter 1**

## **Introduction, Context, and Overview**

In this chapter, the status of gender differences in mathematics achievement among Grade 6 pupils in Sub-Saharan Africa is described. The context of the study (Mozambique) is described in regard to geographic and population data, language policy, the structure of the general education system, policy towards gender equity and its impact in education, and the affective domain in mathematics education. This information is provided in order to assist the understanding, and interpretation of the data presented in Chapters 5 and 6 within its context. Chapter 1 is concluded with an overview of the structure of the thesis.

### **Introduction**

Mathematics is a unique product of human culture. Permitting females to understand this culture is important both for their own appreciation of the beauty of mathematics and the transmission of this culture to future generations. (Fennema, 1990, p. 2)

The influence of gender in mathematics education has been of considerable interest to researchers and educators for over four decades, and gender differences favouring boys have been reported in regard to (i) achievement in standardised tests and problem solving (e.g., Else-Quest, Hyde & Linn, 2010; Mullis, Martin, & Foy, 2008, Saito, 2004, 2010), (ii) strategy use in novel problems and algorithmic computations (e.g., Barnes, 1997; Carr, Jessup, & Fuller, 1999; Villalobos, 2009), (iii) affective dimensions (e.g., Fennema & Sherman, 1976; Hemmings, Grootenboer, & Kay, 2011; Kaiser, Hoffstall, & Orschulik, 2012; Leder & Forgasz, 2002a, 2006, 2008, 2010, 2011), and (iv) with respect to participation in non-compulsory high level mathematics courses and applied fields (e.g., Eccles, 1994, 2007; Watt, 2007; Watt, Eccles, & Durik, 2006).

Over the years, several theoretical models accounting for gender imbalances in mathematics learning outcomes have been postulated, particularly in the west (e.g., Baker & Jones, 1993; Ethington, 1992; Fennema & Peterson, 1985; Leder, 1990; Reyes & Stanic, 1988). Leder, Forgasz and Solar (1996) indicated that the diversity of theoretical perspectives used to explain gender differences in mathematics learning outcomes has resulted in the development and implementation of a variety of intervention programs aimed at redressing the imbalances in many parts of the world.

However, it should be noted that despite the research literature on gender differences in mathematics education being extensive and the existence of examples of successful intervention programs (see Leder et al., 1996 for review), there is still no clarity as to why gender differences in mathematics, science, and technology persist in some parts of the world, particularly in Africa (Asimeng-Boahene, 2006). Other scholars, however, have pointed that as most studies relating gender and mathematics learning were conducted in developed countries, there is no guarantee that findings from these countries can be generalised to other places with different cultural contexts (Else-Quest et al., 2010).

The study reported in this thesis was conducted in Mozambique which is a country in the Sub-Saharan Africa. Thus, to introduce the context of the study, preliminary information relevant to gender differences in mathematics achievement in primary schools in Sub-Saharan Africa is provided in the next section.

## **Mathematics Education in the Sub-Saharan Africa**

The notion of equity in mathematics education used in this study is consistent with the three-dimensional construct proposed by Fennema (1990). That is, equity with respect to (i) equal participation in mathematics courses and related fields, (ii) equal

treatment in mathematics classrooms and textbooks; and (iii) equal educational outcomes for all students. The third dimension of the equity construct, that is, the educational outcomes, refers not only to performance, but also, to the affective factors (e.g., beliefs, attitudes, emotions that evolve during mathematical activities, aspirations, perceived competence at mathematics, and perceived usefulness of mathematics for the person) that the student develops through the study of the subject. The notion of gender equity in education proposed by UNESCO (2012a) captures accurately the essence of the three dimensions of equity in mathematics learning:

The right to gain access and participate in education, as well as to benefit from gender-sensitive and gender-responsive educational environments and to obtain meaningful education outcomes that ensure that education benefits translate into greater participation in social, economic and political development of their societies. (p. 21)

In Africa, the interest in promoting gender equity in education, leadership, and employment opportunities was manifested by the African Union in Mozambique under the framework of the United Nations (see African Union, 2003). The special protocol of the African Union on the rights of women, encourages all African governments members of the union to invest strong and concerted efforts and resources towards the empowerment of women through the elimination of all forms of gender inequalities in education no later than 2015. One of the goals addressed in the protocol is “promoting education and training for women at all levels and in all disciplines, particularly in the fields of science and technology” (p. 13).

Despite the expressed interest of the African governments to mitigate gender differences in education, the majority of girls in Africa continue to be behind boys in terms of their participation and performance in mathematics, science, and technology (Asimeng-Boahene, 2006). Researchers have suggested that gender stereotyping of

some fields of study and occupations, differential family expectations for girls and boys, and early childhood environments contribute to the persistence of gender differences in educational outcomes in most African schools (Asimeng-Boahene, 2006). Other factors such as the schools' socioeconomic status, and policies concentrated on increasing enrolments rather than equality in achievement have also been used to explain the persistence of patterns of gender inequalities in mathematics achievement in Sub-Saharan Africa (Saito, 2004, 2010). More recently, the United Nations reported that:

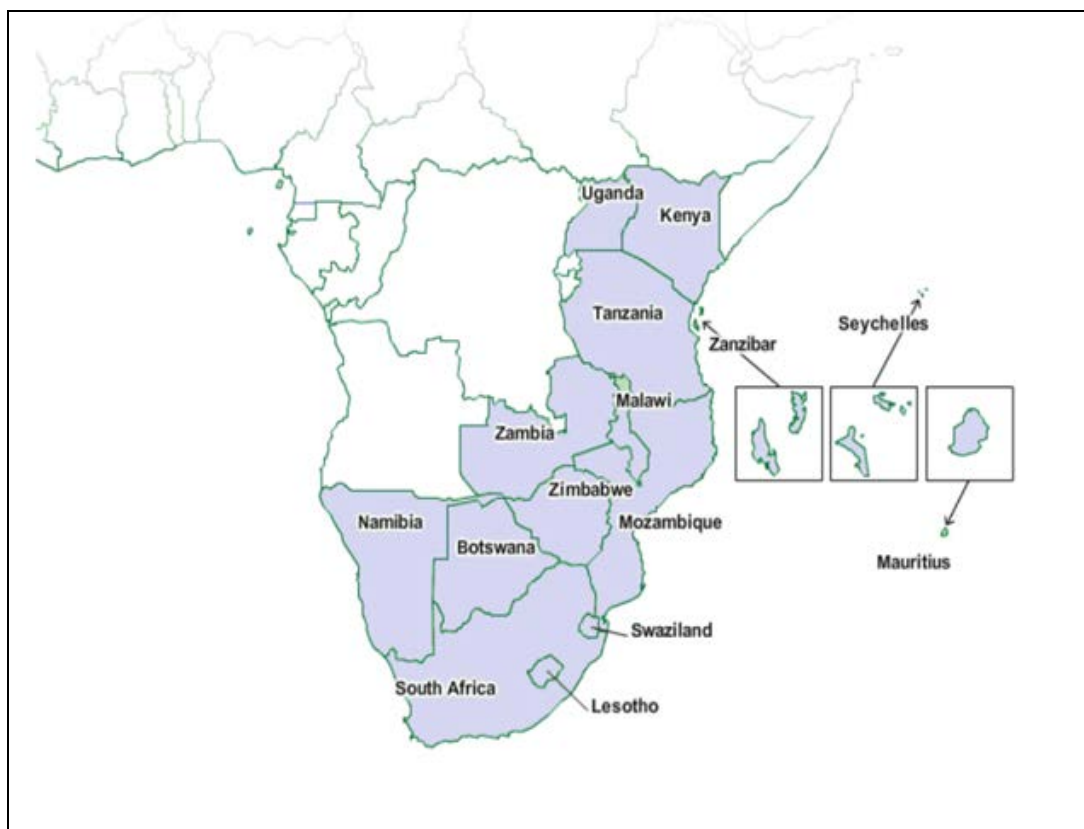
In many countries girls have been narrowing the gaps in these areas of study, but recent evidence from the Southern and Eastern Africa Consortium for Monitoring Educational Quality (SACMEQ) suggests that these gender differences are persisting. (UNESCO, 2012a, p. 106)

The United Nations insisted that the perpetuation of gender differences in mathematics learning in developing countries is reinforced by the shortage of female teachers in schools and the long walking distances to the nearest school. The 2012 year report on gender equality in education (UNESCO, 2012a) indicated that in developing countries female teachers are important as role models for girls and their presence transmits a positive message to girls (and parents) that schools are safe environment for females. The 2012 year report also stated that the long walking distances to school affects students' absenteeism more to girls than to boys.

In the Sub-Saharan Africa, the most comprehensive studies in Mathematics, Reading, and Knowledge of Health Issues commenced in 1995 through the Southern and Eastern Africa Consortium for Monitoring Education Quality [SACMEQ]. SACMEQ is an African initiative aimed at measuring, comparing, and monitoring education quality among Grade 6 pupils from the African countries of the Sub-Saharan region (see Murimba, 2005). The SACMEQ studies are conducted at intervals of four

to six years and involve Grade 6 children and their teachers. Initially, the SACMEQ studies examined children's skills in mathematics and reading only. Due to the prevalence of endemic diseases such as HIV-AIDS in Africa, the more recent studies have included pupils' knowledge of health issues (Murimba, 2005).

With respect to Mathematics, some of the questions tested are adapted from the Trends in International Mathematics and Science Study [TIMSS] and others are prepared specifically for the SACMEQ. As all the other SACMEQ countries use English as the medium of instruction, the mathematics test are translated into Portuguese for Mozambican pupils and into Swahili for pupils in Zanzibar and Tanzania (Saito, 2007). To assist in interpreting and comparing the achievement data of different populations, the SACMEQ also collects the pupils' demographic information, the school infrastructures and facilities, and the professional background of the teachers (Murimba, 2005; Saito, 2007). The country members of the SACMEQ are illustrated in Figure 1.1.



*Figure 1.1.* The SACMEQ member countries  
(Adapted from Saito, 2011, p.1).

In order to demonstrate the trends in gender differences in mathematics achievement among Grade 6 pupils in the Sub-Saharan Africa, a summary of the findings from the last two studies – SACMEQII and SACMEQIII are presented in Table 1.1. The second study was conducted in 2000 and the third study in 2007. It should be noted that Grade 6 is the highest grade of primary education in most countries from the Sub-Saharan Africa and thus the SACMEQ studies are conducted at this grade. Due to the lack of studies involving students from other grades, the research results of Grade 6 students are reported here as revealed by the SACMEQ.



Table 1.1

*Trends in Gender Differences in Mathematics Achievement among Grade 6 Pupils in the Sub-Saharan Africa - From SACMEQII to SACMEQIII*

| Outcome  | SACMEQ II (2000)   | SACMEQ III (2007)   |
|--|--|---|
|  | Countries  |   |
| Girls scored statistically significantly better than boys  | Seychelles   | Seychelles  |
| Boys scored statistically significantly better than girls  | Kenya, Malawi, <b>Mozambique</b> , Tanzania, and Zanzibar                              | Kenya, Malawi, <b>Mozambique</b> , Tanzania, Uganda, Swaziland, and Zambia, |
| No statistically significant gender differences were found | Botswana, Lesotho, Mauritius, South Africa, and Uganda, Namibia, Swaziland, and Zambia | Botswana, Lesotho, Mauritius, South Africa, Namibia, and Zanzibar, Zimbabwe |

Note. The context of this study is highlighted.

(Adapted from Saito, 2010, p. 6).

As can be seen in Table 1.1, the direction of gender differences in mathematics achievement in primary school in the Sub-Saharan Africa varies across countries and fluctuates within some countries. Seychelles is the only country where girls performed better than boys in both studies. In the remaining countries, gender differences were not found or were in favour of boys. In Kenya, Malawi, Mozambique, and Malawi, boys performed better than girls in both studies. No gender differences were noted in the second study in Uganda, Swaziland, and Zambia, but, the advantage of boys in mathematics performance in these countries was obvious in the third study.

Compared to the other SACMEQ countries where the children's achievement had decreased from the second to the third study, Mozambique was the country where it had declined most, for both boys and girls. The following paragraph by the SACMEQ describes the situation and suggests possible reasons:

Between 2000 and 2007, only five SACMEQ countries registered substantial improvements for both reading and mathematics. Mozambique is the only country which registered a substantial deterioration in achievement in both reading and mathematics. This drastic decline of over 40 points was probably linked to rapid structural changes in the education system during this period. These resulted in massive increases in Grade 6 enrolments without corresponding increases in human and material resources. (Makuwa, 2010, p. 4)

In their efforts to understand the reasons that contributed to the degradation of children's achievement in mathematics and reading in Mozambique, Passos, Nahara, and Magaia (2012) examined some primary schools. They noted that with the conversion of lower primary schools (Grade 1 through 5) into full primary schools (Grade 1 through 7) the population of students grew, and consequently, the school conditions worsened. The majority of schools did not have fences and/or toilets. They also found that in 2007 only 27% of the Grade 6 mathematics teachers and 22% of the school principals were women, revealing that the policy oriented at increasing female role models did not produce desirable effects.

In summary, gender differences in mathematics achievement favouring boys persist among Grade 6 pupils in Mozambique. Mathematics achievement among Grade 6 Mozambican pupils had dropped considerably from 2000 to 2007 and the reasons are worth investigating as recommended by the SACMEQ (Saito, 2004, 2010). As noted above, several reasons have been hypothesised such as lack of school facilities, distance to school, shortage of female staff, and socioeconomic status of the schools and families. Thus, in order to gain a better understanding of the contribution of these variables to mathematics education, this study was conducted. Prior to the research questions, the context of the study is described.

## **The Context of the Study**

In order to facilitate the interpretation of the data from this study the context is described in regard to geographic and population data, language policy, the structure of the general education system, the policy towards gender equity in education and its impact, and the affective domain in mathematics learning.

### **Geographic and population data**

Mozambique is a developing country located on the eastern coast of the Sub-Saharan Africa. The country's economic growth is slow, mostly influenced by weak infrastructures inherited from its former coloniser. Poverty and socio economic inequalities are high as indicated by the *Human Development Index* (HDI). Among 187 countries, Mozambique had one of the lowest HDI (0.32) of the world in 2011. That is, Mozambique was only above Burundi, Niger, and Congo (United Nations, 2012).

According to the 2007 Census, the Mozambican population comprises approximately 21 million of whom 52% are females and 48% are males, and about 46% of the population are illiterate (Instituto Nacional de Estatistica, 2011).

There are 11 provinces in Mozambique spread along the coastal line and interior from north to south of the country. These are: Cabo Delgado, Niassa, Nampula, Zambezia, Tete, Manica, Sofala, Inhambane, Gaza, Maputo Provincia, and Maputo Cidade. Maputo is the capital of the country. Beira (one of the contexts of this study) is located in Sofala Province in the central region of Mozambique. It is the second largest city of the country after Maputo. Due to its location, Beira is multilingual as most of its inhabitants come from all over the country and from the landlocked neighbouring countries of Zimbabwe, Malawi, and Zambia.

## Language Policy

Like many African countries, Mozambique is multicultural and multilingual (Ngunga, 2011). Portuguese is the official language and the medium of instruction in Mozambique, and was inherited from the country's former Portuguese colonial masters (1498 –1975). Although Portuguese is the official language, the 2007 Census found that 40% of the population in urban areas, and 80% in rural and remote regions did not speak Portuguese and relied on vernaculars for communication (Instituto Nacional de Estatística, 2011). The main languages of Bantu origin spoken in Mozambique are illustrated in Figure 1.2.



*Figure 1.2.* The main Bantu languages spoken in Mozambique (Adapted from Gerdes, 1993, p. 34).

As can be seen in Figure 1.2, *Sena, Ndau, and Shona* are spoken in the central part of the country. *Ndau* is a variant of *Shona*. There are also several Asian languages (not shown in Figure 1.2) spoken by minority groups together with Portuguese (Lopes, 1998).

## **The Structure of the General Education System**

The formal system of general education in Mozambique follows the model ‘2+3+2+3+2’ as illustrated in Table 1.2. That is, general education is completed after 12 years of formal schooling. Primary education is divided into three cycles of 2, 3, and 2 years. General secondary education is split into two cycles of 3 and 2 years. The transition from one grade to another is promotional within cycles, but to move from one cycle to another the students sit for an examination. According to the government, the policy of free transition (promotion) within cycles serves to ensure that formal assessment takes place after a long period of learning experiences and practice (Ministério de Educação, 2006).

Table 1.2

*The Structure of the General Education System in Mozambique*

| <b>Educational cycles</b>                | <b>Grades</b> | <b>Number of years</b> |
|--|---------------|------------------------|
| Lower Primary Education (First Cycle)    | 1             | 2                      |
|  | 2             |                        |
|  | 3             |                        |
| Lower Primary Education (Second Cycle)   | 4             | 3                      |
|  | 5             |                        |
|  | 6             |                        |
| Upper Primary Education (Third Cycle)    | 7             | 2                      |
|  | 8             |                        |
|  | 9             |                        |
| Lower Secondary Education (Second Cycle) | 10            | 3                      |
|  | 11            |                        |
|  | 12            |                        |
| Upper Secondary Education (Second Cycle) | 13            | 2                      |
|  | 14            |                        |
|  | 15            |                        |

(Adapted from the Ministério de Educação, 2006).

As shown in Table 1.2, primary education is designed to be completed after seven years of formal schooling and Grade 7 is the highest level of primary education. UNESCO (2012b) indicates that the first seven years of schooling are free and compulsory in Mozambique. Education is free in the sense that there are no school fees and children receive free sets of textbooks at the beginning of each academic year, but, in reality, primary schooling is not compulsory and many school aged children do not attend school due to the shortage of schools and teachers (Bartholomew, Takala, & Ahmed, 2009). The official age to start primary education is 6 years, but, in reality, children start schooling at many different ages, beginning with 6 years and extending to the young adults (Wils, Gaspar, Hellmuth, Ibraimo, Prommer, & Sebastião, 2001).

The 2012 Global Education Digest (UNESCO, 2012b) indicates that although repetition rates have reduced due to practice of automatic promotion within educational cycles, repetitions are still common on transitions from one cycle to another (e.g., from Grade 5 to 6, and from Grade 7 to 8) as most children do not achieve sufficiently in their exams. According to UNESCO, the children more disadvantaged economically, and from rural areas are more likely to dropout or to repeat a Grade than other children.

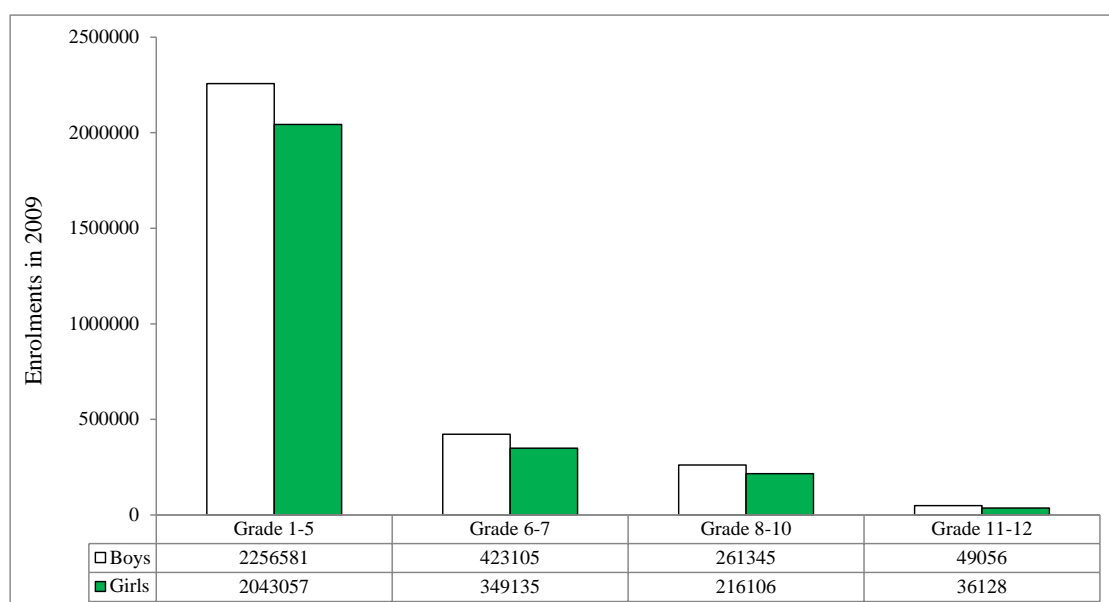
### **Policy towards Gender Equity and its Impact in Education**

Similar to most African countries, Mozambique is a signatory of several international conventions aimed at eradicating gender inequalities, such as the Beijing Platform of Action, The Convention on the Elimination of All Forms of Discrimination against Women, and African Charters on Human and People's Rights (Passos et al., 2012). The creation of the Ministry of Women's Affairs and Social Welfare, and special committees dealing with gender issues in the Ministry of Education, Provincial Directorates of Education, and schools highlights the Mozambican government's commitment towards mitigating gender inequalities in education and other sectors.

Saito (2011) indicated that gender-related policies in education in most SACMEQ countries including Mozambique are focused on increasing girls' access and participation in school. According to this author, enrolments and retention have improved through 'positive discrimination' of girls in education.

Gender equity in education in Mozambique is viewed by the government not only as a human right, but also as a way to eliminate poverty, disease, and malnutrition (Passos et al. 2012). However, the SACMEQ data reveal that girls continue to be disadvantaged in terms of their achievement in mathematics and reading (Saito, 2004, 2010).

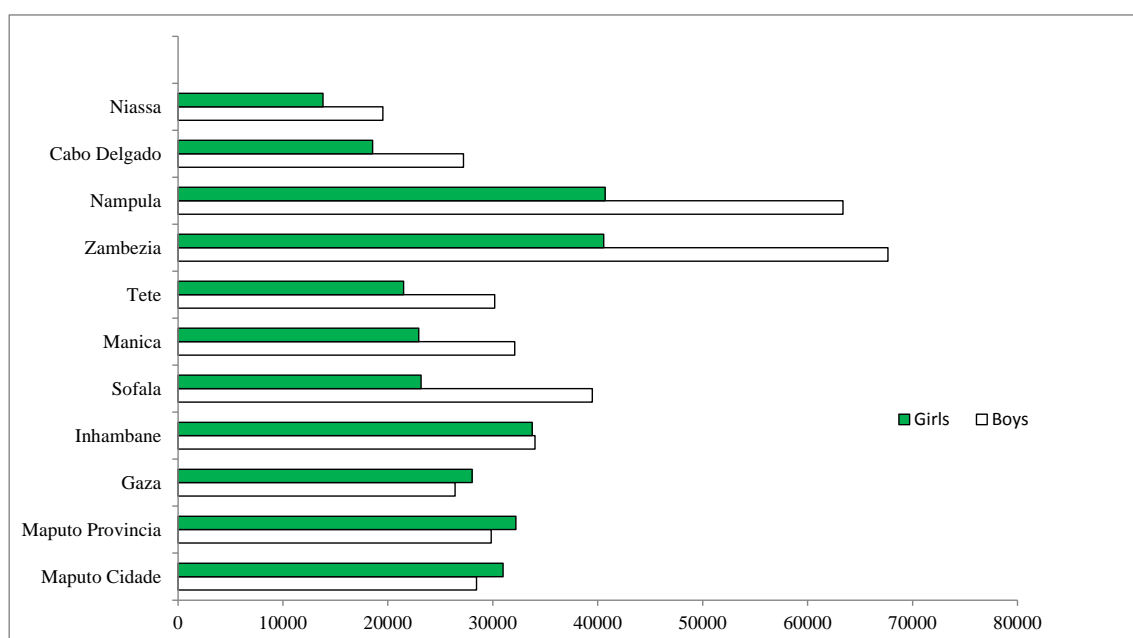
Analyses of several data sets from the Ministry of Education database show that policies towards gender equity in education may not have had a desirable impact. For example, Figure 1.3 shows the pupils' enrolments by gender and level of education in general public schools in 2009.



*Figure 1.3.* Enrolment by grade level, and by gender in general public schools in 2009 (Data from the Ministério de Educação, 2010)

As can be seen in Figure 1.3, while the children's participation in lower primary education (Grades 1-5) was high in 2009, there were fewer children in Grades 6 and 7. Analyses of the enrolment trends (not shown in Figure 1.3) show that fewer boys and girls progress to the upper ladder of primary education and this trend is stable over the years (see Ministério de Educação, 2010).

Figure 1.4 shows gender disparities in enrolments in upper primary education (Grade 6-7) by Province from north (Niassa) to the south (Maputo Cidade) of the country in 2008.



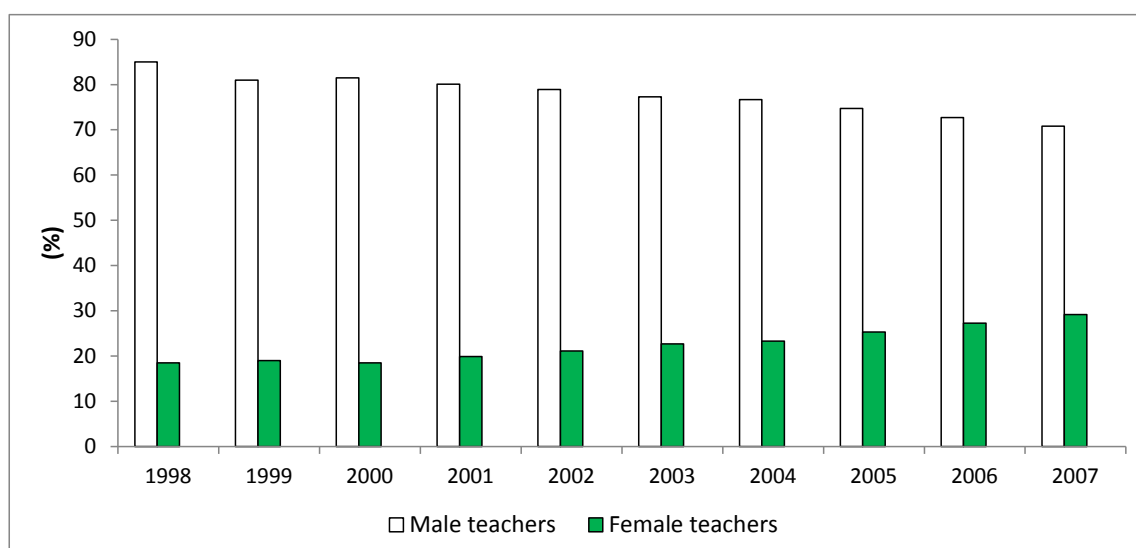
*Figure 1.4.* Enrolments in public schools in 2008 by province, and by gender (Grade 6 and 7). (Data from the Ministério de Educação, 2008a, 2010)

Although the level of statistical significance is not provided, it can be seen in Figure 1.4 that gender differences in access to upper primary education (Grades 6 and 7) are larger in the northern and central provinces of Mozambique. In the south provinces of Inhambane, Gaza, Maputo Provincia and Maputo Cidade, the trend is having fairly equal numbers of boys and girls, or more girls than boys, in school. It is worth noting that, compared to the south, there are less physical infrastructures and the majority of



people are poorer and have less education in the central and northern provinces of Mozambique (Sousa, 2002).

As indicated earlier in this chapter, UNESCO (2012a) perceives female teachers as important in the education of girls due to their role as models and by conveying messages to girls that school is a female friendly environment. In order to determine whether the number of female staff teaching at upper primary education is increasing, the data from the ministry of education were examined. Figure 1.5 shows the percentages of male and female teachers assigned to teach at upper primary education over a period of ten years.



*Figure 1.5.* Male and female teachers in Grade 6 and 7 from 1998 to 2007  
(Data from the Ministério de Educação, 2008a, 2010)

As can be seen Figure 1.5, there have consistently been more male teachers than female teachers teaching at upper primary education in Mozambique. From 1998 to 2007, the gender gap favouring male teachers had just decreased from 67% to 42%. This suggests that despite the interest of the ministry of education, gender equity in teacher education was not achieved.

## **The Affective Domain in Mathematics Learning in Mozambique**

In Mozambique, the mathematics curriculum for primary education indicates that the formation and development of positive affect towards mathematics is one of the core objectives of the mathematics education (Ministério de Educação, 2008b). Thus, alongside the cognitive objectives, the Ministry of Education addressed eight mathematical-related affective goals. It stipulates that all pupils from Grade 6 and 7 must:

- Appreciate and understand the value and place of mathematics in the world and its use in other fields;
- Be interested and persist in the solution of difficult mathematics problems;
- Be interested and hold positive beliefs and attitudes towards mathematics as human knowledge and towards learning this knowledge;
- View mathematics as a useful working tool;
- View mathematics as part of our cultural roots;
- View mathematics as a tool that helps us to think clearly and to reason better;
- View mathematics as a subject that has universal properties; and
- View mathematics as intrinsically beautiful as a logical and formal construction.

(Ministério de Educação, 2008b, pp. 376-378: Ttranslated from Portuguese by the researcher)

The aspirations of the Ministry of Education in Mozambique in regard to the affective factors in mathematics education are legitimate for various reasons. Reyes (1984), for example, indicated that students who hold positive beliefs and attitudes towards mathematics tend to achieve at a higher level and to enjoy their experiences in mathematics more than the students who do not. Leder and Forgasz (2002b) reiterated

that “cognitive as well as affective factors - such as attitudes, beliefs, feelings, and moods - must be explored if our understanding of the nature of mathematics learning is to be enhanced” (p. 95).

Despite acknowledging the importance of the affective domain in mathematics, the curriculum for primary education in Mozambique does not indicate how those objectives will be achieved. Also, while some authors have explained gender differences in mathematics performance using differential affect towards mathematics learning between females and males, the curriculum documents in Mozambique do not make any reference to gender or to the influence of parents, cultural factors, or socio economic status. The lack of reference to equity and diversity issues in the mathematics curriculum may suggest to the teachers who use them that all children have similar difficulties, potentials, and needs.

While the curriculum indicates how and when the learning of the mathematical content (cognitive domain) will be assessed, it does not say how and when to evaluate affect. Mullis et al. (2008) pointed out that if affective variables in mathematics learning are valued in education, then their progress should be monitored constantly and teachers should be made accountable of the students’ affect.

In Mozambique, although affective factors in mathematics learning have been formulated in the official curriculum introduced in 2004 (Ministério de Educação, 2008b), there is scant research on them. Some of the few studies that investigated the affective domain and gender issues in mathematics education were focused on secondary school students (e.g., Cassy, 2003; Fagilde, 2002). In primary education the studies were focused on performance of Grade 6 pupils (Saito, 2004, 2010), analysis of the depictions of females and males in mathematics textbooks for Grades 6 and 7

(Murimo & Forgasz, 2007), examination of school conditions and their impact in educational outcomes (Passos, Nahara, Magaia, & Lauchande, 2005), and evaluation of gender-related policies in schools (Passos et al., 2012).

Thus, in order to address the research gap, a study was conducted in Mozambique with the purpose of understanding some of the factors related to affect of students towards mathematics education in primary schools. The research questions that were addressed are presented next.

## **Research Questions**

The main research question of this study was:

*What are the relationships between Grade 7 students' beliefs and attitudes towards mathematics learning and parents' views, and family circumstances? Are there gender differences?*

To answer the main research question, nine subsidiary research questions were examined in detail. These are:

1. Are there gender differences in children's educational and occupational aspirations? Are parents' educational and occupational aspirations for their children based on the gender of the child?
2. Are there gender differences in self-perceived achievement in mathematics and other school subjects among Grade 7 students? Are parents' perceptions about their children's achievement levels based on the gender of the child?
3. Are Grade 7 boys more confident in learning mathematics than Grade 7 girls?
4. Do boys and girls differ in terms of their perceived usefulness of mathematics? How do students' perceptions of the usefulness of

mathematics compare with parents' perceptions of the usefulness of mathematics for their children?

5. Which selected parental background variables, economic resources, and cultural factors are the best predictors of children's perceived achievement, confidence, and perceived usefulness of mathematics?
6. What is the level of parental involvement in the education of their children?
7. What are the most salient causes that boys and girls attribute to their successes and failures in mathematics? What are the most salient reasons that parents attribute to the successes and failures of their daughters and sons in mathematics?
8. Do Grade 7 males and females, and parents gender stereotype mathematics learning as a male domain?
9. What are the parents' and school principals' views about mathematics learning for girls and boys, and parent involvement in the education of their children?

As can be seen from the subsidiary research questions, parents' views (and practices) refer to their educational and occupational aspirations for their children, perceived achievement and usefulness of mathematics for their offspring, attributions, gender stereotyping of mathematics, and involvement in education.

Family circumstances refer to the educational background and occupation of parent, number of siblings, home language, geolocation, and possession of economic resources. Gender differences in this study were examined in terms of male versus female students, fathers versus mothers, and parents of sons versus parents of daughters.

It should be noted that although gender differences in mathematics achievement have been reported among Grade 6 pupils in Sub-Saharan Africa, this study focused on

Grade 7 students. This is because Grade 7 is the highest Grade of primary education in Mozambique, and the pupils undertake a national examination before moving into secondary education. Passing this examination determines whether students move into secondary education or not. Thus, Grade 7 was selected in order to determine the level of affect towards mathematics that the children may have developed during primary education and that they will carry with them into secondary schooling.

## **Thesis Overview**

This thesis contains seven chapters. In Chapter 1, the context of the study was described including the status of gender differences in mathematics achievement among Grade 6 children in Mozambique. Gender disparities in school participation were described by Province. The research questions were presented and the reason for conducting this study in Grade 7 was also provided.

A review of literature relevant to this study is presented in Chapter 2. First, a distinction between the terms gender and sex is provided including the reason for using the terms gender and gender differences instead of sex and sex differences. Second, selected components of the affective domain in mathematics education are reviewed (e.g., beliefs, attitudes, and emotions) with emphasis on their relationship with gender differences in mathematics learning outcomes. Third, common methods used to measure affect are described. Finally, a model of parent socialization of children's attainments is described.

In Chapter 3, some theoretical explanations of gender differences in mathematics learning are described. Also presented in the same chapter is a psychological model of achievement, attitudes, and behaviours.

The methodological issues of the study are presented in Chapter 4. First, the research problem and research questions are restated. The philosophical worldviews,

research methods, and descriptions of the sample and procedures used to recruit participants and administer surveys and interviews are included.

In Chapter 5 the results of the surveys are presented and discussed. The interview data with parents and schools principals are presented in Chapter 6.

An overview of the context of the study, a summary of the literature, and the main findings are presented in Chapter 7. Also included in chapter 7 are the main conclusions from the study, implications for government policy, for teacher education and development, and for mathematics teaching, and the directions for future research.

## **Summary of Chapter 1**

In this chapter, the persistence of gender differences in mathematics achievement in favour of boys among Grade 6 pupils in Mozambique was demonstrated using the data from the SACMEQ studies (Saito, 2004, 2010). Gender disparities in enrolments favouring boys in the northern and central provinces of the country were also noted. The goals of the affective domain stipulated in the national mathematics curriculum for Grades 6 and 7 were highlighted. It was indicated that in contrast with the cognitive domain, the curriculum does not address equity issues and does not indicate how affective factors will be taught and monitored. Also, the curriculum does not make references to the role of parents on children's education. Thus, due to scarcity of research on these issues in Mozambique, one main research question, and 9 subsidiary research questions were formulated in this chapter.

In Chapter 2, literature that was pertinent to the research questions is reviewed.

## **Chapter 2**

### **Literature Review**

In this chapter, an overview of literature relevant to this study is presented. First, a distinction between the terms *gender* and *sex* is established to prevent confusion, and to emphasise that cultural factors were examined in this study rather than the innate biological characteristics of the learner. Second, the notion of the affective domain in mathematics education is described, as it constituted the basis of the study. Then, in turn, selected components of the affective domain that were critical to the research questions are discussed with an emphasis on their relationships with gender differences in mathematics learning. Finally, the model of parents' socialisation of children's educational attainments proposed by Eccles and her collaborators (Eccles, 2005) is described. Thus, Chapter 2 provides the foundation for the epistemological framework that helps to understand, explain, and theorise the data presented and discussed in Chapters 5 and 6 of this thesis.

#### **Definitional Issues: Gender versus Sex**

When psychologists describe something as gendered or talk about gender differences, there is about a 50% chance that readers will assume that they are referring to sex and about 50% chance that readers will question what they mean. (Pryzgoda & Chrisler, 2000, p. 566-567)

The quotation presented above illustrates that the terms 'gender' and 'sex' require explanation to avoid misunderstanding. As a matter of fact, in their study of people's definitions of the terms 'gender' and 'sex' involving more than 100 people from different social and academic backgrounds, Pryzgoda and Chrisler (2000) found that there were several understandings and beliefs about these two terms. Some respondents viewed gender as a "flexible phenomenon, which may change in accordance with a



person's experience and is not determined by biological sex" (p. 565). Others tended to associate the term gender with women wearing certain kinds of clothes, restroom signs, women's studies, and discrimination against women.

According to Muehlenhard and Peterson (2011), the distinction between 'gender' and 'sex' began with the study conducted by Money, Hampson, and Hampson (1955). Money's et al. (1955) study involved 76 patients with ambiguous biological sexes. Money and his colleagues classified the subjects into three main groups. The groupings were based on (i) anatomical structure and physiological characteristics: that is by "chromosomal sex, gonadal sex, hormonal sex and secondary sexual characteristics, internal accessory reproductive structures, and external genital morphology"; (ii) childhood socialisation: that is by "assigned sex and sex of rearing", and (iii) psychological characteristics: that is by "gender role and orientation as male or female, established while growing up" (p. 302). This classification indicates that Money and his co-workers distinguished the natural and immutable characteristics of their patients from assumed cultural traits considered appropriate for men and women.

After identifying sex and gender-related characteristics, Money et al. (1955) indicated that sex of assignment, and sex of rearing have more influence than biological sex on gender roles and orientations as males or females. They arrived at this conclusion after observing that some of their patients behaved as males or females and reported being males or females despite the contradiction between the reported gender and their biological sex attributes.

Nowadays, most feminist psychologists associate the term *sex* with innate characteristics of the person, and *gender* with behavioural and psychological traits (Etaugh & Bridges, 2010; Helgeson, 2005). The World Health Organisation [WHO]

(2010) also describes sex as “biological and physiological characteristics that define men and women” and gender as “the socially constructed roles, behaviours, activities, and attributes that a given society considers appropriate for men and women” (p. 1). Similarly, the 6<sup>th</sup> edition of the *Publication Manual of the American Psychological Association* (APA, 2010) recommends that gender “is cultural and is the term to use when referring to women and men as social groups” (p. 71). It should be noted that the APA manual does not forbid the use of the term ‘sex’ in its publications but it recommends to use this term only when biological distinctions among the research participants are relevant to the study.

In this study the terms *gender* and *gender differences* are used instead of *sex* and *sex differences*, respectively. These terms are used to stress that the study focused on the role of psychological and socio-cultural factors influencing children’s beliefs and attitudes towards mathematics education rather than on innate (biological) attributes.

## **Affective Domain in Mathematics Education**

Learning mathematics is a cognitive endeavor. Yet, in mathematics, as in other fields, affect can play an important role in students’ decisions about how much mathematics they will need in the future and how they approach the mathematical content they do study. (Reyes, 1984, p. 558)

DeBellis and Goldin (1999) viewed the affective domain as a “highly structured system that encodes information, interacting fundamentally and reciprocally with cognition” (p. 249). McLeod (1992) conceptualized the affective domain in mathematics education as including three components: beliefs, attitudes, and emotions. Anderson and Bourke (2000), and DeBellis and Goldin (1999) added that value, interest, aspirations, anxiety, locus of control, self-efficacy, and self-esteem are also components of the affective domain.

On the other hand, Buxton (1981), and Else-Quest, Hyde, and Hejmadi (2008) examined affect in mathematics in terms of the feelings and emotions that students experience during mathematical activities. These authors revealed in their study that positive emotions (e.g., interest, humour, joy, and pride) were associated with better performance, while negative emotions (e.g., anxiety, tension, frustration, distress, and panic) were related to poor performance. Reciprocal relationships between affective factors and achievement in mathematics have also been suggested in the literature (Ma, 1997).

Grootenboer (2003), Grootenboer and Hemmings (2007), Hemmings, Grootenboer, and Kay (2011), and Leder and Forgasz (2002a, 2008, 2010, 2011) have focused their studies on yet another dimension of affect – beliefs and attitudes towards mathematics learning.

Similar to many other components of the affective domain, beliefs and attitudes do not have consensual definitions, and sometimes are used interchangeably in the literature (see Furinghetti & Pehkonen, 2002, for a review of definitions). To illustrate, Leder and Forgasz (2002b) pointed out that “in everyday language, the term ‘belief’ is often used loosely and synonymously with terms such as attitude, disposition, opinion, perception, philosophy, and value” (p. 96).

With respect to mathematics, McLeod (1992) conceptualized beliefs as the individuals’ subjective knowledge (a) about mathematics, (b) about self, (c) about mathematics teaching, and (d) about the social context where mathematics learning takes place. Similarly, Op’tEynde, De Corte, and Verschaffel (2002) viewed beliefs in mathematics education as “the implicit or explicit ... subjective conceptions students hold to be true about mathematics education, about themselves and mathematicians, and

about the mathematics class context” (p. 27). Lester, Garofalo and Kroll (1989) described a belief as “an individual’s understandings and feelings that shape the ways that the individual conceptualizes and engages in mathematical behavior” (p. 77). As can be seen, all these descriptions have in common the notion that beliefs in mathematics are ‘personal truths’, the view that beliefs are propositions to which a person attributes veracity regardless of the point of view of other people.

As a matter of fact, Abelson (1979) distinguished beliefs from knowledge using three principles:

- (i) *Non-consensuality* – to mean that different people may hold different beliefs about the same psychological object, institution or idea;
- (ii) *Variability of the degree of conviction* – to mean that beliefs are held with varying degrees of certainty: that is, people may agree from less strongly to very strongly with their own perceptions or with the perceptions of others, and
- (iii) *Evaluative and affective nature* – that is, beliefs are evaluated in terms of good/bad, positive/negative, desirable/undesirable, favourable/unfavourable, or acceptable/unacceptable.

Di Martino and Zan (2010) identified three different characterizations of an attitude based on the number of dimensions that they incorporate: One-dimensional (e.g., an attitude viewed as a predisposition to respond favourably or unfavourably to a psychological object, idea, or institution); Two-dimensional (e.g., an attitude viewed as a fusion of the emotional experiences the student has about a topic and the beliefs about the nature of the topic); Three-dimensional (e.g., an attitude viewed as possessing cognitive traits (beliefs, knowledge), affective factors (emotions, motivation), and performance (behaviour, action).

Leder and Forgasz (2002b) observed that terms such as beliefs, attitudes, emotions, perception, opinion, and disposition are difficult to define or to distinguish from each other because they refer to ideas that “are not directly observable and have to be inferred, and because of their overlapping nature” (p. 96). To help differentiate these terms, McLeod (1992) used what he designated levels of intensity of affect and cognition, degree of stability, and the amount of time they take to develop. Specifically, McLeod stated that:

Beliefs and attitudes are generally stable, but emotions may change rapidly. They also vary in the level of intensity of the affect that they describe, increasing in intensity from “cold” beliefs about mathematics to “cool” attitudes related to liking or disliking mathematics to “hot” emotional reactions to the frustrations of solving nonroutine problems. Beliefs, attitudes, and emotions also differ in the degree to which cognition plays a role in the response, and the time that they take to develop. (p. 578)

Formulating the distinction in another way, MacLeod (1992) indicated that beliefs, attitudes, and emotions are individuals’ traits that variously represent “increasing levels of affective involvement, decreasing levels of cognitive involvement, increasing levels of intensity of response, and decreasing levels of response stability” (p. 578).

Abelson (1979), and Furinghetti and Pehkonen (2002) indicated that beliefs can be developed consciously through experiences with other people during the process of socialisation. Many beliefs, however, are acquired spontaneously and without conscious effort and are activated by stimuli (Ajzen, 2001). In regard to beliefs developed through external sources, Aiken (1970) emphasised the role of parents. He indicated that, similar to teachers, parents influence their children’s beliefs through “parental expectations of child’s achievement, parental encouragement, and parents’

own attitudes” (p. 565). This view is also defended by the Eccles’ Expectancy-Value model (Eccles et al., 1983), which is discussed in Chapter 3 of this thesis.

According to Ajzen (2001) people’s beliefs and attitudes can be modified, but although new beliefs and attitudes may prevail, they do not completely eradicate the former ones. He points out that people may have dual beliefs about the same psychological object, but only one will be explicitly reflected in the attitude. To illustrate the plurality of people’s beliefs, Ajzen gave the example of respondents who provided different evaluations of the same object on different occasions. Thus, Ajzen agrees that people are able to form many different beliefs about the same objects, ideas, or situations but only those beliefs that are readily accessible in memory are activated in the presence of stimuli, and these have the potential to trigger an attitude.

Consistent with the research literature outlined above, in this study the affective domain in mathematics education was viewed as incorporating a variety of components such as beliefs, attitudes, emotions, task-values, aspirations, interests, and self-perceptions of competence in a subject area.

Beliefs are important in mathematics education because they activate attitudes and emotions that influence cognitive processes (De Corte, Verschaffel, & Op’t Eynde, 2000). Also, in his theory of mathematics learning as a problem solving domain, Schoenfeld (1992) insisted that to be successful in mathematics, students need to possess positive beliefs and functional behaviours (e.g., disposition, metacognition, and self-regulation skills) apart from having knowledge of the mathematical concepts and algorithms.

The literature proposes several sub-components of the affective domain that influence mathematics-related cognitive processes (see McLeod, 1992). The sub-

components of the affective domain that were of particular interest to this study are discussed next.

### **Confidence in Learning Mathematics [CLM]**

In mathematics education the term ‘confidence’ is related to “what one is willing to attempt” (Fennema & Sherman, 1976, p. 4). More explicitly, Fishbein and Azjen (1975) described mathematical confidence as the individual’s belief of whether the person is able or unable to learn mathematics. Parsons, Croft, and Harrison (2009) distinguished three domains of mathematical confidence: (i) Overall confidence in mathematics; (ii) Topic confidence; and (iii) Applications confidence. These authors viewed the overall confidence in mathematics as the individual’s belief that the person can do well in any topic of mathematics. They called topic confidence the perception that the person can do well on a specific topic of mathematics for example, ‘fractions’ or ‘geometry’. Applications confidence refers to the individual’s belief that the person can apply mathematical knowledge and skills currently and in the future, for example, in a workplace. Parsons et al. (2009) distinguished these three forms of confidence on the grounds of differences in their stability. For example, they argue that the person’s overall confidence in mathematics develops slowly and is difficult to change. The students’ topic confidence, on the other hand, is unstable and thus easily modifiable. For example, topic confidence may increase or decrease after a lesson on the topic.

Researchers found that low overall confidence in mathematics is associated with feelings of anxiety, lack of effort, and avoidance of studying high level mathematics (Fennema & Peterson, 1985; Fennema & Sherman, 1976); past performance (Kloosterman, 1990; Tartre & Fennema, 1995); self-concept of ability (Antunes & Fontaine, 2007); technology used in contemporary mathematics classrooms such as

calculators and computers (Attewell & Battle, 1999); cultural factors, classroom environments, and peers (Jorgensen & Niesche, 2008).

The importance of confidence in learning mathematics derives from the fact that it influences the quality of learning and decisions to enrol in non-compulsory high level mathematics courses and related fields (Simpkins, Davis-Kean, & Eccles, 2006; Watt, 2006, 2007, Watt, Eccles, & Durik, 2006).

Despite confidence being important in education, researchers indicated that girls, on average, tend to hold lower levels of confidence in learning mathematics than boys. Girls, on average, tend to be less confident than boys in learning mathematics even when they are performing equally well or better than boys (see Fennema & Sherman, 1977, 1978; Fennema, Carpenter, Jacobs, Franke, & Levi, 1998; Leedy, LaLonde & Runk, 2003).

Kloosterman (1990) related confidence in learning mathematics with two kinds of behaviours typically found among students: *Mastery orientation* and *academic learned helplessness*. He described mastery oriented students as those who are confident in learning mathematics, that is, as students who are not worried so much about failures and assume full responsibility for their own success and failure in mathematics. In contrast, the students with academic learned helplessness are those who hold low confidence in learning mathematics and attribute their success in mathematics to external factors (e.g., good teacher, help, or luck), and failure to the lack of ability. These causal attribution patterns are discussed later in this chapter.

### **Perceived Achievement in Mathematics [PAM]**

Marsh, Craven, and Debus (1991) viewed perceived achievement/competence as one of the dimensions of academic self-concept. Reyes (1984) defined the notion of



perceived achievement as “the individual’s perception of self with respect to achievement in school” (p. 559). Thus, perceived achievement in a subject is an important variable in school because it triggers the confidence, motivation, and engagement required to effectively tackle the subject matter (Covington, 1984). Silverthorn, DuBois, and Crombie (2005) noted that self-perceived achievement of Grade 8 Canadian students in mathematics was positively correlated with their mathematics achievement in Grade 9.

The expectancy value-model proposed by Eccles and colleagues (1983) indicates that perceived achievement can be influenced by past performance, perceived task difficulty, environmental factors, and socializing agents such as parents, teachers, and peers. In their study involving Grade 7, 8, and 11 students, Dermitzaki and Efklides (2001) found that girls were more likely to rate their achievement lower than boys in mathematics, although there were no gender differences on the actual achievement as determined by the academic scores. Jacobs, Lanza, Osgood, Eccles, and Wigfield (2002) found that students’ perceived achievement in mathematics tended to decline with age and grade level. A reciprocal effect between perceived achievement and the actual achievement has also been suggested in the literature (e.g., Antunes & Fontaine, 2007).

### **Perceived Usefulness of Mathematics [PUM]**

Fennema and Sherman (1976) defined perceived usefulness of mathematics as “the students’ beliefs about the usefulness of mathematics currently and in relationship to their future education, vocation, or other activities” (p. 5).

In their expectancy-value theory, Eccles and colleagues (Eccles et al., 1983) indicated that students’ perceptions of task values are reflected through four

dimensions: (1) *Intrinsic or interest value*, (2) *utility value*, (3) *attainment value*, and (4) *cost value* (p. 89-90). They defined intrinsic or interest value as “the inherent, immediate enjoyment one gets from engaging in an activity” (p. 89). Utility value was deemed by them to be “determined by the importance of the task for some future goal that might itself be somewhat unrelated to the process nature of the task at hand” (p. 89-90). They considered attainment value to be “the [perceived] importance of doing well on the task” including “perceptions of the task’s ability to confirm salient and valued characteristics of the self (e.g., masculinity, femininity, competence), to provide a challenge, and to offer a forum for fulfilling achievement, power, and social needs” (p. 89). According to these authors, the cost of a task is influenced by “the amount of effort needed to succeed, the loss of time that could be used to engage in other valued activities, and the psychological meaning of failure” (p. 94).

Using the expectancy-value framework (Eccles et al., 1983), Luttrell, Callen, Allen, Wood, Deeds, and Richard (2010) developed the *Mathematics Value Inventory* [MVI] – a new instrument to measure the perceived usefulness of mathematics [PUM].

Much of the literature shows that gender differences in the perceived usefulness of mathematics are small or non-existent (Fennema & Sherman, 1977, 1978; Tocci & Engelhard, 1991). Other studies have found gender differences in the perceived usefulness of mathematics favouring girls among secondary school students in the USA (Jacobs et al., 2002). These varying results aside, it should be noted that PUM has also been found to influence achievement and career plans (Mullis et al., 2008).

### **Gender Stereotyping of Mathematics [GSM]**

Whether mathematics is stereotyped as a gendered domain depends on the extent to which individuals “believe that mathematics may be more suited to males, to females,

or be regarded as a gender neutral domain” (Leder & Forgasz, 2002b, p. 3). Since the 1970s, Fennema and Sherman (1977) have reported that mathematics is viewed as a male domain by many people. Leder and Forgasz (2008) have argued that the people’s tendency to view mathematics as a male domain has its roots in the western society:

Historically, mathematics has been viewed as the preserve of males - typically white and middle-class. Females are rarely found among those recognized as fertile contributors to the various branches of mathematics. (p. 513)

Gender stereotyping of mathematics as a male domain has been associated with the ‘fear of success’ construct - fear of negative consequences of success in a traditionally male dominated field (see Leder, 1982), and reluctance to study high level mathematics courses and applied fields (Leder, 1992; Leder, Pehkonen, & Töner, 2002). Several studies conducted since the 1970s have revealed that gender differences in mathematics learning outcomes (e.g., participation, achievement, and affect) increase with the magnitude of gender stereotyping of mathematics in the society in question (Fennema & Sherman, 1976, 1977, 1978).

However, in recent years, mixed results about the magnitude and direction of gender stereotyping of mathematics have been reported in the literature (e.g., Brandell & Staberg, 2008; Martinot & Désert, 2007). For example, Martinot and Désert asked French Grade 4 and 7 boys and girls whether they knew about gender stereotyping of mathematics favouring boys; they also determined the children’s gender stereotyping views about mathematics learning. These authors noted that irrespective of the awareness of gender stereotyping, girls in both grades believed they were better than boys, and boys also believed girls were better at mathematics.

Contradicting the French study, another set of European studies found that the Swedish secondary school students aged between 15 and 17 years were more likely to

view mathematics as a male domain than a female or a gender neutral domain, and the oldest students were more likely to do so than the younger ones (Brandell & Staberg, 2008). Also, in a more recent study involving 1244 German students aged from 11 to 17 years, Kaiser et al. (2012) found that the view that mathematics is a male domain increased in strength with age.

Studies conducted in Australia and the USA (Forgasz, Leder, & Kloosterman, 2004; Kloosterman, Tassell, Ponniah, & Essex, 2008) revealed that most students view mathematics as a gender neutral domain. Trends to view females as better at mathematics than males in terms of their performance and affect have also been noted in these countries.

However, in another study involving much younger children (Grades 1-5) in the USA (Cvencek, Meltzoff, & Greenwald, 2011), several implicit and explicit measures of gender stereotyping of mathematics were employed using child appropriate computer games. For example, children were presented in a computer screen with short stories containing mathematical words, and reading words, male and female names, male and female characters, and they were asked to match stories with names and characters. Using this method, Cvencek et al. (2011) demonstrated that the children as young as those in Grade 2 had started to associate mathematics with males and reading with females. These authors suggested that gender stereotyping of mathematics and reading emerge before gender differences in terms of achievement have started to occur.

In one of their most recent surveys in Australia, Leder and Forgasz (2010, 2011) found that despite a long tradition of supporting mathematics learning for females, there were residues of the traditional gender stereotyped views that males are better than females at mathematics among members of the general public. Although many

respondents in the survey rejected the view that gender does have an influence on achievement, there were others who believed males are naturally better than females at mathematics and females are naturally better than males at English.

Kiefer and Shi (2006) examined the impact of negative feedback on students' persistence in the areas in which they are traditionally negatively gender stereotyped. They found that females were more sensitive to negative feedback in a mathematics test than to a verbal test. They also noted that after failing the first tests, females were more interested in taking a second verbal test than a second mathematics test. Males were more sensitive to negative feedback in a verbal test than to a mathematical test, and were more likely to repeat a second mathematics test than a second verbal test. Kiefer and Shi (2006) concluded that in the face of failure, both males or females are less likely to persist in the areas in which they are negatively gender stereotyped than in the areas where they are positively gender stereotyped.

Leedy et al. (2003) explored beliefs and attitudes towards mathematics using a sample of girls and boys talented at mathematics, their mathematics coaches, teachers, mothers and fathers. Consistent with the results outlined above, they found that males tended to gender stereotype mathematics learning as a male domain while females endorsed gender neutral views. In this study the authors also noted that female respondents were more sensitive to the wording of the research items and considered the items unacceptable in contemporary times. In regard to the females' negative reactions and comments to the item wordings the authors pointed out that:

These [Their] comments centered on the idea that the survey was biased and insulting to women, and not accurate for current times. No such comments were written by boys, fathers, or male teachers. Obviously, if mathematics is still viewed as a male domain by men, and girls and women fail to acknowledge the existence of this bias, an unrealistic relationship is set up. (p. 290)

In conclusion, the literature indicates that the traditional view that mathematics is a male domain prevails, and probably more strongly in some countries than in others. The context, age, gender, and ethnicity may influence the gender stereotyping of mathematics.

### **Causal Attributions in Mathematics [CAM]**

Weiner's (1974) view of attribution theory was that, in achievement-related situations, the perceived causes motivating successes and failures fall into one of the four categories: (i) ability; (ii) effort, (iii) task difficulty, and (iv) luck. Later, other researchers have used the terms 'help', and 'environment' in place of luck (see Fennema et al., 1979). Weiner classified these four causes along the dimensions of stability and locus of control using a 2 x 2 matrix as shown in Figure 2.1.

|                  |                 | <b>Locus of control</b> |                 |
|------------------|-----------------|-------------------------|-----------------|
|                  |                 | <i>Internal</i>         | <i>External</i> |
| <b>Stability</b> | <i>Stable</i>   | Ability                 | Task difficulty |
|                  | <i>Unstable</i> | Effort                  | Luck            |

*Figure 2.1.* Weiner's classification of success and failure attributions along the dimensions of stability and locus of control

(Adapted from Weiner, 1974, p. 6).

As can be seen in Figure 2.1, along the dimension of locus of control, ability and effort are seen as internal in relation to the learner (perceiver) because they are personal traits. In contrast, task difficulty and luck are external because their attributes are outside the learner. Along the parameter of stability, the causal attribution categories are classified as stable and unstable with respect to their endurance. Ability and task difficulty have stable properties because they are sustained over time. Effort fluctuates

over time depending on the willingness of the learner to apply more or less effort. Luck is also variable depending on the perceptions of the learner (see Weiner, 1974).

According to Pedro, Wolleat, Fennema, and Becker (1981), one of the most important contributions of the causal attribution theory to education is that the dimensions of locus of control and stability establish the relationship between former successes and failures and expectations for success and failure in similar tasks in the future. Specifically, Pedro et al. (1981) said that:

If an individual attributes an outcome to a stable factor, a similar outcome tends to be expected in the future. If, however, the outcome is attributed to an unstable factor, an individual may have doubt as to whether the prior success or failure will be repeated. If the probability of achieving a successful outcome is uncertain, behavior in that domain is less likely to persist. (p. 209)

According to Kloosterman (1990), the casual attribution theory proposed by Weiner can be used to gauge students' perceived causes for their success and failure in mathematics for two reasons: first, because it has a strong predictive power, and second, because mathematics is a subject that students often know when they are right (success) or wrong (failure). Using these advantageous features, Fennema et al. (1979) developed the *Mathematics Attribution Scale* [MAS] which has been widely used to examine gender differences in causal attributions of success and failure in mathematics.

Research findings on causal attributions in mathematics reveal that females, on average, tend to exhibit more debilitating beliefs than males (Fennema et al. 1979; Pedro et al., 1981). That is, females tend to attribute their successes in mathematics to external and uncontrollable factors such as help from other people or good teacher, and failures to lack of ability. Males, in contrast, tend to attribute their success to internal and stable traits (e.g., ability), and failure to internal and modifiable traits such as lack of effort or time to prepare lessons due to other obligations.

Kloosterman (1990) indicated that the females' causal attribution patterns resembled academic learned helplessness while the males' causal attribution style was aligned with mastery-orientation behaviours.

Researchers have noted that causal attributions in mathematics interact with other affective factors. For instance, Pedro et al. (1981) found that students with high anxiety in mathematics were more likely to perceive ability to be the main cause for successes in this subject. Stipek and Gralinski (1991) examined causal attribution patterns of more than 400 American children from Grade 3 to junior high school and found that girls tended to rate their ability lower than boys, and were more likely to attribute failure to lack of ability; girls were also less likely than boys to attribute success to ability, and to accept that effort is the prime source of success at mathematics.

Mendick (2005) investigated the self-perceptions of ability of 43 students, and found that only four students believed they were good at mathematics. From this study, Mendick suggested that the way students locate themselves in relation to gendered binary oppositions such as good and bad, fast and slow, competitive and collaborative, independent and dependent, active and passive, naturally able and hardworking, real understanding and rote learning, and reason and calculation may have an influence on the students' beliefs about their abilities in mathematics (science) and reading (arts).

*Facilitative/functional causal attribution* (see Meyer & Koehler, 1990) are expressions used to indicate that success in mathematics should be attributed to internal causes of ability and effort, and failures to the lack of effort. The advantages of these causal attribution patterns are that, in the face of failure, the learner can intensify effort until the success is achieved. That is, the facilitative or functional causal attribution construct proposes that the students should believe that they can control their own



achievement either through effort or through perceived ability. In contrast, if the students believe success in mathematics is caused by external forces (e.g., teacher, help, or luck); their expectation to succeed in the subject will be low because they have limited control over them.

## **Public Views about the Nature of Mathematics**

As Dossey (1992) stated, understanding people's beliefs and attitudes towards mathematics instruction may require understanding their conceptions about the nature and the role of mathematics. Leedy et al. (2003) also pointed out that to understand parental practices regarding mathematics education for their children it is also necessary to understand their conceptions about the nature of mathematics in terms of what they think mathematics is.

In his comprehensive literature review, Dossey (1992) identified two main conceptions about the nature of mathematics: "Mathematics as a static discipline developed abstractly", and "mathematics as a dynamic discipline, constantly changing as a result of new discoveries from experimentation and application" (p. 39). Buxton (1981) identified eight conceptions about the nature of mathematics. Mathematics can be viewed as:

- Fixed, immutable, external, intractable, and uncreative;
- Abstract, and unrelated to reality;
- A mystique accessible to few;
- A collection of rules and facts to be remembered;
- An affront to common sense in some of the things it asserts;
- A time-test;
- An area in which judgments not only on one's intellect but on one's personal worth will be made; and

- Concerned largely with computation

(Adapted from Buxton, 1981, p. 115).

Buxton (1981) pointed out that these views contradict problem solving approaches used in mathematics education in contemporary times, and he proposed some alternative views. For example, mathematics may be viewed as:

- Experimental, exploratory and creative;
- Abstract at times but often directly related to the most practical problems;
- Open to all, but (as with all areas of study) to be penetrated more deeply by some than by others;
- A network of consistent relationships, easily remembered when understood;
- Always reconcilable with the internal logic of the mind;
- A contemplative subject requiring concentrated and undivided attention at times but almost never needing to be done in haste;
- An area in which judgments on one's ability should carry no more weight than in other studies; and
- About relationships in general.

(Adapted from Buxton, 1981, p. 116).

Buxton (1981) indicated that negative classroom experiences and external factors contribute to the formation and development of a variety of views about mathematics including the traditional view that mathematics is a 'finished product' comprising concepts and pre-established rules.

The views in regard to the nature of mathematics outlined above were used in this study as a starting point to examine parents' definitions of mathematics.

## **Measuring Affective Factors in Mathematics Education**

Overviews of the methods commonly used to measure affective factors in mathematics education (e.g., Aiken, 1970, 1974; Chamberlin, 2010; Leder & Forgasz, 2002b) indicate that a variety of instruments have been developed over time. However, as Chamberlin (2010) pointed out, most of the early instruments are no longer used today as they were usually designed to measure only one component of affect while modern tools are prepared to capture a variety of affective dimensions at the same time.

When measuring affective factors, reliability and validity of the data are the main challenges (Aiken, 1970, 1974; Chamberlin, 2010). According to these authors, the barrier is that affect is a complex psychological construct composed of sub-components whose attributes are difficult to quantify. With respect to quantification, Chamberlin contrasted ‘affect’ with ‘height’. That is, while there is a consensual unit to measure height (e.g., 1cm), there is no universal unit to measure affect. The second barrier is that affective components have three dimensions (the target of affect, intensity of affect, and direction of affect) and all need to be taken into consideration when measuring affect (Chamberlin, 2010). Leder and Forgasz (2002b) added that affect cannot be assessed directly and thus it has to be inferred from what the person says or does. This method is consistent with the definition of a belief proposed by Rokeach (1968): “A belief is any simple proposition, conscious or unconscious, inferred from what a person says or does, capable of being preceded by the phrase “I believe that ” (p. 113). This definition suggests that beliefs can be tapped through what people say, do, agree or disagree with.

Some of the most popular methods used to measure affective factors in contemporary times are presented in Table 2.1.

Table 2.1

*Methods Commonly Used to Measure Beliefs and Attitudes*

| <b>Method</b>                            | <b>Characteristics</b>  |
|--|---|
| Observation                              | Consists in observing people's actions and behaviours several times and inferring the underlying beliefs and attitudes.   |
| Interview                                | Consists in asking questions of people in regard to their views about an object or idea; from the responses the researcher infers the relevant beliefs or attitudes.  |
| Rating scales/ Likert scales             | Consist of a set of statements about a belief or attitude. The response format may vary from 'strongly disagree' to 'strongly agree'.   |
| Non-scaled questionnaires and checklists | Consist of statements in which the person says 'yes' or 'no', 'approve' or 'disapprove' about the message conveyed by the statement. A belief or attitude is inferred by the researcher using certain guidelines.                 |
| Content analysis of essays               | Consists in asking people to write about a given topic. Then, the researcher defines the units of analysis, for example, full ideas, paragraphs, or words and identifies relevant beliefs and attitudes using certain guidelines. |

[Adapted from Aiken (1970, p. 552-554), and Leder and Forgasz (2002b, p. 98-99)].

Research indicates that observational methods are one of the best ways to tap people's beliefs, emotions, and attitudes towards a certain object, idea, situation, or institution as they occur in their natural context, but this method is relatively expensive as the researcher usually does not know when relevant behaviours will take place (Leder & Forgasz, 2002b). Interviews, particularly non-structured ones, have also advantages

because they may reveal beliefs and attitudes that were not anticipated by the researcher (Aiken, 1970; Leder & Forgasz, 2002b).

As shown in Table 2.1, another common method of measuring affective components is through Likert scales. When using this kind of scale:

An attitude score is obtained by summing the scores for each item on the scale. Ease of administration and scoring of instruments using such items have ensured that this is a commonly used method for tapping attitudes and beliefs. (Leder & Forgasz, 2002b, p. 98)

It should be noted that some Likert-type scales contain positively and negatively worded items, and to ensure interpretability of the scores one type of items need to be reverse-scored to maintain the property of the scale (see De Vaus, 2002; Pallant, 2009). Non-scaled questionnaires or checklists may require one or more choices from several alternatives (Coakes, Steed, & Ong, 2010). Therefore, when using checklists or content analysis techniques, the researcher relies on previously prepared guidelines to determine pertinent beliefs and attitudes (Aiken, 1970; Leder & Forgasz, 2002b).

Research studies involving a substantial number of participants, such as the Trends in International Mathematics and Science Study [TIMSS], have historically relied on Likert scale items. For example, in the 2007 TIMSS study (Mullis et al., 2008), to predict and interpret the achievement results the researchers collected several amounts of affective data. They used three items to determine students' feelings about mathematics (e.g., 'Mathematics is boring'), four items for confidence in learning mathematics (e.g., 'Mathematics is harder for me than for many of my classmates'), and four items for perceived usefulness of mathematics (e.g., 'I need to do well to get the job I want'). To answer these items students had to indicate whether they agreed or disagreed with the idea conveyed by the statement. After that, the researchers computed

an *Index of Positive Affect towards Mathematics* [PATM]. TIMSS used PATM to predict and explain the variation of mathematics achievement scores (see Mullis et al., 2008).

### **Model of Parent Socialisation of Children's Attainments (Eccles, 2005)**

Eccles and colleagues (1983) proposed a general expectancy-value model that is commonly used to understand and explain females' educational and occupational choices (e.g., Eccles, 1994, 2007; Meece, 2006). The general expectancy-value framework (Eccles et al., 1983) is briefly described in Chapter 3 of this thesis.

The model of parent socialisation of children's educational attainments (see Eccles, 2005) that is illustrated in Figure 2.2 is a translation of the general expectancy-value model into the domain of parents. The model explains the way parents and family characteristics influence children's educational outcomes.

Specifically, Eccles (2005) indicated that parents influence their children's achievement-related behaviours "through their roles as models and through their roles as expectancy and value socializers" (p. 127). The model suggests that children imitate and adopt the behaviours of their parents or those of significant others such as grandparents, siblings, and teachers. This kind of learning has been termed *observational learning* elsewhere (Parsons, Adler, & Kaczala, 1982). According to Eccles (2005), observational learning has implications, particularly in terms of perpetuating the beliefs and attitudes of the family. For example, if mothers demonstrate more mathematics anxiety than fathers, then daughters and sons may learn and exhibit attitudes towards mathematics that are consistent with their gender. If parents believe mathematics is the most difficult school subject, unimportant, or

irrelevant for their children and communicate these views to them, the children may adopt similar views.

Figure 2.2 illustrates the model of parent socialisation of children's attainments.

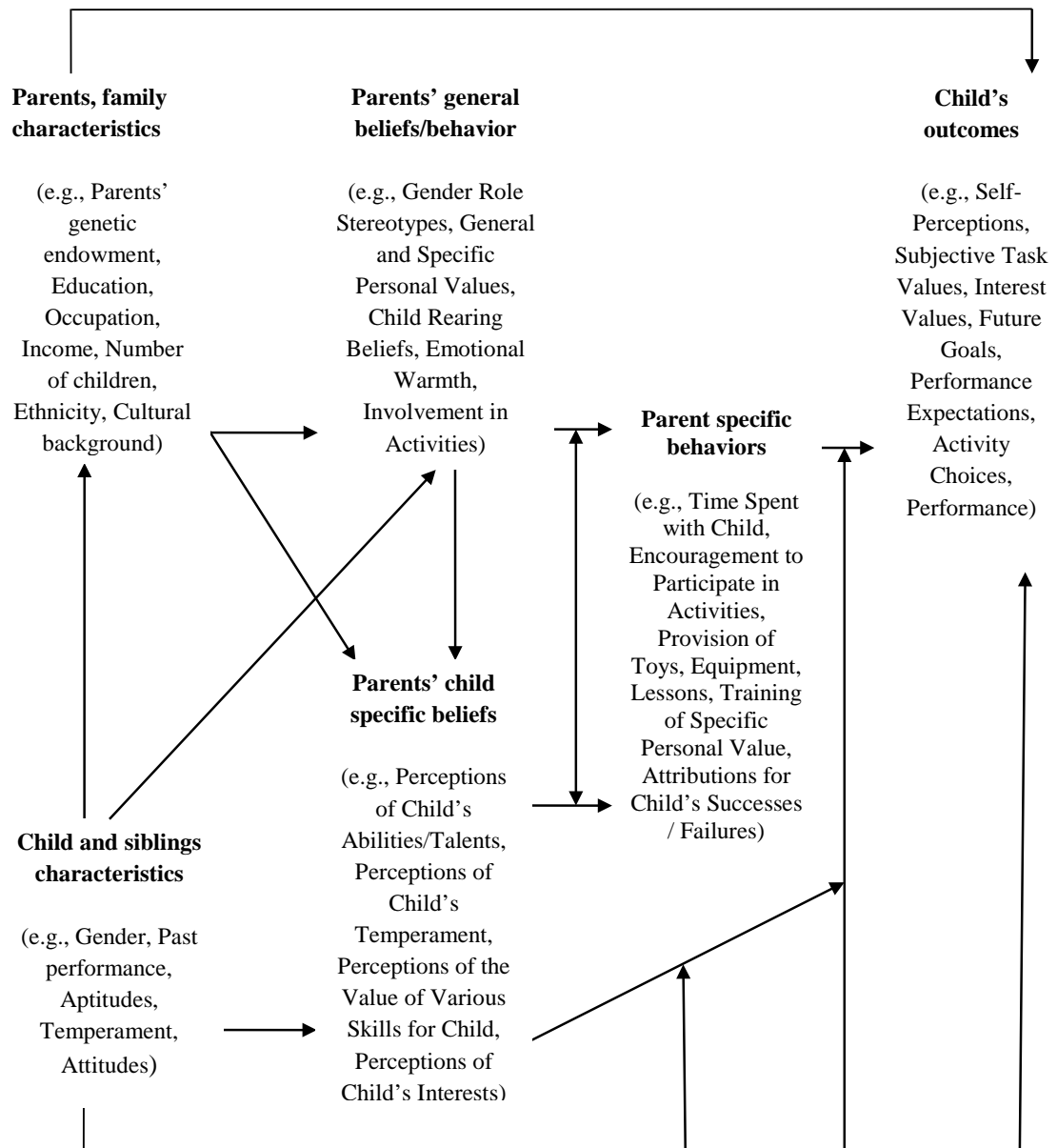


Figure 2.2. Eccles' et al. model of parent socialisation of children's attainment (Adapted from Eccles, 2005, p. 194).

As can be seen in Figure 2.2 the model of parent socialisation of children's attainment suggests that parent and family characteristics, and the child's and siblings'

characteristics influence parents' general and specific beliefs and behaviours towards the education of the child. Parents' expectations and aspirations for their children and their perceptions of how useful a particular task is to them, influence parental investment in the education of their children, and the time they spend helping or encouraging their children to study the subject. Thus, parents' beliefs and behaviours are critical determinants of children's educational attainments such as performance, academic self-concept, task-values and choices.

The model of parent socialisation of children's educational attainments was used in this study because it emphasises the importance of parental education. It was thus viewed as having implications for education in Mozambique as the total adult illiteracy rates in 2007 were 40% in urban areas, and 80% in rural areas (Instituto Nacional de Estatística, 2011).

Research confirms that more educated parents tend to have high educational aspirations for their children, and have the skills to communicate their task-values to their children (Alexander, Entwisle, & Bedinger, 1994). McLoyd (1998) suggested that children of educated parents benefit from educational resources available in their homes and neighbourhood. In contrast, children from less educated parents tend to have less intellectually stimulating experiences in their homes and communities.

Powell, Son, File, and San Juan (2010) noted that parental involvement in education is a positive predictor of children's social and mathematical skills, and a negative predictor of problem behaviours such as bullying, dodging classes, and dropping out.

Using quantitative analysis, Fan and Chen (2001) noted that parental expectations in regard to their children's achievement were more strongly associated with the actual



achievement than parental supervision at home. However, the quality of parental supervision depends on *parenting practices* – the specific behaviours that parents use to socialise their children (Darling & Steinberg, 1993), and *parenting style* – responsiveness to the child's needs and demandingness (Baumrind, 1991).

Manz, Fantuzzo, and Power (2004) described *Parental Involvement in Education* [PIE] using three dimensions: (i) Home-Based Involvement [HBI], (ii) School-Based Involvement [SBI], and (iii) Home-School Communications [HSC]. The HBI dimension of parental involvement in education includes all activities that parents and family members conduct at home with the purpose of increasing the child's educational outcomes. According to Manz et al. (2004), HBI activities can be, for example, helping the child with homework, taking the child to libraries or historical places, or bringing home learning materials such as books, journals, magazines, and video games.

The SBI dimension incorporates activities that parents engage in at school such as attending meetings, participating in the school committee, volunteering to do some work at school, or fundraising for the benefit of the school.

HSC activities consist of all forms of contacts between parents and school, for example, replying to notes from teachers and school principals, or making a phone call to school asking clarification about something that the child said. In regard to parental involvement in education, Nierop (1996) made clear that:

Parents/caregivers are integral participants in the teaching and learning process. Student learning can be maximised if students, parents, caregivers and teachers all have a common understanding of the valued learnings and the range of strategies that are being employed to encourage their development. If we are all pulling in the same direction, we can achieve much more. (p. 5)

Despite the advantages of parental involvement in education, several studies found that economic stress, and neighbourhood contexts (Waanders, Mendez, & Downer, 2007), parental education, occupation, and home language (if different from the medium of instruction) (McWayne, Campos, & Owsianik, 2008; Spera, 2005) may hinder parental engagement in the education of their children.

To get a preliminary understanding of the impact of parental background factors on children's achievement in mathematics, the results of the studies conducted by the *National Assessment Program on Literacy and Numeracy* [NAPLAN] in Australia were examined. The NAPLAN tests in Australia commenced in 2008. Since then, every year all students in Years 3, 5, 7, and 9 are assessed in four strands: numeracy, reading, writing, and knowledge of language conventions. To date, the patterns in the data regarding numeracy are similar for all Year levels. For the purpose of this demonstration, only the data from Year 3 children (numeracy mean scores) are illustrated in Table 2.2. The interest in the NAPLAN data is because they are reported by gender, and parental background variables (e.g., indigenous status, language background, geolocation, education and occupation of parent).

Table 2.2

*The NAPLAN Achievement Results for Australian Year 3 Children in Numeracy by Gender, and by Selected Parental Background Variables*

| Variable name | Levels         | Mean scores/years |       |       |       |
|---------------|----------------|-------------------|-------|-------|-------|
|               |                | 2008              | 2009  | 2010  | 2011  |
| Gender        | Males          | 400.6             | 397.5 | 397.8 | 402.6 |
|               | Females        | 393               | 390.2 | 392.9 | 393.5 |
| Indigenous    | Non-indigenous | 400               | 397.7 | 399.0 | 401.7 |

| Variable name       | Levels   | Mean scores/years |       |       |       |
|---------------------|--|-------------------|-------|-------|-------|
|                     |  | 2008              | 2009  | 2010  | 2011  |
| Status              | Indigenous   | 327.6             | 320.5 | 325.3 | 334.4 |
| Language Background | English  | 396.8             | 393.2 | 395.5 | 398.0 |
|                     | Non-English  | 401.0             | 397.9 | 397.0 | 400.8 |
|                     | Metropolitan   | 402.6             | 400.1 | 401.4 | 404.3 |
| Geolocation         | Provincial   | 388.3             | 383.4 | 384.7 | 386.5 |
|                     | Remote   | 360.0             | 353.6 | 362.1 | 362.1 |
|                     | Very Remote  | 306.2             | 295.9 | 296.4 | 317.6 |
| Parental Education  | Bachelor degree or above   | 425.1             | 430.4 | 431.0 | 433.0 |
|                     | Advanced diploma/diploma   | 398.9             | 400.2 | 399.0 | 400.7 |
|                     | Certificate I to IV  | 383.0             | 382.5 | 382.9 | 384.2 |
|                     | Year 12 or equivalent  | 385.7             | 386.7 | 385.8 | 385.4 |
|                     | Year 11 or equivalent or below   | 360.8             | 358.8 | 357.9 | 358.7 |
| Parental Occupation | Senior management and qualified professionals                          | 421.4             | 428.0 | 429.1 | 431.7 |
|                     | Other business managers and associate professionals                    | 403.6             | 407.2 | 407.9 | 410.1 |
|                     | Tradespeople, clerks, skilled, skilled office, sales and service staff | 386.5             | 388.7 | 389.2 | 391.0 |
|                     | Machine operators, hospitality staff, assistants, labourers            | 373.9             | 373.9 | 374.3 | 376.2 |
|                     | Not in paid work in the last 12 months                                 | 360.5             | 363.6 | 373.6 | 365.5 |

(Adapted from the NAPLAN, 2011).

Although the NAPLAN reports usually do not indicate as to whether differences between groups in terms of their mean scores reach a statistical significance, it can be seen in Table 2.2 that boys tend to have higher mean scores than girls. Non-indigenous children outperform indigenous children. Mean scores decrease with the distance from the metropolitan areas to the more isolated areas of Australia. Parental education and occupation also have strong relationships with achievement scores in numeracy. The children whose parents have a bachelor degree or above tend to achieve better than the children whose parents have Year 12 or below; one exception in the data is that the children from non-English language background have had higher mean scores than the native English speakers. This is possibly because most migrants in Australia in the recent decade needed to be professionals to be granted the visa.

The NAPLAN data is consistent with the 2007 TIMSS data with the exception of the impact of home language on achievement scores. The 2007 TIMSS study involving Grade 4 and 8 students found that:

At both fourth and eighth grades, on average across countries, a large majority of students reported always or almost always speaking the language of the test at home, and these students had higher average mathematics achievement than those who reported speaking it less frequently. Also, students from homes with more books had higher average mathematics achievement than those from homes with fewer books. At the eighth grade, higher levels of parents' education were associated with higher average mathematics achievement in almost all countries. (Mullis et al. 2008, p. 7)

In conclusion, the model of parent socialisation of children's educational attainments (Eccles, 2005), the NAPLAN studies conducted annually in Australia, and the TIMSS studies helped identify variables of interest to examine in Mozambique.

## **Summary of Chapter 2**

In this chapter, the difference between the terms ‘gender’ and ‘sex’ was established, and the rationale for using the terms gender and gender differences was provided. The components of the affective domain in mathematics education that were pertinent to this study were reviewed with emphasis on their relationships with gender differences in mathematics learning outcomes. Apart from gender, a variety of factors influencing students’ affect and performance in mathematics were also identified (e.g., parental education, occupation, home language, and geolocation).

Several methods commonly used to measure affective factors were identified. The advantages of interviews and Likert scales were stressed as these were used to collect data.

The model of parental socialisation of children’s attainments (Eccles, 2005), and the studies conducted by the NAPLAN in Australia, and TIMSS were described as they provided insights and helped orient the way this study was conducted.

In the next chapter, an overview is presented of the main explanations of gender differences in mathematics education that were identified in the literature. Emphasis is placed on explanations revealing factors that are amenable to change through policy and practice rather than those that are immutable (biological) characteristics of the student.

## **Chapter 3**

### **Gender Differences in Mathematics Education: Some Theoretical Explanations**

In this chapter, several explanatory models of gender differences in mathematics education are outlined in order to provide an overview of the perspectives used to examine, and explain gender imbalances in mathematics learning outcomes (e.g., achievement, affective factors, and participation in high level mathematics and related fields). Also presented is a psychological model of achievement, attitudes, and behaviours (Eccles et al., 1983) to illustrate the connection between affective factors and academic performance. A variety of theoretical models was reviewed in this study in order to identify variables that are pertinent to the research questions addressed in Chapter 1 and to the context of Mozambique.

In western countries, particularly Australia and the USA, concerns regarding gender inequalities in mathematics learning outcomes started more than four decades ago (e.g., Australian College of Education, 1977; Fennema & Sherman, 1976; Leder, 1982), and several explanations have been postulated ever since. Leder (1990) indicated that the variety of perspectives and methodologies used to examine gender differences in mathematics education has yielded several explanations but none of them is consensual. However, Leder (1992) noted that in terms of their orientation the existing explanations can be classified as social, psychological, and biological.

Over time, several scholars have used an ‘essentialist’ perspective and tried to identify possible sex-related (biological) characteristics that may explain gender differences in mathematics performance (e.g., Baron-Cohen, 2003; Benbow & Stanley,

1980, 1983; Halpern, 2002; Halpern, Benbow, Geary, Gur, Hyde, & Gemsbacher, 2007).

It should be noted that the discussion about the role of biological sex on gender differences in mathematics learning outcomes has continued over time. For example, Cahill (2005) remarked that despite the fact that in recent decades “investigators have documented an astonishing array of structural, chemical and functional variations in the brains of males and females” (para 2), thus far “no one has uncovered any evidence that anatomical disparities might render women incapable of achieving academic distinction in math, physics or engineering” (para. 2) .

In their review of research on the role of brain on gender differences in mathematics learning, Halpern et al. (2007) indicated that “experience alters brain structures and functioning, so causal statements about brain differences and success in math and science are circular” (p. 1). These authors also acknowledged the role of environmental factors on gender differences in mathematics and science education.

A wide range of sociocultural forces contribute to sex differences in mathematics and science achievement and ability - including the effects of family, neighborhood, peer, and school influences; training and experience; and cultural practices. We conclude that early experience, biological factors, educational policy, and cultural context affect the number of women and men who pursue advanced study in science and math and that these effects add and interact in complex ways. There are no single or simple answers to the complex questions about sex differences in science and mathematics. (p. 1)

Many researchers and mathematics educators have rejected genetic explanations of gender differences in mathematics achievement (e.g., Hanna, 1989, 2003; Hyde & Mertz, 2009; Leder, 1990). One of the reasons is that the focus of biological explanations of gender differences in mathematics learning is the differential spatial

ability between females and males but it has been demonstrated that with training females improve their spatial ability (see Ben-Chaim, Lappan, & Houang , 1988; Ferrini-Mundy, 1987). Linn and Petersen (1985) indicated that gender differences in spatial skills in favour of boys are high in mental rotation, but are small with respect to spatial perception. Friedman (1995) stated that the role of visual ability in mathematics achievement is not fully understood, and its impact on achievement varies between females and males. That is, while spatial skills appear to have a relationship with mathematics achievement for females, it may not be the case for males.

Ben-Chaim et al. (1988) used a sample of more than 1000 students from Grade 5 through 8 to demonstrate that with training gender differences in spatial visualization disappear. Ferrini-Mundy (1987) noted that spatial training had contributed to better achievement for females in certain areas of calculus but the achievement of males who participated in the same training did not improve. Similar results were found using a sample of children as young as 7 years old (Tzurriel & Egozi, 2010).

The lack of unanimity that biological factors are responsible for gender differences in mathematics education is also supported by the fact that the magnitude and direction of gender differences in mathematics achievement vary across countries. Gender differences in mathematics achievement also fluctuate within countries as revealed by the data from large scale international studies (Hanna, 1989, 2003; Hyde & Mertz, 2009). Hanna (1989, 2003) observed that in countries with traditions of supporting mathematics learning for females there are no gender differences or females tend to outperform males.

Although the investigation of the impact of biological sex on gender differences in mathematics learning is important for knowledge, this study takes the position adopted



by Leder (1990) who also rejected biological explanations. Leder noted that most explanatory models of gender differences in mathematics education incorporate factors that are amenable to change rather than stable characteristics of the learner. Hyde and Mertz (2009) also noted that gender differences in mathematics performance are not universal, as:

Their presence correlates with several measures of gender inequality. Thus, it is largely an artifact of changeable sociocultural factors, not immutable, innate biological differences between the sexes. (p. 801)

Using the same perspective, only explanations that focused on variables that are modifiable are considered in this study. The theoretical explanations reviewed are presented alphabetically by the first author's name:

### **Baker and Jones (1993)**

The *gender stratification hypothesis* (Baker & Jones, 1993) claims that gender differences and similarities in mathematics achievement follow the trends of gender stratification of the educational and occupational opportunities of each society. That is, in patriarchal societies, males and females tend to link their achievement to future opportunities and outcomes. As females and males play different roles, therefore, females do not achieve, and do not perceive achievement in male dominated fields (e.g., mathematics, science, technology, and engineering) as being as useful to them as do males. In support of the gender stratification hypothesis, Else-Quest, Hyde and Linn (2010) found that affect and achievement in mathematics were influenced by cultural variations.

## **Eccles et al. (1983)**

Eccles et al. (1983) proposed an expectancy-value theory to explain students' variations in terms of their achievement, persistence, and task choices, including gender differences in these dimensions. Eccles and her colleagues postulated that students' task choices, persistence, and performance are influenced by their beliefs about how well they will perform on the task, and the degree to which they value the activity. On the other hand, the degree to which the students value an activity is influenced by (i) the need for high accomplishment in the task (*attainment value*), (ii) the intrinsic value or interest in the task (*interest value*), (iii) the perceived benefits of the task in the present or for future goals (*utility value*), and (iv) the perceived cost of success and failure in a task (*cost value*).

Specifically, Eccles et al. (1983) described attainment value as “the importance of doing well on the task” (p. 89). These authors believe that the attainment value is strongly influenced by the “perceptions of the task’s ability to confirm salient and valued characteristics of the self (e.g., masculinity, femininity, competence), to provide a challenge, and to offer a forum for fulfilling achievement, power, and social needs” (p. 89).

The interest value refers to the “inherent, immediate enjoyment one gets from engaging in an activity” (p. 89). Utility value refers to the perceived benefits of the activity. According to Eccles et al. (1983), the impact of cost on the value of a task for the person can be influenced by the perceived effort needed to complete the task, perceived loss of other valued alternative tasks, and the psychological effect of success. Counting among the psychological effects is the fear of possible negative reactions of others because one has been successful in a field when not expected to do so.

The expectancy-value framework has been widely used to investigate gender differences in enrolments in optional high level mathematics courses, engineering, and computer science (Eccles, 2007). It has also been used to understand the way teachers and parents influence children's beliefs and attitudes towards mathematics education and careers (e.g., Davis-Kean, 2005; Eccles, 1994, 2005; Eccles & Jacobs, 1986).

### **Ethington (1992)**

Ethington (1992) argued that socioeconomic status (SES), family help, and prior achievement influence gender stereotyping of mathematics, students' perceptions of parents' attitudes and values, academic self-concepts, task difficulty perceptions, expectations of success or failure in a subject, task-choices and achievement in mathematics.

### **Fennema and Peterson (1985)**

Fennema and Peterson (1985) proposed the *Autonomous Learning Behavior* [ALB] model to explain gender differences in high level mathematics learning, such as problem solving. The assumption underpinning the ALB model is that, females will be able to perform like males in mathematics if they engage in autonomous learning behaviours. The authors of the model stress the importance of working independently, solving high-level mathematics problems, persisting in them, and experiencing enjoyment and success in their solution. Thus, autonomous learners are viewed as students who prefer to take full responsibility for their own learning, and prefer to engage in the solution of difficult mathematical problems. The key components of the ALB model are societal influences (family, peers, and media), classroom influences (teachers, peers, interactions, type of mathematics activities), and internal motivational

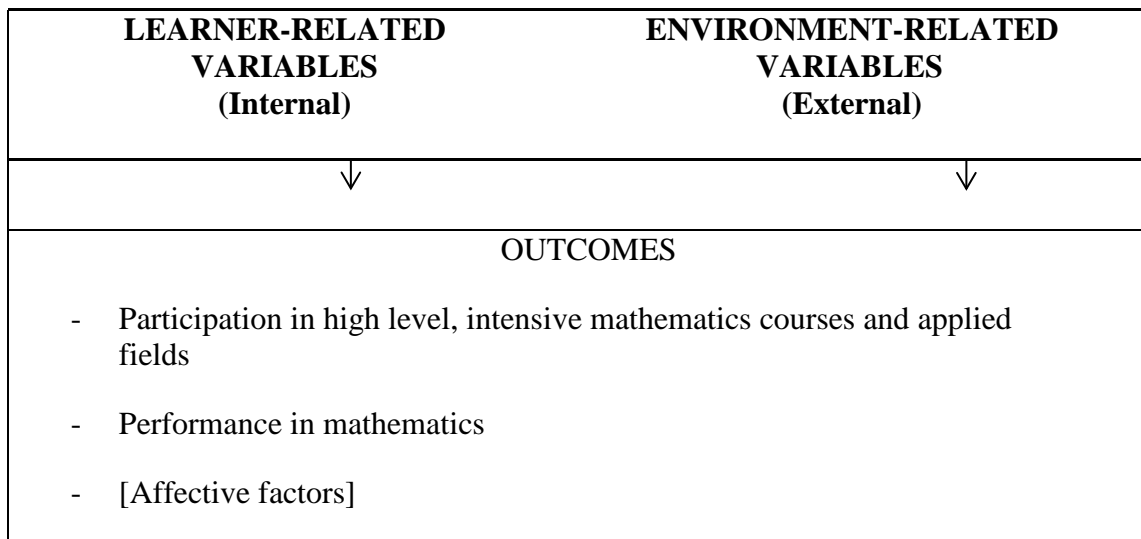
beliefs (confidence, perceived usefulness of mathematics, causal attributions for successes and failures, and gender-role congruency of mathematics).

In her study of the ALB model, Forgasz (1995) found that external and societal factors had an effect on females' and males' engagement in ALB activities, and she argued that "mathematics classrooms which encourage students to engage in ALBs would seem to be more compatible with current views on effective learning of mathematics" (pp. 220-221).

### **Leder (1990)**

Leder (1990) classified into two main groups the variables that play an important role in the formation, development, and perpetuation of gender differences in mathematics learning outcomes: Learner-related variables, and environment-related variables. These variables are illustrated in Figure 3.1.

| <b>LEARNER-RELATED<br/>VARIABLES<br/>(Internal)</b>   | <b>ENVIRONMENT-RELATED<br/>VARIABLES<br/>(External)</b>  |
|---|--|
| <b>Cognitive Development</b> <ul style="list-style-type: none"> <li>- Spatial ability and Verbal ability</li> </ul>   | <b>Society</b> <ul style="list-style-type: none"> <li>- Law, Media, Peers, Cultural expectations</li> </ul>                        |
| <b>Beliefs system</b> <ul style="list-style-type: none"> <li>- Confidence</li> <li>- Sex-role congruence</li> <li>- Usefulness of mathematics</li> <li>- Motivation <ul style="list-style-type: none"> <li>• Attributional style</li> <li>• Fear of success</li> <li>• Learned helplessness</li> <li>• Mastery orientation</li> </ul> </li> </ul> | <b>Home</b> <ul style="list-style-type: none"> <li>- Parents, Socioeconomic status, Siblings</li> </ul>                            |
|   | <b>School</b> <ul style="list-style-type: none"> <li>- Teachers, Organisation, Curriculum, Textbooks, Assessment, Peers</li> </ul> |
| <ul style="list-style-type: none"> <li>• Performance following failure</li> </ul>   | <ul style="list-style-type: none"> <li>- <i>[Plus other factors identified since 1993]</i></li> </ul>                              |



*Figure 3.1. A model of gender differences in mathematics learning outcomes (Italics added. Adapted from Leder, 1990, p. 15).*

As can be seen in Figure 3.1, the first group of variables includes the differential development of spatial and verbal abilities, and beliefs systems. The beliefs system includes confidence in learning the subject, perceived sex-role congruency and usefulness of mathematics, and motivation. These factors are considered internal as they are intrinsic in relation to the learner. The second group of variables includes three categories (society, home, and school), and each category consists of several factors external to the learner.

Although Leder's (1990) model was developed in Australia, it helped immensely to identify factors that are relevant to a developing country. The advantage of the model is that it accounts for variables mentioned in previous models, and stresses factors that are amenable to change when tackled with appropriate policies and practices at school and national levels. In regard to the significance of the model, Leder (1992) stated that:

[The model] emphasizes variables that are most pertinent to educators and which, with increased appreciation of their relationship to the learning of mathematics, should lead to improved classroom practices. (p. 609)

The quotation presented next also acknowledges the value of the model particularly for countries where the factors responsible for or contributing to gender differences in mathematics education have not received substantial attention:

To this day, Leder's (1990) model continues to provide a useful starting point for research on gender issues, particularly for those identifying with liberal feminist theory and Fennema's (1990) three equity principles: equity with respect to access and opportunity, equity with respect to treatment, and equity with respect to outcomes. (Forgasz, 2008, p. 5)

Due to its relevance to the context of Mozambique, Leder's (1990) model of gender differences in mathematics education was used to identify variables that would help address the research questions presented in Chapter 1. However, to understand the relationships between Grade 7 students' beliefs and attitudes towards mathematics and parents' views, and family circumstances the Eccles et al. (1983) model was also considered appropriate.

### **Reyes and Stanic (1988)**

Reyes and Stanic (1988) postulated that socioeconomic status (SES), race, and gender influence achievement on standardized tests, and problem solving in mathematics. They indicated that the combination of low SES with race and gender reinforce group inequalities in mathematics education. The assumption of the model is that the underachievement of minority groups and females in mathematics is largely because of their low SES. Specifically, the authors claim that teachers, curriculum, society, and the media send different messages to different groups of students based on their gender, race, and SES. In turn, the students' academic self-concept, task preferences, and effort are influenced by their perceptions of who they are in terms of gender, race, and SES.

## Villalobos (2009)

Using findings from previous research, Villalobos (2009) indicated that:

Most theories claiming to explain the gender discrepancy in mathematics fall into two basic categories: biological theories of inherent difference, and social theories of gender bias in mathematics. Neither of these theories, which almost universally overlook girls' advantages and seek only to explain why boys are 'better in math' than girls, can adequately explain the complexities in gender and mathematics. (p. 28)

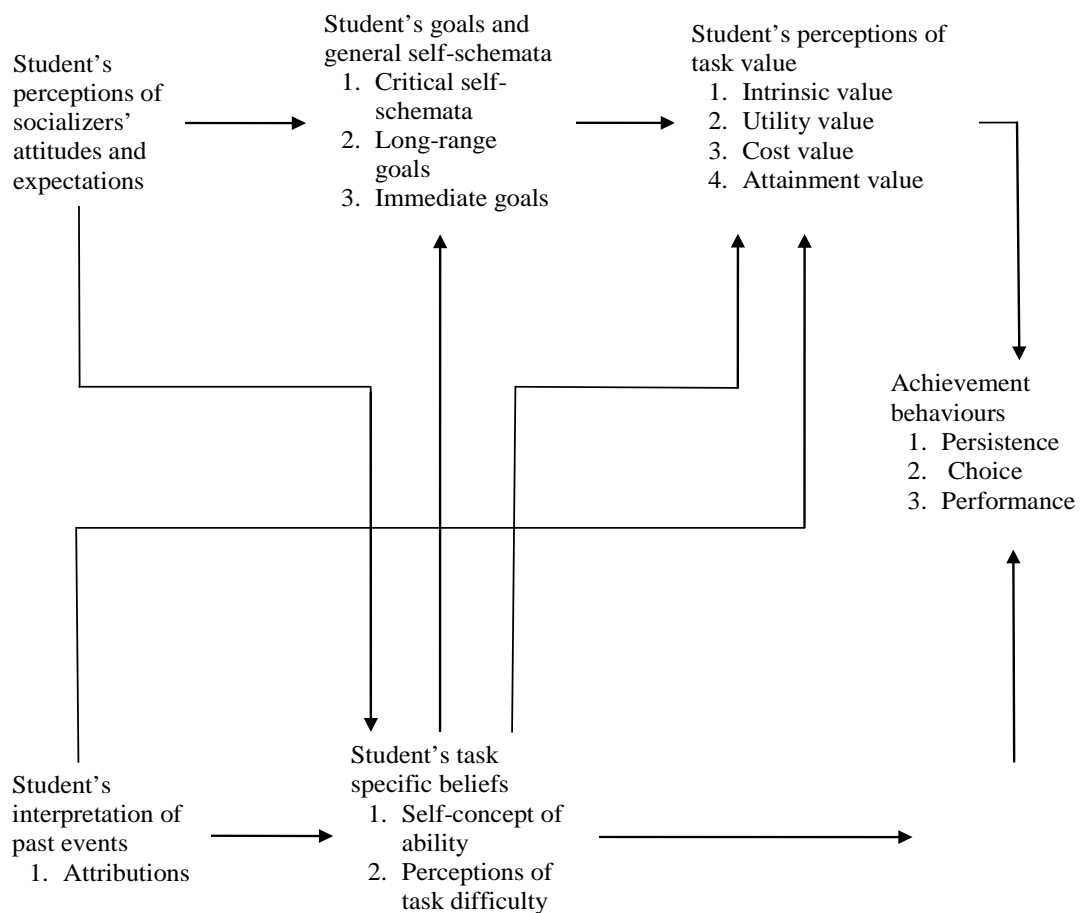
Villalobos (2009) indicated that gender differences in mathematics achievement favouring girls in low level mathematics, and favouring boys in high level mathematics (e.g., problem solving) are due to differential socialisation of *rule-following* (favouring girls) and *risk-taking* (favouring boys) strategies. As elementary mathematics is mainly characterised by pre-established algorithms, Villalobos (2009) suggested that females tend to have the advantage in the early stages of schooling because they follow the rules taught explicitly by the mathematics teacher or illustrated in textbooks; however this strategy later becomes disadvantageous to solve advanced mathematical problems – i.e., problems that cannot be solved using standard and routine procedures. In contrast, boys experience disadvantage in elementary mathematics as they do not follow formal strategies, and that behaviour gives them practice in developing their own methods to solve unfamiliar mathematical problems.

Several researchers have previously reported that girls and boys use different strategies in mathematics in different stages of the curricula (e.g., Anghileri, 2006; Barnes, 1997; Carr et al., 1999; Fennema & Carpenter, 1998). Villalobos (2009) pointed out that the differential socialisation strategies may influence mathematics learning for girls and boys differently. She also indicated that the strategies of rule

following and risk-taking are not innate but they are created and reinforced by the differing experiences that girls and boys have in society.

## Psychological Model of Achievement, Attitudes, and Behaviours

The psychological model of achievement, attitudes, and behaviours was developed out of the expectance-value theory (Eccles et al., 1983). The model is shown in Fig. 3.2.



*Figure 3.2.* Psychological model of achievement, attitudes, and behaviours (Adapted from Eccles et al., 1983, p. 100).

As can be seen in Figure 3.2, the psychological model of achievement, attitudes, and behaviours suggests that students' perceptions of socialisers' attitudes and expectations, and the way they interpret past events related to success and failure in a



subject influence their beliefs such as the academic self-concept, and perception of task difficulty. The students' beliefs, in turn, influence their goals, perceptions of task-values, and expectations. Finally, task-values and expectations determine performance, persistence, and task-preferences. It should be mentioned that the general expectancy-value (Eccles et al., 1983) indicates that the students' perceptions of socialisers' attitudes and expectations are influenced by the socialisers' behaviours, attitudes, and expectations for their children. The socialisers' perceptions, attitudes, expectations, and aspirations for their children are largely influenced by cultural contexts (e.g., in respect of resources available, prevailing gender roles, and policies).

The psychological model of achievement, attitudes, and behaviours described in this chapter was useful to this study because it helped clarify the research questions, and interpret the data using the expectancy-value framework. Also, one of the survey instruments used to collect the data (*The Mathematics Value Inventory*) was developed out of this model.

### **Summary of Chapter 3**

In this chapter, several perspectives accounting for gender differences in mathematics education were outlined.

In the next chapter, a mixed methods research design that combined quantitative and qualitative approaches is described and justified.

## **Chapter 4**

### **Research Design and Implementation**

In this chapter, the research problem and the main research question are restated. The mixed methods research design considered most appropriate to investigate these is described. It combined quantitative (surveys) and qualitative (interviews) approaches. The instruments used to collect data, the characteristics of the sample, and procedures used to recruit participants, and to administer surveys and interviews are also detailed.

#### **Restating the Problem and Research Question**

As indicated in Chapter 1, studies aimed at understanding the factors contributing to persistent patterns of gender differences in mathematics achievement in primary schools in Mozambique are rare. However, the SACMEQ studies maintained that achievement in mathematics among grade 6 pupils is deteriorating in Mozambique (Makuwa, 2010), and gender differences prevail in favour of boys in mathematics and slightly in their favour in reading (Saito, 2004, 2010). Gender differences in mathematics performance in primary schools are consistent with gender disparities in access to basic education in the northern and central provinces of Mozambique (Ministério de Educação, 2010).

Based on the account that mathematics learning outcomes (e.g., achievement, beliefs, and attitudes towards mathematics education) can be influenced by a range of socio-psychological and environmental factors (Leder, 1990), this study examined the influence of parents (e.g., views, education, occupation), economic resources (e.g., electricity, piped water, TV, internet, books, calculators, mathematics and reading textbooks, mobile phones), and cultural factors (e.g., gender, number of siblings, home language, and geolocation) on Grade 7 students' beliefs and attitudes towards

mathematics learning in Mozambique. The main research question addressed in this study was:

What are the relationships between Grade 7 students' beliefs and attitudes towards mathematics learning and parents' views and family circumstances? Are there gender differences?

The mixed methods research design was used to frame the study is presented below. The rationale for using this kind of research is also provided.

## **Mixed Research Methods**

To answer the main research question of this study, a mixed methods research design was adopted. That is, quantitative and qualitative data were combined to ensure that the strength of the study was greater than either quantitative or qualitative research alone (Creswell & Plano Clark, 2007). Quantitative data were collected through paper-and-pencil surveys and qualitative data were collected using one-on-one face-to-face semi-structured interviews. Due to the scarcity of research examining the impact of parents, cultural factors, and economic resources on mathematics learning outcomes in primary schools in Mozambique, surveys and interviews were considered the most appropriate. The advantage of the surveys in this study was obvious because data of a large sample was collected in a relatively short time. De Vaus (2002) acknowledges the power of surveys as they reveal trends in the data and relationship between variables. He also argues that there are currently many sophisticated statistical software applications that can easily examine large amounts of quantitative data. As surveys also have limitations, such as giving more freedom to respondents to leave items unanswered, or to provide reckless responses (Wiersma, 2000), the quantitative data were complemented with small scale qualitative data. This was done in order to gather richer and more detailed and contextually-based data. Neuman (2003) also believes

face-to-face interviews provide more nuanced and context-sensitive data. The surveys did not ask respondents to probe their answers, and thus the interviews served to ‘dig’ much deeper into the items presented in the survey forms. Depending on the research question addressed and the epistemological point of view, in contemporary times some scholars have encouraged the use of mixed research methods. For example, Crotty (1998) stated:

We should accept that, whatever research we engage in, it is possible for either qualitative methods or quantitative methods, or both, to serve our purpose. Our research can be qualitative or quantitative, or both qualitative and quantitative, without this being in any way problematic. (p. 15)

Trochim (2006) linked the use of mixed research methods with post-positivist assumptions. He stated that post-positivist researchers accept and promote the use of various measures in order to estimate the social reality more accurately because:

All measurement is fallible, the post-positivist emphasizes the importance of multiple measures and observations, each of which may possess different types of error, and the need to use *triangulation* across these multiple errorful sources to try to get a better bead on what's happening in reality. The post-positivist also believes that all observations are theory-laden and that scientists (and everyone else, for that matter) are inherently biased by their cultural experiences, world views, and so on. (para. 6)

It should be noted that the choice of quantitative, qualitative, or mixed research methods is influenced by the researchers’ beliefs system about knowledge and research. Historically, quantitative research methods have been associated with ‘scientific method’ – that is, testing theories with the purpose of confirmation or disapproval (Wiersma, 2000). In contrast, in qualitative research the reasoning process starts from a contextually-based situation and evolves to general conclusions. According to Wiersma

(2000), in qualitative research, theories are not usually the basis of the research design, but the results they raise may lead to the formulation of new theories.

In this study, as preliminary theoretical information about the factors influencing gender differences in mathematics education was obtained from the literature, quantitative data were collected using well established measures. However, in order to develop better understandings of the meaning and value that parents attribute to mathematics and mathematics education for their children in Mozambique, qualitative data were collected to complement the survey data.

The mixed methods research design consisting of three phases of the study, the specific research methods (surveys and interviews), and the instruments used to collect data are presented in Table 4.1. The number of items of each instrument and sample sizes are also presented.

Table 4.1

*A Mixed Methods Research Design*

| <b>Phases</b> | <b>Research methods</b> | <b>Instruments used</b>                      | <b>No. Items</b> | <b>Sample</b>    |
|---------------|-------------------------|--|------------------|------------------|
| One           | Survey                  | The Children's Background Questionnaire      | 12               |                  |
|               |                         | The How Good Are You Questionnaire           | 9                | 300              |
|               |                         | The Children's Aspirations Questionnaire     | 4                | Grade 7 Children |
|               |                         | The Confidence in Learning Mathematics Scale | 12               |                  |
|               |                         | The Mathematics Value Inventory              | 14               |                  |

| <b>Phases</b> | <b>Research methods</b> | <b>Instruments used</b>                      | <b>No. Items</b> | <b>Sample</b> |
|---------------|-------------------------|--|------------------|---------------|
|               |                         | The Who and Mathematics Instrument           | 30               |               |
|               |                         | The Mathematics Attribution Scale            | 4                |               |
|               |                         | The Parents' Background Questionnaire        | 9                |               |
|               |                         | The How Good Is Your Child Questionnaire     | 9                |               |
|               |                         |  |                  |               |
| Two           | Survey                  | The Parents' Aspirations Questionnaire       | 4                | 225           |
|               |                         | The Mathematics Value Inventory              | 14               | Parents       |
|               |                         | The Who and Mathematics Instrument           | 30               |               |
|               |                         | The Family Involvement Questionnaire         | 16               |               |
|               |                         | The Mathematics Attribution Scale            | 4                |               |
| Three         | Interviews              | The Interview Protocol for Parents           | 9                | 10 Parents    |
|               |                         | The Interview Protocol for School Principals | 5                | 5 Principals  |

As can be seen in Table 4.1, this study was conducted in three phases. In the first phase, a sample made up of 300 Grade 7 children completed pencil-and-paper surveys. In the second phase, 225 parents and guardians of the participating children completed surveys. In the third phase of the study, ten parents who had completed surveys were selected to participate in a follow up face-to-face interview. The criterion used to select parents for interviews is described later in this chapter. Also, during the third phase, the principals of the participating schools were interviewed. The study was conducted in three districts of Sofala Province in the central part of Mozambique. The research sites are shown in Figure 4.1.



Figure 4.1. The Mozambique map showing the research sites in Sofala Province (Adapted from Spaull, 2011, p. 71).

The three districts where the study was conducted (Beira, Dondo, and Buzi) represented three different geolocations: urban, rural, and remote. These sites also represented two main language groups spoken in the central region of the country. *Sena* and *Ndau* are the predominant vernaculars spoken in Dondo, and Buzi, respectively. Although these languages are also spoken in Beira, the majority of the residents in Beira speak *Portuguese*. Portuguese is the official language and medium of instruction in Mozambique.

## **Validity, Reliability, and Trustworthiness of the Research**

Wiersma (2000) defined internal validity as “the extent to which the results of a research study can be interpreted accurately and with confidence” (p. 6). He viewed external validity as “the extent to which research results are generalizable to populations and/or conditions” (p. 7). With respect to instruments to collect the data, De Vaus (2002) considered valid instruments to be those measuring what they are intended to measure, and reliable instruments to be those producing the same results when replicated in similar conditions.

The survey instruments used in this study were pre-existing and therefore, their validity and reliability had been established in previous studies. As the instruments were originally written in English, to use them in Mozambique they had to be translated into Portuguese. To maintain reliability values, the instruments were back-translated into English and compared with the original versions with the assistance of a person who is fluent in both languages. The back-translation strategy as a method to ensure instruments are reliable when translated from one language to another has been recommended by Brislin (1980). The original reliability coefficients and the reliability values obtained with the sample used in this study are presented later in this chapter.

To ensure generalisability of qualitative data, most of the questions included in the interview protocols for parents and for school principals were selected from previous studies. Several other questions were developed out of the items included in the survey questionnaires. The trustworthiness of the interview data (Guba & Lincoln, 1989) was ensured by conducting semi-structured interviews. This kind of interview was employed in order to have more room to ask further questions, and to clarify questions to parents with difficulties in understanding the items.



The context of the study, the characteristics of the participants, and methods for data gathering and analysis were described in detail to allow replication of the study in the future. Although the participants were not coming from all over the country, they were able to represent Sofala Province in terms of languages (*Sena*, *Ndau*, and *Portuguese*), geolocation (urban, rural, and remote), and affiliations (children, parents, and school principals). Also, due to its geolocation and infrastructure, Sofala represents the broader national population. Thus the results of this study have broader applicability in Mozambique.

The instruments used to collect quantitative and qualitative data are described next.

## **Instruments**

Most of the instruments used to collect data were identified from the mainstream educational and psychological journals and these can be found in Appendices 2 and 3. In this section all the instruments used are described briefly in terms of source, number of items, examples of items, and purpose. The survey instruments for children are described first.

### **Survey instruments for children**

Seven survey instruments were used to collect children's beliefs and attitudes towards mathematics learning including family circumstances: The Children's Background Questionnaire [CMQ], The How Good Are You Questionnaire [HGQ], The Children's Aspirations Questionnaire [CAQ], The Confidence in Learning Mathematics Scale [CLM], The Mathematics Value Inventory [MVI], and The Mathematics Attribution Scale [MAS]. Each instrument is described below:

### ***The Children's Background Questionnaire [CMQ]***

The CMQ was made up of 12 items. Examples of items asked about the language spoken most of the time in the child's home, the geolocation of the school (urban, rural, and remote), the number of books existing in the home, number of siblings, and possession of selected economic resources (e.g., electricity, piped water, television set, computers, and the internet). With respect to personal items, the children were asked whether they possess school uniforms, calculators, mathematics and reading textbooks, and cell phones. There were several other resources that were excluded from the analysis because most children (or their parents) did not have them (e.g., ruler, protractor, laptop, car, and bicycle).

To get information about their parents, the children were also asked to indicate the occupation(s) and the level of education of their parents or primary caregivers. The survey questionnaires for parents also included these items for cross checking of the information as parental background factors were critical to this study. The inclusion of cultural and parental background variables in this study was influenced by previous research such as TIMSS (Mullis et al., 2008), and NAPLAN (see NAPLAN, 2011) in Australia.

### ***The How Good Are You Questionnaire [HGQ]***

The HGQ was composed of nine subjects taught in primary schools in Mozambique. The subjects were presented in a list. For each subject, the children were asked to rate their achievement (i.e., perceived achievement) using a rating scale composed of five options varying from 'weak' to 'excellent'. The category 'weak' was attributed the minimum score of 1 and 'excellent' the maximum score of 5. The instrument was designed so that high scores in one subject also represented high

perceived achievement in the subject. ‘Artwork’ is taught in primary schools in Mozambique but it was removed from the analysis as some schools did not have a teacher for this subject during the period of data collection.

### ***The Children’s Aspirations Questionnaire [CAQ]***

The CAQ was made up of 4 items. The purpose of this questionnaire was to determine boys’ and girls’ educational and occupational aspirations. An example of items the children were asked is: ‘Which profession would you like to have when you are about 30 years of age?’ This is a typical question that TIMSS uses to determine students’ occupational aspirations due to its relationship with effort in school and task-choices (see Mullis et al., 2008). In order to understand the children’s motivation to choose particular occupations they were asked to explain why they were interested in those particular professions.

### ***The Confidence in Learning Mathematics Scale [CLM]***

The CLM is one of the subscales from the popular *Fennema-Sherman Mathematics Attitudes Scales* [FS-MAS] (Fennema & Sherman, 1976). The CLM is commonly used to measure students’ confidence in learning mathematics. The scale is made up of 12 statements, six of which are positively worded (e.g., “I can get good grades in mathematics” – Item 8), and the other six are negatively worded (e.g., “Mathematics has been my worst subject”- Item 1). The response categories of the CLM range from strongly disagree (1) to strongly agree (5). Scores of negatively worded items are reversed to maintain the property of the scale whereby high scores represent high confidence in learning mathematics. In order to use the CLM scale more effectively with primary school children in Mozambique, the wordings of some items was modified. For example, the American abbreviation ‘math’ was replaced by the full

word ‘mathematics’ because a similar short form does not exist in Portuguese. The item “Most subjects I can handle O.K, but I have a knack for flubbing up mathematics” was substituted by “I do understand most of the subjects, but mathematics is exceptionally too hard for me” (Item 3). General expressions such as “more difficult mathematics”, “advanced mathematics”, and “advanced work in mathematics” were considered ambiguous for children and thus they were replaced by specific expressions such as “mathematics in Grade 8” (Item 7), “mathematics in Grade 12” (Item 4), and “mathematics courses at university” (Item 12). The statement ‘I am not the type to do well in math’ was substituted by “I am not the type of person to do well in mathematics” (Item 6).

The CLM scale was used in this study because it has been widely used in America where it was developed (Chamberlin, 2010; Leedy et al., 2003), and has been used in other contexts outside America (e.g., Mittelberg & Lev-Ari, 1999). Also, the authors of the scale reported a good half-split reliability ( $\alpha = .93$ ), suggesting that any six items from the scale could be used to examine students’ confidence in learning mathematics (Fennema & Sherman, 1976). However, only a subset made up of six items (all negatively worded) yielded a good Cronbach alpha coefficient ( $\alpha > .70$ ) in this study; the other six items (all positively worded) yielded a low reliability value ( $\alpha < .70$ ). A more extensive discussion of the CLM scale is presented in Chapter 5 of this thesis.

### ***The Mathematics Value Inventory [MVI]***

The MVI (Luttrell et al., 2010) is an instrument designed to measure students’ beliefs about the usefulness of mathematics currently, and in regard to their future education, and occupations. Other instruments to measure students’ perceived usefulness of mathematics also exist (e.g., Aiken, 1974; Fennema & Sherman, 1976),

but the MVI was recently developed and has a good internal reliability with a Cronbach alpha coefficient reported of .96. However, when used with the Mozambican sample the reliability of the MVI decreased to .75 but was still acceptable (De Vaus, 2002). The MVI consists of 28 items distributed within four dimensions: *interest, general utility, need for high achievement, and personal cost*, but for the purpose of this study 12 items were selected (e.g., ‘Understanding mathematics has many benefits for me’ [Item 3, positively worded]; ‘Mathematics is not useful for me’ [Item 10, negatively worded]). Two items were selected from the instrument proposed by Aiken (1974). An example of these items is: ‘I like to use protractors, compasses, and rulers in mathematics’ (Item 13). This item was selected because at the time of data collection the children were learning elementary geometry and were using these resources.

To complete the MVI, five options varying from strongly disagree (1) to strongly agree (5) are given. After the scores of negatively worded items are reversed, high scores represent high levels of perceived usefulness of mathematics.

### ***The Who and Mathematics Instrument [W&M]***

The W&M instrument was developed by Leder and Forgasz (2002a) in Australia. The instrument comprises 30 items. According to the authors, the items describe typical students’ beliefs, attitudes, and behaviours towards mathematics learning identified in previous studies. To complete items from the W&M instrument, individuals are asked to read each item carefully and to decide who they believe are more likely to match the wording of items (boys, girls, or both). If the respondent believes the behaviour consistent with the item wording is applicable for both boys and girls, the respondent chooses a gender neutral response category.

The W&M instrument was used in this study because it was developed in order to replace the traditional subscale *Mathematics as a Male Domain* [MD] from the *Fennema-Sherman Mathematics Attitudes Scale* [MAS] (Fennema & Sherman, 1976), which was considered to not satisfy temporal validity (see Forgasz, Leder, & Gardner, 1999). The W&M instrument has also become popular outside Australia in recent years (e.g., Brandell & Staberg, 2008; Forgasz & Mittelberg, 2008; Kaiser et al., 2012) but had not been used in Africa before. Hence, the instrument was used to compare results from an African context with findings from outside Africa.

### ***The Mathematics Attribution Scale [MAS]***

Fennema, Wolleat, and Pedro (1979) developed the MAS to measure students' perceived causes for their successes and failures in mathematical tasks; MAS comprises eight hypothetical events (four successes, and four failures); each event is presented together with four possible causes for that event; the causes hypothesized reflect the four causal attribution categories proposed by Weiner (1974): *ability*, *effort*, *task difficulty*, and *luck*. The category *luck* is also designated *environment* or *others* (Fennema et al., 1979; Kloosterman, 1990). To complete MAS items, respondents are asked to read each event and to agree or disagree with each statement as a plausible cause for the event if it had really happened to the student during a mathematical activity. The MAS is made up of eight subscales named: Success- Effort, Success- Ability, Success-Environment, Success-Task difficulty, Failure-(Lack of) Effort, Failure-(Lack of) Ability, Failure-Environment, and Failure-Task difficulty.

According to Fennema et al. (1979) the reliability coefficients of individual subscales vary from .39 (Success-Task) to .79 (Success-Effort). In this study a short version of MAS consisting of four events (two successes and two failures) was used.

As MAS was developed using a sample of secondary school students and using specific subject areas (algebra and geometry), to make the items more relevant to primary school children, all events and possible causes were contextualized and referred to mathematical content taught in Grade 7. For example, events were adapted to read as follows: ‘You do not know how to divide two fractions’. The possible causes for this event were: ‘Mathematics that you study in Grade 7 is very difficult’ [task difficulty]; ‘The teacher is not good at explaining mathematics’ [Environment]; ‘You do not have time to study mathematics at home’ [Effort]; and ‘You have been a weak student at mathematics since Grade 1’ [Ability].

The response categories ranged from strongly disagree (1) to strongly agree (5). The property of the scale is that a high score on a particular subscale represents a strong belief that the cause mentioned was a reasonable reason for the event.

### **Survey instruments for parents**

To collect parents’ views and background data, seven survey instruments were used: Parents’ Background Questionnaire [PBQ], How Good Is Your Child Questionnaire [HGCQ], The Parents’ Aspirations Questionnaire [PAQ], Family Involvement Questionnaire [FIQ], The Mathematics Value Inventory [MVI], Who and Mathematics Instrument [W&M], and Mathematics Attribution Scale [MAS]. Some of these instruments were similar to those used to collect children’s beliefs and attitudes towards mathematics education but were written in order to reflect the perspective of parents.

#### ***The Parents’ Background Questionnaire [PBQ]***

The PBQ was made up of nine items, and included the main occupation of the parent, level of education, language frequently spoken at home, gender, age, and the

family relationship with the child. The children were asked similar questions and the repetition served to confirm the data, and to help solve problems of missing data during analysis. Although both parents were allowed to participate in the study, no child was represented by both father and mother. Also, no parent or guardian completed surveys for more than one child.

### ***The How Good Is Your Child Questionnaire [HGCQ]***

The HGCQ was similar to the 'How Good Are You Questionnaire' used to determine children's perceived achievement levels. The aim of this questionnaire was to know how parents rate their daughters' and sons' achievement levels in mathematics and other subjects.

### ***The Parents' Aspirations Questionnaire [PAQ]***

The purpose of this questionnaire was determining parents' educational and occupational aspirations for their children. That is, parents were asked to indicate the highest educational level they expected their children would complete, and the job they aspired for them. As done with the children, parents were also asked why they preferred those particular occupations for their children.

### ***The Family Involvement Questionnaire [FIQ]***

Manz et al. (2004) developed the FIQ consisting of 46 Likert items. The purpose of FIQ is to measure the level of family involvement in the education of low-income elementary school children in Mozambique. Some of the items included in the FIG originated from a previous measure of the family involvement in childhood education, and thus, the instrument was considered appropriate for primary school children as well. For the purpose of this study, 16 items were selected from the FIQ but they were



reformulated to match the context. Most items were not used because they were unrealistic to the context of Mozambique. One example of items excluded was: 'Parent picks child up from school'. This item did not reflect the reality in Mozambique, particularly in rural and remote areas.

FIQ is completed using a 4-point Likert-type response format: Rarely (1), Sometimes (2), Frequently (3), and Nearly always (4). It should be noted that the extremes of the continuum (i.e., Never and Always) are not used. The total scale score is a sum of scores of all individual items of the scale but scores can also be summed by subscales: home-based involvement, school-based involvement, and home-school communications. High scores represent high levels of family involvement in education.

According to the authors, FIQ has a good reliability coefficient (Cronbach- $\alpha > .80$ ) and also yielded an acceptable reliability value of .79 with the Mozambican sample.

### ***The Mathematics Value Inventory [MVI]***

The same items used for children were used for parents but some modifications were made in terms of language to reflect the perspective of parents. For example, while an item presented to children was formulated as: 'I do not need mathematics in my everyday life' (item 4), the corresponding item for parents was written as: 'My son/daughter does not need mathematics in his/her everyday life'. This was done in order to facilitate the comparison of responses between parents and children.

### ***The Who and Mathematics Instrument [W&M]***

The same items completed by children were also completed by their parents because the W&M instrument can be responded to by students, teachers, and members of the general public without making language modifications.

### ***The Mathematics Attribution Scale [MAS]***

The items presented to children were reworded to reflect the standpoint of parents. For example, the event: ‘You got only 7 out of 20 marks in a final mathematics exam’ presented to children was written for parents as: ‘Your child got only 7 out of 20 marks in a final mathematics exam’. The possible causes for this event were written as follows: ‘The exam was too difficult’; ‘The teacher didn’t want to help your child’; ‘Your child is not good at mathematics’; and ‘Your child was very busy with other activities in that week’.

### **Interview protocol for parents**

The interview protocol for parents included the main topics of the survey instruments, and the specific research questions were taken from previous research. For example, in their study of public’s views about mathematics, Leder and Forgasz (2010) asked adults in Melbourne streets the following questions:

- When you were at school did you like mathematics?
- Were you good at mathematics?
- Has the teaching of mathematics changed since you were at school?
- Who is better at mathematics, girls, boys, or there is no difference?
- Do you think studying mathematics is important for getting a job?

(Adapted from Leder & Forgasz, 2010, pp. 331-334).

Due to their relevance, these questions were translated into Portuguese and used in this study. The interview protocol for parents included nine themes. These are:

- Perceived own achievement in mathematics;

- Perceived children's achievement in mathematics;
- Perceived changes in mathematics teaching and learning;
- Views about girls' and boys' mathematical capabilities;
- Perceived usefulness of mathematics for their children and to get a job;
- Occupational aspirations for their daughters and sons;
- Involvement in the education of their children;
- Views about gender equity in rights and duties in Mozambique; and
- Conceptions about mathematics

### **Interview protocol for school principals**

One of the subsidiary research questions of this study was aimed at investigating the school principals' views about mathematics learning for girls and, and parent involvement in the education of their children. Dinham, Buckland, Callingham, and Mays (2005) conducted a similar study in Australia, which was useful to this research. Dinham and colleagues asked school principals the following research questions:

- How would you describe the community the school serves?
- Are there any features of the school community that make it special or distinctive in some way?
- How would you describe the pattern of achievement of boys and girls in your school?

(Adapted from Dinham et al., 2005, p. 27).

These questions were also translated into Portuguese and used in this study. The interview protocol for school principals was composed of five themes. They are:

- Work experience
- Views about boys' and girls' performances
- Views about the School Parents' committee [SP]
- Views about the Gender Issues' committee [GI]
- Views about parental involvement in education [PIE]

As can be seen, the topics of the interview protocols resembled the subsidiary research questions addressed in Chapter 1, and the survey instruments. This was done in order to use both the survey data and the interview data to answer the research questions

In the next section, the procedures used to recruit participants and conduct surveys and interviews, and the characteristics of the sample are described. Other relevant characteristics of the sample are illustrated in Chapters 5 and 6 when the data are examined.

## **Recruitment and Characteristics of the Sample**

A convenience sample composed of 300 Grade 7 children (134 boys and 166 girls), and 225 parents or guardians of these children (98 fathers, 96 mothers, and 31 guardians), and five school principals (3 males and 2 females) participated in this study. When fathers and mothers were not available, other guardians or primary caregivers were allowed to participate in the study. Thus, the term 'parents' is used in this thesis to refer to the actual parents or guardians who participated in the study on behalf of the participating children.

The ages of the children ranged from 11 to 16 years and the mean age was 12.9. Despite the oldest girls being only 16, three in rural (N =2) and remote (N=1) schools

were already married and their husbands came to participate in the study as their guardians. The participation of the three husbands was decided by the participants themselves and this reinforces the traditional role of husbands in Mozambican society.

The data were collected in five public schools in Sofala Province over a period of four months from February to May 2011.

Although gender differences in mathematics achievement have been widely reported among Grade 6 children in Mozambique and other countries from Sub-Saharan Africa (Saito, 2004, 2010) this study involved Grade 7 children. This was because Grade 7 is the highest grade level of primary education in Mozambique and thus, it offered an appropriate context to investigate the beliefs and attitudes towards mathematics learning that the children developed during 7 years of primary education and were carrying with them into secondary education.

Grade 7 pupils also undertake a national examination before moving into secondary education and thus, their attitudes towards education may differ from those of Grade 6 pupils who benefit from 'automatic promotion' to move into Grade 7.

In order to approach schools and invite children and their parents to participate in this study, approval of the ethical conduct of the research was obtained from the Monash University Human Research Ethics Committee. Research approval is found in Appendix 1. Permissions to conduct the study in five schools from three districts of Sofala Province were obtained from the Education, Youth and Technology Services of Beira, Dondo, and Buzi. Research authorizations from these institutions are found in Appendix 1.

The study was conducted in Sofala Province because the researcher comes from this province, and this facilitated interaction with the research participants. Also, Sofala

is one of the Mozambican Provinces where girls are less likely to enroll or persist in school than boys.

As indicated earlier (see Figure 4.1), the districts that participated in this study represented three distinct regions. Beira is a major regional city (urban); Dondo is a regional town (rural), and Buzi is a remote regional town (remote). The majority of the people from Beira speak Portuguese at home. In Dondo and Buzi most people speak *Sena* or *Ndau* at home (Instituto Nacional de Estatística, 2010). Thus, the choice of these districts was also influenced by the need to maximize participants' differences in terms of their geolocation, and languages they speak at home.

It is difficult to access to districts in Mozambique due to bad roads and lack of transport. During the rainy season, some districts become completely inaccessible. Due to these constraints, the data from this study was collected only in three districts. The frequency distribution of the participating children by gender, geolocation, and language is shown in Table 4.2.

Table 4.2

*Frequency Distribution of the Children by Gender, Geolocation, and Language*  
(*N*=300)

| Gender | Geolocation |       |        |       | Home language |                                |             |              |     |
|--------|-------------|-------|--------|-------|---------------|--------------------------------|-------------|--------------|-----|
|        | Urban       | Rural | Remote | Total | <i>Sena</i>   | <i>Portuguese</i> <sup>†</sup> | <i>Ndau</i> | <i>Other</i> | All |
| Boys   | 82          | 25    | 27     | 134   | 36            | 80                             | 16          | 2            | 134 |
| Girls  | 108         | 35    | 23     | 166   | 45            | 104                            | 13          | 4            | 166 |
| All    | 190         | 60    | 50     | 300   | 81            | 184                            | 29          | 6            | 300 |
| %      | 63          | 20    | 17     | 100   | 27            | 61                             | 10          | 2            | 100 |

Note. <sup>†</sup>The medium of instruction in Mozambique

As can be seen in Table 4.2, the majority of the children (63%) were from urban schools. This was because there were more schools available there than in the countryside. The majority of the children (61%) reported speaking the language of instruction (Portuguese) in their homes. The other 39% spoke vernaculars at home most of the time. About 27% of the children spoke *Sena* and 10% spoke *Ndau*. The remaining 2% of the children spoke languages from the other Mozambican provinces.

As there was no electricity and no piped water in rural and remote areas, economic resources were not examined by geolocation. The variable ‘economic resources’ was measured using two levels (Yes, No), and the frequencies of children possessing and not possessing selected resources are shown in Table 4.3.

Table 4.3

*Frequency Distribution of the Children by Possession of Economic Resource (N=300)*

| Economic resource    | Possession status |    |     |    |
|----------------------|-------------------|----|-----|----|
|                      | Yes               |    | No  |    |
|                      | N                 | %  | N   | %  |
| Electricity          | 210               | 70 | 90  | 30 |
| Television set       | 208               | 70 | 90  | 30 |
| Computer             | 60                | 20 | 238 | 80 |
| Internet             | 33                | 11 | 267 | 89 |
| Piped water          | 148               | 50 | 150 | 50 |
| Calculator           | 89                | 30 | 209 | 70 |
| Mathematics textbook | 225               | 75 | 75  | 25 |
| Reading textbook     | 223               | 75 | 75  | 25 |
| Cell phone           | 114               | 38 | 184 | 62 |
| School uniform       | 271               | 91 | 27  | 8  |

Note. Yes: Frequency of children possessing the selected economic resource;  
No: Frequency of children not possessing the selected economic resource.

As can be seen in Table 4.3, 30% of the 300 children did not have electricity and 50% did not have piped water in their homes and these were generally children from rural and remote regions. Although textbooks are offered by the government without charge, 25% of the children (75) did not have either mathematics or reading textbooks. As will be seen in Chapter 6, the school principals interviewed indicated that most children in rural areas do not keep their textbooks in good condition for the whole academic year. It is possible that, as most children in the countryside do not have school bags to protect their textbooks they get damaged during their way to or from school. Also, the children's homes in rural and remote regions are made from loose straw and grass that do not protect against heavy rain.

To illustrate the educational background and occupation of the parents of participating children, the data is presented in Table 4.4 by geolocation.



Table 4.4

*Frequency Distribution of Parental Education and Parental Occupation by Geolocation*  
*(Males=118; Females=107)*

| Variable               | Levels           | Geolocation |     |       |     |        |     |
|------------------------|------------------|-------------|-----|-------|-----|--------|-----|
|                        |                  | Urban       |     | Rural |     | Remote |     |
|                        |                  | N           | %   | N     | %   | N      | %   |
| Parental<br>education  | No schooling     | 5           | 3   | 5     | 11  | 2      | 7   |
|                        | Grade 1-5        | 9           | 6   | 6     | 13  | 6      | 21  |
|                        | Grade 6-7        | 23          | 15  | 6     | 13  | 5      | 17  |
|                        | Grade 8-10       | 20          | 13  | 4     | 9   | 5      | 17  |
|                        | Grade 11-12      | 26          | 17  | 5     | 11  | 2      | 7   |
|                        | University       | 31          | 21  | 2     | 4   | 1      | 3   |
|                        | Not stated       | 37          | 25  | 17    | 38  | 8      | 28  |
|                        | All              | 151         | 100 | 45    | 100 | 29     | 100 |
| Parental<br>occupation | Unemployed       | 60          | 40  | 20    | 44  | 11     | 38  |
|                        | Manual/Unskilled | 14          | 9   | 15    | 33  | 5      | 17  |
|                        | Clerical         | 61          | 40  | 9     | 20  | 13     | 45  |
|                        | Middle Officers  | 12          | 8   | 0     | 0   | 0      | 0   |
|                        | Managerial       | 1           | 1   | 1     | 2   | 0      | 0   |
|                        | Professional     | 3           | 2   | 0     | 0   | 0      | 0   |
|                        | All              | 151         | 100 | 45    | 100 | 29     | 100 |

As can be seen in Table 4.4, the proportion of parents with primary education or less was higher in rural and remote schools than in the urban schools. Also there were only 2 parents in rural schools (N=45) and 1 parent in remote schools (N=29) with a university degree while there were 31 in the urban schools (N=151).

With respect to unemployment, there were as many unemployed parents in the urban schools as in the rural and remote schools. Managerial and Professional occupations were poorly represented and thus, these occupations were collapsed with others during data analysis due to constraints of the statistical procedures used to examine the data.

## **Procedures**

Participation in this study was based on informed consent. To ensure this, the participating children who wanted to take part in the study had to sign a consent form. As the children were under 18, their parents had to authorize them to participate in the study by signing another consent form due to ethical demands for high risk research. Parents of the participating children were also invited to participate in the study. All consent forms signed by children and by their parents were returned to the grade 7 coordinator or to the researcher directly. The return rate of the consent forms was 100% but not all parents who consented to participate in the study completed the surveys. Of the 300 parents who were expected to complete the survey forms, 225 (75%) did and 75 (25%) did not. The children whose parents did not come to school to complete surveys, however, communicated to the researcher that there was a problem in the family.

The surveys – whether for children or for parents – were completed at school under surveillance of the researcher to prevent collusion. Children and parents completed the surveys on separate occasions. The researcher was the only invigilator of

the children and parents when completing surveys. To avoid impinging on school work, the Grade 7 coordinator had consented that the children complete the surveys after class-time. In rural and remote schools children were entitled to a free lunch donated by non-government organisations, and there were free classrooms to conduct the research in the transition from the first (6:00 - 11:30) to the second shift (14:00 - 17:30). For this reason, the children from rural and remote schools completed the surveys during the school day, but in urban schools surveys were completed during weekends because of noise at school and lack of space and furniture. There were three shifts in urban schools and children did not have free lunch.

The surveys were presented in a booklet format as shown in Appendices 2 (for children) and 3 (for parents). There were several logistical problems in Beira to prepare a large number of booklets – 600 booklets of 13 pages each was a problem as few photocopier shops were able to produce double sided copies. It was necessary to make double sided copies to reduce the size of the booklets due to excess luggage constraints at the airport when dispatching all the research material (all completed survey forms and signed consent forms) to Australia.

The children were given two occasions to complete the surveys and each occasion lasted 45 minutes as it is the normal class period in primary schools in Mozambique. Parents were given only one occasion of 90 minutes to complete the surveys. Verbal introductions were given to children and parents using worked examples also illustrated in the survey booklets.

Although it was not asked to do so in the explanatory statement of the study, the parents who could not read and write brought their family members to read the items and write for them. After completing the surveys all participants were asked to check

their work in order to ensure that they had written their names and the names of their children, and had indicated their gender, age, and other background details. Finally, all participants were asked to write a comment about the study or about any issue related to the survey items. After that, the participants were thanked for their participation in the study.

In order to understand more deeply the survey data, 10 parents and the principals of the five participating schools were interviewed and the data are presented in Chapter 6 of this thesis. All parents were asked whether they were interested in participating in a short interview after they had completed the survey. Among parents who expressed interest in being interviewed, ten were selected based on their gender and geolocation, so as to represent the three regions (urban, rural, and remote) as equally as possible.

## **Summary of Chapter 4**

In this chapter, the research problem that motivated this study and the main research question were restated. As a result of the limited research available in the area of gender, affect, and mathematics education in primary education in Mozambique, a mixed methods research design was used to collect quantitative and qualitative data. Quantitative data were collected using paper-and-pencil surveys and qualitative data were collected using one-on-one face-to-face semi-structured interviews.

The study involved 300 Grade 7 children in Sofala Province in Mozambique (134 boys and 166 girls), 225 parents or primary caregivers of these children (118 males and 107 females), and the principals of the five participating schools (2 females and 3 males). The procedures used to recruit participants and to administer surveys and interviews were also described.

## **Chapter 5**

### **Results of the Surveys: Children and Parents**

Quantitative data were analysed using Excel and Statistical Package for the Social Sciences (SPSS) for Windows, version 20. All quantitative and categorical (nominal) variables were coded for SPSS analysis following the guidelines proposed by Coakes et al. (2010), Pallant (2009), and Tabachnick and Fidell (2007).

#### **Screening and Cleaning the Data**

To ensure accuracy of data entries into SPSS, categorical variables were examined using descriptive statistics and graphical representations. Quantitative variables measured on continuous scales were inspected for out-of-range values, and plausibility of means and standard deviations (Tabachnick & Fidell, 2007). After all data were entered into SPSS the reliability of the data entry was checked by taking 15 random cases (5% of the sample), and determining how many keystrokes had values that differed from the true values (Bowen, Fuhrer, & Guess, 1998). The error rate resulting from punching mistakes was estimated at .12%, and therefore, acceptable for this study as typical human error rate during data entry has been found to vary from 1% to 18% (Sussman & Haug, 1967).

During the screening of data, missing values due to data entry faults were corrected using information from the survey forms. Missing values due to lack of data in the survey forms were preserved as there was no possibility of contacting the participants again.

For the majority of the data analyses performed, cases with missing values were excluded. One consequence of doing this is that sample sizes fluctuate from one

analysis to another. The quantitative variables measured on a continuous scale that were used as dependent variables (DVs) are:

- Perceived Achievement in Mathematics (PAM);
- Confidence in Learning Mathematics (CLM);
- Perceived Usefulness of Mathematics (PUM);
- Parent Involvement in Education (PIE);
- Causal Attribution in Mathematics (CAM); and
- Gender Stereotyping of Mathematics (GSM).

These variables were examined because they were found to have relationships with mathematics achievement (Fennema & Sherman, 1976, 1977, 1978; Grootenboer & Hemmings, 2007; Hemmings, Grootenboer, & Kay, 2011; Ma, 1997; Mullis et al., 2008), and to influence gender differences in mathematics education (see Eccles et al., 1983; Fennema & Peterson, 1985; Leder, 1990). Also, the formation and development of positive beliefs and attitudes towards mathematics is one of the goals of mathematics education in primary schools in Mozambique (Ministério de Educação, 2008b).

The categorical independent variables (IVs) used in the statistical analyses are presented in Table 5.1. The economic resources selected for the study included electricity, piped water, television set (TV), number of books at home, computer, internet, calculator, cell phone, and textbooks for reading and mathematics.

Table 5.1

*Categorical Independent Variables Selected for Quantitative Data Analysis*

| <b>Independent Variables</b>     | <b>Levels</b>   |
|----------------------------------|---|
| Gender of child                  | Boys, Girls   |
| Age of child (in years)          | 11,12,13,14,15,16   |
| Gender of parent/guardian        | Father, Mother  |
| Possession of economic resources | Yes, No   |
| Geolocation                      | Urban, Rural, Remote  |
| Language                         | <i>Sena</i> , <i>Portuguese</i> <sup>c</sup> , <i>Ndau</i> , Other              |
| Siblings                         | [0-2], [3-5], [6-8], [9-...]  |
| Parental education               | No schooling, Grade 1-5, Grade 6-7, Grade 8-10, Grade 11-12, University         |
| Parental occupation              | Unemployed, Manual/Unskilled, Clerical, Officers <sup>d</sup> , and Not stated. |
| Books                            | [0-10], [11-25], [26-100], [101-200], [200-...]                                 |

Note. <sup>c</sup>The medium of instruction in Mozambique;

<sup>d</sup>Managers and professionals were designated 'officers' due to their low frequencies.

As can be seen in Table 5.1, the independent variables examined were gender of the child and parent, age of the child, home language, number of siblings, number of books at home, geolocation, parental education, parental occupation, and economic resources.

Parametric statistical techniques were used to analyse most of the quantitative data because they are generally stronger than the equivalent non-parametric approaches when sample sizes are over 200 (Tabachnick & Fidell, 2007). In order to perform

parametric tests, all DVs measured on a continuous scale were inspected for outliers and normality of data distributions, using histograms, normal probability plots, and boxplots (Pallant, 2009), prior to analysis. Moderate violations of the assumptions of normality were neglected as parametric statistical tests are generally robust when sample sizes are reasonably large (Tabachnick & Fidell, 2007). Levene's Tests for Equality of Variances were performed to ensure that there was no violation of the assumption of homogeneity of variances (Pallant, 2009).

To examine independent variables having two levels (e.g., Gender: Females and Males) independent-groups t-tests were conducted, and statistically significant group differences on the means were established at  $p < .05$  level. However, a more stringent  $p$ -value ( $p < .05/n$ ;  $n$  = number of tests, or a Bonferroni adjustment) was used when multiple separate tests were performed in order to decrease the chance of type 1 errors (Pallant, 2009). Type 1 error occurs when the statistical procedure produces a statistically significant difference between groups when in reality there is no significant difference in terms of their means (Pallant, 2009). As t-tests performed by SPSS programs provide two distinct results, the appropriate result was selected depending on whether the assumption of equal variances was satisfied or not.

One-way between groups analyses of variance (ANOVAs) were conducted to compare mean scores among three or more groups. As recommended by Tabachnick and Fidell (2007), when group differences in terms of their mean scores were found, post hoc comparisons were then performed to identify groups (pairs) responsible for statistically significant differences. A Tukey Honestly Significant Difference Test (Tukey HSD), or a Games-Howell Test (G-H) was performed depending on whether the assumption of Equality of Error Variances was satisfied or not, respectively (Pallant, 2009).



To identify models composed of selected IVs that best predict a DV, a stepwise regression analysis was conducted following the guidelines by Coakes et al. (2010).

Research questions that involved frequencies were examined using a Chi-square ( $\chi^2$ ) test for independence provided that the minimum expected cell counts were not less than five, or when at least 80% of the cells had expected cell counts of 5 or higher (Pallant, 2009). When cell sizes did not meet these constraints some categories were merged as appropriate.

The results of this section are reported in order of the research questions (1 to 8) as presented in Chapter 1. Question 9 is analysed qualitatively in Chapter 6. The first research question addressed in this study was:

### **Question 1**

**Are there gender differences in children's educational and occupational aspirations? Are parents' educational and occupational aspirations for their children based on the gender of the child?**

The children's responses are presented first.

### **Children's educational and occupational aspirations**

First of all, the children were asked to indicate the highest level of education they intended to complete before leaving schooling. A list of seven levels of education ranging from grade 7 to University was presented. A  $\chi^2$  test for independence was considered appropriate to analyse the children's responses as the variables of interest were all categorical (grade levels), and the groups were independent (boys versus girls). However, the  $\chi^2$  test was indeterminate as there were several cells with expected counts less than 5 (Pallant, 2009). To proceed with the  $\chi^2$  test, grades with small frequencies (grade 7-11) were collapsed into the category 'Less than Grade 12'. As a result, only

three categories were formed: Less than Grade 12, Grade 12, and University. The frequency distributions and percentages of children's responses in regard to their educational expectations are presented in Table 5.2.

Table 5.2

*Frequency Distribution of Boys' (N=134) and Girls' (N=166) Educational Expectations*

| Child | Expected educational level |          |            | All |
|-------|----------------------------|----------|------------|-----|
|       | Less than Grade 12         | Grade 12 | University |     |
| Boys  | 5 (4%)                     | 17 (13%) | 112 (84%)  | 134 |
| Girls | 10 (6%)                    | 20 (12%) | 136 (82%)  | 166 |
| All   | 15 (5%)                    | 37 (12%) | 248 (83%)  | 300 |

Note. Grade 12 is the highest level of secondary education in Mozambique.

A  $\chi^2$  test for independence by gender was conducted on the frequencies shown in Table 5.2. The minimum expected cell count obtained was 6.7 and was acceptable for a  $\chi^2$  test (Pallant, 2009). However, the  $\chi^2$  test revealed no statistically significant gender differences in children's educational expectations. The data from Table 5.2 shows that the majority of children (83%) expected to study at university in the future, but there were 52 children (17%) who did not have this expectation.

After exploring their educational expectations, the children were asked which profession they intended to have when they are about 30 years old. Some children did not know the names of the professions they were interested in. To encourage them to answer the question they were asked to describe the profession in words. Some children made drawings in their survey forms such as a guitarist, an airplane or a boat suggesting that they wanted to be singers, pilots, or sailors. About 12% (N=34) of the children's descriptions were difficult to read due to poor hand writing. The children mentioned 37

different professions, but some had very low frequencies and a  $\chi^2$  test could not be performed. Hence, to proceed with the data analysis, all occupations with total frequencies fewer than 10 were merged into the category 'Other'. Six occupations were retained for analysis including the categories 'Other' and 'Not stated'. The children's occupational aspirations are shown in Table 5.3.

Table 5.3

*Frequency Distribution of Boys' (N=134) and Girls' (N=166) Occupational Aspirations*

| Occupations           | Boys      | %         | Girls    | %         | All | %   |
|-----------------------|-----------|-----------|----------|-----------|-----|-----|
| <i>Engineer</i>       | <i>13</i> | <i>10</i> | <i>6</i> | <i>4</i>  | 19  | 6   |
| Lawyer                | 6         | 5         | 21       | 13        | 27  | 9   |
| Nurse                 | 1         | .7        | 13       | 8         | 14  | 5   |
| Physician             | 17        | 13        | 38       | 23        | 55  | 18  |
| Teacher               | 21        | 16        | 41       | 25        | 62  | 21  |
| <i>Police officer</i> | <i>15</i> | <i>11</i> | <i>1</i> | <i>.6</i> | 16  | 5   |
| Other                 | 48        | 36        | 24       | 15        | 72  | 24  |
| Not stated            | 13        | 10        | 22       | 13        | 35  | 12  |
| All                   | 134       | 100       | 166      | 100       | 300 | 100 |

Note. Shaded regions: The proportion of girls aspiring for these professions was higher than that of boys.  
Italics: The proportion of boys aspiring for these professions was higher than that of girls.

A  $\chi^2$  test for independence by gender was conducted on the data shown in Table 5.3. There were no cells with expected count less than 5 (the minimum expected cell count was 6.25). The  $\chi^2$  test for independence revealed a highly statistically significant association between gender of the child and occupational aspiration,  $\chi^2$  (df=7, n=300) =

55.5,  $p < .001$ ; Cramer's  $V = .43$ . The effect size of .43 indicated that the relationship between gender of the child and occupational aspiration was medium (Cohen, 1988).

The majority of the children surveyed wanted to be teachers and physicians in the future, but the proportion of girls who aspired for jobs oriented to 'helping' other people (e.g., teacher, physician, nurse, and lawyer) was higher than the proportion of boys aspiring for these jobs. In contrast, the proportion of boys who wanted to be engineers and police officers was higher than the proportion of girls who did so. Specifically, there was only 1 girl out of 166 who aspired for being a police officer while there were 15 boys out of 134 who wanted this occupation.

After the children indicated the profession they wanted to have in the future, they were asked to justify their choices. About 40% of the children ( $N=119$ ) presented a justification in their survey forms and the majority did not indicate or it was difficult to work out their responses due to writing problems.

The reasons provided by the children for choosing an occupation were examined using the expectancy-value framework (Eccles et al., 1983) as a starting point. The expectancy-value theory states that individual's task-choices are influenced by beliefs about how well the person will perform the task, and perceptions about the value of the task. The perceived value of the task is reflected through four components:

- Attainment value;
- Intrinsic or interest value;
- Utility value; and
- Cost value

(Adapted from Eccles et al., 1983, p. 89).

These task-values were described in Chapter 3. However, their meanings in this thesis will be clarified later using examples from the data.

The children's responses were categorised according to the task-values from the expectancy-value model (Eccles et al., 1983). Selected children's responses that illustrate each task-value category are presented in Table 5.4. The responses of the children were translated from Portuguese into English.

Table 5.4

*Children's Reasons for Choosing Occupations, Frequencies, and Representative Responses (N=119)*

| Reasons  | N           | Selected examples   |
|----------|-------------|---|
| Utility  | 69<br>(58%) | I want to be an engineer to learn about computers (Boy).  |
|          |             | I want to be a physician to have my own home and my own money to be independent from a man (Girl).  |
|          |             | I want to be a teacher to have a lot of money to sustain my wife and my children (Boy).             |
|          |             | I want to be a teacher because teachers know everything from science, computers, and English (Boy). |
|          |             | I want to be a physician to find out the medicine to cure HIV-AIDS (Girl).                          |
| Interest | 36 (30%)    | It is cool to be a traffic police officer to stop cars in the street (Boy).                         |
|          |             | I like to see nurses wearing white uniforms and working (Girl).                                     |
|          |             | I want to be a lawyer; it has been my dream since child, I like justice (Girl).                     |

| Reasons   | N          | Selected examples  |
|---|------------|--|
| Family influence  | 11<br>(9%) | I want to be a physician in a big hospital like my aunt (Girl).                                    |
|   |            | I want to be a security guard like my father (Boy).  |
|   |            | I want to be a truck driver like my father to transport goods from one province to another (Boy).  |
| Self-perceived talent or inclination for the occupation | 3<br>(2%)  | I want to be an engineer because I am good at fixing things; in my house I can fix anything (Boy). |
|   |            | I want to be a nurse because I am a caring person (Girl).  |
|   |            | I want to be a top model because I am tall and I have the body to be a top model (Girl).           |

As can be seen in Table 5.4, the majority of children selected occupations based on their perceived utility, that is, the belief that the job will help the person to grow intellectually and economically in order to be able to help their family, community, and the country. The most relevant motives mentioned by the children included: to learn about computers, to gain money, and to find medicine to cure malaria, cholera, and HIV-AIDS. The second reason mentioned frequently was interest in the job. The jobs were selected because they were interesting or ‘cool’ and the person had dreamed about the job since childhood. For example, a boy wanted to be a police officer because he liked to see traffic police officers stopping cars in the street. A girl wanted to be a nurse because she liked to see nurses wearing white uniforms during their work. Other children selected occupations that their family members currently have or had in the past (e.g., ‘I want to be a nurse like my aunt’; or ‘my grandparent was also an accountant’). Only three children reported to have selected an occupation because they

have talent or inclination to perform the job (e.g., ‘I want to be an engineer because I am good at fixing things’; or ‘I want to be a nurse because I am a caring person’).

Parents’ educational and occupational aspirations for their children are presented next.

### **Parents’ educational and occupational aspirations for their sons and daughters**

Parents were asked to indicate the highest level of education they expected their children to complete before leaving schooling. The same procedure used to analyse children’s data was also employed to examine parents’ responses. Table 5.5 presents the responses of parents of sons and parents of daughters.

Table 5.5

*Parents of Sons’ and Parents of Daughters’ Educational Expectations for their Children*

| <b>Parents</b>       | <b>Expected educational level for child</b> |                 |                   | <b>All</b> |
|----------------------|---|-----------------|-------------------|------------|
|                      | <b>Less than Grade 12</b>                   | <b>Grade 12</b> | <b>University</b> |            |
| Parents of sons      | 13 (15%)                                    | 11 (13%)        | 62 (72%)          | 86         |
| Parents of daughters | 14 (12%)                                    | 14 (12%)        | 87 (76%)          | 115        |
| All                  | 27 (13%)                                    | 25(12%)         | 149 (74%)         | 201        |

As can be seen in Table 5.5, 201 of the 225 parents surveyed indicated the level of education they expected their children would complete; 24 parents did not answer the question. A  $\chi^2$  test by gender conducted on the frequencies presented in Table 5.5, yielded the minimum expected cell count of 10.7 and therefore, acceptable for this test

(Pallant, 2009). The  $\chi^2$  test for independence revealed that parents' educational expectations for their children were not influenced by the gender of the child.

When Table 5.2 (children) and Table 5.5 (parents) were examined simultaneously it was noted that the proportion of parents who believed that their children would not study beyond grade 12 (26%) was higher than the proportion of children who had the same expectation (17%). Also, the proportion of children who expected to study at university in the future (83%) was higher than the proportion of parents who believed their children will do so (74%).

Parents' occupational aspirations for their children are summarised in Table 5.6.

Table 5.6

*Parents of Sons' and Parents of Daughters' Occupational Aspirations for their Children*

| Occupations     | Parents of Sons |    | Parents of Daughters |    | All |    |
|-----------------|-----------------|----|----------------------|----|-----|----|
|                 | (%)             |    | (%)                  |    | (%) |    |
| <i>Engineer</i> | 10              | 10 | 5                    | 4  | 15  | 7  |
| Lawyer          | 4               | 4  | 9                    | 7  | 13  | 6  |
| Nurse           | 2               | 2  | 14                   | 11 | 16  | 7  |
| Physician       | 15              | 15 | 36                   | 28 | 51  | 23 |
| <i>Teacher</i>  | 23              | 24 | 16                   | 13 | 39  | 17 |
| Accountant      | 4               | 4  | 6                    | 5  | 10  | 4  |
| Architect       | 3               | 3  | 2                    | 2  | 5   | 2  |
| Any employment  | 22              | 22 | 28                   | 22 | 50  | 22 |



| Occupations | Parents of Sons |     | Parents of Daughters |     | All |     |
|-------------|-----------------|-----|----------------------|-----|-----|-----|
|             | (%)             |     | (%)                  |     | (%) |     |
| Other       | 15              | 15  | 11                   | 9   | 26  | 12  |
| All         | 98              | 100 | 127                  | 100 | 225 | 100 |

Note. Shaded regions: The proportion of parents of daughters who wanted these professions for their children was higher than that of parents of sons.  
Italics: The proportion of parents of sons who wanted these professions for their children was higher than that of parents of daughters.

A  $\chi^2$  test for independence by gender was conducted on the cell frequencies shown in Table 5.6. The data satisfied the constraint of the minimum expected cell counts (Pallant, 2009). A statistically significant relationship between parents' occupational aspirations for their children and the gender of the child was found,  $\chi^2$  (df=8, n=225) = 21.04,  $p < .01$ , and the effect size (Cramer's  $V=.31$ ) was medium (Cohen, 1988).

As can be seen in Table 5.6, the proportion of parents of boys who aspired for their sons to be engineers and teachers (34%) was higher than the proportion of parents of girls who wanted these occupations for their daughters (17%). Conversely, the proportion of parents of girls aspiring for their daughters to be lawyers, nurses, and physicians (46%) was higher than the proportion of parents of boys interested in these occupations for their sons (21%).

The responses of parents were consistent with the responses of their children with respect to the gender-stereotyping of the profession of engineer for boys, and lawyers, nurses, and physicians for girls. However, to associate the profession of lawyers and physicians with females is inconsistent with the reality in Mozambique and with the literature (see White et al., 1989). The responses of parents and those of their children

were inconsistent in regard to being a teacher. As shown earlier in Table 5.3, a higher proportion of girls (25%) than boys (16%) aspired to be teachers. In contrast, the proportion of parents of boys (see Table 5.6) who aspired for their sons to be teachers (24%) was higher than the proportion of parents of girls who wanted this profession for their daughters (13%).

Table 5.6 also shows that several parents of sons (22%) and parents of daughters (22%) did not indicate any specific occupation that they aspire for their children and wrote the following statement on the survey forms: '*Qualquer trabalho serve para a minha criança*' [Any employment is good for my child]. Others wrote: '*Nestes dias ninguém escolhe trabalho*' [These days people do not choose employments].

In addition to choosing occupations, parents were also asked to justify their preferences. The response rate for this question was low as only 32% of parents answered. The same categories used to analyse the children's responses were used to examine parents' responses, and the results are presented in Table 5.7.

Table 5.7

*Parents' Reasons for Choosing Occupations for their Children (N=71)*

| Reasons     | Selected representative responses  |
|-------------|--|
| Utility     | As a teacher he can help himself and help his family (Parent of a boy).  |
| 45<br>(63%) | As a physician he will have knowledge to combat disease and save lives (Parent of a boy).<br><br>To be an architect will contribute to the development of our country (Parent of a boy). |
| Interest    | She likes it. She always said she wants to be an entrepreneur (Parent of a girl: Business person)  |

| Reasons   | ]          | Selected representative responses  |
|---|------------|--|
| Family influence  | 6<br>(8%)  | It is her desire. She wants to be a physician and we will not interfere (Parent of a boy).   |
|   | 6          | My son is a bit like me. He likes to transport goods and passengers (Parent of a boy).   |
|   | 6<br>(8%)  | The mother, the father, and the two brothers are teachers so it is a good idea for her to be a teacher as well (Parent of a girl).   |
| Perceived child's talent or inclination for an occupation | 6          | We never had a physician in our family (Parent of a girl).   |
|   | 6<br>(8%)  | She is very good and caring. She deserves to be a Physician (Parent of a girl).  |
| Perceived cost  | 8          | She is good at business. She is good at working out change and you cannot deceive her (Parent of a girl).  |
|   | 8<br>(11%) | Any employment is good for him because his parents passed away and no one will pay school fees for him (Guardian of a boy).  |
|   | 8          | Good jobs are difficult to find nowadays without knowing important people or paying money; he can only be trained to be a teacher or a nurse because these courses are free (Parent of a boy). |
|   |            | When teachers complete their course they get employment immediately (Parent of a girl).  |

As can be seen in Table 5.7, similar to the children, the majority of parents selected occupations for their sons and daughters on the basis of perceived utility of the

job. Some jobs were viewed as very useful for the child, family, community, and for the development of the country. Perceptions of the child's career interests, the need to perpetuate family occupations, and perceived child's talent or inclination for the job also influenced parents' occupational choices for their offspring.

One motive influencing occupational choices that was identified among parents, but was not mentioned by any child, was the 'perceived cost' of the occupation. This category is used in this thesis to describe parents' perceptions as to why some jobs were more appropriate for their children than other jobs. Cost value of the job was associated with financial cost of training and probability of finding employment after training. Most parents indicated that they had selected jobs for their children because the training is free (i.e., granted by the government), or after the training the person will be easily employed or be self-employed.

Most parents wanted their children to be nurses and teachers to work in government institutions. Others believed that physicians have employment anywhere in the world and can open their own clinics.

### **Summary of results and discussion – Question 1**

- In this section it was shown that boys and girls did not differ in terms of their educational expectations, and more than 80% of boys and girls expected themselves to have university education. Similarly, parents' educational expectations for their children were not influenced by the gender of the child. About 70% of parents of sons and parents of daughters expected their children to study at university in the future.
- Gender of the child was a statistically significant variable with respect to occupational aspirations. That is, girls and boys differed in terms of occupations they wanted. Girls were more likely to choose jobs oriented to helping people (e.g., lawyers, nurses, physicians, and teachers) than boys.

In contrast, the proportion of boys that wanted to be engineers and police officers was higher than that of girls.

- The data from Question 1 support previous research (e.g., Stockard & McGee, 1990; White & White, 2006; White, Kruczek, Brown, & White, 1989). In their study, Stockard and McGee (1990) noted that gender was the most salient variable influencing occupational preferences among grade 4 children. They also found that perceived earnings, perceived importance of the job, perceived difficulty/easiness of the job, and perceptions that the person will supervise other people, influenced children's occupational preferences.
- In the current study the reasons for preferring particular occupations were perceived utility of the job, interest in the job (like), family influences, perceived talent or inclination for the job, and perceived costs of the job (only parents).
- Thus, the data support the expectancy-value theory (Eccles et al., 1983) in that perceived utility of the job – the perception that the job will allow the person to develop economically and intellectually – was mentioned by high proportions of children and parents.

Late in the 1980s, White et al. (1989) observed that respondents tended to associate engineers, physicians, and architects with males, and nurses with women. In 2006, White and White (2006) employed implicit and explicit measures of gender stereotyping of occupations to demonstrate that the perception that engineers and accountants are males, and elementary school teachers are females was prevalent among adults.

Dunteman, Wisenbaker, and Taylor (1979) noted that males like working with things (e.g., computer engineer) while females like occupations involving interaction with people (e.g., teacher, nurse). More recently, Su, Rounds, and Armstrong (2009) also observed this tendency. Jacobs, Chhin, and Bleeker (2006), and Meece (2006)

indicated that, traditionally, females have been expected to engage in social fields such as taking care of other people and teaching. This may explain why in the current study a higher proportion of girls than boys wanted to be lawyers, teachers, and physicians. Evidence that girls' occupational aspirations were people-oriented was revealed in their reasons for certain jobs, for example, their intention to find out cure for malaria, cholera, and HIV-AIDS.

In some parts of the world, teaching has been viewed as a female profession particularly in primary schools (see Meece, 2006). However, in Mozambique teaching can be viewed as a male profession because the statistics show that 73% of upper primary school teachers are males, and only 27% are females (Ministério de Educação, 2010). This may explain why there were more parents of boys aspiring for their sons to be teachers than did parents of girls for their daughters. However, the occupational interests of the children themselves were not consistent with their parents' views in regard to being a teacher as the proportion of girls who wanted to be teachers was higher than the proportion of boys who wanted this occupation. This is probably a positive impact of the current policies that focused on increasing the numbers of female teachers in schools in Mozambique to serve as role models for girls particularly in rural and remote regions (Passos et al., 2012).

Findings for research question 2 are examined next.

## **Question 2**

**Are there gender differences in self-perceived achievement in mathematics and other school subjects among grade 7 students? Are parents' perceptions about their children's achievement levels based on the gender of the child?**

This question was addressed in order to:

- Compare the students' self-perceived achievement in mathematics [PAM] with their self-perceived achievement in other school subjects;
- Examine gender differences in self-perceived achievement;
- Determine whether parents' perceptions of their children's achievement was influenced by the gender of the child; and
- Determine whether students' self-perceived achievement and parents' perceptions of their children's achievement were similar.

To examine students' self-perceived achievement levels, nine school subjects taught in primary schools in Mozambique were used including mathematics (See Table 5.8). The students were asked the question: "How good are you in these subjects?" The responses were given on a 5-point rating scale ranging from 'Weak' (1) to 'Excellent' (5).

Several one-sample t-tests were conducted following Coakes' et al. (2010) guidelines to determine if mean scores on self-perceived achievement in mathematics [PAM] differed from the mean scores for other subjects. A Bonferroni adjustment was made to a more stringent  $p$ -value ( $<.001$ ) to prevent inflated type 1 errors (Pallant, 2009).

Independent groups t-tests were conducted to compare mean scores on perceived achievement levels between boys and girls, and between parents of sons and parents of daughters. Paired t-tests were also conducted to compare mean scores between parents and children as they completed the same items.

Mean scores on children's perceived achievement levels, standard deviations (SDs), the results of independent groups t-tests and one-sample t-tests are presented in Table 5.8.

Table 5.8

*Mean Scores on Perceived Achievement Levels for Boys (N=134) and Girls (N=166), SDs, and the Results of Independent-Groups T-Tests and One-Sample T-Tests*

| Subjects                      | Means, SD, and one-sample t-test results |     |        |     | Independent-groups t-test results |      |
|-------------------------------|--|-----|--------|-----|-----------------------------------|------|
|                               | Boys                                     |     | Girls  |     | t                                 | p    |
|                               | Mean                                     | SD  | Mean   | SD  |                                   |      |
| Physical education            | 3.76**                                   | 1.1 | 3.94** | .92 | -                                 | ns   |
| Music education               | 3.67**                                   | 1.1 | 3.87** | .98 | -                                 | ns   |
| Portuguese                    | 3.74**                                   | 1.0 | 3.69** | .92 | -                                 | ns   |
| English                       | 3.59**                                   | 1.1 | 3.68** | .09 | -                                 | ns   |
| Visual education & technology | 3.61**                                   | .99 | 3.67** | .09 | -                                 | ns   |
| Natural sciences              | 3.44**                                   | 1.1 | 3.64** | .99 | -                                 | ns   |
| Social sciences               | 3.31                                     | 1.2 | 3.39** | 1.1 | -                                 | ns   |
| Moral and civic education     | 3.27                                     | 1.1 | 3.57** | 1.1 | 2.4                               | <.01 |
| Mathematics                   | 3.17                                     | 1.1 | 3.16   | 1.1 | -                                 | ns   |

Note. Response format: 1=Weak, 2=Below average, 3=Average, 4=Good, 5=Excellent.

Shaded region: Self-Perceived Achievement in Mathematics [PAM] Results

\*\*Mean score is statistically significantly higher than Mean PAM score ( $p < .001$ ) as revealed by one-sample t-test results;

ns: No gender differences at  $p < .01$  level (Bonferroni adjustment) as revealed by independent groups t-test results.

As can be seen in Table 5.8, boys and girls perceived mathematics to be their worst school subject in terms of achievement. The mean PAM score for boys ( $M=3.17$ ) differed from the means on perceived achievement in most subjects with the exception of social sciences, and moral and civic education. For girls, the mean PAM score ( $M=3.16$ ) was lower than the means on perceived achievement in all other subjects.



Interestingly, both girls and boys believed physical education was their best school subject. Gender differences in self-perceived achievement were found only in regard to moral and civic education and favoured girls.

Question 2 was also aimed at determining whether gender of the child influenced the way parents rate their children's achievement. To do so, the data from parents of sons and parents of daughters were analysed separately and compared employing the same methods used to examine the children's data. The responses of parents of sons and parents of daughters are shown in Table 5.9.

Table 5.9

*Parents of Sons' (N=92), and Parents of Daughters' (N=119) Perceived Children's Achievement Levels, SDs, and the Results of Independent-Groups T-Tests and One-Sample T-Tests*

| Subjects                      | Means, & one sample t-test results |     |                      |     | Independent groups t-test results |    |
|-------------------------------|------------------------------------|-----|----------------------|-----|-----------------------------------|----|
|                               | Parents of sons                    |     | Parents of daughters |     | t                                 | p  |
|                               | Mean                               | SD  | Mean                 | SD  |                                   |    |
| Physical education            | 3.93**                             | .90 | 3.76**               | .98 | -                                 | ns |
| Music education               | 3.72**                             | 1.1 | 3.57**               | 1.0 | -                                 | ns |
| Portuguese                    | 3.66**                             | .94 | 3.72**               | .92 | -                                 | ns |
| English                       | 3.21                               | 1.1 | 3.07                 | 1.1 | -                                 | ns |
| Visual education & technology | 3.56**                             | .97 | 3.47**               | .93 | -                                 | ns |
| Natural sciences              | 3.49**                             | .86 | 3.53**               | .96 | -                                 | ns |
| Moral and civic education     | 3.53**                             | .97 | 3.59**               | .98 | -                                 | ns |
| Social sciences               | 3.38                               | .94 | 3.29                 | 1.0 | -                                 | ns |
| Mathematics                   | 3.14                               | 1.1 | 3.07                 | 1.0 | -                                 | ns |

Note. Response format: 1=Weak, 2=Below average, 3=Average, 4=Good, 5=Excellent.

Shaded region: Parent Perceived Achievement in Mathematics [PPAM] for their sons and daughters.

\*\*Mean is statistically significantly higher than PPAM ( $p<.001$ ) as revealed by one sample t-test results;

ns: Means for parents of sons and parents of daughters did not differ statistically significantly at  $p<.01$  level (Bonferroni adjustment) as revealed by independent-groups t-test results.

As can be seen in Table 5.9, no relationship between gender of the child and parents' ratings of their children's achievement was noted. Although no statistically

significant gender differences were found, parents of boys tended to rate their sons' achievement higher than did parents of girls in two-thirds (6/9) of the subjects. Parents of girls rated their daughters' achievement higher than did parents of boys in regard to Portuguese, moral and civic education, and natural sciences.

The results presented in Table 5.8 (children) and Table 5.9 (parents) were similar in many ways. For instance, parents also believed that mathematics was the most difficult subject for their sons and daughters and that physical education was their best. However, in order to compare the responses of parents and children in a systematic way, the responses of parents of sons and parents of daughters were combined. The responses of girls and boys were also combined. As each child and parent completed similar rating scales, paired t-tests were conducted using the mean scores on perceived achievement levels. Means scores on perceived achievement level for each subject area for parents and for children, SDs, and the results from paired t-tests ( $t$  and  $p$  values) are presented in Table 5.10.

Table 5.10

*Mean Scores on Perceived Achievement Levels for Children (N=225), and for Parents (N=225), SDs, and Paired T-Tests Results*

| Subjects                      |          |     |         |     | Paired t-test results |       |
|-------------------------------|----------|-----|---------|-----|-----------------------|-------|
|                               | Children |     | Parents |     | t                     | p     |
|                               | Mean     | SD  | Mean    | SD  |                       |       |
| Physical education            | 3.90     | .98 | 3.84    | .95 | -                     | ns    |
| Music education               | 3.83     | 1.0 | 3.65    | 1.0 | -                     | ns    |
| Portuguese                    | 3.71     | .94 | 3.70    | .93 | -                     | ns    |
| English                       | 3.70     | .99 | 3.13    | 1.1 | 6.4                   | <.001 |
| Visual education & technology | 3.67     | .92 | 3.51    | .95 | -                     | ns    |
| Natural sciences              | 3.57     | 1.1 | 3.51    | .92 | -                     | ns    |
| Moral and civic education     | 3.47     | 1.1 | 3.56    | .98 | -                     | ns    |
| Social sciences               | 3.33     | 1.1 | 3.33    | .99 | -                     | ns    |
| Mathematics                   | 3.21     | 1.1 | 3.10    | 1.1 | -                     | ns    |

Note. Response format: 1=Weak, 2=Below average, 3=Average, 4=Good, 5=Excellent.

ns: Means on children's perceived achievement and parents' perceived achievement for their children did not differ statistically significantly at  $p<.001$  level (Bonferroni adjustment) as revealed by paired t-test results.

As can be seen in Table 5.10, the results of paired samples t-tests revealed that the responses of parents were consistent with those of their children. A discrepancy was only noted in regard to English. Parents rated their children's achievement in English

lower than what the children rated themselves, and the result was highly statistically significant.

## **Summary of results and discussion – Question 2**

The findings in regard to Question 2 are:

- Boys and girls believed mathematics was their worst school subject and physical education their best. The responses of their parents were consistent with these views;
- Gender differences in self-perceived achievement were only revealed in relation to moral and civic education and favoured girls;
- Discrepancies in achievement ratings scores between children and parents were only found in relation to learning English. The children were more optimistic in relation to learning English than were parents for their offspring.

Previous research studies indicated that boys tend to exhibit higher perceived achievement levels than girls in mathematics (e.g., Mendick, 2006; Mittelberg & Lev-Ari, 1999). This was not the case in this study as both the boys and the girls reported that mathematics was their worst school subject.

The literature indicates some factors associated with low perceived achievement in mathematics [PAM]. Drysdale and Hancock (1997) pointed out that low PAM is usually reinforced by early experiences of frustrations in mathematics education. Kloosterman (1990) held the same view, and indicated that repeated failures in mathematics led to ‘learned helplessness’ – the person’s perception that he or she will never succeed in mathematics no matter the amount of time spent or effort invested in the study of the subject.

The interview data with parents presented in Chapter 6 of this thesis will also show that most parents think that their children have no inclination towards understanding mathematics but towards understanding other subject areas such as biology and Portuguese. The disagreement in responses between parents and children with regard to English is likely to be influenced by the fact that English was introduced in primary schools in Mozambique in 2004, and most parents never learnt English in their lives.

Girls believed that they were better than boys at moral and civic education. Interestingly, one of the main aims of this subject in Mozambican schools is teaching children:

To acknowledge the importance of good behaviour in the family, school, and in the public domain, and to respect the rules for personal and public hygiene; To develop love, patriotic spirit, and pride for their country. (Ministério de Educação, 2008b, p. 348: Translated from Portuguese by the researcher)

This finding has implication for mathematics learning. For example, the differential socialisation of ‘rule-following’ (girls) and ‘risk-taking’ (boys) has been used to explain why girls, on average, outperform boys in low level mathematics and, inversely, boys, on average, outperform girls in high level mathematics (see Villalobos, 2009). Villalobos indicated that girls are more successful in elementary mathematics than boys because low level mathematics is characterised by following pre-established rules and algorithms. As high level mathematics is characterised by problem solving, girls have disadvantage because they did not develop the ability to devise their own strategies to solve mathematical problems during their primary education while boys did.

The optimism of girls, boys, and parents in regard to physical education is likely to be associated with the nature of the subject. Physical education is typically an outdoor activity. Also, assessment in this subject is generally qualitative rather than quantitative, and all children are capable of participating in school sports that they are interested in.

Findings for research question 3 are presented next.

### **Question 3**

#### **Are Grade 7 boys more confident in learning mathematics than Grade 7 girls?**

Question 3 was aimed at determining whether there were gender differences in confidence in learning mathematics favouring boys as claimed in the literature (e.g., Antunes & Fontaine, 2007; Fennema & Sherman, 1976, 1977, 1978; Mittelberg & Lev-Ari, 1999).

As indicated in Chapter 4, the *Confidence in Learning Mathematics* [CLM] scale from the *Fennema-Sherman Mathematics Attitudes Scales* (Fennema & Sherman, 1976) was used with some modifications to reflect the context of primary school children in Mozambique.

The CLM scale was used in this study because it is a popular instrument, and the authors reported a very good split-half reliability coefficient of .93. Instead of the split-half reliability, Cronbach- $\alpha$  coefficient was determined in this study to see if the CLM scale had a good internal consistency. The Cronbach- $\alpha$  coefficient was low ( $\alpha = .57$ ) with the Mozambican sample as the minimum  $\alpha$ -value acceptable for a scale is usually .70 (De Vaus, 2002). Due to the low  $\alpha$ -value obtained, the CLM scale was examined in detail. To do so, an exploratory factor analysis was performed through the Principal

Components Analysis [PCA] to determine whether the responses of the children would reveal multidimensionality of the scale (De Vaus, 2002).

Prior to conducting PCA on the 12 items of the scale, the suitability of the data for factor analysis was verified. Inspection of the correlation matrix showed the presence of many coefficients of .3 and above, indicating suitability for factor analysis (Tabachnick & Fidell, 2007). Tabachnick and Fidell also recommend examination of the Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO). KMO was .76, and therefore, exceeding the minimum recommended value of .60. Bartlett's Test of Sphericity was statistically significant ( $p < .001$ ) supporting the factorability of the correlation matrix (Pallant, 2009). The extraction of initial factors using PCA revealed the presence of two components with eigenvalues exceeding 1 (2.97 and 2.03). The first component explained 25% of the variance, and the second component explained 17%.

Table 5.11 shows the initial set of factors extracted.

Table 5.11

*Extraction of Initial Set of Factors by the Principal Component Analysis*

| ITEM  | COMPONENTS |      |
|---|------------|------|
|   | 1          | 2    |
| Mathematics has been my worst subject.  | .664       |      |
| I'm no good at mathematics.   | .641       | .316 |
| I do understand most of the subjects, but mathematics is exceptionally too hard for me. | .636       | .312 |
| I will not understand mathematics in grade 12 <sup>†</sup> .                            | .634       |      |



| ITEM  | COMPONENTS |      |
|---|------------|------|
|   | 1          | 2    |
| For some reason even though I study, mathematics seems unusual hard for me. | .621       |      |
| I am not the type of person to do well in mathematics <sup>†</sup> .        | .582       |      |
| I will understand mathematics in grade 8 <sup>†</sup> .                     | -.375      | .363 |
| I can get good grades in mathematics.                                       |            | .617 |
| Generally I have felt secure about attempting mathematics.                  |            | .597 |
| I am sure that I can learn mathematics.                                     |            | .543 |
| I have a lot of self-confidence when it comes to mathematics.               | -.326      | .542 |
| I am sure I will take mathematics courses at university <sup>†</sup> .      | -.392      | .446 |

Note. Unrotated factor loadings;

<sup>†</sup>Items differ slightly from the original ones.

An examination of the scree plot provided by the SPSS output revealed a sudden change of the direction after the second component, and using Cattell's (1966) scree test it was decided to retain the two components for further analysis as recommended by Pallant (2009) and Tabachnick and Fidell (2007). This decision was supported by the results of Monte Carlo PCA for Parallel Analysis (Watkins, 2000), which showed only two components with eigenvalues exceeding the corresponding criterion values for a randomly generated data matrix of the same size (12 items x 300 children).

Varimax rotation method with Kaiser Normalization was conducted to obtain the final set of factors as shown in Table 5.12.

Table 5.12

*Extraction of Final Set of Factors by the Principal Component Analysis*

| ITEM  | COMPONENTS |      |
|---|------------|------|
|   | 1          | 2    |
| Mathematics has been my worst subject.  | .703       |      |
| I'm no good at mathematics.   | .715       |      |
| I do understand most of the subjects, but mathematics is exceptionally too hard for me. | .708       |      |
| I will not understand mathematics in grade 12 <sup>†</sup> .                            | .656       |      |
| For some reason even though I study, mathematics seems unusual hard for me.             | .629       |      |
| I am not the type of person to do well in mathematics <sup>†</sup> .                    | .625       |      |
| I will understand mathematics in grade 8 <sup>†</sup> .                                 |            | .489 |
| I can get good grades in mathematics.   |            | .667 |
| Generally I have felt secure about attempting mathematics.                              |            | .620 |
| I am sure that I can learn mathematics.   |            | .619 |
| I have a lot of self-confidence when it comes to mathematics.                           |            | .629 |
| I am sure I will take mathematics courses at university <sup>†</sup> .                  |            | .572 |

Note. Rotation method: Varimax with Kaiser Normalization, <sup>†</sup>Items differ slightly from the originals.

As can be seen in Table 5.12, six items (1 to 6) loaded quite strongly on component 1, and the other six items (7 to 12) loaded strongly on component 2. The two-component solution explained 42% of the variance of the children's responses, with

component 1 contributing to 25%, and component 2 contributing to 17% of the total variance.

It should be noted from Table 5.12 that all negatively worded items are clustered together on component 1, and all positively worded items are clustered together on component 2. It is possible that the negatively worded items measure what Kloosterman (1990) described as *learned helplessness*, and the positively worded items measure *mastery orientation*. As an illustration, when the scores of the negatively worded items are unreversed, high scores would represent high levels of learned helplessness (e.g., I strongly agree that “I am not the type of person to do well in mathematics” - item 6). In contrast, high scores of positively worded items (e.g., I strongly agree “I can get good grades in mathematics” - item 8) would reflect mastery orientation.

The component transformation matrix generated by the SPSS revealed that the correlation between component 1 and component 2 was reasonably good ( $r=.43$ ), indicating that the two components were related.

However, in this study the two components were examined separately after the 12 items were analysed one by one. All items negatively worded were reverse-scored to ensure that high scores represent high confidence in learning mathematics (Fennema & Sherman, 1976). Then, independent-groups t-tests were conducted with a Bonferroni adjustment to  $p<.01$  for every item of the scale to compare mean scores between boys and girls. Mean CLM scores and SDs for boys and for girls, and independent-groups t-test results (t and  $p$  values) are presented in Table 5.13 by item.

Table 5.13

*Mean CLM Scores and SDs for Boys (N=134), and for Girls (N=166), and Independent- Groups T-Tests Results*

|    | ITEM  | CLM  |     |       |     | Indep.<br>t-tests |
|----|---|------|-----|-------|-----|-------------------|
|    |   | Boys |     | Girls |     |                   |
|    |   | Mean | SD  | Mean  | SD  |                   |
| 1  | Mathematics has been my worst subject.  | 2.77 | 1.1 | 2.76  | 1.3 | ns                |
| 2  | I am no good at mathematics.  | 3.02 | 1.2 | 2.83  | 1.3 | ns                |
| 3  | I do understand most of the subjects, but mathematics is exceptionally too hard for me. | 2.94 | 1.4 | 2.90  | 1.3 | ns                |
| 4  | I will not understand mathematics in grade 12 <sup>†</sup> .                            | 2.93 | 1.3 | 2.69  | 1.2 | ns                |
| 5  | For some reason even though I study, mathematics seems unusual hard for me.             | 2.66 | 1.2 | 2.71  | 1.2 | ns                |
| 6  | I am not the type of person to do well in mathematics <sup>†</sup> .                    | 3.05 | 1.3 | 2.84  | 1.2 | ns                |
| 7  | I will understand mathematics in grade 8 <sup>†</sup> .                                 | 3.62 | .90 | 3.67  | 1.1 | ns                |
| 8  | I can get good grades in mathematics.   | 3.77 | 1.1 | 3.60  | 1.2 | ns                |
| 9  | Generally I have felt secure about attempting mathematics.                              | 3.78 | 1.1 | 3.73  | .90 | ns                |
| 10 | I am sure that I can learn mathematics.   | 3.77 | 1.2 | 3.61  | 1.2 | ns                |

| ITEM | CLM  | Indep.<br>t-tests |     |       |     |             |
|------|--|-------------------|-----|-------|-----|-------------|
|      |  | Boys              |     | Girls |     | t, <i>p</i> |
|      |  | Mean              | SD  | Mean  | SD  |             |
| 11   | I have a lot of self-confidence when it comes to mathematics.          | 3.83              | 1.2 | 3.63  | 1.1 | ns          |
| 12   | I am sure I will take mathematics courses at university <sup>†</sup> . | 3.72              | 1.2 | 3.58  | 1.4 | ns          |

Note. Response format: 1=Strongly disagree, 2=Disagree, 3=Unsure, 4=Agree, and 5=Strongly agree

<sup>†</sup>Items differ slightly from the original ones;

Negatively worded items (1, 2, 3, 4, 5, and 6) were reverse-scored so that high scores represent high confidence level in learning mathematics;

ns: Means for boys and for girls did not differ statistically significantly at  $p < .01$  level (Bonferroni adjustment).

The scores of items negatively worded (see items 1 to 6 in Table 5.13) were all reversed to ensure that high scores indicate high confidence in learning mathematics. That is, if the child agreed strongly with item 1 ('Mathematics has been my worst subject'), the score of '5' was transformed into '1' to reflect the lowest level of confidence in learning mathematics. In contrast, if the child disagreed strongly with item 1, the score of '1' was transformed into '5' to reflect the highest level of confidence. The score of '3' (Unsure) remained the same.

As can be seen in Table 5.13, no item revealed statistically significant gender differences. However, boys tended to report higher confidence in learning mathematics than girls for most items. Girls were more confident than boys that they will understand mathematics in grade 8 (item 7), while boys were more confident towards understanding mathematics in grade 12 (item 4), and taking mathematics courses at the university (item 12).

Following the analyses item by item, each component was analysed. The reversed scores of the six negatively worded items (Items 1-6 in Table 5.13) were added and the sum divided by 6 (number of items) to facilitate the interpretation of the mean scores on

a 5-point scale. To distinguish the components, component 1 was designated as CLM-Negative (i.e. the higher the score, the more confident in learning mathematics the person was). The scores for the six positively worded items (Items 7-12) were also added and the sum divided by 6. Component 2 was designated as CLM-Positive (i.e. the higher the score, the more confident in learning mathematics the person was). These designations will be used throughout this thesis.

The CLM-Negative subscale had a good Cronbach- $\alpha$  coefficient of .76, but the  $\alpha$ -value for the CLM-Positive subscale was below the minimum acceptable value of .70 (De Vaus, 2002).

To examine gender differences in CLM-Negative and CLM-Positive subscales, independent-groups t-tests were conducted on the means for boys and for girls. The results are presented in Table 5.14.

Table 5.14

*Mean CLM-Negative and Mean CLM-Positive Scores and SDs for Boys (N=134) and for Girls (N=166), and Independent- Groups T-Tests Results (t and p Values)*

| DVs          |              |     |               |     | Independent groups t-test results |    |
|--------------|--------------|-----|---------------|-----|-----------------------------------|----|
|              | Boys (N=134) |     | Girls (N=166) |     | t                                 | p  |
|              | Mean         | SD  | Mean          | SD  |                                   |    |
| CLM-Negative | 2.90         | .88 | 2.79          | .84 | -                                 | ns |
| CLM-Positive | 3.75         | .70 | 3.64          | .66 | -                                 | ns |

Note. Response format: 1=Strongly disagree, 2=Disagree, 3=Unsure, 4=Agree, and 5=Strongly agree  
ns: Means for boys and for girls did not differ statistically significantly at  $p<.05$  as revealed by independent-groups t-test results.  
Negatively worded items were reverse-scored to ensure that high scores indicate high confidence in learning mathematics.

As can be seen in Table 5.14, no statistically significant gender differences were found on either the CLM-Negative or the CLM-Positive at the marginal level of statistical significance. However, the mean scores for girls were slightly lower than the mean scores for boys in both subscales. Using the scores 1 and 2 to represent low level of confidence in learning mathematics, 3 as moderate, and 4 and 5 as high, the average level of the children's confidence in learning mathematics varied from moderate to high.

It should be noted in Table 5.14 that the mean scores on CLM-Negative were lower than the mean scores on CLM-Positive subscale for both boys and girls. This indicates that the way children reacted to the negatively worded items and to the positively worded items was not the same.

### **Summary of results and discussion – Question 3**

The aim of Question 3 was to examine possible association between gender and confidence in learning mathematics. Gender was not a statistically significant variable on CLM scores and this finding contradicts previous studies (see Antunes & Fontaine, 2007; Fennema & Sherman, 1977, 1978; Mendick, 2005; Mittelberg & Lev-Ari (1999). Although the mean scores did not differ statistically significantly, boys tended to hold higher levels of confidence in learning mathematics than girls (CLM-Negative and CLM-Positive items).

Despite having contextualized some of the items from the CLM scale to increase their relevance to the primary school children in Mozambique, the reliability value of the scale was low. It was evident from the completed survey forms that some children had writing problems and thus, is it possible that they misinterpreted items due to reading difficulties. The results for research question 4 are examined next.

#### **Question 4**

**Do boys and girls differ in terms of their perceived usefulness of mathematics? How do students' perceptions of the usefulness of mathematics compare with parents' perceptions of the usefulness of mathematics for their children?**

To measure students' perceived usefulness of mathematics [PUM] and parents' PUM for their children, 14 items from the *Mathematics Value Inventory* [MVI] (Luttrell et al., 2010) were selected and used in this study. Examples of items used were:

- “Understanding mathematics has many benefits for me” (item 3: Positively worded);
- “I do not need mathematics in my everyday life” (item 4: Negatively worded).

(Adapted from Luttrell et al., 2010, p. 151).

The response format for items on the MVI varied from 1 (Strongly disagree) to 5 (Strongly agree). Negatively worded items were reverse-scored so that high scores represented high levels of PUM. To facilitate interpretation of scores within the range 1 to 5, the sum of the scores was divided by the number of items (14).

Independent-groups t-tests were conducted to compare PUM mean scores between: (i) boys and girls; (ii) mothers and fathers; and (iii) parents of sons and parents of daughters.

Table 5.15 presents a summary of the results obtained.



Table 5.15

*Mean PUM Scores, SDs, and Independent-Groups T-Tests Results for Boys and Girls, Mothers and Fathers, and Parents of Daughters and Parents of Sons*

| Grouping (IVs)       | Independent-groups |      |     |   |    |
|----------------------|--------------------|------|-----|---|----|
|                      | t-test results     |      |     |   |    |
|                      | N                  | Mean | SD  | t | p  |
| Boys                 | 134                | 3.71 | .53 | - | ns |
| Girls                | 164                | 3.61 | .57 |   |    |
| Mothers              | 104                | 3.46 | .29 | - | ns |
| Fathers              | 115                | 3.52 | .30 |   |    |
| Parents of daughters | 123                | 3.48 | .29 | - | ns |
| Parents of sons      | 96                 | 3.51 | .31 |   |    |

Note. Response format: 1=Strongly disagree, 2=Disagree, 3=Unsure, 4=Agree, and 5=Strongly agree  
 ns: Mean PUM scores did not differ statistically significantly at  $p < .05$  level.

As can be seen in Table 5.15, the influence of gender on PUM scores was not statistically significant at the marginal  $p$  level ( $<.05$ ). Despite the gender of the child or of the parent not having a statistically significant effect on the PUM scores, the data from Table 5.15 show that boys tended to report higher PUM than girls, with a difference of 10 points. Also, fathers and parents of sons reported slightly higher PUM for their children than did mothers and parents of daughters, respectively.

In order to compare children's and parents' responses, a paired t-test was conducted on PUM mean scores for children and parents following Pallant's (2009) guidelines. The results revealed that the parents' PUM for their children ( $M=3.49$ ,  $SD=.30$ ) was statistically significantly lower than the children's PUM ( $M=3.68$ ,  $SD=.56$ );  $t(216) = 4.5$ ,  $p < .001$ . That is, parents perceived mathematics to be less

useful for their children than the children themselves viewed it, and the results were highly statistically significant.

### **Summary of results and discussion – Question 4**

The findings that emerged from the data were:

- Children's PUM was not influenced by gender;
- Parents' PUM for their children was not associated with gender of the child or parent.

Previous research found associations between gender and perceived usefulness of mathematics favouring males (Fennema & Sherman, 1976, 1978; Tocci & Engelhard, 1991). In the current study gender differences in PUM scores were not found. Using the same instrument used in in this study (i.e., *Mathematics Value Inventory*), Luttrell et al. (2010) also did not find statistically significant gender differences and the effect sizes were very small.

Parents perceived mathematics as less useful for their children than the children's perceptions of the usefulness of mathematics for themselves. This result constitutes a concern because parents may influence their children's beliefs and attitudes towards the study of mathematics through their roles as task-value socialisers (Eccles, 2005; Eccles & Jacobs, 1986; Eccles et al., 1983). It should be noted that PUM is an important variable in education due to its association with other mathematics learning outcomes such as performance, further education, and careers (Mullis et al., 2008; Tiedemann, 2002).

### **Question 5**

**Which selected parental background variables, economic resources, and cultural factors are the best predictors of children's perceived achievement, confidence, and perceived usefulness of mathematics?**

Question 5 had two aims: The first aim was to identify a model made up of independent variables (e.g., *family circumstances* – parent educational background and occupation, number of siblings, number of books, home language, and geolocation; *child's characteristics* – age, and gender) that best predict children's perceived achievement in mathematics [PAM], confidence in learning mathematics [CLM-Negative, and CLM-Positive], and perceived usefulness of mathematics [PUM]. The second aim was to identify economic resources that were statistically significantly associated with these variables.

To identify a model made up of family circumstances and child's characteristics that best predict the dependent variables (PAM, PUM, CLM-Negative, and CLM-Positive), a stepwise regression analysis was applied because it specifies multiple models in a single regression command, and lists all the excluded variables (Coakes et al., 2010). According to Coakes et al. (2010), variables are excluded when they do not meet the selection criteria established by the stepwise regression, or when they do not reach the level of statistical significance.

A summary of the stepwise regression statistics and the statistically significant predictor models for the dependent variables examined is presented in Table 5.16.

Table 5.16

*Stepwise Regression Statistics and the Statistically Significant Predictor Models for PUM, PAM, CLM-Negative, and CLM-Positive Scores (N=225)*

| DVs | Models | Predictor IVs | Model Summary |     |         |     |     |                |    |     |
|-----|--------|---------------|---------------|-----|---------|-----|-----|----------------|----|-----|
|     |        |               | B             | SE  | $\beta$ | t   | p   | R <sup>2</sup> | F  | p   |
| PUM | 1      | Age           | .15           | .03 | .38     | 6.0 | .00 | .141           | 36 | .00 |
|     | 2      | Age           | .13           | .03 | .33     | 5.3 | .00 | .177           | 24 | .00 |
|     |        | Education     | .05           | .02 | .19     | 3.1 | .01 |                |    |     |
|     | 3      | Age           | .11           | .03 | .28     | 4.3 | .00 | .202           | 18 | .00 |
|     |        | Education     | .04           | .02 | .17     | 2.7 | .01 |                |    |     |
|     |        | Geolocation   | .13           | .05 | .17     | 2.7 | .01 |                |    |     |
|     | 4      | Age           | .10           | .03 | .23     | 3.5 | .00 | .222           | 16 | .00 |
|     |        | Education     | .04           | .02 | .18     | 2.9 | .01 |                |    |     |
|     |        | Geolocation   | .12           | .05 | .15     | 2.3 | .02 |                |    |     |
|     |        | Siblings      | .10           | .04 | .14     | 2.3 | .02 |                |    |     |
|     | PAM    | -             | -             | -   | -       | -   | -   | -              | -  | -   |
|     | CLM    | -             | -             | -   | -       | -   | -   | -              | -  | -   |
|     | -N     | -             | -             | -   | -       | -   | -   | -              | -  | -   |
|     | CLM    | -             | -             | -   | -       | -   | -   | -              | -  | -   |
|     | -P     | -             | -             | -   | -       | -   | -   | -              | -  | -   |

Note. B=Unstandardized coefficients, SE=Standard error,  $\beta$ =Beta coefficient, t=t-test statistics, p=significance level; R<sup>2</sup>: The proportion of variance in the DV that can be explained by the model. F=Mean square (Regression)/Mean square (Residual).

PUM: Perceived usefulness of mathematics;

PAM: Perceived achievement in mathematics;

CLM-N: Confidence in learning mathematics (negatively worded items);

CLM-P: Confidence in learning mathematics (positively worded items).

As can be seen in Table 5.16, a model composed of age of the child, education of parent, geolocation, and number of siblings was the best predictor of PUM scores. This model explained about 22% of the variance of PUM scores as revealed by  $R^2 = .222$ . Age of the child alone was an important variable of PUM as it explained 14% of the variance of scores and the result was highly statistically significant.

Table 5.16 also shows that no independent variable examined was a statistically significant predictor of PAM, CLM-Negative, and CLM-Positive scores.

After observing that age of the child, education of parent, geolocation, and number of siblings were the best predictors of PUM scores at various levels of statistical significance, to identify groups (pairs) that differed from each other, one way between groups analyses of variance (ANOVAs) were conducted on the mean scores with Tukey or Games-Howell post hoc comparisons as appropriate (Pallant, 2009).

ANOVAs results revealed that:

- The youngest children (age=11 years<sup>1</sup>; N=41; M=4.13; SD=.48) had higher mean PUM score than the children aged 12 and over (N=184; M=3.74;  $p<.001$ ).
- Children whose parents had university education or were studying at university at the time of data collection had higher mean PUM score (N=34; M=4.04; SD=.56) than the children whose parents did not have this level of education (N=191; M=3.46; SD=.41;  $p<.001$ ).
- Children from urban schools had higher mean PUM score (N=151; M=3.79; SD=.58) than the children from rural (N=45; M=3.47; SD=.42;  $p<.001$ ), and remote schools (N=29; M=3.39; SD=.43;  $p<.001$ ). Mean PUM scores for children in rural and remote schools did not differ from one another.
- Children with two or fewer siblings had higher mean PUM score (N=52; M=3.89; SD=.56) than the children with three or more siblings<sup>2</sup> (N=173; M=3.63;  $p<.01$ ).

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<sup>1</sup> The ages of the children ranged from 11 to 16 and the mean age was 12.9.

<sup>2</sup> The numbers of siblings varied from 0 to 18.

The second aim of Question 5 was to identify selected economic resources that were statistically significantly associated with PAM, PUM, CLM-Negative, and CLM-Positive scores. To do so, the independent variable ‘possession of economic resource’ was examined using two levels: ‘Yes’ and ‘No’. The former was used when the child had the resource and the latter when the child did not. Independent-groups t-tests were conducted in order to compare mean scores on dependent variables between the children who owned selected economic resources and those who did not. Due to the number of tests, a Bonferroni adjustment ( $p < .001$ ) was applied to reduce the probability of inflated ‘type 1 errors (Pallant, 2009). Mean scores on dependent variables (DVs), frequencies, and independent-groups t-test results are presented in Table 5.17 by economic resource.

Table 5.17

*Mean Scores on Dependent Variables (DVs), Frequencies, and Independent-Groups t-Test Results by Economic Resource*

| Economic resources | DVs   | Possession status |      |     |      | Independent-groups t-tests results |       |
|--------------------|-------|-------------------|------|-----|------|------------------------------------|-------|
|                    |       | Yes               | Mean | No  | Mean | t                                  | p     |
| Electricity        | PAM   | 210               | 3.22 | 90  | 3.02 | -                                  | ns    |
|                    | PUM   | 208               | 3.76 | 90  | 3.42 | 5.0                                | <.001 |
|                    | CLM-N | 210               | 2.99 | 90  | 2.48 | 4.9                                | <.001 |
|                    | CLM-P | 210               | 3.72 | 90  | 3.62 | -                                  | ns    |
| Television Set     | PAM   | 210               | 3.19 | 90  | 3.10 | -                                  | ns    |
|                    | PUM   | 208               | 3.75 | 90  | 3.45 | 4.4                                | <.001 |
|                    | CLM-N | 210               | 3.00 | 90  | 2.46 | 5.8                                | <.001 |
|                    | CLM-P | 210               | 3.70 | 90  | 3.66 | -                                  | ns    |
| Computer           | PAM   | 60                | 3.22 | 240 | 3.15 | -                                  | ns    |
|                    | PUM   | 60                | 3.90 | 238 | 3.59 | 3.9                                | <.001 |
|                    | CLM-N | 60                | 3.25 | 240 | 2.74 | 4.3                                | <.001 |
|                    | CLM-P | 60                | 3.72 | 240 | 3.68 | -                                  | ns    |
| Internet           | PAM   | 33                | 3.52 | 267 | 3.12 | -                                  | ns    |
|                    | PUM   | 33                | 3.93 | 267 | 3.62 | 3.1                                | <.001 |
|                    | CLM-N | 33                | 3.47 | 267 | 2.76 | 4.6                                | <.001 |
|                    | CLM-P | 33                | 3.67 | 267 | 3.69 | -                                  | ns    |
| Piped water        | PAM   | 150               | 3.11 | 150 | 3.21 | -                                  | ns    |
|                    | PUM   | 148               | 3.74 | 150 | 3.58 | 2.6                                | <.001 |
|                    | CLM-N | 150               | 3.00 | 150 | 2.68 | 3.3                                | <.001 |

| Economic resources   | DVs   | Possession status |      |     |      | Independent-groups t-tests results |       |
|----------------------|-------|-------------------|------|-----|------|------------------------------------|-------|
|                      |       | Yes               | Mean | No  | Mean | t                                  | p     |
| Calculator           | CLM-P | 150               | 3.76 | 150 | 3.62 | -                                  | ns    |
|                      | PAM   | 89                | 3.34 | 211 | 3.09 | -                                  | ns    |
|                      | PUM   | 89                | 3.66 | 209 | 3.65 | -                                  | ns    |
|                      | CLM-N | 89                | 2.80 | 209 | 2.86 | -                                  | ns    |
|                      | CLM-P | 89                | 3.76 | 211 | 3.66 | -                                  | ns    |
| Mathematics textbook | PAM   | 225               | 3.18 | 75  | 3.11 | -                                  | ns    |
|                      | PUM   | 224               | 3.67 | 74  | 3.61 | -                                  | ns    |
|                      | CLM-N | 225               | 3.67 | 75  | 3.61 | -                                  | ns    |
|                      | CLM-P | 225               | 3.70 | 75  | 3.65 | -                                  | ns    |
|                      | PAM   | 224               | 3.18 | 76  | 3.12 | -                                  | ns    |
| Reading textbook     | PUM   | 223               | 3.67 | 75  | 3.63 | -                                  | ns    |
|                      | CLM-N | 224               | 2.81 | 76  | 2.94 | -                                  | ns    |
|                      | CLM-P | 224               | 2.81 | 76  | 2.94 | -                                  | ns    |
|                      | PAM   | 115               | 3.26 | 185 | 3.10 | -                                  | ns    |
|                      | PUM   | 114               | 3.61 | 184 | 3.69 | -                                  | ns    |
| Cell phone           | CLM-N | 115               | 2.79 | 185 | 2.87 | -                                  | ns    |
|                      | CLM-P | 115               | 3.76 | 185 | 3.64 | -                                  | ns    |
|                      | PAM   | 273               | 3.17 | 27  | 3.07 | -                                  | ns    |
|                      | PUM   | 271               | 3.68 | 27  | 3.45 | 2.6                                | <.001 |
|                      | CLM-N | 273               | 2.87 | 27  | 2.57 | -                                  | ns    |
| School uniforms      | CLM-P | 273               | 3.70 | 27  | 3.59 | -                                  | ns    |

Note. ns: Means do not differ statistically significantly at  $p < .01$  level (Bonferroni adjustment).

Yes: They do possess the economic resource. No: They do not possess the economic resource.

PUM: Perceived usefulness of mathematics;

PAM: Perceived achievement in mathematics;

CLM-N: Confidence in learning mathematics (negatively worded items);

CLM-P: Confidence in learning mathematics (positively worded items).

As can be seen in Table 5.17, children who had electricity, television set, computer, internet, piped water, and school uniforms reported higher PUM and confidence in learning mathematics (CLM-Negative) than the children who did not have these resources. Although the impact of the other resources examined was not statistically significant at  $p < .01$  level (Bonferroni adjustment), the children with resources in their homes tended to have higher scores on all measures than the children who did not have them. Exceptions were noted in relation to some resources. For example, children with calculators and textbooks for reading and mathematics did not have advantages over the children who did not have them in terms of their confidence in

learning mathematics. Also, children possessing cell phones did not outperform the children who did not have them in terms of their PUM scores.

### **Summary of results and discussion – Question 5**

The key findings were:

- Children from urban schools, children with more educated parents, and children with fewer siblings had higher PUM and confidence in learning mathematics than other children.
- Electricity, TV set, computer, the internet, piped water, and school uniforms were positively associated with perceived usefulness of mathematics and confidence in learning mathematics.
- Despite not reaching statistical significance in some cases, ownership of a resource was generally associated with better scores with the exception of calculators, textbooks, and cell phones.

Textbooks are granted by the government in Mozambique and thus, possession of a textbook may not indicate the child's socioeconomic status. Calculators are not formally used in Mozambican schools although some children have and use them under their own initiative. Thus, it is possible that most children did not yet appreciate the power of calculators for mathematics learning. About 40% of the children reported having a cell phone, but possession of this device did not improve any DV. Hence, it is possible that the children did not relate mathematics with technology. The lack of association between mathematics and technology was observed among parents during interviews as will be demonstrated in Chapter 6 of this thesis. Also, as most of the items included in the survey asked to indicate things that children had at home, it is possible that some children reported having a cell phone that belongs to their family members when they do not necessarily use it.



Several studies reviewed in this thesis indicate that cultural and background factors such as home language, parental education, parental occupation, geolocation, and family economic resources influence mathematics learning outcomes, such as performance, beliefs, attitudes, and task-values (e.g., Grootenboer & Hemmings, 2007; Mullis et al., 2008; NAPLAN, 2011). This was also found in this study in relation to the perceived usefulness of mathematics, and the confidence in learning mathematics. However, there was no variable that predicted perceived achievement in mathematics [PAM]. This was probably due to data problems or the pertinent variables that best explain the variation of PAM scores were not examined. As indicated earlier in this chapter, Drysdale and Hancock (1997) indicated that PAM is created and reinforced *by* early experiences of success and failure in mathematics learning. Thus, to understand PAM may also require examination of students' past performances, and classroom environments.

The results for research question 6 are presented next.

## **Question 6**

### **What is the level of parental involvement in the education of their children?**

The aim of Question 6 was determining the level of parents' involvement in the education of their children. Parental involvement in education [PIE] was measured using 16 items from the *Family Involvement Questionnaire* [FIQ] (Manz et al., 2004). Examples of items used are:

- “Help child to understand homework” (item 1);
- “Contact teacher or school principal to get information” (item 4);
- “Attend school meetings” (item 2).

(Adapted from Manz et al., 2004, p. 468).

Each item above represents one dimension of parental involvement in education: home-based involvement (item 1), home-school contacts (item 4), and school-based involvement (item 2).

FIQ uses a 4-point Likert-type response format: 1=Rarely, 2=Sometimes, 3=Frequently, and 4=Nearly always. To facilitate the interpretation of results the sum of scores was divided by the number of items (16) in order to obtain mean scores ranging from 1 to 4.

Mean PIE scores equal or close to the mid-point 2.5 of the 4-point scale represented moderate parental involvement in education. Mean PIE scores below and above 2.5 indicated low and high parental involvement in education, respectively. As FIQ comprises three different dimensions, to identify activities that parents perform most often, items were examined one by one. One-sample t-tests were conducted to determine whether means for each item differed from 2.5. A Bonferroni adjustment

( $p < .001$ ) was applied (Pallant, 2009). Table 5.18 shows mean PIE scores for each item and average, and one-sample t-test results.

Table 5.18

*Mean PIE Scores by Item, and Average PIE Score, and One-Sample T-Tests Results (N=222)*

| Activities  | PIE (Means) | One-sample t-test results<br>Test Value = 2.50 |    |
|---|-------------|--|----|
|   |             | t  | p  |
| 1 Help child to understand mathematics homework   | 2.40        | -  | ns |
| 2 Attend meetings at school   | 2.88        | 5.9  | ** |
| 3 Reward child for good grades  | 2.30        | 3.3  | ** |
| 4 Contact teacher or principal to get information   | 2.10        | 6.1  | ** |
| 5 Talk to other parents about school problems   | 2.14        | 5.5  | ** |
| 6 Attend parent workshops or training at school   | 1.77        | 10.8   | ** |
| 7 Do creative activities with child (e.g., building a barn in the yard to store agricultural products, playing games, fixing damaged things ) | 2.33        | 2.5  | *  |
| 8 Ask child about day at school   | 2.91        | 5.9  | ** |
| 9 Talk to teacher about child's accomplishments   | 2.06        | 6.7  | ** |
| 10 Attend meetings organised by the commission of parents   | 2.36        | -  | ns |
| 11 Participate in social events at school (e.g. school day, and open day)   | 2.59        | -  | ns |
| 12 Buy and bring home learning materials (e.g., newspapers, magazines, books, games)  | 2.45        | -  | ns |

| Activities   | PIE<br>(Means) | One-sample t-test<br>results<br>Test Value = 2.50 |    |
|--|----------------|---|----|
|  |                | t   | p  |
| 13 Talk to teacher about disciplinary problems involving the child                       | 2.17           | 4.8   | ** |
| 14 Talk to child about the importance of school  | 2.88           | 5.4   | ** |
| 15 Limit house chores for the child (e.g. cooking, fetching water, trading, babysitting) | 2.51           | -   | ns |
| 16 Limit child's entertainment (e.g., TV watching, playing , fishing, hunting)           | 2.55           | -   | ns |
| Mean PIE scores  | 2.40           |   | ns |

Note. Response format: 1=Rarely, 2=Sometimes, 3=Frequently, 4=Nearly always.

One-sample t-test results: Test value = 2.50 (Mid-point of a 4-point scale)

\*\* $p < .001$ ; \* $p < .01$  (Bonferroni adjustment)

ns: Means did not differ statistically significantly from 2.5 (moderate involvement in education).

Table 5.18 shows that the mean PIE score (2.40) did not differ from 2.5 statistically significantly. This indicates that the level of parental involvement in the education of their children was moderate. Analysis item by item revealed that PIE was reasonably high in regard to attending meetings at school (item 2), asking the child about day at school (item 8), and talking to the child about the importance of school (item 14). PIE was low in regard to most activities examined. For example, parents rarely attended workshops or training at school. Only on few occasions (sometimes) parents:

- Rewarded their children for good grades (2);
- Contacted teacher or principal to get information (4);
- Talked to other parents about school problems (5);

- Talked to teacher about child's accomplishments (9);
- Talked to teacher about disciplinary problems involving their children (13);

ANOVAs were conducted on the mean PIE scores to verify whether geolocation (i.e., Urban, Rural, and Remote) influenced PIE scores. Parental involvement in education was influenced by geolocation:  $F(2,214) = 4.1, p < .05$ . Despite reaching statistical significance, the actual difference was small. The effect size statistics using  $\eta^2$  was .04 (Cohen, 1988). Follow up comparisons using a Tukey HSD test indicated that the mean PIE score for parents in urban schools ( $N=145, M=2.46, SD=.47$ ) was higher than the mean PIE score for parents in rural ( $N=43, M=2.21, SD=.57$ ), and remote schools ( $N=29, M=2.35, SD=.35$ ). Mean PIE scores for parents in rural and remote schools did not differ from one another.

Parental involvement in education was not statistically significantly influenced by parental education, number of siblings, and the gender of the child or parent. However, parents of girls ( $M=2.42$ ) and mothers ( $M=2.45$ ) reported slightly more involvement than parents of boys ( $M=2.36$ ) and fathers ( $M=2.34$ ), respectively.

### **Summary of results and discussion – Question 6**

Question 6 revealed that the level of parental involvement in the education of their children was moderate. That is, in a scale from 1 to 4 the mean PIE score (2.40) was slightly below the middle value. Parents in urban schools were relatively more involved than parents in rural and remote schools. No relationships between parental education, number of siblings, gender of the child or parent and parental involvement in education were found. However, when the same instrument (i.e., *Family Involvement Questionnaire*) was used by Manz et al. (2004) in the USA, more educated parents

were more involved in the education of their children than the less educated parents.

Also, parents of boys were more involved in education than parents of girls.

Data analyses item by item indicated that parents surveyed in the current study often attended school meetings, asked child about the day at school, and talked to child about the importance of school.

Parents rarely participated in a workshop or training at school, but this information is not completely surprising as this kind of activity, although important to support parents, is unusual in Mozambican schools.

The literature reviewed in Chapter 2 indicated that socioeconomic constraints, school language if different from the language spoken at home, and school environment may influence parents' involvement in education (Waanders et al., 2007; McWayne et al., 2008). The interview data presented in Chapter 6 provide an insight into the reasons why most parents do not help their children to understand mathematics homework.

The results from question 7 are presented next.

### **Question 7**

**What are the most salient causes that boys and girls attribute to their successes and failures in mathematics? What are the most salient reasons that parents attribute to the successes and failures of their daughters and sons in mathematics?**

To answer Question 7 the data were collected using four hypothetical events – two events described successes and two described failures in mathematical activities. Items presented to parents were similar to those completed by their children but reflected the standpoint of parents. All events mentioned familiar situations that happened or could have happened to children during their work in mathematics. The four events were:

1. You got 18 out of 20 marks<sup>3</sup> in a mathematics test;
2. You got only 7 out of 20 marks in a final mathematics exam;
3. You simplified very well a fraction;
4. You do not know how to divide two fractions.

(Adapted from Fennema et al., 1979, p. 83-87)

As can be seen, events 1 and 3 represented success and events 2 and 4 represented failure. Each event was accompanied by four possible causes that reflected the four attribution categories proposed by Weiner (1974): Ability, Effort, Task difficulty, and Environment. For each possible cause, the children were asked to indicate the extent to which they agreed or disagreed with it as a plausible reason for the event if it had happened to them. A Likert-type response format ranging from 1 (Strongly disagree) to 5 (Strongly agree) was used. Each attribution category – ability, effort, task difficulty, and environment was treated as a subscale of causal attribution in mathematics [CAM]. Thus, a high mean CAM score on a subscale indicated strong agreement that the cause mentioned was reasonable. The subscale totals were worked out and divided by 2 (number of items) to facilitate interpretation of scores using the range 1 to 5.

To examine gender differences in causal attributions for success and failure in mathematics, independent-groups t-tests were performed on the mean CAM scores for boys and girls.

Table 5.19 presents a summary of mean CAM scores for boys and for girls, standard deviations (SDs), and the results of independent-groups t-test (t and p values)

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<sup>3</sup> The scale '0-20' is commonly used to assess students in Mozambique.

by subscale. A Bonferroni adjustment was applied to a cut-off of  $p < .001$  (Pallant, 2009).

Table 5.19

*Mean CAM Scores and SDs for Boys (N=134) and for Girls (N=166), and Independent-Groups T-Tests Results*

| Subscale |             | Mean | SD  | Mean  | SD  | Independent groups t-test results |    |
|----------|-------------|------|-----|-------|-----|-----------------------------------|----|
|          |             | Boys |     | Girls |     | t                                 | p  |
| SUCCESS  | Ability     | 3.81 | .88 | 3.59  | .85 |                                   | ns |
|          | Effort      | 4.23 | .75 | 4.01  | .80 |                                   | ns |
|          | Task        | 4.22 | .79 | 4.05  | .80 |                                   | ns |
|          | Environment | 4.31 | .79 | 4.11  | .80 |                                   | ns |
| FAILURE  | Ability     | 2.96 | 1.1 | 3.05  | 1.1 |                                   | ns |
|          | Effort      | 3.11 | 1.1 | 3.06  | .99 |                                   | ns |
|          | Task        | 3.46 | .99 | 3.50  | .96 |                                   | ns |
|          | Environment | 2.98 | 1.0 | 3.18  | 1.1 |                                   | ns |

Note. Response format: 1=Strongly disagree, 2=Disagree, 3=Unsure, 4=Agree 5=Strongly agree.  
ns: Boys and girls did not differ in terms of their CAM means as revealed by independent-groups t-test results at  $p < .001$  level of statistical significance (Bonferroni adjustment).

As can be seen in Table 5.19, the responses of boys did not differ from the responses of girls as revealed by the independent-groups t-test results. The attributions of both boys and girls ranked in the following decreasing order: Environment, effort, task difficulty, and ability. This means that the children believed the environment was the most plausible reason for their successes in mathematics. ‘Environment’ in this



thesis refers to having a teacher who explains mathematics very well, or having someone at home who can help the child to understand mathematics.

It is interesting to note that the children viewed ability as the least credible cause for their success in mathematics and there was no gender difference in this belief.

With respect to failure in mathematics, the causal attributions of boys decreased following the order: Task, (lack of) effort, environment, and (lack of) ability. In regard to girls' causal attributions the environmental factors ranked second.

As can be seen, the children tended to perceive the nature of the task (task difficulty) to be the most probable cause for their failures in mathematics. Generally, the children were unsure about the role of ability, effort, and environment on their failures in mathematics (see scores all are close to 3). This could also indicate that the children were divided on their responses.

To determine the most salient reasons that parents of sons and parents of daughters attributed to their children's successes and failures in mathematics, the four events that were presented to children were modified into the following statements:

1. Your child got 18 out of 20 marks in a mathematics test;
2. Your child got only 7 out of 20 marks in a final mathematics exam;
3. Your child simplified very well a fraction;
4. Your child does not know how to divide two fractions

To facilitate comparison of the data, the same procedures used to analyse the children's attributions were employed to examine parents' attributions. The attributions of parents of boys were compared with the attributions of parents of girls to see whether

there was an influence of the gender of the child on attribution patterns. Table 5.20 presents the results.

Table 5.20

*Parents' Mean CAM Scores and SDs for Parents of Boys (N=96) and for Parents of Girls (N=123), and Independent-Groups T-Tests Results*

| Subscale |             | Mean            | SD  | Mean             | SD  | Independent groups t- test results |    |
|----------|-------------|-----------------|-----|------------------|-----|------------------------------------|----|
|          |             | Parents of boys |     | Parents of girls |     | t                                  | p  |
|          | Ability     | 3.72            | .80 | 3.62             | .75 | -                                  | ns |
| SUCCESS  | Effort      | 4.04            | .75 | 4.00             | .77 | -                                  | ns |
|          | Task        | 3.72            | .81 | 3.76             | .73 | -                                  | ns |
|          | Environment | 3.79            | .84 | 3.82             | .76 | -                                  | ns |
|          | Ability     | 2.66            | .99 | 2.87             | 1.0 | -                                  | ns |
| FAILURE  | Effort      | 2.46            | 1.0 | 2.61             | 1.0 | -                                  | ns |
|          | Task        | 2.98            | .97 | 3.19             | .98 | -                                  | ns |
|          | Environment | 2.82            | .90 | 3.00             | .92 | -                                  | ns |

Note. Response format: 1=Strongly disagree, 2=Disagree, 3=Unsure, 4=Agree 5=Strongly agree.  
ns: Parents of girls and parents of sons did not differ in terms of their means as revealed by independent-groups t-test results ( $p < .001$ ).

As can be seen in Table 5.20, the attributions of parents of boys did not differ from the attributions of parents of girls. This means that, parents' perceived causes for their children's successes and failures in mathematics may have not been influenced by the gender of the child.

The reasons that parents attributed to their children's successes rated in the following decreasing order: Effort, environment, and task or ability. This attribution sequence differs slightly from that of their children. Parents viewed effort (e.g., to

spend a lot of time preparing for a test) as the most plausible cause for their children's success in mathematics. But parents, similar to their children, also held the view that ability is the least credible cause for success in mathematics.

Contrary to the success attributions, parents were unsure as to whether the nature of the task (task difficulty), teacher or other people (environment), and lack of effort or ability were responsible for their children's failure in mathematics (see scores are all close to 3). This issue was also explored qualitatively through interviews conducted with parents. Chapter 6 provides substantial information about parents' beliefs in regard to their children's poor achievement in mathematics.

### **Summary of results and discussion – Question 7**

The key findings were:

- There were no gender differences on children's causal attributions for success and failure in mathematics;
- Parents' causal attributions for their children's successes and failures were not related to the gender of the child.
- Children believed environment was the most plausible cause for their success in mathematics and ability the least one.
- In regard to failure, children viewed the nature of the task (task difficulty) to be the most credible reason.
- Parents viewed effort to be the most reasonable cause for their children's success in mathematics but were neutral about failure.

Gender differences in causal attributions for success and failure in mathematics have been found and described in many studies (e.g., Fennema et al., 1979; Mendick, 2005; Pedro et al., 1981; Stipek & Gralinski, 1991; Tiedemann, 2002). These studies indicated that boys tend to attribute their success experiences in mathematics to internal

factors (e.g., ability or effort), and failure to internal and unstable factors such as lack of effort or time to study. Girls, on the other hand, tend to attribute their successes to the external and uncontrollable factors such as luck or help from other people (environment), and failure to lack of ability.

In the present study, gender differences in either success or failure attributions were not found among children and among parents for their children.

Another important finding is that the children and parents viewed ability as the least plausible cause for success in mathematics.

The responses of parents and children differed in regard to success attributions. By agreeing strongly that success in mathematics is achieved through effort, parents held a more positive belief than their children because effort is a personal trait, and the learner has the possibility to control it (Weiner, 1974). As also Pedro et al. (1981) indicated, in the presence of failure, the student can put on more effort until success is achieved. In contrast, the view that success in mathematics is achieved through external forces (e.g., good teacher, help), withdraws the responsibility of the students to their learning.

Accordingly, previous studies indicated that attribution of success to external sources is not functional at the educational point of view because these factors are unreliable or have stable properties, and after a success a learner has no reason to expect that a similar outcome will occur in the future (Meyer & Koehler, 1990).

The notion of *facilitative attribution* proposed by Meyer and Koehler (1990) was that success in mathematics should be attributed to effort and ability, and failure to lack of effort. The basis of this recommendation is that effort and ability are internal traits in relation to the learner. The perception that failure is due to the lack of effort has

advantages over perceived lack of ability because effort is malleable, and thus, the learner can increase or decrease effort based on [perceived] achievement.

### **Question 8**

#### **Do Grade 7 males and females, and parents gender stereotype mathematics learning as a male domain?**

In this section, the terms *males* and *females* are used to refer to grade 7 boys' and girls' responses for clearer distinctions with the terms *boys* and *girls* used in the wording of items from the *Who and Mathematics* [W&M] instrument (Leder & Forgasz, 2002a).

Question 8 had two aims. The first aim was determining the extent to which respondents gender stereotype mathematics as a male domain. To gender stereotype mathematics as a male domain means to hold and to expect boys and girls to hold beliefs and behaviours towards mathematics learning that are consistent with previous studies (see Leder & Forgasz, 2002a), that is, that mathematics is a discipline more suited to males than to females. The second aim was determining whether the strengths of the beliefs held by grade 7 males and females and their parents were consistent with: "Mathematics continues to be viewed as a male domain, more so by males than by females" (Tiedemann, 2002, p. 50).

The respondents' gendered beliefs about mathematics learning were collected using the 30 items from the W&M instrument developed by Leder and Forgasz (2002a) in Australia. According to these authors, the 30 items are worded in a way to reflect typical beliefs and/or behaviours towards mathematics learning that have been identified in previous studies. Consider, for example, item 14 ("Think mathematics will be important in their adult life"), and item 26 ("Consider mathematics to be boring") of the W&M instrument. Respondents are asked to decide whether the pertinent belief or

behaviour consistent with the wording of each of these items is more likely to be true for boys, girls, or whether there is no difference. Previous research indicates that respondents tend to match the wording of item 14 with ‘boys’, and of item 26 with ‘girls’ (Leder & Forgasz, 2002a); Thus, associating the wording of item 14 with ‘boys’ or item 26 with ‘girls’, is aligned with the traditional view (gender stereotyping) of mathematics learning as a male domain. The five response options that the W&M instrument provides are presented in Table 5.21.

Table 5.21

*Response Format and Scoring System from the Who and Mathematics [W&M] Instrument*

| Response                               | Code | Score |
|--|------|-------|
| Boys definitely more likely than girls | BD   | 1     |
| Boys probably more likely than girls   | BP   | 2     |
| No difference between boys and girls   | ND   | 3     |
| Girls probably more likely than boys   | GP   | 4     |
| Girls definitely more likely than boys | GD   | 5     |

Note. ND: Response that corresponds to the view that mathematics is a gender neutral domain. (Adapted from Leder & Forgasz, 2002a, p. 3).

The respondents are asked to read each statement carefully, and to choose one of the options above. To facilitate interpretation of the responses, Leder and Forgasz (2002a) proposed the following scoring system: BD=1; BP=2; ND=3; GP=4 and GD=5. Thus, mean scores for each item are worked out and interpreted on the basis of their proximity to 3 – the score corresponding to a gender-neutral belief. Specifically, mean scores are interpreted using the following criteria:

A mean score  $<3$  indicated that, on average, the students believe that boys [B] are more likely than girls to match the wording of the item; mean scores  $>3$  that they believe girls [G] to be more likely than boys to do so. One-sample t-tests can be used to determine if mean scores are significantly different from 3, the score that represents a belief that “there is no difference between boys and girls” [ND], and independent groups t-tests to explore for possible gender differences in the responses to each item. (Leder & Forgasz, 2002a, p. 4)

This procedure was also used in this study in order to facilitate comparison of results with other studies that used the same instrument. The Mozambican data (grade 7 students) were compared with data from four countries: Germany, Greece, Australia, and USA. The W&M instrument has also been used in Israel (Forgasz & Mittelberg, 2008), and Sweden (Brandel & Staberg, 2008), but the data reported in these studies did not allow comparisons.

Mean scores for grade 7 males, and for grade 7 females, one-sample t-test results, and the directions of the responses to the 30 items of the W&M instrument are presented in Table 5.22. Also shown in Table 5.22 are the predicted response directions that are consistent with gender stereotyping of mathematics as a male domain (Leder & Forgasz, 2002a). Shaded regions indicate where findings were consistent with the predicted response directions.

Table 5.22

*Means for Grade 7 Males (N=134), and for Grade 7 Females (N=166), One-Sample T-Tests Results, Independent-Groups T-Test Results, Directions of Beliefs for the 30 Items of the W&M Instrument, and the Predicted Response Directions (Pred.)*

| ITEM |   |      | M                 |     | F                 |     | Indep.<br>t-test<br>results<br><i>p</i> |
|------|---|------|-------------------|-----|-------------------|-----|---|
|      |   | Pred | Mean              | Dir | Mean              | Dir |   |
| 1    | Mathematics is their favourite subject                                    | B    | 2.32              | B   | 2.87 <sup>†</sup> | ND  | **                                      |
| 2    | Think it is important to understand the work in mathematics               | G    | 2.20              | B   | 2.94 <sup>†</sup> | ND  | **                                      |
| 3    | Are asked more questions by the mathematics teacher                       | B    | 2.54              | B   | 2.76              | B   | ns                                      |
| 4    | Give up when they find mathematics problem is too difficult               | G    | 2.83 <sup>†</sup> | ND  | 2.55              | B   | ns                                      |
| 5    | Have to work hard in mathematics to do well                               | G    | 2.42              | B   | 3.07 <sup>†</sup> | ND  | **                                      |
| 6    | Enjoy mathematics   | B    | 2.24              | B   | 3.17 <sup>†</sup> | ND  | **                                      |
| 7    | Care about doing well in mathematics                                      | B/G  | 2.29              | B   | 3.17 <sup>†</sup> | ND  | **                                      |
| 8    | Think they did not work hard enough if they do not do well in mathematics | B    | 2.71              | B   | 2.85 <sup>†</sup> | ND  | ns                                      |
| 9    | Parents would be disappointed if they did not do well in mathematics      | B    | 2.69              | B   | 2.97 <sup>†</sup> | ND  | ns                                      |
| 10   | Need mathematics to maximize future employment opportunities              | B    | 2.37              | B   | 3.07 <sup>†</sup> | ND  | **                                      |
| 11   | Like challenging mathematics  | B    | 2.30              | B   | 3.16 <sup>†</sup> | ND  | **                                      |



| ITEM   |      |                   | M   | F                 |     | Indep. t-test results |
|--|------|-------------------|-----|-------------------|-----|-----------------------|
|  | Pred | Mean              | Dir | Mean              | Dir | <i>p</i>              |
| problems   |      |                   |     |                   |     |                       |
| 12 Are encouraged to do well by the mathematics teacher        | B    | 2.67              | B   | 3.07 <sup>†</sup> | ND  | *                     |
| 13 Mathematics teachers think they will do well                | B    | 2.45              | B   | 3.15 <sup>†</sup> | ND  | **                    |
| 14 Think mathematics will be important in their adult life     | B    | 2.33              | B   | 3.04 <sup>†</sup> | ND  | **                    |
| 15 Expect to do well in mathematics                            | B    | 2.60              | B   | 3.26              | G   | **                    |
| 16 Distract other students from their mathematics work         | B    | 2.91 <sup>†</sup> | ND  | 2.76              | B   | ns                    |
| 17 Get the wrong answers in mathematics                        | G    | 3.11 <sup>†</sup> | ND  | 2.81 <sup>†</sup> | ND  | ns                    |
| 18 Find mathematics easy                                       | B    | 2.53              | B   | 3.17 <sup>†</sup> | ND  | **                    |
| 19 Parents think it is important for them to study mathematics | B    | 2.30              | B   | 2.88 <sup>†</sup> | ND  | **                    |
| 20 Need more help in mathematics                               | G    | 2.61              | B   | 3.04 <sup>†</sup> | ND  | *                     |
| 21 Tease boys if they are good at mathematics                  | B    | 2.88 <sup>†</sup> | ND  | 2.98 <sup>†</sup> | ND  | ns                    |
| 22 Worry if they do not do well in mathematics                 | B/G  | 2.48              | B   | 3.20 <sup>†</sup> | ND  | **                    |
| 23 Are not good at mathematics                                 | G    | 2.62              | B   | 2.84 <sup>†</sup> | ND  | ns                    |
| 24 Like using calculators to work on mathematics problems      | B    | 3.02 <sup>†</sup> | ND  | 2.73              | B   | ns                    |

| ITEM |  |      | M                 |     | F                 |     | Indep.<br>t-test<br>results<br><i>p</i> |
|------|--|------|-------------------|-----|-------------------|-----|---|
|      |  | Pred | Mean              | Dir | Mean              | Dir |   |
| 25   | Mathematics teachers spend more time with them | B    | 2.84 <sup>†</sup> | ND  | 2.99 <sup>†</sup> | ND  | ns                                      |
| 26   | Consider mathematics to be boring              | G    | 3.05 <sup>†</sup> | ND  | 2.81              | B   | ns                                      |
| 27   | Find mathematics difficult                     | G    | 2.79 <sup>†</sup> | ND  | 2.85 <sup>†</sup> | ND  | ns                                      |
| 28   | Get on with their work in class                | G    | 2.20              | B   | 3.39              | G   | **                                      |
| 29   | Think mathematics is interesting               | B    | 2.24              | B   | 3.21              | G   | **                                      |
| 30   | Tease girls if they are good at mathematics    | B    | 2.58              | B   | 2.58              | B   | ns                                      |

Note. M: Grade 7 Males; F: Grade 7 Females;

Response directions (Dir.): B: Boys more likely than girls to hold the belief or behaviour supporting item wording (mean < 3); G: Girls more likely than boys to hold the belief or behaviour consistent with item wording (mean > 3); ND: No difference between boys and girls (mean = 3);

B/G: Previous studies produced mixed results in regard to these items (see Leder & Forgasz, 2002a);

Pred: Predicted response directions consistent with gender stereotyping of mathematics as a male domain as determined in previous studies (Leder & Forgasz, 2002a);

One-sample t-test results: <sup>†</sup>Means did not differ from 3, statistically significantly ( $p < .05$ ).

Independent-groups t-test results: \*  $p < .01$ ; \*\*  $p < .001$ ; ns: No statistically significant gender differences at  $p < .001$  level (Bonferroni adjustment).

Shaded regions: Findings consistent with the predicted response directions.

Table 5.22 shows the response directions for the grade 7 males and females in regard to the 30 items from W&M instrument. For each item, the directions of the beliefs are compared with the predictions (Pred.) that were established based on previous research (Leder & Forgasz, 2002a). As can be seen in Table 5.22, about 57% (17 items) of the responses of grade 7 males were consistent with the predictions (see items 1, 3, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 18, 19, 22, 29, and 30) suggesting that boys' views tended to support the traditional belief that mathematics is a male domain. Some of these items were related to teachers' classroom actions and expectations (3, 12, and

13); pupils' perceptions about parents (9, and 19); classroom behaviours (16, and 30), and self-efficacy beliefs (e.g., 8, 10, 11, 14, 15, 18, and 29). For example, males believed boys are 'asked more questions by the mathematics teacher' (3), 'are encouraged to do well by the mathematics teacher' (12), and 'mathematics teachers think they will do well' (13). Males believed parents think it is important for boys to study mathematics (19), and that they would be disappointed if boys did not do well in mathematics (9). In regard to classroom behaviours, males believed boys 'distract other students from their mathematics work' (16), and 'tease girls if they are good at mathematics' (30). With respect to pupils' self-efficacy beliefs, males believed boys are more likely than girls to 'think they did not work hard enough if they do not do well in mathematics' (8), to 'think mathematics will be important in their adult life' (14) to 'need mathematics to maximize future employment opportunities' (10), to 'like challenging mathematics problems' (11), to 'expect to do well in mathematics' (15), to 'find mathematics easy' (27), or to 'think mathematics is interesting' (29).

The responses of grade 7 females were consistent with the predictions for only 5 items (3, 16, 24, 28, and 30). One of these items was related to teachers' classroom actions (3), and two were associated with pupils' classroom behaviour (16, and 30). That is, females believed boys 'are asked more questions by the mathematics teacher' (3), 'distract other students from their mathematics work' (16), and 'tease girls if they are good at mathematics' (30). Females also considered boys more likely than girls to 'like using calculators to solve mathematics problems' (24); females believed girls are more likely than boys to 'get on with their work in class' (28).

There were only two items (3, and 30) that were gender stereotyped by both males and females and in the directions predicted (see Table 5.22). This means, both males and females believed, as expected in the literature, that boys are more likely than girls

to be ‘asked more questions by the mathematics teacher’ (3), and to ‘tease girls if they are good at mathematics’ (30). Given that the female and the male respondents tended to disagree with one another for most items from the W&M instrument, the significance of the agreement on items 3 and 4 can only be understood through follow up research focused on classroom environments created by the mathematics teacher and boys.

As shown in Table 5.22, there were several items for which the responses did not support the view that mathematics is a male domain. Some of these items were in the direction of boys, girls, or were considered gender-neutral. For example, items traditionally associated with girls, male respondents tended to associate with boys (2, 5, 20, 23, and 28) or to consider them gender-neutral (4, 17, 26, and 27). Also, items that respondents were expected to associate with boys, they considered gender-neutral (21, and 25) – that is, both groups of respondents agreed that boys and girls are equally likely to tease ‘boys’ if they are good at mathematics (21), and they also believed the mathematics teachers spend equal time with boys and girls (25).

In summary, the responses of grade 7 males were more aligned with the predicted responses – the view consistent with gender stereotyping of mathematics as a male domain than were the responses of the females. As indicated, the responses of grade 7 females were consistent with the literature for only five items. For the majority of items from the W&M instrument, females endorsed a gender-neutral response (22 of the 30 items).

To explore possible gender differences in terms of the strengths of the beliefs held by grade 7 males and females, independent-groups t-tests were conducted on the mean scores with a Bonferroni adjustment to a cut-off of  $p < .01$  (Pallant, 2009). Mean scores

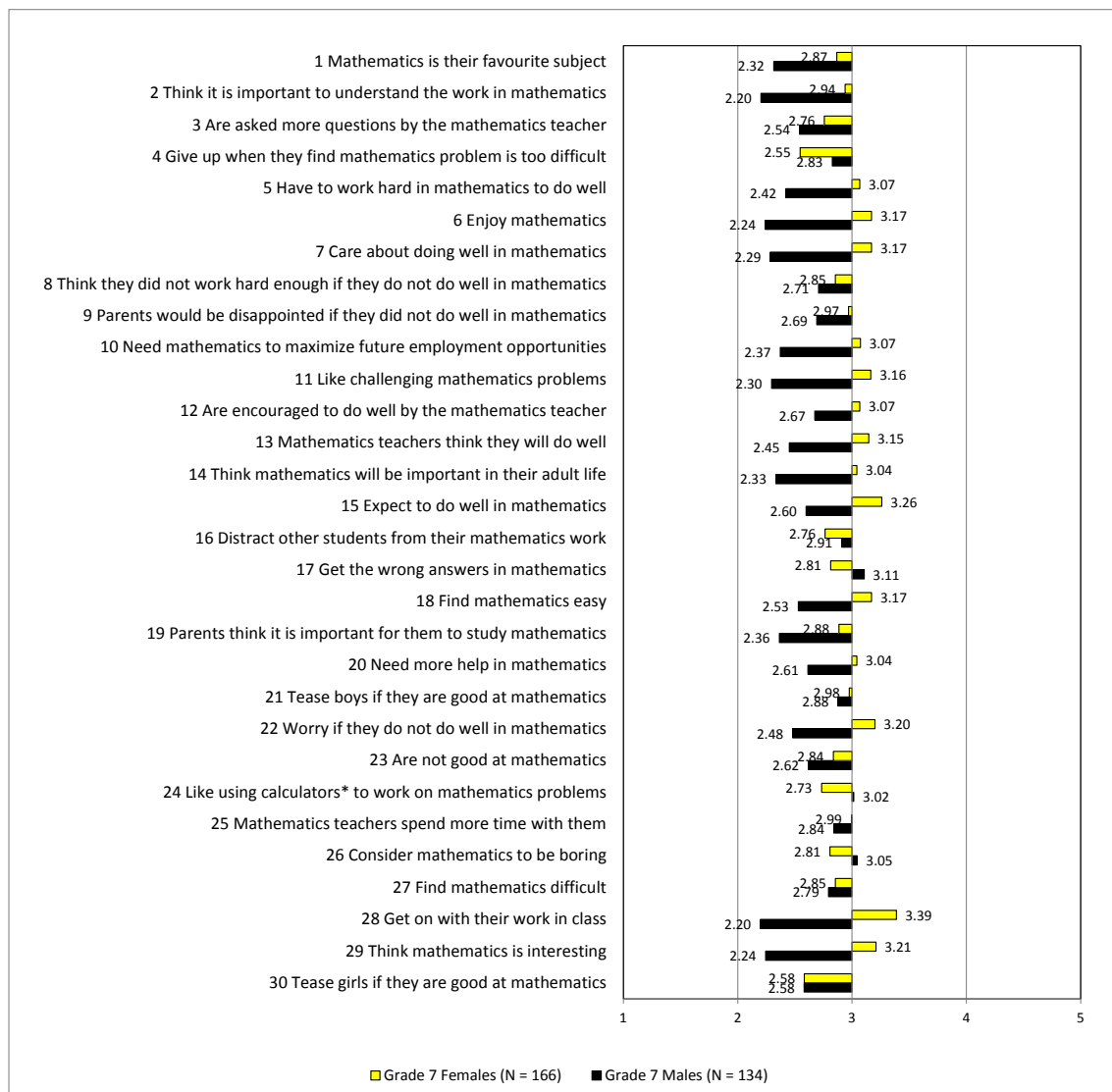
for males and for females, and independent-groups t-test results were presented in Table 5.22.

As can be seen in Table 5.22, there were gender differences in the mean scores for 17 items (1, 2, 5, 6, 7, 10, 11, 12, 13, 14, 15, 18, 19, 20, 22, 28, and 29). For three of the items (15, 28, and 29), grade 7 males believed boys are more likely than girls to ‘expect to do well in mathematics’ (15); to ‘get on with their work in class’ (28); and to ‘think mathematics is interesting’ (29). Grade 7 females endorsed views on these items in favour of girls.

Statistically significant gender differences in the strengths of the beliefs were also noted on 14 items for which grade 7 males favoured boys and grade 7 females believed there was no difference (1, 2, 5, 6, 7, 10, 11, 12, 13, 14, 18, 19, 20, and 22). For example, males believed that boys are more likely than girls to ‘care about doing well in mathematics’ (7), to ‘worry if they do not do well in mathematics’ (2), to ‘need more help in mathematics’ (20), to work hard in mathematics to do well (5), to ‘enjoy mathematics’ (6), and to think that it is important to understand the work in mathematics (2). Females, in contrast, did not gender stereotype any of these issues.

To illustrate who held their beliefs more strongly, the same data are represented graphically in Figure 5.1. Consistent with Leder and Forgasz (2002a), the vertical line passing through 3 (see Figure 5.1) represents mean scores equal to 3 – the belief that there is no difference between boys and girls in regard to the belief or behaviour reflected in the item wording (ND); bars to the left of the line represent mean scores smaller than 3 – the belief that boys were considered to be more likely than girls to hold the belief or behaviour conveyed by item wording; bars to the right of the line represent mean scores greater than 3 – the belief that girls were perceived to be more likely than

boys to hold the belief or behaviour emanated by item wording. The lengths of the bars indicate the strengths of the beliefs, and the longer the bars the stronger the beliefs held by the respondents.



*Figure 5.1.* Directions and strengths of beliefs of Grade 7 females (N=166) and Grade 7 males (N=134) in regard to the 30 items from the W&M instrument.

As can be seen in Figure 5.1, grade 7 males' bars face to the left of the vertical line passing through 3, with the exception of items 17, 24, and 26. The grade 7 females' bars are more scattered than the males' bars. The grade 7 males' bars are generally longer than the grade 7 females' bars and this indicates that males held their beliefs

more strongly than did females. Consider for example, item 1 in Figure 5.1. The orientations and the lengths of the bars for males and for females show that both believed boys are more likely than girls to view mathematics as their favourite subject. However, males held this belief more strongly than females. In regard to item 26 (Figure 5.1), females believed boys are more likely than girls to consider mathematics boring. Males, in contrast, believed girls are more likely than boys to do so, but males held their belief less strongly than females.

There was only one item for which grade 7 males and females held their beliefs in the same direction and with the same strength: boys ‘tease girls if they are good at mathematics’ (Item 30 in Figure 5.1). It should be noted that there was consensus between males and females in terms of direction and/or strength of beliefs on items describing classroom environment or easily observable behaviours (e.g., ‘tease girls if they are good at mathematics’: 30; ‘distract other students from their mathematics work’: 16; ‘are asked more questions by the mathematics teacher’: 3; or ‘give up when they find mathematics problem is too difficult’: 4).

Figure 5.1 also illustrates items for which males and females held conflicting views (e.g., 6, 7, 11, 13, 15, 18, 22, 28, and 29). Conflicts on these items were due to females matching item wording with girls and males matching them with boys; however, the differences in terms of mean scores were not always different statistically as revealed by independent-groups t-test results.

The responses of parents to the W&M instrument are presented next.

### **Parents’ responses to W&M instrument**

The responses of parents were examined using the same techniques used to analyse the children’s data. Initially, the responses of parents of sons and parents of

daughters were examined separately but they did not differ substantially. The means for parents as a group (males and females and also not discriminated by gender of their children), directions of beliefs, and predicted response directions are presented in Table 5.23, including one-sample t-test results ( $p$  values).

Table 5.23

*Means for Parents (N=225), Directions of Beliefs, and the Predicted Response Directions (Pred.) for the 30 Items from the W&M Instrument, and One-Sample T-Test Results*

|    |   |       | Findings          |     |
|----|---|-------|-------------------|-----|
|    |   |       | M                 | Dir |
|    |   | Pre d |                   |     |
| 1  | Mathematics is their favourite subject                                      | B     | 2.50              | B   |
| 2  | Think it is important to understand the work in mathematics                 | G     | 2.61              | B   |
| 3  | Are asked more questions by the mathematics teacher                         | B     | 2.80              | B   |
| 4  | Give up when they find mathematics problem is too difficult                 | G     | 3.00 <sup>†</sup> | ND  |
| 5  | Have to work hard in mathematics to do well                                 | G     | 2.80              | B   |
| 6  | Enjoy mathematics   | B     | 2.53              | B   |
| 7  | Care about doing well in mathematics-                                       | B/G   | 2.80              | B   |
| 8  | Think they did not work hard enough if they do not do well in mathematics - | B     | 2.73              | B   |
| 9  | Parents would be disappointed if they did not do well in mathematics        | B     | 2.78              | B   |
| 10 | Need mathematics to maximize future employment opportunities                | B     | 2.81              | B   |
| 11 | Like challenging mathematics problems                                       | B     | 2.54              | B   |



|    |   | <b>Pred</b> | <b>Findings<br/>M Dir</b> |
|----|---|-------------|---------------------------|
| 12 | Are encouraged to do well by the mathematics teacher                | B           | 2.83 B                    |
| 13 | Mathematics teachers think they will do well                        | B           | 2.87 <sup>†</sup> ND      |
| 14 | Think mathematics will be important in their adult life             | B           | 2.67 B                    |
| 15 | Expect to do well in mathematics                                    | B           | 2.77 B                    |
| 16 | Distract other students from their mathematics work                 | B           | 2.95 <sup>†</sup> ND      |
| 17 | Get the wrong answers in mathematics                                | G           | 2.99 <sup>†</sup> ND      |
| 18 | Find mathematics easy   | B           | 2.86 <sup>†</sup> ND      |
| 19 | Parents think it is important for them to study mathematics         | B           | 2.72 B                    |
| 20 | Need more help in mathematics                                       | G           | 2.90 <sup>†</sup> ND      |
| 21 | Tease boys if they are good at mathematics                          | B           | 3.32 G                    |
| 22 | Worry if they do not do well in mathematics                         | B/G         | 2.77 B                    |
| 23 | Are not good at mathematics   | G           | 3.15 G                    |
| 24 | Like using calculators <sup>#</sup> to work on mathematics problems | B           | 2.92 <sup>†</sup> ND      |
| 25 | Mathematics teachers spend more time with them                      | B           | 3.10 <sup>†</sup> ND      |
| 26 | Consider mathematics to be boring                                   | G           | 3.08 <sup>†</sup> ND      |
| 27 | Find mathematics difficult  | G           | 3.01 <sup>†</sup> ND      |
| 28 | Get on with their work in class                                     | G           | 2.44 B                    |
| 29 | Think mathematics is interesting                                    | B           | 2.64 B                    |
| 30 | Tease girls if they are good at mathematics                         | B           | 2.49 B                    |

Note. B: Boys more likely than girls; G: Girls more likely than boys; ND: No difference between boys and girls;  
 One-sample t-test results: <sup>†</sup>Means did not differ from 3, statistically significantly ( $p < .05$ ).  
 Shaded regions: Findings consistent with the predicted response directions (Pred) based on previous research.

As can be seen in Table 5.23, similar to the grade 7 males' responses, 53% (16 items) of the parents' responses were consistent with the predictions (see shaded regions in Table 5.23). Two of these items were related to the teachers' actions – that is, parents believed that boys are asked more questions by the mathematics teachers than girls are (3), and boys are more likely than girls to be encouraged to do well by the mathematics teacher (12).

Two items were related to the parents. That is, guardians believed that parents think it is important for boys to study mathematics (19), and that they would be disappointed if boys did not do well in mathematics (9).

The data showed that parents believed girls were more likely than boys not to be good at mathematics (see item 23, Table 5.23), and this view was consistent with gender stereotyping of mathematics as a male domain.

However, there were also several responses that were inconsistent with the view that mathematics is a male domain. For example, of the nine items that were predicted to be in the direction of girls, parents associated only one item with girls ('Are not good at mathematics': 23). They (parents) associated 3 items with boys, and considered 10 items to be gender-neutral. That is, parents believed that there was no difference between boys and girls with respect to who:

- Gives up when a mathematics problem is too difficult (4);
- Teachers think will do well (13);
- Distracts other students from their mathematics work (16);
- Gets the wrong answers in mathematics (17);

- Finds mathematics easy (18);
- Needs more help in mathematics (20);
- Like using calculators to work on mathematics problems (24)
- Mathematics teachers spend more time with (25);
- Considers mathematics to be boring (26);
- Finds mathematics difficult (27)

As can be seen, although most of the parents' responses were consistent with the traditional view that mathematics is a male domain, there were also responses revealing a change of this belief, which is appropriate in contemporary times.

A summary of the main findings in regard to Question 8 is presented next. To determine whether the differences and similarities identified between the responses and the predictions also appear in other countries, the Mozambican data were compared with data from previous studies that have used the W&M instrument. The results of the comparisons are then discussed.

### **Summary of results and discussion – Question 8**

The key findings from Question 8 were:

- For more than half of the items from the W&M instrument the responses of parents and grade 7 males were consistent with the gender stereotyping of mathematics as a male domain.
- In contrast, the responses of grade 7 females were consistent with the predictions for only five items.
- Grade 7 males held their beliefs in regard to the 30 items from the W&M instrument more strongly than did females.

- Contrasting the predicted response directions, several items from the W&M instrument were considered gender-neutral by the Mozambican respondents, more so by grade 7 females than by their male counterparts and parents.

These results reveal that parents and grade 7 males hold the traditional view that some aspects related to mathematics learning are more suited to boys than to girls. As suggested in other studies (e.g., Leder & Forgasz, 2002a), the inconsistencies that were noted between the predicted responses and the responses obtained in this study suggest that the direction of gender stereotyping of mathematics learning may be changing particularly among Mozambican girls. The proportions of items that grade 7 males and grade 7 females associated with the predicted responses demonstrate clearly the claim that “mathematics continues to be viewed as a male domain, more so by males than by females” (Tiedemann, 2002, p. 50).

The responses of grade 7 males and females were aggregated to form the Mozambican data (Moz), and were compared with the data from similar research conducted in four countries: Germany (Kaiser et al., 2012), Israel (Forgasz & Mittelberg, 2008), Greece (Barkatsas, Leder, & Forgasz, 2002), Australia (Leder & Forgasz, 2002a), and USA (Forgasz, Leder, & Kloosterman, 2004). These studies were selected for comparison with the Mozambican data because they used the same instrument – The W&M instrument (Leder & Forgasz, 2002a), and data were available. Table 5.24 presents a summary of the response directions (B, G, and ND) on the 30 items from the W&M instrument. Shaded regions indicate where findings were consistent with the predicted response directions.

Table 5.24

*Response Directions on the 30 Items from the W&M Instrument in Five Countries  
(Germany, Greece, Australia, USA, and Mozambique)*

| ITEM |   | Pred | Ger | Gre | Aus | USA | Moz |
|------|---|------|-----|-----|-----|-----|-----|
| 1    | Mathematics is their favourite subject                                    | B    | B   | B   | G   | ND  | B   |
| 2    | Think it is important to understand the work in mathematics               | G    | G   | G   | G   | G   | B   |
| 3    | Are asked more questions by the mathematics teacher                       | B    | B   | B   | B   | ND  | B   |
| 4    | Give up when they find mathematics problem is too difficult               | G    | G   | B   | B   | B   | B   |
| 5    | Have to work hard to do well in mathematics                               | G    | G   | G   | ND  | ND  | B   |
| 6    | Enjoy mathematics   | B    | B   | G   | G   | ND  | B   |
| 7    | Care about doing well in mathematics                                      | B/G  | ND  | G   | G   | G   | B   |
| 8    | Think they did not work hard enough if they do not do well in mathematics | B    | G   | G   | G   | G   | B   |
| 9    | Parents would be disappointed if they do not do well in mathematics       | B    | ND  | B   | G   | G   | B   |
| 10   | Need mathematics to maximize future employment opportunities              | B    | B   | B   | ND  | ND  | B   |
| 11   | Like challenging mathematics  | B    | B   | B   | ND  | ND  | B   |

| ITEM   | Pred | Ger | Gre | Aus | USA | Moz |
|--|------|-----|-----|-----|-----|-----|
| problems   |      |     |     |     |     |     |
| 12 Are encouraged to do well by the mathematics teacher        | B    | G   | G   | ND  | ND  | ND  |
| 13 Mathematics teachers think they will do well                | B    | B   | B   | G   | ND  | B   |
| 14 Think mathematics will be important in their adult life     | B    | B   | B   | G   | ND  | B   |
| 15 Expect to do well in mathematics                            | B    | B   | B   | G   | ND  | ND  |
| 16 Distract other students from their mathematics work         | B    | B   | B   | B   | B   | B   |
| 17 Get the wrong answers in mathematics                        | G    | G   | G   | B   | ND  | ND  |
| 18 Find mathematics ease                                       | B    | B   | B   | G   | ND  | ND  |
| 19 Parents think it is important for them to study mathematics | B    | ND  | B   | ND  | ND  | B   |
| 20 Need more help in mathematics                               | G    | G   | G   | B   | ND  | B   |
| 21 Tease boys if they are good at mathematics                  | B    | B   | B   | B   | B   | ND  |
| 22 Worry if they do not do well in mathematics                 | B/G  | G   | G   | G   | G   | ND  |
| 23 Are not good at mathematics                                 | G    | B   | B   | B   | ND  | B   |
| 24 Like using calculators to work on mathematics problems      | B    | B   | B   | B   | B   | ND  |

|    | ITEM   | Pred | Ger | Gre | Aus | USA | Moz |
|----|--|------|-----|-----|-----|-----|-----|
| 25 | Mathematics teachers spend more time with them | B    | G   | B   | ND  | G   | ND  |
| 26 | Consider mathematics to be boring              | G    | G   | B   | B   | B   | ND  |
| 27 | Find mathematics difficult                     | G    | G   | G   | B   | ND  | B   |
| 28 | Get on with their work in class                | G    | B   | B   | G   | G   | ND  |
| 29 | Think mathematics is interesting -             | B    | B   | B   | G   | ND  | B   |
| 30 | Tease girls if they are good at mathematics    | B    | B   | B   | B   | B   | B   |

Note. Ger: Germany (age range: 11-17; grades: 5-11); Gre: Greek (age range: ---; grade: 7-10); Aus: Australia (age range: ---; grade: 9); USA: USA students (age range: ---; grades: 7-12); Moz: Grade 7 Mozambican males and females (age range: 11-16; grade: 7)  
Response directions (Dir.): B: Boys more likely than girls; Girls more likely than boys: Girls; ND: No difference between boys and girls;  
Pred: Predicted response directions based on previous studies (Leder & Foragsz, 2002a);  
Shaded regions: Findings consistent with the prediction response directions.

The responses from each country to the 30 items were examined and compared with the predicted response directions in terms of how many responses were in the direction predicted. As can be seen in Table 5.23, the numbers of responses supporting the predictions were distributed by country in the following decreasing order: Greece: 23 items (77%); Germany: 22 items (73%); Mozambique: 14 items (47%); Australia: 9 items (30%); and the USA: 8 items (27%). This means, mathematics learning was more likely to be gender stereotyped as a male domain in Greece, Germany, and Mozambique, than in the USA and Australia.

The distribution of items that were considered gender-neutral by country by increasing order was: Greece: 0 items; Germany: 3 items; Australia: 6 items; Mozambique: 10 items; and the USA: 17 items. This indicates that in the USA, Mozambique, and Australia there was a trend to view some of the aspects of

mathematics learning formulated in the W&M instrument to be equally appropriate for girls and boys.

Using the predicted response directions as the basis, Table 5.25 presents the percentages of responses changed to the opposed direction in five countries.

Table 5.25

*Gender stereotyping of mathematics as a male domain in five countries (N=30 items from the W&M instrument: Leder & Forgasz, 2002a)*

| <b>Country</b> | <b>Responses<br/>consistent with<br/>mathematics as a<br/>male domain</b> | <b>Gender neutral<br/>responses</b> | <b>Responses<br/>changed to<br/>opposed direction</b> |
|----------------|---|-------------------------------------|---|
| Australia      | 30%   | 20%                                 | 50%   |
| USA            | 27%   | 52%                                 | 22%   |
| Greece         | 77%   | 0%                                  | 23%   |
| Germany        | 73%   | 10%                                 | 17%   |
| Mozambique     | 47%   | 33%                                 | 20%   |

As can be seen in Table 5.25, the responses were more inconsistent with the predicted response directions in Australia than in other countries. This indicates that a substantial change in the perception that mathematics is a male domain may have taken place in this country.

It should be noted that the construct ‘gender stereotyping of mathematics as a male domain’ emerged in western countries and research on this issue concentrated in the west. Thus, without prior research on this topic in Mozambique, it is not clear how



much the Mozambican people may have changed their perceptions in regard to gender stereotyping of mathematics learning.

However, the results from Table 5.24 provide several interesting highlights. For example, despite cultural differences, in all five countries the students believed boys were more likely than girls to ‘distract other students from their mathematics work’ (16), and to ‘tease girls if they are good at mathematics (30).

In all countries, with the exception of Mozambique, the students believed girls are more likely than boys to ‘think it is important to understand the work in mathematics’ (2); to ‘worry if they did not do well in mathematics’ (22); and to ‘think they did not work hard enough if they did not do well in mathematics’ (8).

Several items yielded mixed results across the five countries suggesting that the direction of gender stereotyping of mathematics learning may be influenced by the cultural context. Different from other countries, respondents in Australia and USA expected parents to be disappointed if girls did not do well in mathematics (9). In Australia and Greece girls were viewed as enjoying mathematics more than boys. In Mozambique and Germany boys were viewed as enjoying mathematics more than girls. In the USA respondents believed that there was no difference. Girls in Germany and Greece were viewed as more likely to be encouraged to do well by the mathematics teacher (12).

The comparative data across countries showed that the traditional gender stereotyping of mathematics learning as a male domain prevails in some parts of the world, but there are also important changes as compared to the 1970s. Leder and Forgasz (2002b) pointed out that the stereotyping of mathematics as a male domain has a long tradition in the western society. Thus, given that the mathematics curriculum

taught in Mozambique was transplanted from the former colonial masters, and it keeps its western roots (Gerdes, 1988), it was not totally unexpected that parents were more likely to view mathematics learning as a male domain than a female or a gender-neutral domain.

## **Students' and Parents' Reactions to the Surveys**

As indicated in Chapter 1, few studies focused attention on children's beliefs and parents' views about mathematics education for their children in Mozambique. As some instruments used to collect data were being used probably for the first time in Mozambique, it was decided also to investigate the respondents' reactions to the study and to the items used. To do so, after the respondents were thanked for their participation in the study, they were asked to write a comment about the study. The majority of children (N=111), and parents (N=180) who wrote a comment about the study or about particular items on the instruments were from urban schools. Generally, both the children and parents reacted positively to the study and asked for similar studies to be conducted in the future. Some children believed the survey would change their views about mathematics learning and would influence their studies. Raquel and Fernando wrote:

I enjoyed this questionnaire a lot because I am sure it will help me to like mathematics more and my marks will start improving this year. (Raquel, 12, Female, Urban)

I thank you very much because this study taught us many new things because some students do not like mathematics. Now they will like mathematics. Our teacher teaches very well, but mathematics is a very difficult subject, but it is a very good subject too. I love mathematics. (Fernando, 12, Male, Urban).

Many children wanted the same questionnaires to be used in their lessons and textbooks and to serve as assessments. The comments from Hilário and Isabel reflected these perspectives:

I enjoyed this questionnaire because it teaches us true things. It should count to our mathematics assessment this year. Our teacher should use questionnaires like these ones. (Hilário, 12, Male, Rural)

I liked these questions. I had no problems to answer them, and I hope that mathematics textbooks will include some of these questions. (Isabel, 13, Female, Urban)

Parents encouraged similar studies to continue in the future, and to involve more parents and schools. Parents reacted extensively in relation to their involvement in education and to the role of the teachers. Magid's and Manecas' comments presented below represent the views of many parents surveyed.

I welcome this study. I would appreciate if the school principal could monitor the teacher on daily basis too. If the principal does that, we parents will monitor our children on daily basis as well. Only in this way education of our children can go ahead. (Magid, 48, Father, Urban)

I liked this study very much and it should continue in the future. These survey forms should be available to all parents to help us assist our children. It would be very important if the study was expanded to all other schools of this country. (Manecas, 53, Father, Rural)

Several parents commented that mathematics is a good and important subject for their children but it is very difficult. Others commented that their children do not learn properly because the teachers are not good at teaching. Comments relating to the teacher included:

- Teachers nowadays are ill-prepared and do not have the necessary teaching skills;
- Teachers nowadays are not demanding and do not force pupils to learn;
- Teachers nowadays are rushing to complete the syllabuses and have no patience to attend slow learners;
- Teachers of mathematics, in special, do not explain the subject well; they do that to force the child to pay them for extra explanation and this is completely wrong;
- When teachers give homework or class work they should solve some examples to serve as illustrations so that the pupils follow the steps;
- The teachers should be clear in their explanations so that the pupils understand their message.

Belita believed that parental involvement in education would be effective only if the teachers were also playing their roles:

I would like to see teachers helping children more, and giving them some extra lessons if necessary. I promise that I will help my child to understand the subject. I will encourage her to play less and to study more. (Belita, 49, Mother, Urban)

In summary, children and parents appreciated the study and encouraged similar studies to be carried out in the future. It was apparent that the respondents rarely participated in similar studies before. Both children and parents commented that mathematics is difficult. However, parents believed teachers did not help their children to understand mathematics. Comments that emerged revealed that parents disagree with the methods that teachers use nowadays in schools. It was evident that parents support traditional teaching methods with teachers spending most of their time solving mathematical problems by themselves, while the pupils observe and imitate the teachers' steps. There were no obvious gender differences in this belief. Both mothers

and fathers wanted the teacher to work out some examples to facilitate child's understanding of mathematics.

Parents support the traditional teaching methods probably because they were taught using the same methods, and may not be aware of the contemporary teaching methods that advocate problem solving rather than rote learning and repetition (Schoenfeld, 1992). To teach children how to think and produce (not reproduce) knowledge appears to be more aligned with the current times. This is so because to solve the main problems that the world faces today requires exploration and discovery of new concepts and thus, mathematics education offers appropriate context to teach children to do so through problem solving.

## Summary of results - Chapter 5

Most of the data reported in this chapter were quantitative in nature. Statistical techniques were employed in order to reveal possible trends in the data and associations between variables. The main findings are summarised below:

- No influence of gender was noted on children's educational expectations.
- Parents' educational expectations for their children were not influenced by the gender of the child.
- However, children's occupational aspirations, and parents occupational aspirations for their children were influenced by the gender of the child. A higher proportion of boys than girls aspired to be engineers, and police officers. In contrast, a higher proportion of girls than boys wanted to engage in people oriented jobs (i.e., nurses, teachers, lawyers, and physicians). The aspirations of parents were similar to those of their children with the exception of being a teacher. Parents were more likely to aspire for their sons to be teachers than their daughters, but, in contrast, girls were more likely than boys to be interested in this profession. Perceived utility of the job was the main reason mentioned when selecting an occupation.
- There were no gender differences in children's perceived achievement in mathematics. Gender differences were noted only in regard to moral and civic education and favoured girls. However, children reported their lowest perceived achievement in mathematics and their highest in physical education. Differences in achievement rating scores for the children and their parents were revealed in relation to English; that is, parents rated their children's achievement at English lower than the children rated themselves.
- No gender differences in confidence in learning mathematics were noted for any item of the *Confidence in Learning Mathematics Scale* (Fennema & Sherman, 1976). Although means did not differ statistically

significantly, boys tended to report more confidence in learning mathematics on individual items and for scale totals.

- There were no statistically significant gender differences in children's perceived usefulness of mathematics as measured by the *Mathematics Value Inventory* (Luttrell et al., 2010). However, the trend in the data indicated that mathematics was viewed as more useful for boys than for girls. Compared to the children, parents perceived mathematics to be less useful for their offspring than the children themselves did and the results were highly statistically significant ( $p < .001$ ).
- Age of the child, geolocation, parental education, and number of siblings were statistically significant predictors of perceived usefulness of mathematics but not confidence and perceived achievement in mathematics. That is, the youngest children, children from urban schools, children with more educated parents, and the children with fewer than 3 siblings were more likely to report higher levels of perceived usefulness of mathematics. Ownership of selected economic resources was associated with better scores in confidence and perceived usefulness of mathematics but not with perceived achievement in mathematics.
- Parental involvement in education (PIE) was measured using a short-version of the *Family Involvement Questionnaire* (Manz et al., 2004). The survey data revealed that the level of parental involvement in education was moderate. The activities that parents conducted frequently were attending meetings at school (2), asking child about day at school (8), and talking to child about the importance of school (14).
- Four items from the *Mathematics Attribution Scale* (Fennema et al., 1979) were adapted and used to measure causal attributions for success and failure in mathematics among grade 7 pupils and parents in mathematics. No gender differences in causal attributions were found on either children's or parents' responses. From the highest to the lowest, the children's success attributions were ranked as: Environment, effort, task (easiness), and ability. The failure attributions followed the order: Task difficulty, (lack of) effort, environment, and ability; that is, the children

agreed more strongly that success in mathematics is achieved with good teachers or external help than with ability or effort. They agreed more strongly that failures are caused by the task (task difficulty) than the lack of effort, lack of ability, or influence of the teacher. Parents, on the other hand, agreed more strongly that success in mathematics is achieved through effort, but they were unsure about the causes for failure.

- *Who and Mathematics* (Leder & Forgasz, 2002a) was used to measure the extent to which the gender stereotyping of mathematics as a male domain prevails among Grade 7 males and females and their parents in Mozambique. The data were contrasted with findings from similar research conducted in other countries. The results revealed that despite some items being perceived as appropriate for girls and boys, the gendered beliefs of grade 7 males and parents were similar to those identified in the 1970s. Grade 7 females did not endorse the view that mathematics is a male domain. Although they held their views less strongly than males, the females viewed most of the mathematics experiences described in the W&M instrument to suit both girls and boys equally.
- The findings across countries showed some interesting consistencies and also inconsistencies. Forgasz and Mittelberg (2008) have pointed out that the variability of results across countries suggests the influence of the cultural context on the magnitude and direction of gender stereotyping of mathematics learning. The similarities between the Mozambican data and the data from western countries with respect to gender stereotyping of mathematics may reflect past experiences with western colonial powers for about 500 years (1498-1975). It should be noted that the medium of instruction and the mathematics content taught in Mozambique have western roots.

The findings reported in this chapter were quantitative. Qualitative data that were gathered using interviews are presented in Chapter 6.



## Chapter 6

### Results of Interviews: Parents and School Principals

In this chapter, the results of interviews that were conducted with 10 parents and 5 schools principals are presented. The interviews were conducted in order to answer the following subsidiary research question:

What are the parents' and school principals' views about mathematics learning for girls and boys, and parent involvement in the education of their children?

The research question above was asked in order to gain a better understanding of the survey data and to do so, one-on-one face-to-face semi-structured interviews were conducted. The profile of parents/guardians interviewed is presented in Table 6.1, in alphabetical order.

Table 6.1

*Profile of Parents and Guardians Interviewed, Alphabetically (N=10)*

| Parent            |        |     |              |            | Child             |        |     |             |
|-------------------|--------|-----|--------------|------------|-------------------|--------|-----|-------------|
| Name <sup>†</sup> | Gender | Age | Relationship | Education  | Name <sup>†</sup> | Gender | Age | Geolocation |
| Albano            | Male   | 59  | Father       | Secondary  | Zinha             | Girl   | 14  | Rural       |
| Cláudia           | Female | 26  | Sister       | University | Josefina          | Girl   | 12  | Urban       |
| Gimo              | Male   | 53  | Father       | Secondary  | Ernesto           | Boy    | 14  | Urban       |
| Isaura            | Female | 36  | Mother       | University | Nádia             | Girl   | 12  | Urban       |
| Manassa           | Female | 47  | Mother       | Secondary  | Elisa             | Girl   | 12  | Urban       |
| Manuel            | Male   | 61  | Father       | Secondary  | Ivo               | Boy    | 12  | Urban       |
| Mário             | Male   | 38  | Uncle        | University | Ezdine            | Boy    | 11  | Urban       |
| Matias            | Male   | 56  | Father       | Secondary  | João              | Boy    | 16  | Urban       |

| <b>Parent</b>           |               |            |                     |                  | <b>Child</b>            |               |            |                    |
|-------------------------|---------------|------------|---------------------|------------------|-------------------------|---------------|------------|--------------------|
| <b>Name<sup>†</sup></b> | <b>Gender</b> | <b>Age</b> | <b>Relationship</b> | <b>Education</b> | <b>Name<sup>†</sup></b> | <b>Gender</b> | <b>Age</b> | <b>Geolocation</b> |
| Nené                    | Female        | 33         | Mother              | Secondary        | Amanda                  | Girl          | 13         | Urban              |
| Paulina                 | Female        | 47         | Mother              | Primary          | Yuran                   | Boy           | 11         | Remote             |

Note. <sup>†</sup>All names are pseudonyms

The data shown in Table 6.1 were collected through surveys and checked during interviews. Female and male guardians (parents) were evenly represented in the sample (5 females and 5 males). Also, there were as many parents of sons as parents of daughters. However, as participation in the interview was based on expressed consent, it was difficult to balance the sample using all variables of interest such as education and geolocation.

The profile of the five school principals interviewed is presented in Table 6.2, in alphabetical order.

Table 6.2

*Profile of School Principals Interviewed, Alphabetically (N=5)*

| <b>Name<sup>†</sup></b> | <b>Gender</b> | <b>Age</b> | <b>Education</b> | <b>Years of experience as principal</b> | <b>Geolocation</b> |
|-------------------------|---------------|------------|------------------|---|--------------------|
| Alfredo                 | Male          | 59         | University       | 15                                      | Urban              |
| Angélica                | Female        | 46         | University       | 6                                       | Remote             |
| Mucauro                 | Male          | 35         | University       | 4                                       | Rural              |
| Pedro                   | Male          | 52         | Secondary        | 26                                      | Urban              |
| Rotafina                | Female        | 44         | University       | 1.5                                     | Urban              |

Note. <sup>†</sup>All names are pseudonyms

The variables age, level of education, and the number of years of work experience as principals were collected at the beginning of each interview. As can be seen in Table 6.2, the numbers of years that the respondents had worked as principals varied from 1.5 to 26 years. Rotafina was recently nominated a school principal after she graduated from a local pedagogical university. Pedro was the only principal without a university degree, and was not studying in any university at the time of data collection. Pedro, however, had been a principal for more than two decades in rural and urban schools in Sofala Province. Alfredo, Angélica, and Pedro had been principals in several primary schools.

## Qualitative Data Analysis

The qualitative data reported in this chapter were collected by means of one-on-one semi-structured interviews. The interview protocol for parents is presented in Table 6.3.

Table 6.3

### *Interview Protocol for Parents*

| Main themes |   | Questions |  |
|-------------|---|-----------|--|
| <b>1</b>    | Parents' perceived own achievement in mathematics | 1.1       | When you were a child which school subject did you like most?                |
|             |   | 1.2       | Why? (Refer to Question 1.1)   |
|             |   | 1.3       | Did you like mathematics as well? (If the answer to 1.1 was not mathematics) |
|             |   | 1.4       | Why did you like/did not like mathematics?                                   |
|             |   | 1.5       | Imagine a scale ranging from 0 to 20, how good were you at mathematics?      |

| Main themes  | Questions  |
|--|--|
| <b>2</b> Parents' perceived children's achievement in mathematics        | 1.6 In your opinion, which factors contributed to you being good /not being good at mathematics?   |
|  | 1.7 Do you usually tell your child how good you were at mathematics during your childhood education?   |
|  | 2.1 Does your child like mathematics?  |
|  | 2.2 Why? (Refer to Question 2.1)   |
|  | 2.3 Imagine a scale ranging from 0 to 20, how good is your child at mathematics?   |
|  | 2.4 Which subjects is your child good at?  |
| <b>3</b> Parents' perceived changes in mathematics teaching and learning | 2.5 Why do you say that? (Refer to Question 2.4)   |
|  | 2.6 You said your child is good/not good at mathematics. In your opinion what are the reasons?   |
| <b>4</b> Parents' views about girls' and boys' mathematical capabilities | 3.1 Do you think the teaching of mathematics has changed since the time when you were at school?   |
|  | 3.2 (If yes) In which aspects do you think changes have occurred? (Refer to Question 3.1)  |
|  | <p>4.1 Three statements A, B, and C are given. Which of these do you agree with most?</p> <p>A: "Girls are better than boys at mathematics".</p> <p>B: "Boys are better than girls at mathematics".</p> <p>C: "There is no difference between girls and boys at mathematics".</p> <p>(Adapted from Leder &amp; Forgasz, 2002a).</p> |
|  | 4.2 Why do you think so? (Refer to Question 4.1)   |

| Main themes  | Questions  |
|--|--|
| <b>5</b> Parents' perceived usefulness of mathematics for their children, and to get a job | 4.3 If the subject was Portuguese would you change your response?  |
|  | 4.4 Why? (Refer to Question 4.3)   |
|  | 5.1 Do you think mathematics is important for your child?  |
|  | 5.2 Why? (Refer to Question 5.1)   |
| <b>6</b> Parents' occupational aspirations for their daughters and sons                    | 5.3 Do you think mathematics is important to get a job?  |
|  | 5.4 Why? (Refer to Question 5.3)   |
|  | 6.1 Which profession do you aspire for your son/daughter in the future?                                    |
|  | 6.2 Why do you prefer this profession for your child? (Refer to Question 6.1)                              |
| <b>7</b> Parents' involvement in the education of their children                           | 6.3 Do you think parents should influence their children's career choices?                                 |
|  | 6.4 Why do you think so? (Refer to Question 6.3)   |
|  | 7.1 Let's talk again about mathematics. Do you usually help your child to understand homework?             |
|  | 7.2 Why? (Refer to Question 7.1)   |
| <b>8</b> Parents' views about gender equity in rights and duties in Mozambique             | 7.3 Are you satisfied with your child's school progress?   |
|  | 7.4 Why? (Refer to Question 7.3)   |
|  | 8.1 Now we are going to talk about one general issue:<br><br>"The independence against the Portuguese, and |

| Main themes                              | Questions  |
|--|--|
|  | the multiparty system brought more equality in opportunities between women and men in Mozambique”.         |
|  | Do you agree that men and women should have equal rights and duties in our country?                        |
|  | 8.2 Why do you think so? (Refer to Question 8.1)   |
| 9 Parents’ conceptions about mathematics | 9.1 Now I am going to ask you the last question. In your opinion what is mathematics?                      |
|  | 9.2 Before we finish our interesting interview is there anything that you would like to say or comment on? |

As can be seen in Table 6.3, the interview protocol for parents included nine main themes. Each theme was explored using several subsidiary questions. Transcripts of interviews conducted with one father (Gimo, Father, Secondary, Urban) and one mother (Paulina, Mother, Primary, Remote) can be seen in appedices 4 and 5, respectively.

The interview protocol for school principals is shown in Table 6.4. A transcript of an interview conducted with one school principal (Mucauro, Male, University, 4 years of experience as aprincipal in a rural school) is presented in appendix 6.

Table 6.4

*Interview Protocol for School Principals*

| Main themes                   | Questions  |
|-------------------------------|--|
| 1 Principals’ work experience | 1.1 How long have you been the principal of this school? |
|                               | 1.2 Before you came to this school were you              |

| Main themes  | Questions  |
|--|--|
|  | a principal in any other school?                                       |
|  | 1.3 (If yes) For how long? (Refer to Question 1.2)                     |
| 2 Principals' views about girls' and boys' performances      | 2.1 How can you describe the children's achievement in your school?    |
|  | 2.2 Are you satisfied with the children's achievement?                 |
|  | 2.3 Why? (Refer to Question 2.2)                                       |
|  | 2.4 Are there any subjects that boys are performing better than girls? |
|  | 2.5 (If yes) Which subjects and why? ( see Question 2.4)               |
|  | 2.6 Are there any subjects that girls are performing better than boys? |
|  | 2.7 (If yes) Which subjects and why? (see Question 2.6)                |
| 3 Principals' views about the School Parents' committee [SP] | 3.1 Does the school have a School Parents' committee?                  |
|  | 3.2 (If yes) What is its role? (Refer to Question 3.1)                 |
|  | 3.3 Are you satisfied with the work of the School Parents' committee?  |
|  | 3.4 Why? (Refer to Question 3.3)                                       |
| 4 Principals' views about the Gender                         | 4.1 Does the school have a Gender Issues                               |

| Main themes  | Questions  |
|--|--|
| Issues committee [GI]  | committee?   |
|  | 4.2 (If yes) What is its role? (Refer to Question 4.1)   |
|  | 4.3 Are you satisfied with the work of the Gender Issues committee in your school?                         |
|  | 4.4 Why? (Refer to Question 4.3)   |
| <b>5</b> Principals' views about parental involvement in the education of their children [PIE] | 5.1 How can you describe the relationship between teachers and parents that the school serves?             |
|  | 5.2 How can you describe the parents that the school serves?   |
|  | 5.3 Are there any characteristics of the parents that seem to prevent children's learning?                 |
|  | 5.4 Can you indicate some aspects? (see Question 5.3)  |
|  | 5.5 Are there any characteristics of the parents that seem to facilitate children's learning?              |
|  | 5.6 Can you indicate some aspects? (Question 5.5)  |
|  | 5.7 Before we finish our interesting interview is there anything that you would like to say or comment on? |



As can be seen in Table 6.4, the interview protocol for school principals included five themes. Each theme was examined using several subsidiary questions. As with parents, some school principals were asked more questions than others depending on the relevance of the issues they raised. This flexibility was facilitated by the structure of the interview that was not rigid.

As there were only 15 interviews, the transcriptions and data analyses were carried out manually. Fifteen interviews of approximately 45 minutes each, corresponded to 675 minutes of information in the form of words, or 11 hours of data storage. To deal with this amount of data, the guidelines proposed by Creswell (2009) were followed. The first step consisted in transcribing all interviews. After the transcription of interviews, Creswell (2009) suggests reading one interview transcript carefully and then to try to identify the first group of themes. This step was not followed in this study because the main themes were pre-determined by the topics included in the interview protocols. The main themes were consistent with the issues explored quantitatively through the surveys.

In the second stage of the data analysis, the interview data were analysed beyond the main themes. To do so, the interview data were further coded and categorised into the smaller and more manageable sub-themes that emerged. To ensure that sub-themes were accurately coded, the data were re-coded a second time three months later (reliability check).

As few participants were interviewed (10 parents, 5 principals), the answers from all interviewees are presented as part of the results to show the scope of their views in regard to the issues examined. Brief interview extracts are also presented to show the flow of the interviews.

The results of the interviews conducted with parents are presented first followed by the responses of the school principals. In each section, the interview data are compared with the survey data when appropriate. Also, the responses of parents are compared with the responses of their children to determine possible associations.

The main results that emerged from the interview data are summarised at the end of each section. A more general overview of the results and discussion is presented at the end of the chapter.

## **Results of Interviews: Parents**

The data from this section are presented following the order of the main themes as mentioned at the beginning of this chapter.

### **Parents' perceived own achievement in mathematics**

All interviews began with introductions and an explanation of the aims of the study. After that, parents were asked which subject they liked most, and the subject they were good at when they were school children. Only two of ten parents interviewed (both males) indicated that they liked, and were good at mathematics. They provided the following responses:

I liked mathematics because I enjoyed calculating with numbers: adding, subtracting, multiplying, and dividing using big numbers. (Gimo: Father of son, Secondary, Urban)

I was good at mathematics because the system of education of the time was very good. It is not like today that education is very bad. (Manuel: Father of son, Secondary, Urban)

The majority of parents interviewed (8 out of 10), reported that they were not good and did not like mathematics. The reasons they provided were:

I never understood mathematics. I have more inclination for languages. Even the course I am taking now at university is about languages and I have no problems with it. In my view, people are born with the gift that God gives them. I believe that if I had taken mathematics or something involving numbers at university I would be in a very big trouble. (Mário: Uncle of boy, University, Urban)

I liked biology. I understood biology better. I have inclination to biology. I did not like mathematics because I was not good at it. It was too difficult to assimilate. At the time the teachers explained mathematics very well, and I could understand some of it in the classroom, but after a few days, I could not remember the steps that the teacher used. (Isaura: Mother of daughter, University, Urban)

I preferred biology because I was trying to follow medicine. I also tried to understand mathematics and Portuguese because these two subjects were the prerequisites to take any course but I failed because I was not good at mathematics. Exams were too difficult for me. (Matias: Father of son, Secondary, Urban)

I liked mathematics when I was in Grades 1 and 2, but when I reached Grade 3 the teacher started to teach us about insects, birds, fish, and trees; I lost immediately my interest for mathematics because I found nature more amazing than numbers. (Albano: Father of daughter, Secondary, Rural)

I studied hard but I never understood mathematics. During tests I usually relied on my classmates to pass me their solutions. (Nené: Mother of daughter, Secondary, Urban)

Portuguese was my favourite subject. Mathematics was too difficult for me because it has lots of puzzles and traps. You never know how and where to start to solve a mathematical problem. (Cláudia: Sister of girl, University, Urban)

I liked biology and I had very good scores. Mathematics for me was like a 'beast of seven heads'. It was more complicated than the other subjects. When the teacher explained mathematics on the blackboard it seemed ok, but after leaving the classroom I could not remember anything. (Manassa: Mother of daughter, Secondary, Urban)

When I was a girl I liked political education. I liked to hear the stories the teacher told us about the national heroes, liberated zones, and the Independence Day. I also liked biology and Portuguese. I totally disliked mathematics because I was not good at mathematics. I never understood all those numbers. The problem was not about teachers because in that time the teachers had patience and explained mathematics detail by detail. The problem was 'me'. It is not like today that the teachers do not explain things well. (Paulina: Mother of son, Primary, Remote)

In summary, the two parents who liked and were good at mathematics attributed their success to enjoyment working with numbers, and to the system of education. The reasons that parents attributed to their failure in mathematics were (a) task difficulty (5 parents); and (b) lack of giftedness/inclination to understand and to work with numbers (3 parents). It is interesting to note that no parent attributed failure in mathematics to the teacher. The parents' mathematics teachers were considered good because they explained mathematics step by step on the blackboard. It should be noted that despite adopting this approach, most parents did not understand mathematics and did not remember the steps used by the teacher.

### **Parents' perceived children's achievement in mathematics**

To determine whether parents viewed their children as mathematically more competent than themselves or otherwise, parents were also asked whether their children liked and were good at mathematics. Only one parent (Manassa: Mother of daughter, Secondary, Urban) believed her child (Elisa: Daughter, 12, Urban) enjoyed mathematics and was good at it. Manassa liked biology when at school, but not mathematics (see previous page). The following interview extract reveals Manassa's views of her daughter's achievement at mathematics.

Researcher: What about your daughter? Does she like mathematics?  
Manassa: Yes, she does.  
Researcher: Is she good at mathematics?

Manassa: Yes, she is very good.  
 Researcher: On a scale from 0 to 20 how good is she at mathematics?  
 Manassa: She usually gets over 15 marks.  
 Researcher: In your opinion, which factors contribute to her success at mathematics?  
 Manassa: I think she is good at mathematics because of her father. The father likes mathematics a lot and he is very good at it too. She is more like him than me.

Nine parents believed their children were not good and did not like mathematics.

The reasons they attributed to their children's failure in mathematics were:

He hates mathematics. He hates mathematics because he is not good at it. He always complains saying that the teacher does not explain well. He makes no effort to try to understand the subject. He does not investigate<sup>4</sup>. But I have a daughter a daughter who is very good at mathematics. (Gimo: Father of son, Secondary, Urban)

My nephew is a bit like me. He is more inclined to languages than to mathematics. That is why I want him to pursue international relations. (Mário: Uncle of boy, University, Urban)

My daughter likes mathematics but she has problems with getting good scores. I usually check the teachers' feedback. Sometimes she gets good scores but most of the time she gets very low scores. She oscillates a lot, and I do not know why. (Isaura: Mother of daughter, University, Urban)

The children who do not like mathematics they don't know that without mathematics they have limited course options in the future. The problem is also aggravated when the teacher is a demotivated person. (Matias: Father of son, Secondary, Urban)

The system of education nowadays is very bad. Also the children nowadays have more entertainment and many toys to play with. They spend all their time having fun. The younger children know better than the older ones and have fewer disciplinary problems. Adolescents have more problems. The older girls are

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<sup>4</sup> In Portuguese the word 'investigar' (to investigate) is commonly used to refer to persistence in the solution of a mathematical problem.

already thinking about getting married to help their family. The older boys have already started smoking and drinking. They may still go to school but they do not care about having good scores anymore. Teachers are also a problem. Most teachers have no aptitude for teaching. Most of them are teachers because they find no other jobs. (Manuel: Father of son, Secondary, Urban)

My son is very weak at mathematics. I am even better than him. But he is very good at servicing cars with his father. (Paulina: Mother of son, Primary, Remote);

I am not so sure how good my daughter is at mathematics, but I know that she is very good at Portuguese. She is good at things involving writing, painting, and hairdressing. She likes doing creative things. (Nené: Mother of daughter, Secondary, Urban)

She likes mathematics, and she is a very dedicated person. She studies a lot at home, but I think she does not understand mathematics and she has reading problems too. Her prior education was very poor as she was living in another Province. She came last year, so it will take time for her to recuperate. (Cláudia: Sister of girl, University, Urban)

In summary, there were several reasons that parents attributed to their children's failure in mathematics. Some parents provided more than one reason. The main reasons were: (a) lack of effort or interest to study the subject (2 parents); (b) lack of giftedness or inclination to the subject (4 parents); (c) teacher or the system of education (2 parents); (d) poor prior education (1 parent), (e) age of the children (1 parent); (f) lack of knowledge about the usefulness of mathematics (1 parent), (g) and disciplinary problems (1 parent). Two parents did not know why their children did not perform well at mathematics. These reasons can also be classified using failure attributions (Weiner, 1974). Weiner stated that in achievement-related situations, people tend to attribute their failures to perceived lack of ability (see *b* above), perceived lack of effort to perform the activity (see *a* above), and environmental factors (e.g., teachers, curriculum, and education system; see *c* above). It is interesting to note that most parents indicated

to have not liked and to have not been good at mathematics due to the complexity of the subject (result shown previously) but no parent attributed their children's failure at mathematics to task difficulty.

To determine whether the parents' perceptions of children's achievement were similar to their views in regard to their own achievement, and whether these views were consistent with the children's self-perceived achievement in mathematics, the responses of both parents and children are summarised in Table 6.5.

Table 6.5

*Comparison of Responses of Parents and Children in Regard to Perceived Achievement in Mathematics [PAM]*

| Parent          |                                       | Child                                       |                 | Geolocation  |       |
|-----------------|---------------------------------------|---|-----------------|--|-------|
| Name/<br>gender | How good<br>are you at<br>mathematics | How good is<br>your child at<br>mathematics | Name/<br>gender | How<br>good are<br>you at<br>mathemat<br>ics (PAM<br>scores) |       |
| Albano<br>(M)   | No Good                               | No Good                                     | Zinha (G)       | 4  | Rural |
| Cláudia<br>(F)  | No Good                               | No Good                                     | Josefina<br>(G) | 1  | Urban |
| Gimo (M)        | Good                                  | No Good                                     | Ernesto (B)     | 3  | Urban |
| Isaura (F)      | No Good                               | No Good                                     | Nádia (G)       | 1  | Urban |
| Manassa<br>(F)  | No Good                               | Good  | Elisa (G)       | 1  | Urban |
| Manuel<br>(M)   | Good                                  | No Good                                     | Ivo (B)         | 4  | Urban |
| Mário (M)       | No Good                               | No Good                                     | Ezdine (B)      | 1  | Urban |
| Matias<br>(M)   | No Good                               | No Good                                     | João (B)        | 4  | Urban |
| Nené (F)        | No Good                               | No Good                                     | Amanda          | 3  | Urban |

|         |         |         |           |   |        |
|---------|---------|---------|-----------|---|--------|
|         |         |         | (G)       |   |        |
| Paulina | No Good | No Good | Yuran (B) | 3 | Remote |
| (F)     |         |         |           |   |        |

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Note. PAM: Perceived Achievement in Mathematics: Response format: 1 (weak); 2 (below average); 3 (average); 4 (good); 5 (excellent);  
M: Male parent; F: Female parent; B: Boy; G: Girl  
Shaded regions: Responses of parents are consistent with responses of their children

As can be seen in Table 6.5, the responses of three parents were consistent with the responses of their children (shaded regions). These three parents indicated that mathematics was a difficult subject for themselves and for their children, and their children also rated themselves as weak at mathematics.

The way parents viewed their children's achievement in mathematics may have not been influenced by the gender of the child or of the parent as only one parent (mother) out of the ten parents interviewed believed her child (daughter) was good at mathematics. This is possibly because parents view mathematics as a very difficult subject for everyone. But there were more girls who rated themselves as weak at mathematics than boys. The children from rural and remote schools (i.e., Zinha, and Yuran) rated their achievement better than did most pupils from urban schools.

The interview data confirmed the survey data presented in Chapter 5. The survey data showed that parents, on average, view mathematics as the most difficult subject for their children irrespective of the gender of the child.

The data presented in Table 6.5 also show that the majority of parents believed their children were not good at mathematics but some children rated themselves as good (4) or average (3). There are several possible reasons for this contradiction. As parents had difficulties with the subject, they may also believe their children are having similar problems. If the children provided a correct account of their own achievement, then it is possible that many parents are unaware of their children's mathematical competence.



Manassa (mother of daughter) was the only parent interviewed who believed her child is good at mathematics; Manassa attributed her daughter's success at mathematics to the influence of the father who likes and is good at this subject; in contrast, Manassa's daughter (Elisa) believed she was weak at mathematics but excellent at English and Physical education. According to the expectancy-value theory (Eccles et al., 1983), parents who like and value certain tasks have the possibility to influence their children as they expose their beliefs and values to them. In the case of mathematics, if parents like and value the subject they will be more likely to provide useful mathematical experiences for their children than parents who do not. Thus, if Elisa is good and likes mathematics, her success at this subject may be explained using parental socialisation of children's academic preferences. But, Eccles et al. (1983) also indicated that if mothers and fathers exhibit different gendered beliefs and attitudes towards mathematics learning, the probability of sons and daughters to develop expectations and task-interests that match their gender is high. This could also explain why Elisa perceives herself as weak at mathematics but excellent in other subjects.

In summary, in this section was shown that parents' views about their children's mathematical capabilities were generally similar to their perceived own competence in this subject. However, in some cases they were not. The reasons parents attributed to their children's poor performance in mathematics were diverse and included the child's teacher who was viewed as having no motivation and no preparation to teach mathematics as compared to the parents' former mathematics teachers.

In regard to the impact of age on children's mathematics education, adolescent students were associated with lack of effort and interest, and disruptive behaviours. Accordingly, the survey data demonstrated that the younger children held more positive beliefs about mathematics education than the older ones. It should be noted that the

ages of the children ranged from 11 to 16 and the mean was 12.9. The standard deviation of 1.5 demonstrated that the ages were dispersed. As indicated in Chapter 4, some girls were already married and thus, although studying in the same classrooms with the 11-year olds, the children had different experiences in mathematics learning and outside the classroom.

### **Parents' perceptions of changes in mathematics teaching and learning**

After indicating the [perceived] reasons for their children's poor achievement in mathematics, parents were asked whether they thought mathematics teaching and learning had changed since they were at school. All parents believed it had changed. Nine of the ten parents believed the content and the teaching methods changed into a situation worse than it was when they were at school. Only one parent believed it had changed for the better. Parents were also asked to indicate one important change that has occurred. Their responses were:

It has changed a lot; people nowadays do not study; they have no time to investigate; they go to school just to show off. (Gimo: Father of son, Secondary, Urban)

Nowadays there are pupils who cannot read and write. In the past, teachers demanded children memorise all tables of addition, subtraction, multiplication, and division. Children without knowledge of tables were not allowed to enter into the classroom. Nowadays children pass from one grade to another without any assessment. (Mário: Uncle of boy, University, Urban)

Classrooms are overcrowded and the teacher cannot assist individual children. (Isaura: Mother of daughter, University, Urban);

In the past the teacher used to give us problems to solve and we had to investigate, and could not return to the classroom before we found the solution. Well, mathematics is the same but the philosophy for teaching it is different. Now

teachers do not force the children to study. But children are children they need to be forced to study by the teacher. I don't know where these people found this philosophy of teaching; maybe they brought it from Cuba, East Germany, or Soviet Union. (Matias: Father of son, Secondary, Urban)

There is much content that the children learn in the secondary school nowadays; we learned this content in primary school. (Manuel: Father of son, Secondary, Urban)

Nowadays they call it mathematics. In the past we called it arithmetic. Mathematics was taught only in secondary schools. (Albano: Father of daughter, Secondary, Rural)

In the past the teachers explained mathematics very well, and they used blackboards to explain content quite often. Nowadays, teachers rarely use the blackboard. They often say: 'open your mathematics textbook to page 122 and do all the tasks that you find there'. That is not good for the children because the child needs to see all the steps clearly. (Paulina: Mother of son, Primary, Remote)

The kind of mathematics the children study today is much harder than the one I studied. My daughter always asks me to explain something and I say "I don't know". (Nené: Mother of daughter, Secondary, Urban)

Nowadays the teaching and learning is more interesting and has been facilitated with calculators. In my time we had to memorise everything and we had to perform unreasonably very long and complicated calculations by hand. (Cláudia: Sister of girl, University, Urban)

In the past no child was allowed to enter into the classroom without having completed homework. Today the teachers do not require the children to do homework. That is why children today do not care about homework, preparing for the next class, and to get good scores. They know from day one that they will pass the grade level. (Manassa: Mother of daughter, Secondary, Urban)

These responses reinforce the views of parents in regard to the reasons influencing children's poor achievement in mathematics. As can be seen, parents believed the

changes in mathematics teaching occurred in regard to the following issues: (a) teachers' role (5 parents); (b) assessment – introduction of automatic transitions from one grade to another in primary schools (2 parents); (c) mathematics content (2 parents); (d) children's attitudes towards learning (1 parent); (e) increased class sizes (1 parent); and (f) the use of calculators to solve mathematical problems (1 parent).

The responses of parents revealed several conflicting views. For instance, one parent (Manuel: Father of son, Secondary, Urban) implied that the content now taught in secondary schools used to be taught in primary schools. Another parent (Nené: Mother of daughter, Secondary, Urban) indicated that she cannot help her daughter because mathematics taught in primary schools is too difficult. However, another parent believed the change of the terminology from 'arithmetic' to 'mathematics' contributes to children's low performance. These comments suggest that most parents may not have a correct idea of what their children are learning at school and what is the nature of the change.

The most frequently perceived change in mathematics education was in regard to the role of the teacher. Compared to the parents' mathematics teachers, parents emphasised that the children's mathematics teachers are not good: that is, they do not explain mathematics well, and they do not oblige the children to do the assignments or to memorise the material.

In regard to increased class sizes, the average number of pupils per classroom in the participating schools was 82 in urban schools and 60 in rural and remote schools. Hence, it is surprising that only one parent (Isaura: Mother of daughter, University, Urban) mentioned class sizes. Further examination of occupations of the parents interviewed revealed that the parent who mentioned class sizes was a recently trained

teacher and thus she was aware of the difficulties arising from teaching huge class sizes. In some participating urban schools there were no chairs for pupils and for teachers in the classrooms. The pupils were sitting on the floor and the teachers were standing during the whole class-time.

It is interesting that one parent (Cláudia: Sister of girl, University, Urban) mentioned calculators in mathematics education. She believed mathematics learning nowadays is more interesting and has been facilitated with the use of calculators. Cláudia held this positive belief probably because she was the youngest of the ten guardians (age=26), and thus she might have studied in contemporary times, and also she has a university degree in environmental studies. However, it should be noted that calculators are not formally used in Mozambican schools although the children use them under their own initiatives.

### **Parents' views about girls' and boys' mathematical capabilities**

To examine parents' views about girls' and boys' mathematical capabilities, three prompts were taken from the *Who and Mathematics* instrument (Leder & Forgasz, 2002a) and presented to parents. The prompts were:

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G: Girls are better than boys at mathematics.

B: Boys are better than girls at mathematics.

ND: There is no difference between girls and boys at mathematics.

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The statements were written on individual sheets and the letters A, B, and C were used to distinguish each statement instead of the codes G, B, and ND. To begin, the researcher read each statement to the parents aloud. Then, he handed the sheets to the

parents to let them examine the statements closely. After ensuring that they had understood and retained the content of each statement, the researcher asked which statement they believed was true and why. After selecting a statement and providing a justification, the researcher replaced the subject (mathematics) with Portuguese.

In regard to mathematics, one parent (Gimo: Father of son, Secondary, Urban) said boys were better than girls; another parent (Albano: Father of daughter, Secondary, Rural) said girls were better than boys; the remaining eight parents said there was no difference between boys and girls at mathematics. The reasons provided by parents are presented next by response category.

#### **Girls are better than boys at mathematics (N=1).**

Only one parent believed girls are better than boys at mathematics. When asked why, he said:

I support girls because they are very intelligent. Anything that is in the hands of a woman, that thing is safe. They are very smart and that is why the world today is surrounded by women, and most of them are leaders. Without the intelligence of women the world could not exist. (Albano: Father of daughter, Secondary, Rural)

Albano's response is interesting because in rural areas of Mozambique there is scarcity of females in leadership occupations or working as teachers in schools. Also, access to information is limited as most families have no television sets at home and thus, Albano's assessment may be unrealistic particularly within the context of Mozambique. Albano may also have given a politically correct response (Paulhus, 2002) as he was responding for his daughter. However, intervention initiatives aimed at promoting the status of women conducted by non-governmental organisations are concentrated in rural areas.

**Boys are better than girls at mathematics (N=1).**

Gimo believed boys are better than girls at mathematics. He said:

Boys are better; since the colonial times boys were superior at mathematics. ...[Well, I don't know whether I am trapped by old times]. (Gimo: Father of son, Secondary, Urban)

Gimo made the comment presented in brackets after he was asked to explain why he thought boys are better than girls at mathematics.

**There is no difference between girls and boys at mathematics (N=8).**

Parents who believed there was no gender difference in mathematics achievement provided the following justifications:

It is because in one school you may find very good girls and also very good boys at mathematics. Personally I know many very good girls at mathematics. (Isaura: Mother of daughter, University, Urban)

It is because in one classroom you may find girls who are better at mathematics than boys. In the next classroom, maybe boys are better. Do you see? There is no difference. Everything tends to equilibrium. (Mário: Uncle of boy, University, Urban)

It depends on the person. Every person thinks differently. A girl can be able to investigate what a boy is unable to investigate. You may also find a boy who investigates more than a girl. There is equality in that matter. I have no doubt about that. (Matias: Father of son, Secondary, Urban)

It depends on how the child starts schooling. The system is responsible for this because it distinguishes between science and arts and this makes children lazy because they know they can choose one thing, for example, arts. When I compare my children I cannot conclude that the boys are better than the girls at mathematics. (Manuel: Father of son, Secondary, Urban)

I see in my home my youngest daughter is now in Grade 6 and she is very good at mathematics and she helps the brother who is in Grade 7. The brother does not understand anything about numbers although he is more advanced than the sister. (Paulina: Mother of son, Primary, Remote)

It is because I as a woman, I may not be good at mathematics but there are many women out there who are very good at mathematics. The same thing happens among men. There are many stupid men at mathematics out there who cannot do any sort of calculations but there are also very smart men. (Nené: Mother of daughter, Secondary, Urban)

Boys and girls are doing equally well or equally badly in school nowadays. In the past there was the perception that girls are weaker than boys at mathematics but not today. (Cláudia: Sister of girl, University, Urban)

There is no difference between boys and girls at mathematics because when a person has decided to learn something, with dedication the person will learn that thing. (Manassa: Mother of daughter, Secondary, Urban)

These responses reveal that the majority of parents interviewed did not gender stereotype mathematics achievement. They also show that parents' views were influenced by personal experiences and observations of the current trends in educational outcomes. It is interesting to note that all the five female respondents believed they were not good at mathematics but, despite holding this view, they did not believe boys are better than girls at mathematics. This suggests that the responses of the females may have been influenced by the perception that 'I am not good at mathematics but other women are'. The parent (Gimo: Father of son) who believed boys were better than girls at mathematics mentioned his past experiences in mathematics education.

It should be noted that some parents (Gimo: Father of son; Mário: Uncle of boy) did not have a stable belief about who is better at mathematics as they changed their responses during the interviews. Gimo initially said boys were better than girls and



when asked to probe his response he said there is no difference. Mário initially said there was no difference but during the interview he revealed that he believes males are more intelligent than females generally (and better at mathematics) and that there is evidence of that in the real world. The following interview extract shows Mário's comments:

Researcher: Which statement do you agree with most?

Mário: There is no difference.

Researcher: Why do you say that?

Mário: It is because in one classroom you may find girls who are better at mathematics than boys. In the next classroom, maybe boys are better. Do you see? There is no difference. Everything tends to equilibrium.

Researcher: There are people who say that boys, on average, are better than girls at mathematics. Do you agree with them?

Mário: I agree but I do not agree in 100%. I agree only in 40% and 60%.

Researcher: What do these numbers mean?

Mário: I am saying that, if the difference exists, women are 40% and men are 60%. I am trying to make the difference be very small.

Researcher: I would like to understand what do these numbers really represent?

Mário: I am saying that if the difference exists, men are 20% more intelligent than women.

Researcher: Why is not the opposite, for example, women 20% more intelligent than men?

Mário: I never heard of women scientists or educators. All scientists, educators, and philosophers I read about at university are men.

Researcher: Is there any possible reason for that?

Mário: It is because, in life, there are situations that need contribution of all people, and the women are not showing up there. There are situations in life that among three men, there is only one woman. Now, looking at these disproportions in important events, I believe that men are 20% more intelligent than women.

Researcher: What about in regard to Portuguese?

Mário: Well, I would keep option 'no difference'. But in the modern times there are a lot of challenges. You might find males fighting for certain goals and women fighting for other goals, and all of these challenges drive us to what is called 'discrimination'. In the past men went to school and women

remained at home. Nowadays, the educational space is more open for women, and they are taking it aggressively; they do not obey any fair rules, and the result is that they supplant men in most fields today.

Researcher: Do they supplant men?

Mário: Yes they do supplant men because there are more advantages favouring them.

Researcher: Can you mention one advantage favouring women?

Mário: As I said, women are having more and more space and opportunity to education nowadays and men are left behind.

As can be seen, Mário's views were influenced by personal experiences and observations that females are misrepresented in some academic fields and occupations.

It should be noted that despite the majority of parents interviewed holding a gender neutral position in relation to achievement in mathematics, the survey data presented in Chapter 5 revealed that parents (and grade 7 boys) tended to gender stereotype mathematics learning as a male domain – the view that is consistent with the research findings from the 1970s (see Fennema & Sherman, 1976; Leder & Forgasz, 2002a). This is probably because apart from the perceptions about achievement, the W&M instrument also includes other dimensions such as perceptions about persistence, effort, and behaviours.

In order to compare children's and their parents' perceptions about "who are not good at mathematics" [ANGM] item 23 from the W&M instrument (Leder & Forgasz, 2002a) shown in Figure 6.1 was used to collect the data.

|    |  |                                |                                |                                |                                |                                |
|----|--|--------------------------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|
|    |  | <input type="checkbox"/>       | <input type="checkbox"/>       | <input type="checkbox"/>       | <input type="checkbox"/>       | <input type="checkbox"/>       |
| 22 | Worry if they do not do well in mathematics.                         | BD<br><input type="checkbox"/> | BP<br><input type="checkbox"/> | ND<br><input type="checkbox"/> | GP<br><input type="checkbox"/> | GD<br><input type="checkbox"/> |
| 23 | Are not good at mathematics.   | BD<br><input type="checkbox"/> | BP<br><input type="checkbox"/> | ND<br><input type="checkbox"/> | GP<br><input type="checkbox"/> | GD<br><input type="checkbox"/> |
| 24 | Like using calculators <sup>†</sup> to work on mathematics problems. | BD<br><input type="checkbox"/> | BP<br><input type="checkbox"/> | ND<br><input type="checkbox"/> | GP<br><input type="checkbox"/> | GD<br><input type="checkbox"/> |
| 25 | Mathematics teachers spend more time with them.                      | BD<br><input type="checkbox"/> | BP<br><input type="checkbox"/> | ND<br><input type="checkbox"/> | GP<br><input type="checkbox"/> | GD<br><input type="checkbox"/> |

*Figure 6.1.* Item 23: "Are not good at mathematics" from the W&M instrument (Adapted from Leder & Forgasz, 2002a, p.14).

To facilitate the comparison of results, respondents (parents and children) who believed boys are definitely (or probably) more likely than girls not to be good at mathematics were considered to hold the belief that girls are better than boys at mathematics because item 23 is negatively worded. On the other hand, respondents who believed girls are definitely (or probably) more likely than boys not to be good at mathematics were considered to hold the belief that boys are better than girls at mathematics. The gender neutral response – there is no difference between girls and boys at mathematics – remained the same. The responses of parents in regard to “who is better at mathematics” (WBM: interview data), “who are not good at mathematics” (ANGM: survey data), and “how good is your child at mathematics” (HGCM: interview data) and the responses of the children in relation to “who are not good at mathematics” (ANGM: survey data) are presented in Table 6.6.

Table 6.6

*Gender Stereotyping of Mathematics and Perceptions of Who is Better at Mathematics: Comparison of responses Between Parents and Children*

| Parents         |     |      |         | Children        |      |                 |
|-----------------|-----|------|---------|-----------------|------|-----------------|
| Name/<br>gender | WBM | ANGM | HGCM    | Name/<br>gender | ANGM | Geo<br>location |
| Albano (M)      | G   | ND   | No Good | Zinha (F)       | B    | Rural           |
| Cláudia (F)     | ND  | ND   | No Good | Josefina (F)    | ND   | Urban           |
| Gimo (M)        | B   | G    | No Good | Ernesto (M)     | B    | Urban           |
| Isaura (F)      | ND  | ND   | No Good | Nádia (F)       | ND   | Urban           |
| Manassa         | ND  | ND   | Good    | Elisa (F)       | ND   | Urban           |
| Manuel (M)      | ND  | ND   | No Good | Ivo (M)         | B    | Urban           |
| Mário (M)       | ND  | G    | No Good | Ezdine (M)      | ND   | Urban           |

| Parents         |     |      | Children |                 |      |                 |
|-----------------|-----|------|----------|-----------------|------|-----------------|
| Name/<br>gender | WBM | ANGM | HGCM     | Name/<br>gender | ANGM | Geo<br>location |
| Matias (M)      | ND  | G    | No Good  | João (M)        | G    | Urban           |
| Nené (F)        | ND  | ND   | No Good  | Amanda (F)      | ND   | Urban           |
| Paulina (F)     | ND  | ND   | No Good  | Yuran (M)       | ND   | Remote          |

Note. G: Girls; B: Boys; ND: No difference between girls and boys. M: Male; F: Female  
WBM: Who is better at mathematics (interview data);  
ANGM: 'Are not good at mathematics' (Item 23) (survey data);  
HGCM: How good is your child at mathematics (interview data);  
Shaded regions: Responses of parents to the surveys and interviews were consistent, or the responses of parents were consistent with the responses of their children.

As can be seen in Table 6.6, 7 out of the 10 parents interviewed did not change their response when asked who is better at mathematics. That is, the responses that they provided during the interviews were consistent with those they provided in their survey forms. Three parents changed their responses. One parent (Matias: Father of son, Secondary, Urban) who said there was no difference between boys and girls in terms of achievement in mathematics during the interview, indicated that boys were better than girls during the survey. One parent (Albano: Father of daughter, Secondary, Rural) who said there was no difference between boys and girls at mathematics during the survey indicated that girls were better than during an interview. Mário (Uncle of boy, University, Urban) indicated that boys were better than girls during the survey but during the interview his first response was that there is no difference.

Generally, the responses of most parents may have reflected their true beliefs as the interviews were conducted one month after the surveys and they could not remember the responses that they provided to the survey items. However, some parents may not be sure about who is better at mathematics and thus, their responses fluctuated on the basis of the method used to collect the data.

Table 6.6 also shows that there were six parents who consistently held a gender neutral position in regard to mathematics achievement (ND). Interestingly, these were all female and one male parent (Manuel: Father of son, Secondary, Urban). The children of the female interviewees also believed there was no gender difference in mathematics achievement while the other children believed girls were better (Zinha: Girl, Rural; Ernesto: Boy, Urban; Ivo: Boy, Urban) or boys were better (João: Boy, Urban).

In summary, the responses of mothers were consistent with those of their children and were gender-neutral. The responses of fathers were consistent with the responses of their children for two parents (Albano: Father of daughter, Secondary, Rural; and Matias: Father of son, Secondary, Urban). This is possibly because fathers and mothers interact differently with their children in Mozambican society. It will be shown later in this thesis that mothers were more likely to help their children with mathematics homework than fathers. If fathers have less communication with their children about mathematics than mothers, then the children will have more opportunities to know and to adopt the beliefs and values of their mothers than those of their fathers. The gender of parent and child were associated with the response directions in regard to gender stereotyping of mathematics achievement. Mothers' views were also reflected in their children's views. This was probably because most mothers (N=4) represented their daughters and both did not hold gender stereotyped beliefs about mathematics performance. The common response of parents was that there is no difference between boys and girls in terms of their mathematics achievement. This view was held by all female parents but not by all male parents. There was no indication that geolocation and level of education of the parent influenced the perception of who is better at mathematics.

## **Parents' perceived usefulness of mathematics for their children, and to get a job**

In this section the data in regard to parents' perceptions about the usefulness of mathematics for their children and for getting jobs are reported. During interviews parents were asked how important mathematics is for their children and why. After answering this question they were asked whether mathematics helps to get jobs. All parents interviewed believed mathematics is important for their children and provided a variety of reasons. Three parents did not believe mathematics is important to get a job. The data are reported next by response category.

### **Mathematics is important for their children (N=10).**

All the 10 parents interviewed believed mathematics is important for their children. When asked why they provided the following reasons:

Mathematics is important because it opens capacity, and improves reasoning. (Gimo, Father of son, Secondary, Urban)

Mathematics improves memory and reasoning. (Mário: Uncle of boy, University, Urban)

It is important because everything we do involves mathematics. (Isaura: Mother of daughter, University, Urban)

You cannot study any other subject if you have difficulties with mathematics. Even geography needs mathematics. That is why, in the past, mathematics was considered a basic subject, and was compulsory for everyone. (Matias: Father of son, Secondary, Urban)

Yes, mathematics is important. That is why in the past all students studied mathematics and Portuguese until Grade 12. For me, mathematics and language should be compulsory subjects until Grade 12. Others such as geography and history could be optional. (Manuel: Father of son, Secondary, Urban)

Mathematics is important for my child because it helps to understand other subjects, for example physics and chemistry in the secondary education. (Albano: Father of daughter, Secondary, Rural)

Mathematics is important because it helps us to make calculations. All sorts of calculations: for example to check if the change that you received is correct or not. (Paulina: Mother of son, Primary, Remote)

It is important because it helps to perform calculation; to check bills, change, and salary. (Nené: Mother of daughter, Secondary, Unban)

It is through mathematics that we can carry out calculations and to perform some services. (Cláudia: Sister of girl, University, Urban)

It helps counting and making calculations. (Manassa: Mother of daughter, Secondary, University)

In summary, all parents interviewed believed mathematics is important for their children. However, the perceived importance of mathematics was in terms of understanding other school subjects (3 parents); performing calculations (3 parents); developing reasoning skills and memory (2 parents); and counting (1 parent). The most common terms that parents associated with mathematics were ‘reasoning’, ‘memory’, ‘calculation’, ‘counting’, ‘salary’, ‘money’, and ‘change’. The terms calculation and counting were used more by female respondents while male respondents used more the terms memory and reasoning.

**Mathematics is important to get a job (N=7).**

Seven out of the ten parents believed mathematics was important to get a job. To justify their responses they said:

People who understand mathematics can work in big industries, laboratories, and plants. In these kinds of jobs, advanced mathematics is used and mathematical precision is required. No mathematics mistakes are allowed there. The mathematicians say: 'this is it'. We, as social science people, say: 'this looks like this or that'. People from social sciences make judgments, but mathematicians never make judgements because they are not allowed to make mistakes. So, people who know mathematics have special types of jobs waiting for them. (Mário: Uncle of boy, University, Urban)

Any employment uses mathematics (Isaura: Mother of daughter, University, Urban)

Even during the Portuguese colonial regime to get a job we were required to know mathematics. People who went to work in sawmills had to know how to work out the volume of a piece of wood. (Matias: Father of son, Secondary, Urban)

It is important because mathematics means intelligence. If you are good at mathematics you can do anything you like. You can do physics, chemistry or something else. Mathematics is the foundation of everything. Carpenters, shoemakers, or builders rely on mathematical skills. (Albano, Father of daughter, Secondary, Rural)

Companies like people who are good at mathematics. (Paulina: Mother of son, Primary, Remote)

Because any job nowadays requires mathematics. In every job people do calculations, for example to check whether the amount of money your employer paid you is correct. (Nené: Mother of daughter, Secondary, Urban)

Mathematics is important, for example, accounting needs people who are good at mathematics. (Manassa, Mother of daughter, Secondary, Urban)



Parents who agreed that mathematics helps to get a job, three believed that all jobs use mathematics (see Nené: Female, Isaura: Female, and Albano: Male) and four indicated that some jobs require the use of high level mathematics and knowing such mathematics entitles people to jobs (Manassa: Female, Paulina: Female, Matias: Male, and Mário: Male).

The survey data that were presented in Chapter 5 revealed that the level of parents' perceived usefulness of mathematics [PUM] for their children was 3.48 on a scale ranging from 1 to 5: that is, parents agreed that mathematics is useful for their children but not strongly. This mean score is likely to have been influenced by parents' association of mathematics with low level uses such as counting and calculating rather than for getting jobs.

### **Mathematics is not important to get a job (N=3).**

Three parents believed mathematics is not important to get jobs. (Matias: Male, Gimo: Male, and Cláudia: Female). The reasons that Gimo provided during the interview were similar to those mentioned by the other two parents. The following is an extract of the interview conducted with Gimo. (Father of son, Secondary, Urban):

Researcher: Do you think mathematics is important for your son?

Gimo: Yes, it is important.

Researcher: Why?

Gimo: Mathematics opens capacity and improves reasoning. Mathematics is about intelligence. People who know mathematics are clever.

Researcher: Do you think mathematics is important to get a job?

Gimo: No, it is not important to get a job.

Researcher: Why do you think so?

Gimo: There are many people out there with a university degree without a job.

Well, if you have a job already and you also know mathematics, your mathematical skills can help you to do your work much better.

Researcher: How?

Gimo: You can make calculations, for example, to check if the salary employer paid is correct.

Researcher: Which profession would you like for your son in the future?

Gimo: An Engineer.

Researcher: Why?

Gimo: He likes electricity, computers, and football.

Researcher: Do you think mathematics is important to learn about computers?

Gimo: No. It is not important.

As can be seen, although all parents believed mathematics is important for their children, some did not associate it with jobs. They tended to hold utilitarian views that mathematics is about counting, calculating, memorising, and reasoning. The data revealed clearly that some parents (e.g., Gimo, see above) did not relate mathematics with knowledge about computers and technology. Cláudia indicated that job advertisements do not request mathematical knowledge but skills in the use of computers and competence at both languages Portuguese and English.

In order to determine whether children of the parents who perceived mathematics as useful for their children, also their children believed understanding mathematics has many benefits for them, comparisons of responses between parents and children were made, and the results are summarised in Table 6.7.

Table 6.7

*Perceived Usefulness of Mathematics [PUM]: Comparison of Responses Between Parents and Children*

| Parents         |            |              |                                    |                               | Children        |   |
|-----------------|------------|--------------|------------------------------------|-------------------------------|-----------------|---|
| Name and gender | Education  | Geo-location | Mathematics is useful for my child | Mathematics helps to get jobs | Name and gender | Understanding mathematics has many benefits for me <sup>†</sup> |
| Albano (M)      | Secondary  | Rural        | Yes                                | Yes                           | Zinha (F)       | SA  |
| Cláudia (F)     | University | Urban        | Yes                                | No                            | Josefina (F)    | SA  |
| Gimo (M)        | Secondary  | Urban        | Yes                                | No                            | Ernesto (M)     | U   |
| Isaura (F)      | University | Urban        | Yes                                | Yes                           | Nádia (F)       | A   |
| Manassa (F)     | Secondary  | Urban        | Yes                                | Yes                           | Elisa (F)       | A   |
| Manuel (M)      | Secondary  | Urban        | Yes                                | No                            | Ivo (M)         | U   |
| Mário (M)       | University | Urban        | Yes                                | Yes                           | Ezdine (M)      | A   |
| Matias (M)      | Secondary  | Urban        | Yes                                | Yes                           | João (M)        | D   |
| Nené (F)        | Secondary  | Urban        | Yes                                | Yes                           | Amanda (F)      | SA  |
| Paulina (F)     | Primary    | Remote       | Yes                                | Yes                           | Yuran (M)       | SA  |

Note. D:Disagree; SD: Strongly Disagree; U: Unsure; A: Agree; SA: Strongly Agree

<sup>†</sup>Item 3 from the *Mathematics Value Inventory* (Luttrell et al., 2010);

Shaded regions: Responses of parents are consistent with the responses of their children.

As can be seen in Table 6.7, all parents perceived mathematics as useful for their children. Despite all parents holding this positive view, one child (João: Boy, Urban) disagreed that understanding mathematics has many benefits for him, and two boys (Ernesto and Ivo) both from urban schools were unsure if mathematics benefitted them. It should be noted that the parents of these three children were males. For the two children (Ernesto and Ivo) who were unsure as to whether mathematics has many benefits for them, their parents believed mathematics was not important to get jobs. However, Cláudia (Sister of girl, University, Urban) also believed mathematics is not important to get jobs but her sister (Josefina) agreed strongly that mathematics has many benefits for her.

Based on the expectancy-value theory (Eccles et al., 1983), the children whose parents perceive mathematics as a useful subject should attribute high value to this subject. However, to influence children's task-values depends on several factors, such as the way parents communicate these values to their children, and the children's own interpretations of their parents' task-values and occupational aspirations for their children. Thus, if the parents interviewed in this study rarely communicate their task-values to their children, this may explain why some children did not view mathematics as useful while their parents did.

Table 6.7 also shows that geolocation (Albano: Father of daughter, Secondary, Rural; and Paulina, Mother of son, Primary, Remote), and parental education (Paulina, Mother of son, Primary, Rural) were not related to parents' perceived usefulness of mathematics [PUM] for their children. Also, the children of these parents (Zinha: Girl, and Yuran: Boy) agreed strongly that mathematics has many benefits for them. All girls agreed (A) or strongly agreed (SA) that mathematics has many benefits for them. In

contrast, there was one boy (Joao) who disagreed and two boys (Ernesto and Ivo) who did not know if mathematics has many benefits for them.

### **Parents' occupational aspirations for their daughters and sons**

After they indicated how important mathematics is for their children and for getting jobs, parents were asked the following questions:

- Which profession do you aspire for your son/daughter in the future? (6.1)
- Why do you prefer this profession for your child? ( 6.2)

The occupations parents aspired for their children were compared with the children's own occupational interests. The parents' and children's reasons for choosing occupations were similar to those identified in Chapter 5 (survey data) and thus, the same categories were used to classify the data. The occupations mentioned by parents and by children and the reasons for their preferences are presented in Table 6.8.

Table 6.8

*Parents' Occupational Aspirations for their Children and the Children's Own Occupational Aspirations and the Reasons for Occupational Preferences*

| Parents         |                      |                                   | Children        |                      |          |              |
|-----------------|----------------------|-----------------------------------|-----------------|----------------------|----------|--------------|
| Name and gender | Occupation mentioned | Reason                            | Name and gender | Occupation mentioned | Reason   | Geo location |
| Albano (M)      | Physician (P)        | Talent                            | Zinha (F)       | Nurse (P)            | Talent   | Rural        |
| Cláudia (F)     | Physician (P)        | Utility                           | Josefina (F)    | Teacher (P)          | Interest | Urban        |
| Gimo (M)        | Engineer (T)         | Talent                            | Ernesto (M)     | Engineer (T)         | Utility  | Urban        |
| Isaura (F)      | Economist (T)        | Utility                           | Nádia (F)       | Lawyer (P)           | Utility  | Urban        |
| Manassa         | Accountant (T)       | Talent                            | Elisa (F)       | Teacher (P)          | Interest | Urban        |
| Manuel (M)      | Agronomist (T)       | Need to retain jobs of the family | Ivo (M)         | Police officer (P)   | Utility  | Urban        |
| Mário (M)       | Diplomat (P)         | Talent                            | Ezdine (M)      | Engineer (T)         | Utility  | Urban        |
| Matias (M)      | Scientist (T)        | Utility                           | João (M)        | Engineer (T)         | Utility  | Urban        |
| Nené (F)        | Accountant (T)       | Utility                           | Amanda (F)      | Architect (T)        | -        | Urban        |
| Paulina (F)     | Engineer (T)         | Talent                            | Yuran (M)       | Engineer (T)         | Utility  | Remote       |

Note. M: Males; F: Females; P: People-oriented jobs; T: Things-oriented jobs;  
 Talent: perceived talent or 'inclination' to perform the job; Utility: Perceived value of the job for personal intellectual grow or to develop economically; Interest: the person wants the job because enjoys /likes it.  
 Shade regions: Responses of parents were similar to those of their offspring.

As can be seen in Table 6.8, the occupations that parents aspire for their children resemble children's own occupational aspirations for three respondents (shaded regions:

Albano: Father of daughter - Zinha; Gimo: Father of son - Ernesto; and Paulina:

Mother of son - Yuran). Specifically, parents who aspired for their children to be engineers (2 parents: Gimo and Paulina) or a physician (1 parent: Albano), their children (Ernesto, Yuran, and Zinha) also wanted these professions.

However, there were several inconsistencies between the occupational aspirations of parents for their children and the children's own aspirations; for example, Manassa (Mother of daughter, Secondary, Urban) aspired for her daughter (Elisa, 12 years old) to be an accountant in the future but Elisa herself wanted to be a teacher. Most children and their parents had different occupational perspectives; the differences may be stimulated by a lack of communication of occupational aspirations between parents and children. Some parents viewed their children as still young and thus, needless to talk to them about occupations.

Interestingly, some parents believed their children were not good at mathematics but even so they aspired for them to be engineers and accountants (see Gimo: Father of son, Paulina: Mother of son, and Néne: Mother of daughter). There were also children who believed they were not good or were unsure about their mathematical competence, but even so, they wanted to be engineers and accountants (see Yuran, Ezdine, and Ernesto). This suggests that these parents and children did not relate mathematics to the occupations they are interested in. Professor Trevor Gale (personal communication, November, 01, 2012) from Deakin University in Australia indicated that aspirations involve two capabilities: 'doing' and 'being'. According to him, useful aspirations require that what one is willing to be (being) is mapped with knowledge of what the person needs to do (doing) to make the aspiration become reality. The view from Professor Gale has implications for the Mozambican children who participated in this study. That is, if the children (and their parents) do not make associations between the

occupations that they are interest in with mathematical knowledge that they should have, their occupational aspirations will not become reality.

Using a similar classification as that proposed by Dunteman et al. (1979), all occupations mentioned in Table 6.8 were classified in terms of people-oriented jobs [*P*] and ‘things-oriented’ jobs [*T*]: Physician, teacher, nurse, lawyer, and police officer were classified as *P* jobs because they are concerned with social interaction and helping other people. On the other hand, engineer, economist, accountant, agronomist, scientist, and architect were classified as *T* jobs because their central activity is manipulating things or objects of the physical world such as money, goods, and materials. The data were then examined to determine whether parents were more likely to aspire for *P* jobs for their daughters than for their sons, and for *T* jobs for their sons than for their daughters; the data were also examined to determine whether fathers were more likely than mothers to choose a *T* or a *P* job for their children or otherwise. This analysis was carried out to compare with previous research that indicates that females tend to engage in *P* jobs and males in *T* jobs (Dunteman et al., 1979; Su et al., 2009).

Of the five parents interviewed on behalf of girls, two (Albano: Father; and Cláudia: Sister) aspired for their children to engage in *P* jobs and three (Nené: Mother; Manassa: Mother; and Isaura: Mother) to engage in *T* jobs. Of the five parents who represented their sons, four (Gimo: Male, Manuel: Male, Matias: Male, and Nené: Female) wanted their children to engage in *T* jobs. However, mothers were more likely than fathers to choose a *T* job for their children. Thus, the ‘*P-T*’ jobs orientation bias was evident among the children and parents of boys, but this was not true for mothers. As shown in Table 6.8, four of the five girls aspired for *P* jobs and four of the five boys aspired for *T* jobs. Also four parents of boys wanted their sons to engage in *T* Jobs. Thus, the claim that boys tend to choose *T*-oriented occupations and girls tend to choose



*P*-oriented jobs was obvious in the data but the responses of mothers did not follow this pattern.

The majority of parents (Albano: Father of daughter, Gimo: Father of son, Manassa: Mother of daughter, Mário: Uncle of boy, and Paulina: Mother of son; N=5) selected occupations for their children based on perceived talent of the child or inclination to perform the job successfully. The second most mentioned reason (Cláudia: Sister of girl, Isaura: Mother of daughter, Matias: Father of son, and Nené: Mother of daughter; N=4) was utility of the occupation for the child: the perception that the occupation will give the child opportunities to learn new things such as computers, and to have money to help family. Similar to the survey data, the jobs of family members also influenced parents' occupational aspirations for their children. The following extract of the interview conducted with Manuel (Father of son, Secondary, Urban) shows how past and present family jobs may influence parents' occupational aspirations for their children:

Researcher: Which profession would you like your son to have when he is grown up?

Manuel: The field that I have initiated.

Researcher: Which field is that?

Manuel: Agronomy.

Researcher: Why?

Manuel: I pray every day that he continues the field that I initiated, but as he does not obey me, and he does not listen to me, he can do anything that he likes.

Researcher: What do you mean?

Manuel: I am saying that he can do anything that he thinks is important for him, but personally I would like him to continue the profession that I have commenced.

Researcher: Agronomy?

Manuel: Yes.

Researcher: Why are you interested in agronomy for him?

Manuel: It would be good to continue the profession I started but he can continue the field at university. In my time it was not possible to do agronomy at university but now it is possible.

This interview extract shows that parents' occupational aspirations for their children may be influenced by the need to retain jobs of family members such as parents, grandparents, uncle, and aunt. The next extract of interview conducted with Cláudia shows that the lack of some valuable jobs in the family can also motivate parents' occupational aspirations for their children.

Researcher: Which profession do you aspire for your sister?.

Cláudia: Physician.

Researcher: Why?

Cláudia: To diversify professions in our family. Physicians are very important and unfortunately we never had a physician or even a nurse in our family.

Researcher: What is the most common profession in your family?

Cláudia: Teachers; the majority are teachers. My mother is a teacher. My aunt and my two brothers are teachers. That is why I say we need to diversify occupations.

Researcher: Do you usually discuss with your sister about job prospects?

Cláudia: No! She is very young and she is still studying. Maybe after completing secondary education we can start talking about that issue.

Cláudia's sister (Josefina) wanted to be a teacher in the future. This is probably because the majority of Josefina's family members are teachers, and thus she wants to become a teacher like them. It would appear that Josefina is not aware that her sister aspires for her to be a physician in the future.

## **Attitude towards influencing child's career choice**

To explore parents' views as to whether they believed they should or should not influence their children's career selections, qualitative data were collected using the following interview questions:

- Do you think parents should influence their children's career choices? (6.3)
- Why do you think so? (6.4)

Of the ten parents interviewed in this study, six (Gimo: Male; Matias: Male; Manuel: Male; Albano: Male; Cláudia: Female; and Nené: Female; 2 female and 4 male) were favourable towards influencing the child's career choices, and four (Mário: Male; Manassa: Female; Paulina: Female; and Isaura: Female; 3 female and 1 male) were against. Parents who were in favour said:

I think parents have to suggest occupations for their children because they have a better vision about things due to their life experience. If the child does not accept the vision of the parent, then if anything goes wrong with the child, the child has no right to blame the parent. (Gimo: Father of son, Secondary, Urban)

Yes, parents should have some kind of a role because children nowadays can be easily deceived by the luxurious things they see on the internet and television. Parents have more life experience, they have gone through all these things, but the children also do not listen to anyone. (Matias: Father of son, Secondary, Urban)

Parents should orient what the child has to do including to continue what the parents have dreamed about and were not able to fulfil themselves; parents have rights as parents. (Manuel: Father of son, Secondary, Urban)

Any parent has a dream with respect to the child, but the dreams never come true because the child does not obey what parents want or say. (Albano: Father, Secondary, Rural)

Parents should influence their children's occupational prospects because most children are deceived by the things they see on the screen; they don't distinguish between fantasy and reality. Parents are always right because they passed through the same experiences in their lives and made many mistakes that they regret today and should not allow their children to make the same mistakes. As I am saying, I am now a domestic hairdresser because I abandoned schooling at the age of 16 because I was pregnant. At the time I disobeyed my parents and I am now paying a very hard price for that. So, if I do not do anything to safeguard my daughter, like monitoring her every day, she might end up being a hairdresser like me. She is good at hairdressing but what is the profit of being a hairdresser? That is why I do everything for her despite having financial difficulties. I try to do my best. (Nené: Mother of daughter, Secondary, Urban)

Parents should influence their children but not in terms of obligation. Parents should propose several possible occupations for the child and indicate the advantages and disadvantages of having those occupations nowadays. (Cláudia: Sister of girl, University, Urban)

In summary, the responses of parents indicated that those who favoured impelling a child's career choices were influenced by their perceptions that parents are more experienced than the children (Cláudia: Female, Nené: Female, Matias: Male, and Gimo: Male; N=4), and parents have rights in regard to their children (Albano: Male, Manuel: Male; N=2). Nené (Mother of daughter) and Matias (Father of son) believed it is necessary to guide the child to avoid the negative influences of the internet and TV programs.

The four parents (Mário: Uncle of boy, Manassa: Mother of daughter, Paulina: Mother of son, and Isaura: Mother of daughter) who were against influencing a child's career choices provided the following reasons:

I don't think parents should do that because if I do that, I am cutting my daughter's dreams. She is a person, and, as a person she has started to develop her

own dreams including those related to jobs. I cannot interfere in her dreams because she has rights as a person. (Isaura: Mother of daughter, University, Urban)

It is not good to influence because maybe the job that you want the child doesn't want; also, the danger is that if the child does not accomplish the job you proposed, the child will always blame you. It is like to arrange a husband for your daughter or a wife for your son. (Mário: Uncle of boy, University, Urban)

If she selects something that she thinks she is inclined to, we should let her go for it because she has the right to choose. (Manassa: Mother of daughter, Secondary, Urban)

It is not good to interfere because a child is also a person; the children should do whatever they like and want to do. (Paulina: Mother of son, Primary, Remote)

All four parents who disagreed about influencing the child's career choices alleged that the child has rights to do whatever he or she likes and wants to try. More mothers (3) than fathers (1) believed parents should not influence children's career choices. In contrast, more fathers (4) than mothers (2) believed parents should have an influence. In Mozambican society, fathers and uncles have traditionally assumed the role of decision makers on issues involving their children such as education, participation in rituals, and marriage. Thus, the differences in perceptions between mothers and fathers in regard to impelling a child's career choices may reflect the differential gender roles in Mozambican society. The data also suggest that some mothers may no longer hold the view that fathers have the role of deciding what the child should do. This is likely to be influenced by current times, as the number of women engaged and willing to engage in activities traditionally dominated by males is increasing.

## **Parents' involvement in the education of their children**

Parental Involvement in Education [PIE] is usually examined using three dimensions: home-based involvement, school-based involvement, and home-school communications (Manz et al., 2004). Several aspects of these dimensions were explored quantitatively in this study and the results were presented in Chapter 5. Using mean PIE scores equal or close to the mid-point 2.5 of a 4-point Likert scale to represent moderate parental involvement in education, the survey results showed that the average PIE was moderate (mean=2.40). However, there were activities that parents reported to have conducted often (e.g., attending school meetings), but most activities were rarely conducted. Thus, to gain a better understanding of some of the aspects influencing PIE, during interviews parents were asked the following questions:

- Do you usually tell your child how good you are at mathematics? (1.7)
- Do you usually help your child to understand homework? (7.1)
- (If not) Why? (7.2)
- Are you satisfied with your child's school progress? (7.3)
- Why? (7.4)

Eight parents never told their children how good they are at mathematics. Two parents (Mothers – Nené: Mother of daughter, and Paulina: Mother of son) usually tell their children that they do not understand the current mathematics taught in schools when the child asks for help. For example, Paulina said:

He always asks me to explain something but there are many things from the textbooks that I also don't know. I always tell him that in my time we did not study these things. Things have changed a lot. Now they study mathematics but we studied arithmetic. Mathematics was studied in secondary schools. It is very

complicated for me to help my child because things are not the same. (Paulina: Mother of boy, Primary, Remote)

Another mother said:

The kind of mathematics that children study today is harder than what we studied. Well, I never said that to her, but I tell her to try hard, but she always says: 'Mum! Mathematics is too difficult', and asks me for help, and I tell her: 'What you are showing me I don't know how to solve', and she keeps trying and trying. (Nené: Mother, Secondary, Urban)

In regard to homework, eight parents indicated they never help their children.

Two parents (Mothers: Paulina and Isaura) said they usually do. The eight parents who did not help their children provided the following justifications:

I am a busy person. But he has his older siblings who can help him in case of necessity. (Gimo: Father of son, Secondary, Urban)

He does not live with me, and I also study. I have no time. (Mário: Uncle of boy, University, Urban)

He has many brothers and sisters who can help him in case of necessity. (Matias: Father of son, Secondary, Urban)

There are many children in my home. They help each other. (Manuel: Father of son, Secondary, Urban)

When she has problems the siblings are there. (Albano: Father of daughter, Secondary, Rural)

To be honest, I rarely help her because the things they study these days are very complicated. They introduced many subjects that I have never studied, such as English, and Visual and technology education. I know nothing about these subjects, and mathematics has become much more complex than it was. (Nené: Mother of daughter, Secondary, Urban)

I hired someone to teach her after classes because when she arrived last year she could not even write her own name. (Cláudia: Sister of girl, University, Urban)

I am not better than her. As I said, she is much like her father; she is very dedicated and likes things involving numbers. (Manassa: Mother of daughter, Secondary, Urban)

In summary, most parents rarely speak about their past experiences in mathematics to their children, and rarely help them to understand homework. Although there were only two parents (both females) who admitted having difficulties in understanding the current mathematics curriculum, it is possible that many parents have the same problem and, thus, they rely on the child's older siblings to help, if the child has them. The other reason preventing parents from engaging in education is time constraints due to other priorities.

Parents were also asked whether they were satisfied with their children's school progress or not and why. Only two parents (Fathers of boys: Gimo and Matias) were not satisfied and their reasons were related to the child's attitude towards school (lack of interest and effort). The eight parents who reported being satisfied with their children's school progress said:

I am satisfied because he has started to demonstrate skills in languages. (Mário: Uncle of boy, University, Urban);

My daughter never failed since she started school, and thus at the age of 13 she is in Grade 7; she is promising. Most girls at that age have abandoned the school or are pregnant (Isaura: Mother of daughter, University, Urban)

I am happy because she is doing very well. One day she will get there (Albano: Father of daughter, Secondary, Rural)

Yes, I can say I am satisfied because he is persisting and little by little I hope he will get there (Manuel: Father of son, Secondary, Urban)



I am satisfied because he is doing well in most subjects. He only has problems with mathematics (Paulina: Mother of son, Primary, Remote)

I am satisfied because she gets good scores, and she is still young to ensure that she will get a place in the secondary school next year. Her behaviour is very good; although she does lots of housework and hairdressing she still finds time to sit and review her school work. It is not easy for her but she understands my situation (Nené: Mother of daughter, Secondary, Urban)

This year I am noticing some improvements. Her confidence seems to have improved and she has more classmates to study with than last year. (Cláudia: Sister of girl, University, Urban)

I am satisfied because she gets good scores and has no distractions. Her older sister was more interested in boys than she is. This one is very interested in education. (Manassa: Mother of daughter, Secondary, Urban)

In summary, the data show that parents' dissatisfaction with their children's school progress was mostly due to perceived lack of interest in education, and disciplinary problems. On the other hand, satisfaction was due to either good scores or persistence at school. Some mothers (e.g., Isaura) were proud of their daughters particularly because they are persisting in school while most other girls of the same age have dropped out due to pregnancy or other social and economic constraints in their families.

To examine whether telling the child how good the parent is at mathematics, helping the child to understand homework, and satisfaction with child's school progress influences children's perceived achievement in mathematics [PAM], the responses of both parents and children are presented in Table 6.9.

Table 6.9

*Influence of Parental Involvement in Education [PIE] and Child's Perceived Achievement in Mathematics [PAM]*

| Parent          |  |                                      |   | Child           |                                       |              |
|-----------------|--|--------------------------------------|---|-----------------|---------------------------------------|--------------|
| Name and gender | Usually tell my child how good I am at mathematics | Help my child to understand homework | Satisfied with my child's school progress | Name and gender | How good are you at mathematics (PAM) | Geo location |
| Albano: M       | No   | No                                   | Yes                                       | Zinha: F        | 4                                     | Rural        |
| Cláudia: F      | No   | No                                   | Yes                                       | Josefina: F     | 1                                     | Urban        |
| Gimo: M         | No   | No                                   | No  | Ernesto: M      | 3                                     | Urban        |
| Isaura: F       | No   | Yes                                  | Yes                                       | Nádia: F        | 1                                     | Urban        |
| Manassa: F      | No   | No                                   | Yes                                       | Elisa: F        | 1                                     | Urban        |
| Manuel: M       | No   | No                                   | Yes                                       | Ivo: M          | 4                                     | Urban        |
| Mário: M        | No   | No                                   | Yes                                       | Ezdine: M       | 1                                     | Urban        |
| Matias: M       | No   | No                                   | No  | João: M         | 4                                     | Urban        |
| Nené: F         | Yes  | No                                   | Yes                                       | Amanda: F       | 3                                     | Urban        |
| Paulina: F      | Yes  | Yes                                  | Yes                                       | Yuran: M        | 3                                     | Remote       |

Note. PAM = Perceived Achievement in Mathematics:

Response format: 1 (Weak); 2 (Below average); 3 (Average); 4 (Good); 5 (Excellent);

The results in Table 6.9 show that children with the highest PAM score (4) (Zinha, Ivo, and João) were not helped by their parents to understand homework; also, their parents did not tell them about their own mathematical competence. This does not mean that these children were not helped with homework at all, as most parents indicated that they rely on the assistance of older siblings if the child has them.

The children of mothers (Paulina, and Nené) who revealed having difficulties with mathematics were unsure about their achievement (Yuran: Boy; and Amanda: Girl). Interestingly, parents (Cláudia: Female, Isaura: Female, Manassa: Female, and Mário: Male; 3 females and 1 male) whose children had the lowest PAM score (1) were satisfied with the school progress of their children. This may be because in Mozambique many school-aged children leave school early due to several factors such as economic constraints, family duties, and a school system that is not responsive to the increase in the numbers of students in terms of new schools, classrooms, furniture, and teachers (see Passos et al., 2012). As indicated in Chapter 1, the policy of automatic transitions from one grade to another in primary schools, the transformation of lower primary schools (Grade 1 through 5) into complete primary schools (Grade 1 through 7), and the growth in the population of primary school children in Mozambique has resulted in the deterioration of school conditions.

### **Parents' views about gender equity in rights and duties in Mozambique**

To explore more deeply parents' gender stereotyped views, the following prompt was prepared and presented to them:

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“The independence against the Portuguese, and the multiparty system brought more equality in opportunities between women and men in Mozambique”.

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- Do you agree that men and women should have equal rights and duties in our country?
- Why do you think so?

After they read the prompt, parents were asked whether they agree that men and women should have equal rights and duties in Mozambique and why. All parents agreed that men and women should have equal rights and duties but the reasons they provided differed. The reasons they mentioned were:

They [females] can contribute to the development of the country. They can get a good job and help their family (Gimo: Father of son, Secondary, Urban)

Gender equity brings development to a country because both men and women contribute something. (Mário: Uncle of boy, University, Urban)

To discriminate against people is not good because it leads to all kinds of social and economic inequalities. (Isaura: Mother of daughter, University, Urban)

To discriminate is just unfair and there is no reason to do that. (Matias: Father of son, Secondary, Urban)

To discriminate is injustice and injustice is not a good thing. (Manuel: Father of son, Secondary, Urban)

Gender equity ensures that families are happy and live in harmony. (Albano: Father of daughter, Secondary, Rural)

There is no reason to discriminate. Women are also human beings. (Paulina: Mother of son, Primary, Remote)

I support this idea because if a women studies she has the right to be in a leadership position. You are not going to put an uneducated man in a leadership position just because he is a man. That would be unfair and no one would accept that. Nowadays everything that men do women can also do as long as they have education; it is not like the time our ancestors lived. (Nené: Mother of daughter, Secondary, Urban)

I believe that we are all equal, and being equal, why should rights and duties differ? Having equal rights and obligations gives equal access to education, employment, and to take your children in case of divorce. (Cláudia: Sister of girl, University, Urban)

For a woman it is an advantage because the life status of women compared to men was low in the past. Now, with a non-discriminatory policy, women are benefiting and that is important for society in general. (Manassa: Mother of daughter, Secondary, Urban)

As can be seen from the responses presented above, parents defended gender equity in rights and duties using a variety of perspectives. They believed gender equity ensures fairness in society (Cláudia: Female, Nené: Female, Paulina: Female, Manuel: Male, and Matias: Male; 3 female and 2 male), social and family stability (Albano: Male), and economic development (Manassa: Female, Isaura: Female, and Mário: Male; and Gimo: 2 female and 2 male).

In conclusion, the data suggested that parents support a non-gender discriminatory society. However, one parent (Gimo, Father of son, Secondary, Urban) believed there were possible consequences of gender equity on marriage. That is, husbands may lose their traditional role as decision-makers and owners of family assets. Gimo stated:

Gender equity is fine because it is written in our constitution but it involves consideration of cultural issues as well. Many women when they reach high positions in life they spoil their marriages. They start to despise their husbands. When they have money the first thing they do is buy a house without their husband's knowledge. There is much destruction of marriages in this country because of that aspect of gender equality. But, in other countries where people are considerate and educated enough there are no such problems. In such societies people keep their marriages progressing normally, and women do not lack respect for their husbands. (Gimo: Father of son, Secondary, Urban)

This comment indicates that probably some parents value gender equity in some aspects of life such as education but they may still support a patriarchal society – one where men are the decision-makers and have more privilege compared to females, particularly on issues involving family relations or ownership of assets such as a house, or a car. However, this study did not yield sufficient data to make this claim and future studies should explore this issue.

## **Parents' conceptions about mathematics**

At the end of the interview parents were asked what mathematics is all about. The underlying assumption of this question was that the parents' views of what mathematics is might influence the way they assist their children to understand homework, and the value they attribute to this subject for their offspring. All parents understood that the question required them to define 'mathematics'. The definitions/characterisations they provided were:

Mathematics is about rules and procedures that when well understood and followed carefully, they improve reasoning skills and memory. (Gimo: Father of son, Secondary, Urban)

Hum... mathematics is an exact and precise science because in mathematics you cannot say 'it looks like x', you must say 'this is x'; only people from social sciences say 'this seems x' but mathematicians are not permitted to doubt or to make judgements. (Mário: Uncle of boy, University, Urban)

I think mathematics is a science that helps us to solve a variety of problems. It is a problem solving tool. That is all that I can say at this time. An exact definition of mathematics I do not remember. I forgot it. (Isaura: Mother of daughter, University, Urban)

Mathematics is a science that when well applied develops memory. Mathematics and intelligence refer to the same thing. Mathematics is a term used to describe intelligent people. (Manuel: Father of son, Secondary, Urban)

Mathematics is a basic discipline of consciousness. It dominates all ideas and answers every question because it is performed meticulously. It does not accept lies or abuse. (Albano: Father of daughter, Secondary, Rural)

Mathematics ... mathematics is a basic subject that teaches us to count and to make calculations. (Paulina: Mother of son, Primary, Remote)

Mathematics is a basic subject that deals with calculations. (Nené: Mother of daughter, Secondary, Urban)

I only remember that the definition of mathematics contains the word ‘basic’ and the word ‘exact’. I don’t remember how it was defined. (Cláudia: Sister of girl, University, Urban)

Mathematics is a language that is understood everywhere in the world. Mathematics is also related to other subjects such as physics and chemistry. (Manassa: Mother of daughter, Secondary, Urban)

To analyse the parents’ responses, the early work by Buxton (1981) was of immense help. As described in Chapter 2 of this thesis, Buxton identified two groups of views about the nature of mathematics typically held by adults. One group of views reflects the traditional perception that mathematics is a stable subject mainly consisting of rules and algorithms to be memorised and applied in an uncreative manner. The other group of views reflects the contemporary conception that mathematics is an exploratory and dynamic field that allows and encourages learners to be creative. The responses of parents tended to support the former view. That is, mathematics was generally viewed as:

- A collection of facts, rules, and procedures (N=1; Gimo: Male);
- An exact and precise science (N=2; Mário: Male; Cláudia: Female);
- A science of counting and calculating (N=2; Paulina: Female, Nené: Female);
- A science of intelligence, memory, and reasoning (N=3; Gimo: Male, Manuel: Male, Albano: Male);

Two mothers of daughters (Isaura, and Manassa), however, viewed mathematics as a worldwide language, a subject related to other subjects, and a problem solving tool. These views are closely related to the contemporary views about mathematics described

by Buxton (1981). Similar views are also promoted by the mathematics curriculum for primary education in Mozambique as described in Chapter 1 (see Ministério de Educação, 2008b).

In summary, the majority of parents interviewed held the traditional views that mathematics mainly comprises knowledge of facts, rules, algorithms, and the ability to memorise and follow them. However, there were two parents (both females) who held the belief more aligned with the contemporary view that mathematics is a problem solving tool, universal language, and a subject that assists understanding and interpreting other fields. The conceptions of parents about mathematics and mathematics learning identified in this study may explain why most respondents disagreed with the current teaching methods used in schools. Parents' views about the subject may also explain why they avoid or are unable to help their children to understand mathematics homework.

In this section, the interview data from parents were presented and compared with their responses to the surveys, and with the responses of their children when appropriate. In the next section the results of interviews conducted with five school principals are outlined.



## **Results of Interviews: School Principals**

In this section the results of interviews conducted with five school principals are presented in regard to five issues: (i) work experience; (ii) views about girls' and boys' performances; (iii) views about the School Parents' committee [SP]; (iv) views about the Gender Issues committee [GI]; and (v) views about parental involvement in education. The views of the school principals were collected for two reasons: First, because they were the principals from the participating schools. Second, as principals, it was assumed that they are aware of the main problems involving children's learning and parental involvement in education. Third, due to their position in the school, the views of the principals may facilitate or prevent the quality of education.

To ensure validity of the responses, prior to interviews, the principals were assured that the purpose of the study was merely academic, and that no organisation other than Monash University in Australia would have access to the data. Also, trust and rapport between the principals and the researcher were built during a period of three months preceding the interviews. The interviews were conducted and audio-recorded only after the principals expressed consent and interest in speaking about their schools. The data from the principals are presented starting with their work experience as principals.

### **Principals' work experience**

First, the principals were asked how long they had worked as principals of the participating schools and whether they had assumed a similar responsibility in another school. The average number of years of work experience as principal was 10.5, and four of the five principals had university education or were still studying at university. In terms of education/training, the sample may not be a good representation of primary

school principals in Mozambique. The majority of primary school teachers in Sofala Province, although teaching for more than a decade, only have primary or secondary education, and the average number of years of teacher training is less than 2 years (Passos et al., 2005). Thus, the responses of the principals interviewed may not reflect the views of the majority of primary school principals in Mozambique but they were the principals of the participating schools.

### **Principals' views about girls' and boys' performances**

Before introducing any question related to gender, the principals were asked to describe the children's achievement as a whole, and to indicate whether they were satisfied with the outcomes or not. At this stage of the interview no principal suggested the existence of a gender-related problem in their schools. The principals were generally happy with the school outcomes, and dissatisfaction was reported only in relation to parents who do not attend school meetings and due to the lack of chairs for pupils and teachers.

When asked explicitly whether there were any school subject areas for which girls or boys performed better than the opposite gender, the principals replied:

Although we are making the necessary effort to overcome that problem, and we think are moving forward, the traditional preconception that boys know more than girls still persists in our community, and these preconceptions are having visible consequences in our school. But the difference is not that large. I mean we still note that the boys are having relatively higher scores. This is the case for mathematics and natural sciences; the trend is to have boys more engaged than girls, but when the discipline is Portuguese, girls outperform boys. This problem is caused by misconceptions that exist; when girls look at boys they think boys are superior or that they know a lot; this self-perception ends up influencing girls' capacity and performance. (Rotafina: Female, Urban)

At this time I do not see any subject that girls are weaker in than boys. On the contrary, in some classrooms there are more girls than boys in terms of participation. (Pedro: Male, Urban)

There is no difference; all students face the same difficulties; in some classrooms there are no chairs, and both the girls and the boys sit on the floor. No person is given priority. If you come late to the class you find no chair to sit on and no one will give up a chair for you. (Alberto: Male, Urban)

We haven't conducted any study to investigate that issue. The only thing that we know is that when the exam in a particular subject is too difficult, it tends to be too difficult for everyone, girls and boys. No one escapes. No student will say the exam went well for me. But, in general terms, we think that the majority of girls have lower achievement than the majority of boys but we did not investigate to know that. (Mucauro: Male, Rural)

Girls are better than boys in all subjects with the exception of mathematics. Mathematics is the only subject in which boys outperform girls. The reason for this is because girls do not like to investigate. Boys investigate and girls do not. How can someone succeed in mathematics without investigating? In my opinion that is the main problem. (Angélica: Female, Remote)

As can be seen from the responses presented above, only the female principals believed there were gender differences in mathematics favouring boys and in Portuguese favouring girls in their schools. Male principals did not report gender differences in learning of any subject in their schools. The two female principals believed girls did not perform well in mathematics due to the lack of effort and persistence in the study of the subject and because of gender stereotyping of mathematics as a male domain.

## **Principals' views about the School Parents' Committee [SP]**

According to the school principals, the SP is made up of some mothers and fathers who are elected by other parents at the beginning of each academic year. When the principals were asked about the role of the SP in their schools they replied:

The role of the school parents' committee is suggesting and controlling the school activities. The parents elected to be part of the SP come to school regularly to get information about problems. (Rotafina: Female, University, Urban);

The task of the committee of parents is linking the school and the community. (Pedro: Male, Secondary, Urban)

In our school the committee of parents helps us to solve problems associated with the school, students, and teachers. For example, the committee helps us to persuade other parents to pay the school guard and to fix school roofs. If you know how to work with the school parents' committee you can find solutions for many problems that you may have in your school. But, the members of the committee become upset very easily if you don't give them the decision power. They like to be valued and to be given autonomy in the solution of problems. In this zone I think I am one of the most successful principals in terms of working with a School Parents' committee; most of my colleagues in other schools have lots of trouble with their SPs. (Alfredo: Male, University, Urban)

The task of the committee of parents is questioning the way we manage and administer the school. The committee also helps us in case of problems. We have many problems here, and I think you saw that all children sit on the floor and the teachers stand up the whole lesson. It is because all chairs and desks were stolen during the school break. (Mucauro: Male, University, Rural)

The role of the committee of parents is monitoring our work. (Angélica: Female, University, Remote)

In general the school principals reported being satisfied with their SP. The tasks of the SP were: suggesting activities to schools, controlling school activities, helping to

solve school problems, persuading other parents to pay the school guard and to fix school roofs and chairs, and visiting the class to get information about problems.

The principals were also asked about the role of the Gender Issues committee (GI) in their schools and their responses are presented next.

### **Principals' views about the Gender Issues Committee [GI]**

In Mozambique, the recently created *Ministério para os Assuntos da Mulher e Acção Social* [MMAS] or the Ministry of Women's Affairs and Social Welfare made compulsory the establishment of GIs – special committees dealing with gender disparities, gender equity, and protection of children with disabilities and from vulnerable groups – at the Ministry of Education, Provincial Directorates of Education, and schools (Passos et al., 2012). In conformity with the mission of MMAS, each participating school had established a GI locally designated *Unidade de Género*. The GIs were composed of two to three experienced mothers and one female teacher. No school principal explained why there were no fathers or male teachers in these committees. In rural and remote schools, groups of HIV-AIDS activists worked together with the GI committees. When asked to explain the activities of the GI in their schools, the principals replied:

The GI serves as a parent or a guardian for homeless children. We have many homeless children in our school this year. (Rotafina: Female, University, Urban)

The mission of the GI is monitoring the behaviours of both the boys and the girls. One of its tasks is identifying students with bad conduct. It also deals with harassment and pregnancy problems. (Pedro: Male, Secondary, Urban)

Our committee for gender issues is made up of three ladies. The task of these ladies is persuading girls aged above 13 to study hard and to avoid pregnancy. I

am very satisfied with the work of these ladies because we have more girls than boys in the school lately. (Alfredo: Male, University, Urban)

The committee responsible for gender issues was established here to ensure that girls also assume leadership responsibilities in the school and in their classrooms. It also educates girls in order to avoid dropouts and premature pregnancies. (Mucauro: Male, University, Rural)

The role of the committee of gender issues is sensitising girls to understand that education is important in their lives and for society in general. (Angélica: Female, University, Remote)

In summary, the main activities of the Gender Issues committees are to serve as a parent or guardian of vulnerable and homeless children, monitoring girls' and boys' behaviours, solving harassment and pregnancy problems, persuading girls to persist in school, and ensuring that girls participate in the decision-making process in their classrooms and schools. These roles are consistent with the mission of MMAS which is ensuring equal access to education for all children, irrespective of their gender or socioeconomic condition (Ministério para os Assuntos da Mulher e Acção Social, 2012).

As can be seen, the mission of MMAS and the activities carried out by GIs in schools have focused mainly on ensuring equal educational opportunities for all children in terms of enrolment and provision of learning materials. However, the other important dimension of equity in education – equity with respect to 'equal educational outcomes' (Fennema, 1990) is not stressed and no specific activities aimed at achieving this goal appear to be conducted. Fennema indicated that equal educational outcomes is the dimension of equity in education that will produce true equity, and there is now evidence that equal access to education, although important as a starting point, does not resolve the problem by itself (UNESCO, 2012).

Finally, it should be noted that in Mozambican schools, both the SP and the GI committees were established in order to solve context specific problems related to education of girls, boys, and children with disabilities or whose parents passed away due to HIV-AIDS. Thus, it is possible that similar committees do not exist in the western or other countries that do not have these problems.

The information obtained about the SP and GI is relevant to this study because it allowed identifying potential sources existing in the schools that can help plan and implement intervention activities aimed at improving the quality of learning for girls and boys in the future.

### **Principals' views about parents' involvement in education**

To examine the school principals' views about parental involvement in education [PIE], they were asked to describe the parents that the schools serve, and to indicate any characteristics of the parents that hinder or facilitate children's learning. The specific research questions that were asked are:

- How can you describe the parents that the school serves? (5.2)
- Are there any characteristics of the parents that seem to prevent children's learning? (5.3).
- If yes, could you indicate some aspects? (5.4)
- Are there any characteristics of the parents that seem to facilitate children's learning? (5.5)
- If yes, could you indicate some aspects? (5.6)

The responses of the school principals are presented in three subsections:

### **How can you describe the parents that the school serves?**

The five principals described the parents that the schools serve in the following ways:

Because of the location of this school one half of the parents are strongly motivated, and are involved in the education of their children. The other half is very disappointing. There are many parents who never come to school. They send their domestic employees to attend our meetings on their behalf, and they do not care about the school progress of their own children. We honestly don't know who they are and which problems they have. But we try to understand and tolerate all the problems with the expectation that one day they will realise that education for their children is important. We don't know exactly whether they lack interest, or whether they have serious economic and social constraints that prevent them from approaching the school when they are needed. (Rotafina: Female, University, Urban)

Parents and guardians always share the life of the school with us, and they are always ready and available to understand that the school belongs to them. (Pedro: Male, University, Urban)

Our relations with parents are positive and open. We have open parents and guardians because everything they consider wrong they tell us explicitly. They do not gossip and complain outside school; they discuss with us openly because we give them the opportunity to do so. I am sure that parents from this school are more open than the parents I served in previous schools. Despite their level of education being low, they easily understand our demands and that is very encouraging to us. (Alfredo: Male, University, Urban)

The teachers complain all the time. They say that parents never come to school when asked. (Mucauro: Male, University, Rural)

They are good parents. They do care about the education of their children because they attend our school meetings regularly. (Angélica: Female, University, Remote)



In summary, three principals (Pedro: Male, Urban; Alfredo: Male, Urban; Angélica: Female, Remote) were satisfied with the level of parents' involvement in education and two were not (Rotafina: Female, Urban; Mucauro: Male, Rural). Principals' satisfaction or dissatisfaction with parents was generally related to participation in school meetings. Rotafina did not know why most parents do not participate in school meetings. As a principal, Rotafina should know and be able to describe the kind of problems that parents who do not participate in school meetings have. This information would be important when planning intervention programs aimed at supporting targeted parents.

**Are there any characteristics of the parents that seem to prevent children's learning?**

**If yes, could you indicate some aspects?**

After the principals described the parents they were asked explicitly whether there were any aspects of the parents that hindered children's learning. The principals replied:

Yes, there are. In my view the child's learning does not depend only on the school and teachers. The child's learning is a responsibility of both of us, the school and the parents. But, in this school most parents are not engaged in the education of their children. I am not saying that the children are not learning anything, they are learning, but there are many learning gaps because there is no parental control. As parents do not help us, the only remedy that we use is redoubling our efforts and our limited resources. If parents were here with us all the time I believe something positive could be done. (Rotafina: Female, University, Urban)

As I said before, there is a good relationship between parents and teachers in this school. There are no difficulties that prevent the educational progress of the

children. On the contrary, when the children receive homework, the parents themselves help their children. (Pedro: Male, University, Urban)

There are parents who behave like they have psychological problems. Many parents mix politics with education. For example, when our teachers are teaching social sciences they tell the story of our country as it is written in the textbooks. They may talk about the history of our country, national heroes, and former movements for liberation, independence, and things like that. They say things in the way they appear in the official curricula. Some parents do not agree that these things happened in this way, and they want their children to learn according to their interpretation of events which are also the perspectives that are supported by their political parties. But, we, as a school, we have our internal regulations that are based on official curricula. For example, before the start of classes all children must sing the national anthem, but it happens that some parents don't want their children to sing the anthem due to political animosities. We are very concerned that we have many parents who associate our school activities with political parties and prohibit their children from attending our educational activities. I think these attitudes may have a direct or indirect influence on the quality of children's learning because parents are always disturbing the minds of their children. We know that the children belong to them, but there are also limits after which they should not interfere. If we tolerate this kind of things our school will no longer be a school; it will be a battlefield of political interests. (Alfredo: Male, University, Urban)

There are many children who come to this school without uniforms and without any school material such a pencil or a piece of paper. All the children are given textbooks at the beginning of each year but three months later most children have lost their textbooks or their textbooks have several missing pages. Parents do not help the children to maintain textbooks in good condition, maybe because they do not pay anything for them. Most parents in this community are very negligent. For me, according to my understanding, parents are blamed for some of the issues related to low quality of education. I say this because in this school we have two distinct groups of students. We have one group made up of brilliant students in all subjects, and we also have a group of underachievers who are unable to read and write their names. For me, these groups of students represent differential levels of

responsibility of parents in the education of their children. (Mucauro: Male, University, Rural)

Maybe there are some aspects of parents that prevent children's learning but it is difficult to know. At the moment I am not aware of them. (Angélica: Female, University, Remote)

As can be seen, when asked explicitly whether there were any characteristics of the parents that prevented children's learning, the principals mentioned the following aspects: Parents do not approach schools to get information (Rotafina: Female, Urban); parents try to influence what their children learn at school (Alfredo: Male, Urban); parents do not buy school uniforms and school material for their children (Mucauro: Male, Rural); and parents do not help their children to maintain textbooks in good condition (Mucauro: Male, Rural).

It was surprising that one school principal (Angélica: Female, Remote) said she was not aware of any characteristics of parents that may prevent children's learning because the data from this study shows clearly that there is a relationship between Grade 7 students' beliefs and attitudes towards mathematics learning and family circumstances. Thus, the response provided by Angélica may not be realistic because most parents who failed to complete surveys for their children were from rural and remote schools; the level of parental involvement in education in these regions was low as compared to urban schools probably due to language difficulties (Portuguese) or other social and economic constraints.

Another school principal (Pedro: Male, Urban) also said the relationship between parents and school was good and there were no problems preventing children's learning. This perception was not consistent with the physical conditions of the school. Although the school is located in an urban area, there were no chairs for children and teachers to

sit. All children were sitting on the floor and the teacher was standing during the whole class-time. There were no fences and members of the general public used the school yard as a short-cut to access the neighbourhood. This contrasted with the rural school where parents had purchased furniture for their children.

**Are there any characteristics of the parents that seem to facilitate children's learning?**

**If yes, could you indicate some aspects?**

In regard to positive aspects of parents that may contribute positively to children's learning the school principals provided the following comments:

There are also some positive aspects. For example, each class is assisted by one mother and one father. These parents regularly visit the class and the children become motivated when they see their parents at school. In doing so we believe the children will take more responsibility in their education because they know their parents are watching them. (Rotafina: Female, University, Urban)

Some parents help their children with homework, and maintain the child's textbook in good condition. (Pedro: Male, University, Urban)

There are some parents who take their children to extra-curricular tutorials after the school time. I know that some children have private coaches for every subject that we teach, and I know that some parents coach their children themselves. (Alfredo: Male, University, Urban)

We have the school council; when the school council meets, parents and guardians are invited. We resolve our school problems with the help of some parents. Parents also contribute financially to pay our school guard because the guard is not on government payroll. We find a school guard under our own initiative and parents need to pay the guard. We also thank parents for the acquisition of some furniture for children this year. Last year all children were sitting on the floor. Because of these actions I can say that parents are being useful to the school. (Mucauro: Male, University, Rural)

Parents help teachers, the school principal, and they talk to children. It is important when the children know that their parents communicate with the school. (Angélica: Female, University, Remote)

In summary, the positive characteristics of parents that were mentioned by the school principals were: Mothers and fathers visit the schools and classrooms and attend school meetings regularly (Angélica: Female, Rural; Rotafina: Female, Urban; Mucauro: Male, Rural ); parents pay the school guard and help the school to purchase chairs for children to sit (Mucauro: Male, Rural); parents tutor their own children or hire coaches to assist them (Alfredo: Male, Urban); parents help their children to maintain textbooks in good condition (Pedro: Male, Urban).

It should be noted that the responses of some school principals (Pedro, Alfredo) were inconsistent with the responses of most parents interviewed. For example, of the ten parents interviewed only two parents (mothers) reported to help their children with homework.

In regard to the aspects of parents that hinder children's learning the principals described five types of parents: (a) parents who do not attend schools meetings (Rotafina: Female, Urban); (b) parents who do not pay the school guard (Mucauro: Male, Rural; Alfredo: Male, Urban); (c) parents who do not buy the school uniforms and school materials for their children (1 Mucauro: Male, Rural ; (d) parents who do not help their children to maintain the textbooks in good condition (Mucauro: Male, Rural); and (e) parents who forbid their children to learn controversial issues (Alfredo: Male, Urban).

These results show that the school principals' views in regard to parental involvement in education varied from one school to another. Some principals (Pedro: Male, Urban; Angélica: Female, Remote) did not see any characteristics of the parents

that may hinder children's learning. The responses of these principals were inconsistent with previous studies that revealed that achievement in mathematics and reading in primary schools in Mozambique is declining rapidly (Makuwa, 2010). This is probably due to socially desirable response bias (Paulhus, 2002), or the principals do not have a correct account of the educational outcomes in their schools. However, one of the principals interviewed (Mucauro: Male, Rural) commented that there are two distinct groups of children in his school. One group composed of brilliant students in all subjects, and another group made up of children who cannot read or write their names. Mucauro also suggested that the differential levels of parental involvement in education may have originated the two groups of children. This claim deserves further research.

## **Summary of Results and Discussion**

In this chapter, parents' views in regard to mathematics learning for girls and boys were examined and compared with the responses of their children. The school principals' views were also examined and compared with the parents' views when appropriate. In the present section, the main findings are outlined and discussed starting with the views of parents.

### **Parents' views**

Of the ten parents interviewed in this study, only two reported to have liked, and to have been good at mathematics when they were school children. The majority of parents viewed mathematics as a very difficult subject for them and for their offspring. To illustrate, only one parent (mother) believed her child (daughter) enjoyed and was good at mathematics. In some cases the responses of parents were similar to those of their children. For example, three children of parents who viewed mathematics as difficult for their offspring rated themselves as weak at mathematics. However, there

were four parents who believed their children were not good at mathematics but the children rated their own achievement as average or good.

The perceptions of parents in regard to their children's achievement may have not been influenced by the gender of parent and/or child as there was only one parent out of 10 (mother) who believed her child (daughter) was good at mathematics. It is possible that parents do not gender stereotype mathematics achievement because they view mathematics as a very difficult subject for everyone. However, of the ten pupils whose parents were interviewed, there were more girls than boys who rated themselves as weak at mathematics.

Eighth of the ten parents interviewed did not help their children to understand mathematics homework. They also did not communicate their mathematical competence to their children. There was evidence that most parents are not comfortable with the subject. Two parents (females) believed there are substantial innovations in the mathematics curriculum that they do not understand, and thus they cannot assist their children.

Interestingly, the reasons parents attributed to their failures in mathematics were not the same as those they attributed to their children's failure. For example, while parents believed their mathematics teachers were very good at explaining the subject, they believed their children's poor achievement was caused by their mathematics teachers who are not good at teaching the subject. This suggests that some parents believed their children did not understand mathematics because of the teacher (external, unstable factor). However, despite having had a "good teacher" themselves, most parents did not enjoy and did not understand mathematics. There were parents who mentioned children's attitudes towards schooling (e.g., lack of motivation to study) and

curriculum (e.g., textbooks that do not explain mathematics clearly), and negative impact of the automatic promotions adopted in primary schools, and entertainment (e.g., TV programs).

Using the four attribution categories proposed by Weiner (1974) (i.e., effort, ability, environment, and task difficulty) the interview data revealed that parents tended to believe they were not good at mathematics due to *internal* factors (e.g., lack of inclination of giftedness, or lack of ability to understand numbers). But in regard to their children they tended to believe poor achievement was caused by *external* factors such as teachers who do not emphasise memorising and practice, and the curriculum (quality of the content taught, and the fact that children are promoted from one grade to another).

It should be noted that attribution of failure to external forces (e.g., teacher, textbooks, and assessments) may be detrimental to the learning process because the learner has no control over them. Meyer and Koehler (1990) reiterated that failures in mathematics should be attributed to internal and controllable traits such as lack of effort because, depending on the level of the person's motivation, effort can be increased until success is achieved.

As indicated earlier, all parents interviewed believed changes in mathematics teaching and learning have occurred in several areas since they were at school. Notably, only one parent (sister of a girl) believed these changes were positive whereas the other respondents believed they were negative. Parents disagreed with the current teaching methods used in schools in which the teachers encourage children to solve the problems by themselves. They also disagreed with the automatic transitions from one grade to another and with the mathematical content taught in schools. Some parents believed



changes have occurred that contribute to their children's poor performance in mathematics but they had a shallow idea about the nature of the change and were unable to explain the reasons for the changes.

The comments of most parents in regard to the current status of mathematics education in primary schools in Mozambique suggest that they have not been informed about the innovations introduced in the curriculum in terms of their nature, advantages, and disadvantages. As Nierop (1996) suggested, mathematics teachers need to explain to parents what the children are learning, how they are learning, and what assistance they should provide; this is important because some parents might not be aware of contemporary mathematics teaching practices. The responses of parents revealed clearly that they support traditional teaching methods; that is, teaching approaches that emphasise rote learning. As Buxton (1981) and Schoenfeld (1992) pointed out, this approach contrasts with current teaching practices that encourage problem solving, experimentation, and discovery.

When asked who was better at mathematics, boys, girls, or no difference, one parent said boys were better; another said girls were better; eight parents said there was no difference. The parent who gender stereotyped mathematics achievement in favour of boys mentioned his personal experience/observation when he was a student. Those who did not gender stereotype mathematics achievement were influenced by their observations at home, classrooms, and current trends in education.

The views of mothers in regard to gender stereotyping of mathematics achievement (no difference between boys and girls: N=5) were consistent with those of their children whereas the views of fathers (boys are better: N=1; there is no difference: N=2) were not for 3 out of the five fathers. As mothers tended to assist their children

with homework, it is possible that during these interactions they pass their views about mathematics learning to their children.

All parents interviewed believed mathematics is important for their children but the perceived importance of this subject was mainly in terms of calculations, counting, and development of reasoning skills and memory.

Although all parents viewed mathematics as useful for their offspring, some children disagreed strongly that mathematics has benefits for them or were unsure as to whether mathematics has benefits. Using the expectancy-value theory (Eccles et al., 1983), the children whose parents perceived mathematics as useful were expected to attribute high value to the subject but this was not necessarily true. According to the same theory, however, to influence children's task values more effectively, parents need to communicate these values to their children, or to expose their children to activities that they value. Thus, it is possible that some parents, although viewing mathematics as important for their children, did not provide them with rich mathematical experiences at home or did not communicate their task-values with the children.

There was no evidence of the influence of geolocation or gender on perceived usefulness of mathematics [PUM]. The lack of association between these variables and PUM was understandable as most parents tended to associate mathematics with low level uses such as counting, calculating, reasoning, and memory. The two parents who viewed mathematics at a more advanced level (mathematics as a worldwide language, a subject related to other fields, and a problem solving tool) were mothers from urban schools; one had a university degree and the other had secondary education. This result reinforces the belief that education of women has the potential to change the way

females value and engage in certain fields – particularly those traditionally dominated by males.

While mathematical knowledge is considered a ‘critical filter’ for access to higher education and to rewarding jobs (Leder, Pehkonen, & Töner, 2002), three parents disagreed that knowing mathematics helps to get jobs. The lack of reference to mathematics when jobs are advertised, and the lack of connections between school mathematics and skills needed in the workplace were some of the reasons parents used to argue that mathematics is not important to get jobs. This suggests that to promote mathematics learning, job advertisements could say how much mathematics is necessary to perform the jobs in the same way they say how much Portuguese, English, and computer skills are required to perform certain jobs. Also, when introducing new topics, mathematics teachers should inform students how the new content is used or could be used in the workplace. Mathematics textbooks should make clear the connections between mathematics and occupations. It is evident that, if children do not like mathematics and rate their achievement at the lowest level at this subject, and at the same time they aspire for professions that require the use of high level mathematics (e.g., engineer, and accountant), they do not see how useful mathematics is for the occupations they are interested in.

Similar to the survey data, there was evidence that parents’ occupational aspirations for their children were influenced by the gender of the child. Parents were more likely to aspire for their sons to engage in ‘Things-Oriented’ jobs (e.g., engineer) than in ‘People-Oriented’ jobs. However, there were parents who aspired for their daughters to engage in Things-Oriented jobs as well. The responses of the children were more gender biased across the ‘People-Things’ jobs divide than the responses of parents. Four of the five boys aspired for Things-Oriented jobs while four of the five

girls were interested in People-Oriented jobs. Thus, the responses of the children tended to support previous research (see Duntzman et al., 1979; Su et al., 2009). Similarly, parents of boys tended to aspire for their sons to engage in Things-Oriented jobs than were parents of girls. However, there were more mothers interested in Things-Oriented jobs for their children than were fathers.

The child's perceived talent or inclination for the occupation was the most frequent reason mentioned by parents when choosing a profession for the child. The second most common reason was the perceived utility of the occupation in terms of the opportunities to learn new things and to have money to support the family. Also some parents wanted a particular job for the child because it runs in the family. Thus, the reasons provided by parents were perceived value of the task, and perceptions that the child has been performing or will be able to perform the job successfully. These are also the reasons said to motivate task-choices by the Expectance-value framework (Eccles et al., 1983).

Six parents believed they should influence their children's occupational choices and four did not. Those who favoured influencing the child's occupational choices indicated that parents are more experienced and have rights over the child. Parents who were against (3 female and 1 male) argued that to do so is violating the children's rights to fulfil their dreams.

However, Mulemwa (1999) indicated that while in other countries students may have information about jobs that are available, in African schools career guidance is needed because the children lack knowledge about occupations that are available to them, and as girls are less exposed to jobs, they tend to have poor knowledge about occupations as compared to boys. In the current study there was no evidence that boys

knew occupations better than girls but it was clear that both girls and boys tended to select occupations that resemble traditional occupations for women and men, respectively.

Thus, as the children hold gender stereotyped beliefs about occupations and so do their parents, probably intervention programs involving parents, and career advice at school should be provided systematically.

However, it should also be noted that parents' occupational aspirations for their children is the dimension of parental involvement in education that has one of the strongest relationships with children's achievement (Fan & Chen, 2001). Although all the ten parents interviewed had an occupation that they aspired for their children, most of them never communicated those aspirations to their children. The survey data also showed that 22% of the 225 parents did not have any specific occupational aspirations for their children and they said that any employment was good for their children. Although this attitude is influenced by the lack of jobs in Mozambique, to communicate occupational aspirations and the process needed to ensure that the aspiration can come about should exist and should be known by both the parents and the children. As Professor Trevor Gale (personal communication, November, 01, 2012) said, children (and parents) need to have a clear idea and to be able to map out their aspirations. That is, they need to learn to express their aspirations in terms of what to do now, and what to do next, to ensure that aspirations will come true and not to leave them to chance.

All parents interviewed in this study were in favour of the gender equity policy in Mozambique. The most common reason for supporting this policy was fairness. Other parents also believed gender equity might bring economic development and family stability. The economic development dimension of gender equity has also been

addressed in several government documents including the eradication of diseases, malnutrition, and to ensure that women assume civic responsibilities as citizens (Passos et al., 2012). However, there was one parent (Male, Secondary, Urban) who was concerned about the cultural dimension of gender equity; he believed gender equity policy could put marriages under pressure. Accordingly, the Atlas of Gender and Development by the Organisation for Economic Cooperation and Development [OECD, 2010] stated that although the Mozambican constitution upholds gender equality in all social, political, and economic domains, family customs are still gender-biased in favour of husbands particularly in regard to family relations, inheritance, and ownership of assets (OECD, 2010).

Finally, most of the survey data (N=225 parents) were replicated through the interviews with selected parents (N=10 parents). The interview data revealed that parents view mathematics as a very difficult subject for them and for their children, irrespective of the gender of the child. This perception was common and there was no evidence of the influence of geolocation, or level of education of parent.

One of the main findings was that parents' views in regard to their children's mathematical competence was similar to their perceived own competence (8 out of 10 cases). In three cases these views were similar to those reported by their children.

Parents' conceptions of mathematics tended to reflect the traditional views about the nature of mathematics (Buxton, 1981). Specifically, parents tended to describe mathematics as a fixed set of rules and procedures to be memorised and applied carefully, and as an exact and precise science that is opposed to a creative, experimental, and exploratory field of human knowledge. There was a trend to equate mathematics with low level uses such as calculating using the four basic operations (i.e.,

addition, subtraction, multiplication, and division), counting, reasoning, and memorising. These views probably influence parents' perceptions that the teaching and learning of mathematics has changed into a situation worse than it was when they were school children. One possible consequence of this view is avoidance and/or inability to help the children to understand mathematics homework.

The majority of parents interviewed did not believe boys are better than girls at mathematics. One important finding was that children of parents who held the view that there is no difference between boys and girls at mathematics also did not gender stereotype mathematics achievement, and this was specifically true for all mothers but not for all fathers; fathers who believed boys are better at mathematics or there is no difference, their children believed girls or boys are better.

All parents believed mathematics is useful for their children but not all agreed that mathematics helps to get jobs. Despite parents believing that mathematics is important for their children, there were children who disagreed or were unsure as to whether understanding mathematics has many benefits for them. This result is interesting because these children were boys and their parents were males. This is probably because some parents do not communicate the tasks they value to their children. Also, as parents equate mathematics with low level uses, it is possible that the children do not have rich mathematical experiences at home that could help them develop the view that mathematics has benefits either currently or in the future.

The reactions of parents revealed that they are generally satisfied with their children's education, particularly mothers. But the reason for satisfaction was not triggered by good scores but by continuing enrolment and persistence to stay at school. Obviously, ensuring that the children have a place in public schools is quite difficult in

Mozambique due to the growing population of children seeking education. This is because the increase in educational infrastructure, such as the construction of new schools and training of teachers, does not meet demand (Passos et al., 2012). Also, with the policy of automatic transitions prevailing in primary schools, the need for high attainment might have lost its significance. Thus, age of the child becomes the most important variable to ensure that the child is retained within the educational system. However, without academic achievement these children generally do not move into secondary education because they do not succeed in the examination at Grade 7.

### **School principals' views**

The responses of the five school principals were interesting for various reasons. First, they did not mention any gender-related problems in learning in their schools when asked to describe students' achievement patterns. Second, when asked explicitly to compare the achievement of boys and girls in their schools, only two principals (both female) indicated that boys were performing better than girls at mathematics, and girls were performing better than boys at Portuguese. It should be noted that the account from the female principals that girls outperformed boys at Portuguese is not consistent with the SACMEQ data (Saito, 2004, 2010). The studies by the SACMEQ revealed that boys outperform girls at both mathematics and Portuguese (but to a lesser extent).

The female principals indicated that the lack of interest, effort, and persistence, and perceptions that males are naturally better than females at mathematics contribute to girls' low achievement in this subject. Several scholars have also explained gender differences in mathematics learning outcomes using students' beliefs and attitudes towards mathematics education (e.g., Fennema & Peterson, 1985; Leder, 1990).



The male principals reported that there were no gender differences in achievement in any subject in their schools. One principal said the school never investigated the topic. This response is questionable because principals should have access to the academic results of all children, and should be aware and be able to describe the achievement patterns in their schools. That is, schools should have the ability to monitor changes in children's academic performances and take the appropriate measures when necessary. The responses of the three male principals were curious particularly because persistent gender differences in mathematics performance and in reading (but to a lesser extent) in favour of boys have been extensively reported by the SACMEQ (Saito, 2004, 2010). However, it is possible that most teachers and school principals have no access to the SACMEQ findings due to the lack of literature written in Portuguese in the country. It is also possible that the male principals provided socially desirable responses (Paulhus, 2002).

The principals reported being satisfied with the School Parents' committee and the Gender Issues committee. The former helps finding solutions to school problems related to furniture, refurbishing infrastructure, and to pay the school guard. School guards are not on the government payroll and thus schools have to find a way to pay them. The Gender Issues committee was created as part of the government policy to promote gender equity in the educational sector and has the role of monitoring girls' and boys' behaviours, solving harassment and pregnancy problems, and to look after homeless and vulnerable children. The data from this study show that the Gender Issues committees perhaps do not have specific activities aimed at promoting gender equity in terms of academic achievement although they persuade girls to persist at school. Without academic achievement it is difficult to ensure that girls persist at school because all children sit for national examinations at the end of Grade 7, and low

achievers will not progress to secondary education. Also, mathematics being a subject for which gender differences in terms of affect and performance have been reported extensively in the literature, the Gender Issues committee should have activities aimed at engaging girls in the study of this subject.

The reactions of three school principals towards parental involvement in education were consistent with the information provided by the parents, but the responses of two principals were not. These two principals were satisfied with parents and indicated that parents have regularly helped their children to understand homework. This information was not consistent with the responses of parents as 8 of the 10 parents interviewed did not help their children with homework because they did not know how to do it or did not have time to do so. The surveys completed by parents revealed that the average parental involvement in education [PIE] was moderate, and high in terms of attending school meetings.

According to the literature reviewed in Chapter 2, parental involvement in education is important for many reasons. First, it is positively associated with a child's achievement (Fan & Chen, 2001; Gonzalez-DeHass et al., 2005). Second, it influences various motivational constructs such as "school engagement, intrinsic/extrinsic motivation, perceived competence, perceived control, self-regulation, mastery goal orientation, and motivation to read" (Gonzalez-DeHass et al., 2005, p. 99). Also, the presence of parents in the school, together with school support, increases the child's perceived connection to the school environment and, consequently, the child's sense of security (Niehaus, Rudasill, Rakes, 2012). Thus, in the context of Mozambique, to engage parents in the education of their children may increase school attendance and persistence, particularly for girls in rural and remote schools.

Despite these advantages several studies have demonstrated that family circumstances may negatively influence parental involvement in the education of their children (see McWayne, Campos, & Owsianik, 2008; Waanders, Mendez, & Downer, 2007). This was evident in this study as 25% of the 300 parents did not come to school to complete the survey despite having consented to do so. In rural and remote areas it was particularly difficult to interview mothers due to their lack in confidence to speak publicly and be recorded, and because of their perceptions that husbands or older offspring were in a better position to speak about the education of the child.

Finally, the female principals were more likely than the male principals to reveal gender discrepancies in educational outcomes in their schools. It is possible that the female principals were more aware of this problem in their schools than the male principals. The principals were generally satisfied with the work of the School Parents' committee. However, they indicated that 50% of the parents that the schools serve did not engage in the education of their children. Perhaps these are parents who are more disadvantaged educationally and economically, but the schools did not have any organised information about them. It would be important if schools had information about the parents who appear to 'neglect' the education of their children, so that appropriate support is provided to the target group.

All participating schools had established the Gender Issues committees which offer space and the context to research gender related issues in primary schools. The tasks of these committees revolve around ensuring that disadvantaged children have opportunities for education. However, it appears that the committees have not focused attention towards ensuring equity in terms of learning outcomes yet. According to Fennema (1990), equity in learning outcomes is the dimension of equity in education that might bring true justice because there will be equal opportunities for access to jobs

and to other activities in society. Consistent with Fennema, equity in education is not achieved if after completion of primary education girls and disadvantaged children have developed less mathematical skills, less confidence to study further mathematics in secondary school, and view mathematics as having no benefits for them compared to other children.

In the next chapter, the conclusions and recommendations of the study are presented.

# Chapter 7

## Conclusions and Recommendations

In this chapter an overview of the context of the study, the main research question, and the literature that was pertinent to the subsidiary research questions is presented. The rationale for mixing quantitative and qualitative research methods in this study is also explained. A summary of the results and conclusions of the study, and findings in relation to the context of Mozambique are described. The implications of the findings for government policy, for teacher education, and for mathematics teaching, the limitations of the study, and the directions for future research are also outlined.

The main research findings are presented following the order of the subsidiary research questions as addressed in Chapter 1. The answer to the main research question that motivated this study is provided subsequently.

### **The Context of the Study and Research Question**

Mozambique is a country from Sub-Saharan Africa. Although there are several languages of *Bantu* origin spoken in Mozambique (see Gerdes, 1993), the medium of instruction is Portuguese. The Portuguese language was inherited from the former colonial settlers (1498-1975).

Unlike developed countries, research on the impact of gender and the affective domain in mathematics education in primary schools in Mozambique is scarce. The few studies in which these topics were explored concentrated on performance among secondary school students (Cassy, 2003), and mathematics teachers' classroom discourses (Fagilde, 2002). In primary education, studies focused on examination of gender issues in mathematics textbooks introduced in 2004 (Murimo & Forgasz, 2007),

school conditions and infrastructure (Passos et al., 2005), and the impact of gender-related policies in enrolment trends by province and nationally (Passos et al., 2012).

However, in Sub-Saharan Africa, the studies by the Southern and Eastern Africa Consortium for Monitoring Education Quality [SACMEQ] have regularly measured and compared Grade 6 pupils' achievement in mathematics, reading, and knowledge of health issues within and across countries every five to six years since 1995. The second and the third studies by the SACMEQ were conducted in 2000 and 2007 and these studies found statistically significant gender differences in mathematics achievement favouring boys in Mozambique and many other countries of the SACMEQ region (Saito, 2004, 2010). Comparison of the results from the second and the third study revealed that Mozambique is the country of the SACMEQ region where the overall performance of Grade 6 children in mathematics had deteriorated most (Makuwa, 2010).

A study conducted by Passos et al. (2012) revealed that although the participation of girls in school had increased from 2000 to 2007, there were more boys than girls in primary education, particularly in the central and northern provinces of Mozambique. These authors also indicated that school safety and sanitary conditions had declined since the educational reforms introduced in this period.

It should be noted that since 2004 the SACMEQ researchers have called for research aimed at understanding the reasons contributing to persistence of gender differences in mathematics achievement of primary school children in Mozambique (see Saito 2004, 2010). Thus, this study was inspired by the SACMEQ reports and was aimed at gaining an understanding of some of the factors associated with affect of

students towards mathematics learning in primary schools in Mozambique. The main research question addressed was:

*What are the relationships between Grade 7 students' beliefs and attitudes towards mathematics learning and parents' views, and family circumstances? Are there gender differences?*

To answer this research question, nine subsidiary research questions were examined using both quantitative and qualitative data. Pencil-and-paper surveys and one-on-one face-to-face semi-structured interviews were used to collect the data.

The literature that influenced this study is summarised briefly below.

## **Summary of Literature**

The literature was reviewed in four strands: distinction between the terms 'gender' and 'sex'; components of the affective domain in mathematics education; the role of parents in the education of their children; and theoretical models of gender differences in mathematics learning outcomes.

The distinction between the terms gender or gender differences and sex or sex differences was established to avoid confusion. The terms gender and gender differences were used throughout the thesis to emphasise that psychological and cultural factors influencing students' beliefs and attitudes towards mathematics learning were the focus of the study rather than biological characteristics of the learner. As Leder (1992) stated, research that examines psychological and environmental factors are important to education because these factors are modifiable with appropriate policies and practices at national and school levels.

Components of the affective domain that were related to the research questions were reviewed with emphasis on their relationships with gender differences in

mathematics learning outcomes (e.g., performance, participation, beliefs, and attitudes). Leder et al. (1996) provided a useful summary of the major findings associated with affective domain variables in mathematics education. They indicated that, compared to boys, girls tend to hold less ‘functional’ beliefs about mathematics learning such as a lack of confidence, and the attribution of success in mathematics to external factors (e.g., help), and failure to lack of ability. In contrast, boys are more likely than girls to attribute their successes in mathematics to ability and failure to lack of effort or time to study. Leder and colleagues reiterated that mathematics learning continues to be viewed as a male domain and more strongly by boys than girls, and that “external influences can differentially influence students’ beliefs: for example, parents, the peer group, socialization patterns, and the media” (p. 958).

Leder’s (1990) explanatory model of gender differences in mathematics learning outcomes, and the NAPLAN studies in Australia were used to identify variables of interest to examine in Mozambique. Although Leder’s (1990) model was developed in Australia, it provides a starting point to examine gender issues in mathematics learning outcomes in developing countries (Forgasz, 2008).

The expectancy-value model (Eccles et al., 1983), and the model of parent socialisation of children’s attainments (Eccles, 2005) were considered pertinent to this study. These models view parents as critical in the education of their children, first as role models, and second, as expectancy and value socialisers. The expectancy-value framework was used to interpret the data because it emphasises that parents and family characteristics (e.g., education, occupation, number of siblings, and ethnicity) influence their beliefs and behaviours towards children’s education; it was thus viewed as having implications for children’s education in Mozambique due to high adult illiteracy rates.



According to the 2007 Census, 40% of adults in urban areas were illiterate; in rural areas 80% of adults were illiterate (Instituto Nacional de Estatística, 2011).

It should be noted that research on the factors influencing gender differences in mathematics education has a long tradition in the west and, as a result, a number of explanatory models have been hypothesized over the years (e.g., Baker & Jones, 1993; Eccles et al., 1983; Ethington, 1992; Fennema & Peterson, 1985; Leder, 1990; Reyes and Stanic, 1988). Despite intervention programs to ameliorate the disparities which are well documented in the literature (see Leder, et al., 1996), there is still no clarity why girls continue to be disadvantaged in mathematics, science, and technology in most African schools including Mozambique (Asimeng-Boahene, 2006; Saito, 2004, 2010). Hence, due to the lack of research in this field in African contexts, most of the literature reviewed in this study has its origin in the west.

## **The Study**

The study was conducted in five government-owned primary schools from the central Province of Sofala in Mozambique. The schools were selected in three districts on the basis of geolocation: urban (3 schools), rural (1 school), and remote (1 school). The districts were selected in order to represent different languages spoken in children's homes (*Sena*, *Ndau*, and *Portuguese*).

A purposive sample composed of 300 Grade 7 children (166 girls and 134 boys), 225 parents or primary caregivers of these children (98 fathers, 96 mothers, and 31 guardians), and 5 principals from participating schools (2 females and 3 males) took part in the study. The ages of the children ranged from 11 to 16 and the mean age was 12.9. Grade 7 pupils were selected to participate in the study for two reasons. First, Grade 7 pupils undertake a national examination, so their beliefs and attitudes towards

mathematics learning may differ from those of children from lower grades who benefit from automatic promotions within educational cycles. Second, Grade 7 is the highest grade of primary education. Thus, it was viewed as important to know the beliefs and attitudes towards mathematics learning that these children had developed during seven years of primary schooling and that they would probably transfer to their secondary education.

A mixed methods research design that combined quantitative (survey data), and qualitative (interview data) was adopted in order to have a general outlook on the data, and also to examine closely and more deeply the issues included in the surveys. The survey data were gathered using pre-existing instruments that were identified in the literature and these were translated into Portuguese (see Appendices 2 and 3). Children and parents completed similar surveys but the surveys for parents were written in a way to reflect the perspective of parents. Ten parents (5 females and 5 males) and five school principals (2 females and 3 males) participated in one-on-one semi-structured interviews. Social desirability response bias during interviews (Paulhus, 2002) was reduced through the guarantee of confidentiality and the rapport that was built between the researcher and the interviewees prior to interviews.

## **Summary of Results and Conclusions**

The subsidiary research questions and the main research question identified in Chapter 1, and a summary of the main findings are presented below. Details of the statistical techniques used to analyse the quantitative data were described in Chapter 5. The method used to analyse the interview data was described in Chapter 6.

1. Are there gender differences in children's educational and occupational aspirations? Are parents' educational and occupational aspirations for their children based on the gender of the child?

There were no statistically significant gender differences in children's educational expectations. Likewise, parents' educational expectations for their children were not influenced by the gender of the child. Both parents and children reported high educational expectations (e.g., to complete university education), but 4% of boys and 6% of girls did not expect to conclude Grade 12. Also, 15% of parents of sons and 12% of parents of daughters did not expect their children would complete Grade 12.

However, boys and girls differed in terms of their occupational aspirations. The proportion of girls aspiring for 'people-oriented' jobs (e.g., lawyer, nurse, physician, and teacher) was higher than that of boys. Boys were more likely than girls to want to be engineers and police officers.

The results were similar to those reported by Stockard and McGee (1990), White and White (2006), and White et al. (1989). For example, in their study involving Grade 4 children, Stockard and McGee (1990) found that gender was the most salient variable influencing occupational preferences. They also noted that job characteristics such as perceived earnings, perceived importance, perceived difficulty, and perceived likelihood to supervise other people were associated with children's occupational preferences although the children had incorrect information about the characteristics of the jobs. The current study differs from that of Stockard and McGee (1990), in that occupations and characteristics of the jobs were not suggested by the researcher. The reasons for preferring particular occupations mentioned by children and parents in this study were: perceived utility of the job (earnings and intellectual development), interest (e.g. like the job; the job is 'cool'), family influence (e.g., father has the same job), perceived inclination for the job (e.g., child is good at fixing things), and perceived costs associated with the job (e.g., non-expensive course, and easy to get access to jobs after

training). Consistent with Eccles et al. (1983), utility of the job – the perception that the job will allow the person to grow intellectually and economically in order to fulfill a range of goals such as to help family, community, and the country – was mentioned the most often by both children and parents.

Using a sample of undergraduate students, White et al. (1989) found that respondents tended to associate the profession of engineer, physician, and architect with males and nursing jobs with women. White and White (2006) used implicit and explicit measures of gender stereotyping of occupations to demonstrate that the perception that engineers and accountants are males and elementary school teachers are females prevails among adults. Duntzman et al. (1979) and Su et al. (2009) also found that males preferred to work with things, while females were more interested with occupations involving people. Thus, the results from this study support these previous studies in that boys and parents of sons were more likely to prefer the profession of engineer for their children, while girls and parents of daughters aspired for their children to be teachers, nurses, and physicians. However, there were parents who wanted their daughters to engage in things-oriented jobs (e.g., accountants).

In only a few cases were the occupational aspirations of parents for their children similar to those of their children. This suggests that parents may not be communicating their aspirations to their offspring. However, to communicate or not to communicate may not make difference as both parents and children hold the view that some jobs are more suited to females and others to males.

In summary, no gender differences in educational expectations were noted. However, gender of the child was a statistically significant variable associated with the type of occupation that the child aspired to. Boys tended to aspire to jobs involving

things and girls tended to select jobs involving interaction with people. In most cases there was a mismatch between parents' occupational aspirations for their children and the children's occupational aspirations for themselves.

2. Are there gender differences in self-perceived achievement in mathematics and other school subjects among Grade 7 students? Are parents' perceptions about their children's achievement levels based on the gender of the child?

Boys and girls perceived mathematics as their worst school subject and physical education their best. Gender differences in perceived achievement were noted only in regard to moral & civic education and favoured girls. This result did not support studies that found boys rating their achievement higher than girls in mathematics (e.g., Dermitzaki & Efklides, 2001). Discrepancies in achievement rating between children and parents were noted only in relation to English and favoured children. One possible reason that contributed to conflicts in rating is the fact that English was introduced in primary schools recently, in 2004. Also, despite Mozambique being surrounded by former British colonies, many parents cannot speak English and they may view their children as having difficulties with this language.

It was interesting to note that, parents viewed mathematics as the most difficulty subject for themselves and for their children. Also most children believed mathematics was the most difficulty subject they study in school. To some extent, the similarity of views between children and their parents in regard to the perceived difficulty of mathematics validates the expectancy-value model (Eccles et al., 1983).

3. Are Grade 7 boys more confident in learning mathematics than Grade 7 girls?

The 12 items from the *Confidence in Learning Mathematics* scale [CLM] (Fennema & Sherman, 1976) were analysed one by one first, and by dimension as determined by the factor analysis described in Chapter 5. Boys and girls did not differ statistically significantly in terms of their mean scores on any item, and on either of the dimensions. Although not reaching statistical significance, confidence scores for boys were slightly higher than those of girls on 10 of the 12 items examined. Boys tended to be more confident in learning mathematics than girls but further research is needed to confirm this, particularly as the literature reveals gender differences in confidence towards learning mathematics (Fennema and Sherman, 1977, 1978; Mendick, 2005; Mittelberg & Levi-Ari, 1999).

In summary, although gender was not a statistically significant factor for confidence, boys tended to agree more strongly than girls that they will be able to learn mathematics in secondary school and at university.

4. Do boys and girls differ in terms of their perceived usefulness of mathematics? How do students' perception of the usefulness of mathematics compare with parents' perceptions of the usefulness of mathematics for their children?

Statistically significant gender differences in perceived usefulness of mathematics were not found among children or among parents for their sons and daughters. Luttrell et al. (2010) also used the same instrument used in this study (*Mathematics Value Inventory*) and did not find statistically significant gender differences. However, Luttrell and colleagues (2010) found that students' perceived usefulness of mathematics increased with the number of mathematics courses taken.

In the current study despite gender differences in perceived usefulness of mathematics not reaching statistical significance, boys tended to view mathematics as more useful for them than did girls. Also, fathers, and parents of sons tended to view mathematics as more useful for their children than mothers and parents of daughters believed it was for their children. Parents viewed mathematics as less useful for their children than the children themselves and the differences were highly statistically significant.

The interview data added substantial information about parents' perceived usefulness of mathematics for their children, and for getting jobs. All parents interviewed believed mathematics was important for their children; however, the perceived importance of mathematics was mainly in terms of counting, carrying out calculations, checking the accuracy of the bills, and the salaries that employers pay. Some parents also said mathematics improves reasoning skills, and memory. Only two (females) of the ten parents interviewed held a more positive view about mathematics – A problem solving tool, a worldwide language, and a subject related to other fields.

With respect to occupations three out of the ten parents interviewed believed mathematics is not important for getting jobs. This is probably because mathematics does not stand out in most occupations, and schools rarely show the connections between mathematics and jobs.

There was no statistically significant influence of the gender of the child on parents' perceived usefulness of mathematics for their children probably because parents conceive mathematics as about counting and calculating. At this level of use, mathematics may be viewed as equally useful for boys and girls. As with this study, some studies also did not find statistically significant gender differences in perceived

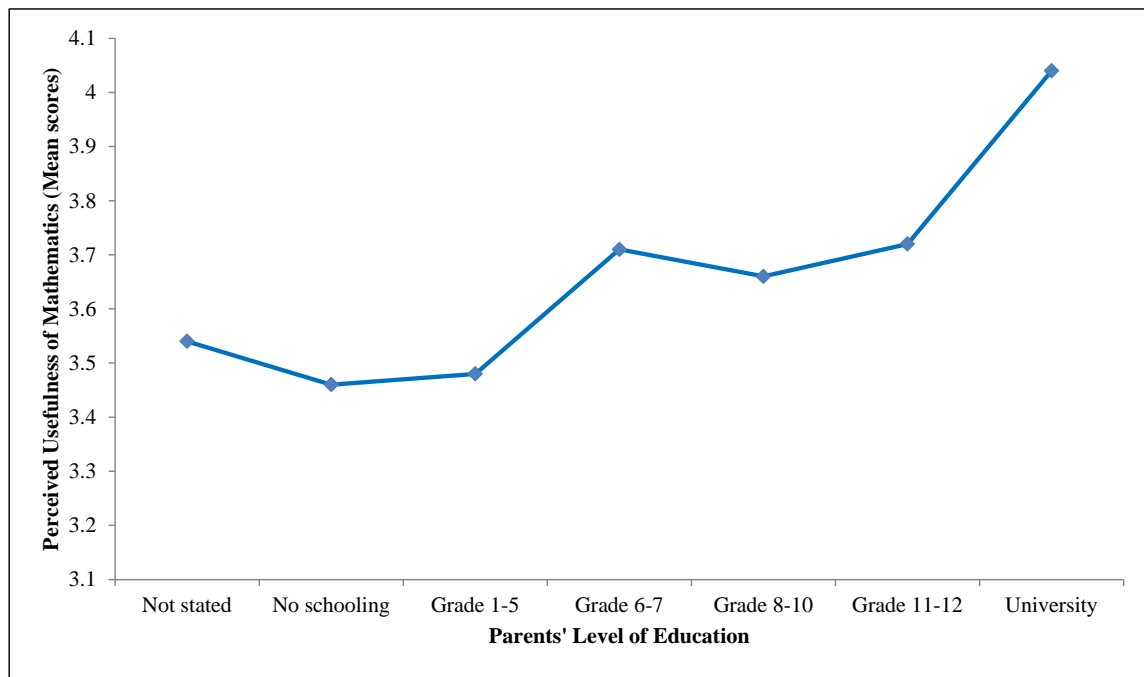
usefulness of mathematics (Luttrell et al., 2010; Tocci & Engelhard, 1991). However, as will be seen next, perceived usefulness of mathematics was strongly associated with parental background and family circumstances.

5. Which selected parental background variables, economic resources, and cultural factors are the best predictors of children's perceived achievement, confidence, and perceived usefulness of mathematics?

The survey data showed clearly that the age of the child, education of parents, geolocation, and number of siblings predicted children's perceived usefulness of mathematics [PUM], but not confidence in learning mathematics [CLM] and perceived achievement in mathematics [PAM]. Possession of selected economic resources was positively associated with [CLM] and [PUM] but not [PAM]. Specifically, the youngest children (age=11), children studying in urban schools, children whose parents had university education, children with fewer than 3 siblings, and children having electricity, piped water, TV sets, computer, the internet, and school uniforms *reported* more positive beliefs and attitudes towards mathematics learning than the other children. These results support those found in 2007 by TIMSS among Grade 8 students (see Mullis et al., 2008).

To provide an overview, and to stress that some dependent variables were strongly associated with children's affect towards mathematics, parental education is used as an illustration. Figure 7.1 shows the relationship between Grade 7 children's perceived usefulness of mathematics [PUM] and parental education.





Note. High mean scores indicate high perceived usefulness of mathematics on a scale from 1 (strongly disagree) to 5 (strongly agree).

*Figure 7.1.* Relationship between Grade 7 children's Perceived Usefulness of Mathematics [PUM] and parental education

As can be seen in Figure 7.1, the children from more educated parents, on average, viewed mathematics as more useful to them than did the children from parents with lower education. The children from less educated parents were unsure as to whether mathematics is useful to them or not. It is possible that the association between parental education and children's beliefs and attitudes towards mathematics is one of the ways that cyclical educational disparities perpetuate and this calls for specific intervention activities aimed at breaking the cycle.

Ownership of textbooks for mathematics and for reading, calculators, and cell phones did not influence the variation of scores on any dependent variable examined. This was probably because textbooks are granted to children by the government, and thus ownership of a textbook may not be an indicator of child's socioeconomic status.

Calculators are not officially used in Mozambican schools although some children have them and use them under their own initiative. Thus, it is possible that most children did not yet appreciate the value of calculators for mathematics learning. About 40% of the children reported having a cell phone, but possession of this device did not improve scores on any dependent variable. Thus, it is possible that the children did not relate mathematics with technology.

In summary, the independent variables examined did not predict perceived achievement in mathematics [PAM]. Possession of selected economic resources was positively related to confidence in learning mathematics, and perceived usefulness of mathematics. However, only 22% of variance of scores on perceived usefulness of mathematics [PUM] was explained by age of the children, education of parent, geolocation, and number of siblings, and the remaining 78% was unexplained. This implies that perhaps other variables might explain better the dependent variables examined.

6. What is the level of parental involvement in the education of their children?

The average level of parental involvement in education was moderate. Compared to parents in rural and remote schools, parents in urban schools were more involved in their children's education. Activities that parents reported having conducted frequently were attending school meetings, asking the child about the day at school, and talking to the child about the importance of school. However, three of the five school principals interviewed were not satisfied with the level of parental involvement in education and the reasons were: (a) parents do not attend meetings at school; (b) parents do not support the school; and (c) parents do not help their children to maintain the textbooks

in good condition. It appeared that some parents have time constraints due to other priorities; others are unable to assist their children because they do not understand the current mathematics taught in schools.

There were no statistically significant relationships between parental education, number of siblings, the gender of the child or parent and parental involvement in education. However, when the same instrument (i.e., *Family Involvement Questionnaire*) was used by Manz et al. (2004) in the USA, more educated parents and parents of boys were more involved in education than the less educated parents and parents of daughters, respectively.

In the current study the children were not asked questions related to their parents' involvement in education. However, the perceptions and interpretations of the children about their parents' actions are important because they influence children's effort, persistence, and the type of academic activities they engage in (Eccles et al., 1983).

7. What are the most salient causes that boys and girls attribute to their successes and failures in mathematics? What are the most salient reasons that parents attribute to the successes and failures of their daughters and sons in mathematics?

The children's attributions for their success in mathematics were ranked in the following decreasing order: Environment, effort, task difficulty, and ability. Parents' attributions for their children's success in mathematics followed the order: Effort, environment, and task difficulty or ability. The children agreed strongly that success in mathematics is achieved through external forces such as a good teacher or help from someone who knows mathematics. Parents believed the most plausible cause for their children's success in mathematics is effort.

From the most to the least salient, the children's attributions for their failure in mathematics were: Task difficulty, effort, environment, and ability. That is, the children agreed strongly that failure in mathematics is caused by the nature of the task (e.g., hard mathematics test/curriculum), but their parents were unsure as to whether failure is due to the nature of the task, teacher, or the lack of effort or ability. However, the interview data showed clearly that parents believe their children's poor achievement in mathematics is caused by external forces – the teacher who is not good, the teaching methods that do not emphasise memorising and practice, and the curriculum that is not demanding enough and allows automatic promotions in primary schools.

Using Weiner's attribution framework presented in Chapter 2 (see Weiner, 1974), these attributions can be classified along the dimensions of stability (stable versus unstable) and locus of control (internal versus external). For example, ability and effort are considered internal in relation to the perceiver because they are personal traits. In contrast, task difficulty and environment are viewed as external because their attributes are outside the perceiver. With respect to their endurance, ability and task difficulty have stable properties because they are sustained over time. Effort and environment are variables as they fluctuate over time.

The literature reviewed in Chapter 2 suggests that boys are more likely than girls to attribute their success in mathematics to having ability and to their personal effort (e.g., Fennema et al., 1979; Mendick, 2005; Pedro et al., 1981; Stipek & Gralinski, 1991; Tiedemann, 2002 ) but this claim was not supported by the results of this study. However, the claim that girls tend to attribute their successes to external sources such as teachers and help from other people were supported by the data, but the same perception was also noted among boys and parents. In general, the pattern of success and failure attributions exhibited by girls and boys was similar. The children agreed strongly that

success in mathematics is achieved through external forces of the environment surrounding the learner (e.g., teacher or other people), and failure to complexity of the subject. The consequence of this attribution pattern to mathematics learning has been clearly articulated by Pedro et al. (1981):

If an individual attributes an outcome to a stable factor, a similar outcome tends to be expected in the future. If, however, the outcome is attributed to an unstable factor, an individual may have doubt as to whether the prior success or failure will be repeated. If the probability of achieving a successful outcome is uncertain, behavior in that domain is less likely to persist. (p. 209)

It was interesting to note that both parents and children believed 'ability' is the least plausible cause for success in mathematics. There was evidence that most respondents (children and parents) viewed mathematics as a very difficult subject for everyone. This perception may be reinforced by national examinations as most students generally fail the grade due to unsatisfactory scores. For example, in 2012, only 7% of Grade 10 students in Maputo city obtained an acceptable score in mathematics (i.e., score equal or over 10 in a scale ranging from 0 to 20) and the remaining 93% failed the grade (Reflectindo Sobre Moçambique, 2012).

If mathematics teachers and national examinations assess more than what was taught and beyond what the children learnt or can do, the children might develop the sense that mathematics is really very difficult. Factors that originate and reinforce the view that mathematics is the most difficult subject in the curriculum need to be examined and addressed accordingly. It is possible that most parents had unsatisfactory experiences with mathematics learning in the past and thus they view their children as having similar difficulties today.

8. Do Grade 7 males and females, and parents gender stereotype mathematics learning as a male domain?

The ‘Who and Mathematics’ [W&M] instrument (Leder & Forgasz, 2002a) was used to determine the extent to which Grade 7 males and females, and their parents hold the traditional beliefs associated with the view that mathematics learning is a male domain. The responses of the pupils were contrasted with findings from similar research conducted in other countries. Despite some items from the W&M instrument being viewed as appropriate for both boys and girls, the gendered beliefs of parents and Grade 7 males were consistent with the gender stereotyping of mathematics learning as a male domain. The responses of Grade 7 females were consistent with the traditional gender stereotyping of mathematics as a male preserve for only five items. Generally, Grade 7 females tended to view the items to be gender-neutral. This means that Grade 7 females did not strongly endorse the view that mathematics is a male domain.

When the Mozambican data were compared with the data from other countries, similarities and differences were noted. For example, Martinot and Désert (2007) found that Grade 4 and 7 males and females in France believed girls were better at mathematics than boys, irrespective of their awareness of the gender stereotyping of mathematics favouring boys. But, in a study involving more mature school students in Sweden, Brandell and Staberg (2008) found that both girls and boys viewed mathematics as a male domain, and the older students held this view more strongly than the younger ones.

Using a systematic method of data analysis, the Mozambican data (Grade 7 males and females) were compared with the data from Germany (Kaiser et al., 2012), Greece (Barkatsas et al., 2002), Australia (Leder & Forgasz, 2002a), and USA (Forgasz et al., 2004) as these studies used the W&M instrument to collect the data. The W&M

instrument contains 30 items and the response directions (Boys; Girls; and No difference) are determined for each item individually. The responses that were consistent with gender stereotyping of mathematics as a male domain were distributed in decreasing order by country as follows: Greece: 23 items/77%; Germany: 22 items/73%; Mozambique: 14 items/47%; Australia: 9 items/30%; and the USA: 8 items/27%. This indicated that mathematics learning was gender stereotyped as a male domain more strongly in Greece, Germany, and Mozambique, than in the USA and Australia. The distribution of items that were considered gender-neutral by country by increasing order was: Greece: 0 items; Germany: 3 items; Australia: 6 items; Mozambique: 10 items; and the USA: 17 items. That is, in the USA, Mozambique, and Australia there was a trend to view several mathematics experiences described in W&M instrument to be appropriate for both girls and boys. This result challenges the view that mathematics is a male domain.

Despite some consistencies, the mixed results that were identified across countries for some items suggested that cultural background may have an influence on the direction of gender stereotyping of mathematics. A similar hypothesis was also drawn by Forgasz and Mittelberg (2008) in their study involving Israeli Jews and Israeli Arab students. The similarities identified on some items (e.g., Boys more likely than girls to ‘distract other students from their mathematics work’ (16), and ‘tease girls if they are good at mathematics’ (30) suggest that despite obvious cultural differences some views are universal.

9. What are the parents’ and school principals’ views about mathematics learning for girls and boys, and parent involvement in the education of their children?

The subsidiary research Question 9 was asked in order to explore qualitatively the main issues included in the surveys. Thus, most of the results from the interviews complemented the survey data and were used to answer the previous subsidiary research questions. The most important findings from the interviews conducted with 10 parents (5 females and 5 males) and 5 school principals (2 females and 3 males) are:

- Of the ten parents interviewed only two (males) reported to have liked and to have been good at mathematics;
- Only one parent (mother) believed her child (daughter) was good at mathematics;
- Only two parents (mothers) helped their children do understand mathematics homework; the other parents had time constraints due to other priorities and relied on the child's older siblings if the child has them; other parents did not understand the current mathematics taught in schools.
- The majority of parents (8) did not gender stereotype mathematics achievement. That is, they believed there is no difference between girls and boys with respect to mathematics achievement; only two parents (males) associated mathematics achievement with gender; one believed boys were better and the other believed girls were better.
- All parents believed mathematics is important for their children but three (2 males and 1 female) believed mathematics is not important to get jobs.
- Parents' occupational aspirations for their children tended to follow the traditional patterns. That is, parents aspired for their sons to engage in Things-Oriented jobs (e.g., engineer) and their daughters in People-Oriented jobs (e.g., Physician).
- However, there were more mothers aspiring for their children to engage in Things-Oriented jobs than fathers.



- Two of the five school principals (females) interviewed revealed that boys outperform girls in mathematics and girls outperform boys in Portuguese in their schools.
- The three male principals believed girls and boys were performing equally well in their schools.
- Three principals (1 female and 2 male) were not satisfied with the level of parental involvement in education.

These findings have several possible interpretations. Parents did not gender stereotype mathematics achievement probably because they view mathematics as a very difficult subject for everyone.

The interviews revealed that parents do not help their children to understand mathematics homework because they believe the curriculum has changed too much since the time they were at school; others reported to have difficulties in understanding the current curriculum; fathers indicated that the child has older siblings who can help in case of necessity.

Some parents did not associate mathematics with occupations. This was probably because mathematics does not stand out in most jobs available to the people in Mozambique; Mathematics teachers and curriculum also do not show clearly the connections between school mathematics and jobs. Most parents defined mathematics in terms of its low level uses such as counting, and calculating.

Despite gender differences in mathematics and slightly in reading favouring boys among Grade 6 pupils in Mozambique being extensively reported in the last decade (Saito, 2004, 2010), it was astonishing to note that all the male principals said girls and boys are performing equally well in their schools. This could be due to the lack of

awareness of the reality or the male principals provided socially desirable responses (Paulhus, 2002) to avoid providing explanations.

This study was aimed at understanding possible relationships between Grade 7 girls' and boys' beliefs and attitudes towards mathematics learning and parents' views, and family circumstances. The response to this question is presented next.

### **Answer to the Main Research Question**

The main research question of this study was:

*What are the relationships between Grade 7 students' beliefs and attitudes towards mathematics learning and parents' views, and family circumstances?  
Are there gender differences?*

To answer this question several quantitative (surveys) and qualitative (interviews) data were gathered and examined carefully. Most of the quantitative data were analysed using parametric statistical techniques when appropriate, but others were analysed using Chi-square tests for independence. Qualitative data were examined using a method proposed by Creswell (2009). That is, all interviews conducted with parents and school principals were transcribed and the main themes and sub-themes that emerged from the interview transcripts were identified. Thus, the answer to the main research question is drawn using both quantitative and qualitative data. The answer to the main research question is presented next:

Grade 7 students' beliefs and attitudes towards mathematics education are statistically significantly associated with parents' views, and family circumstances with respect to a number of dependent variables. There is an influence of the gender of the child on occupational aspirations and gender stereotyping of mathematics. This conclusion was drawn based on the following findings:

- Grade 7 boys' and girls' perceived usefulness of mathematics was strongly associated with age of the child, education of parent, geolocation, and number of siblings; specifically, the youngest children (age=11), children studying in urban schools, children having more educated parents, and children having fewer than 3 siblings had better scores than the other children.
- Having electricity, piped water, television set, computer, the internet, and school uniforms were positively related to perceived usefulness of mathematics and confidence in learning mathematics, but not with perceived achievement in mathematics.
- Having calculators, cell phones, textbooks for reading and for mathematics did not increase children's affective views towards mathematics.
- Speaking Portuguese (the medium of instruction in Mozambique) at home or vernaculars (Sena, Ndau, and others) were not statistically significantly associated with children's affective views towards mathematics. That is, in terms of their beliefs and attitudes towards mathematics learning, children frequently speaking Portuguese at home, did not have advantages over the children who speak vernaculars.
- Gender was not a statistically significant variable on Grade 7 students' perceived usefulness of mathematics, confidence in learning mathematics, perceived achievement in mathematics, and educational expectations.
- Parents viewed mathematics as less useful for their children than the children viewed this subject for themselves.
- Students' perceived achievement in mathematics and parents' perceptions of their children's achievement in mathematics were comparable. Parents' views of their children's achievement in mathematics were not based on the gender of the child.
- Children's occupational aspirations were associated with parents' occupational aspirations for their children and these aspirations resembled the traditional gendered occupational interests: boys working with 'things' and girls working with 'people'. However, among the parents interviewed, there were more

mothers than fathers who aspired for their children to engage in ‘things-oriented’ jobs.

- Grade 7 boys and parents tended to view mathematics learning as a male domain. In contrast, girls tended to view mathematics learning as a gender-neutral domain. The view of boys and parents mirrored the traditional belief identified in the 1970s (see Fennema & Sherman, 1976) that mathematics is a male preserve. However, girls did not endorse this belief strongly.
- Children’s perceptions of the most plausible reasons for their successes and failures in mathematics were not the same as those of their parents. The most salient children’s attribution for their success was environment (e.g., teacher, help) and for failure was task difficulty (e.g., hard mathematics test or curriculum content they study in Grade 7). The attribution pattern for parents was effort (for success) and environment (for failure). There was no influence of the gender of the child on these response patterns.

### **Findings in Relation to the Context of Mozambique**

As was indicated in Chapter 1, the Mozambican mathematics curriculum for Grades 6 and 7 stipulates that all primary school children must (i) appreciate and understand the value and place of mathematics in the world and its use in other subjects; (ii) be interested and persist in the solution of difficult mathematics problems; (iii) be interested and hold positive beliefs and attitudes towards mathematics learning; and (iv) view mathematics as a useful working tool (Ministério de Educação, 2008b, p. 376-378: Translated from Portuguese by the researcher). In regard to these goals, the conclusions that were drawn from the main findings of this study are:

- Grade 7 boys and girls who participated in this study do not hold positive beliefs and attitudes towards mathematics learning. This is because they view mathematics as the most difficult subject they study in school and physical education the easiest. The pupils’ beliefs about mathematics learning are not ‘functional’ as they tend to attribute their failure experiences to task difficulty, and successes to external factors in their

environment (e.g., good teacher, help). The children are unsure as to whether ability and effort (the most functional causal attributions for success experiences) yield success in mathematics. Thus, the beliefs that the children have developed during the period of seven years of primary education contradict the goals and aspirations of the mathematics curriculum in Mozambique.

- A gender difference for perceived achievement was only noted in regard to ‘moral and civic education’ and benefited girls. It should be noted that one of the aims of this subject in Mozambican schools is teaching children the importance of good behaviour in the family, school, and society, and to obey rules for personal and collective hygiene and safety. By tradition, in Mozambican society girls tend to be, and are expected to be, polite and obedient. Girls also are more likely than boys to be censored due to their behaviour. This may explain why girls ranked their achievement at moral and civic education much higher than boys. However, it should be noted that the differential socialisation of *rule-following* (girls tend to follow rules taught by the teacher or illustrated in textbooks) and *risk-taking* (boys do not follow predetermined rules and invent their own strategies to solve mathematical problems) has been used to explain why girls, on average, outperform boys in low level mathematics and, conversely, boys outperform girls in high level mathematics (see Villalobos, 2009).
- Age of the child was the most important factor influencing the dependent variables in this study. This is probably because Grade 7 is composed of children from dispersed ages that range from 11 to 16 years. The youngest children held more positive affective views towards mathematics learning than the older ones. These age differences indicate that the older children started schooling late or may have repeated grades, and thus, their experiences in mathematics education differ from those of the younger children.
- Although the children were very interested in this study, their ability to read and to write may have hindered their responses. Some children were unable to write the name of occupations they were interested in, or to

justify why they were interested in a particular occupation. Similarly, parents' lack of knowledge of the relationship between mathematics and occupations was striking. Parents' educational expectations for their children were high, however, many did not have any specific occupational aspiration for their children. That is, they were happy with any employment for their children. There are several possible reasons for this. First, it may be that parents had not previously thought about this issue; second, parents may have avoided mentioning occupations when they know that there are no resources in the environment that will ensure their occupational aspirations for their children will come true.

- Children's beliefs and attitudes towards mathematics learning tended to deteriorate with the decrease of parental education, geolocation (from urban to rural, to remote schools), increase in number of siblings, and the lack of selected economic resources at home.

The results from this study were interpreted considering the Mozambican context. Since in Mozambique mathematics may not be identified with many professions available to the people, parents may have viewed mathematics as less useful for their children than the children themselves viewed it. Also, as many parents may themselves have had negative experiences in mathematics education (see interview data in Chapter 6), they viewed mathematics as too difficult for themselves and for their children.

Physical education is an outdoor activity that engages all children. On the other hand, mathematics, the mathematics curriculum, and the expository teaching methods and assessments accompanying it, are associated with clever people. This may explain why parents and the children themselves believed mathematics is the most difficult subject and physical education the easiest subject of the curriculum.

Calculators, either graphic or simple, are valuable instruments for mathematics learning in primary schools in many countries around the world in the 21<sup>st</sup> century.

However, as indicated earlier, in Mozambique this is not the case to date. Thus, informal use of the calculators in mathematics classrooms or at home may explain why possession of this device did not boost perceived achievement, confidence, and perceived usefulness of mathematics. That is, calculators are not associated with the mathematics classroom.

The results of this study have several implications for Mozambique, and probably also in countries with similar contexts. Some of these implications are outlined next.

### **Implications for Government Policy, Teacher Education, and Mathematics Teaching**

The results from this study are important to education in Mozambique. The literature has demonstrated that parents' beliefs and attitudes towards the study of mathematics for their children influence the children's affect and performance in mathematics (Eccles & Jacobs, 1986; Frome & Eccles, 1998; Jacobs, 1991; Jacobs & Eccles, 1992). Thus, the results of this study have implications for several areas starting with government policy, teacher education and development, and mathematics teaching.

With respect to the role of the government, the results suggest the necessity of designing and implementing intervention programs aimed at supporting low income parents, and parents with less education in order to eliminate the probable negative impact of family illiteracy and economic deprivation on children's educational outcomes. The USA and Australia have a long tradition of designing and implementing such intervention programs. Thus, the Mozambican government may learn from past intervention programs that were conducted in these countries such as *Family Math* (Vasey, 1989), and the *Mathematics Multiplies Your Choices* campaign (McAnalley, 1991). These two intervention programs are particularly relevant to the context of Mozambique because they target girls and their parents.

The *Family Math* project was developed in the USA (Vasey, 1989), and due to its pertinence to students, parents, and school communities, subsets of the program such as *Family Science* have been developed and used outside the USA. The relevance of an intervention program similar to *Family Math* in Mozambique is because parents and other family members would have the opportunity to learn how to help their children with homework and how to design and maintain an appropriate environment for learning at home; parents also would learn how mathematics is related to other school subjects and occupations. Students and parents need to know that mathematics is important for further education and for jobs. Mullis et al. (2008) stated that many students are interested in mathematics, even if they do not really like the subject, due to their perceptions that mathematics will help them to get the job of their aspiration in the future.

The *Mathematics Multiplies Your Choices* campaign was officially launched in 1989 by the Victorian (Australia) Department of Labour and used all forms of media to raise peoples' awareness about gender segregation in the labour market in Victoria. The campaign was aimed at encouraging parents to have a broader perspective about jobs for their daughters and how mathematics influences their daughters' careers (McAnalley, 1991). The *Mathematics Multiplies Your Choices* project was successful as it influenced girls' enrolments in mathematics and science courses. Due to its success in Victoria, the project was adopted by other Australian states (see McAnalley, 1991).

The *Family Math* and the *Mathematics Multiplies Your Choices* interventions involved parents and were successful. However, to adopt them in Mozambique, it is important to consider some factors that contribute to the success of an intervention initiative. In their comprehensive literature review of intervention programs conducted



during a period of 35 years around the world, Leder et al. (1996) identified several factors that make a successful intervention program. These are: goals need to be realistic and manageable; the population target needs to be clearly defined (e.g., low-income parents); goals need to reflect the needs of the population target; participants should be involved in the design and delivery of the intervention program and to assume responsibilities; the intervention program needs to get support from the government; there should be sufficient budget or the ability to fundraise; there should be external people in the project such as advisers, role models, and guest speakers; the intervention program should be sufficiently disseminated among the target group; the program should be evaluated regularly by external experts and activities adjusted based on the identified needs of the participants. In regard to learning strategies, these authors indicate that intervention programs tend to be more successful if participants work together in cooperative tasks than individually.

The findings from this study also have implications for teacher education and/or development, and mathematics teaching in primary and secondary school classrooms in Mozambique. Until recently, the curriculum for mathematics teacher education either for primary or secondary schools had not considered gender issues and affective factors in mathematics learning comprehensively. For example, at the pedagogical university, the second largest public university and the biggest public institution for teacher training, the curriculum focuses on cognitive aspects of mathematics learning. More than 90% of the topics that prospective teachers study and investigate in schools as part of their training deal with misconceptions and errors that students make during their work with negative numbers, elementary algebra, functions, and reading graphs. Studies conducted towards understanding the impact of gender, parents, and cultural factors on students' difficulties with mathematics are rare. Linda Sidumo is one of the

first students in the teacher education program who examined a gender issue in Grade 6 mathematics classrooms (Sidumo, 2008). Sidumo examined the way mathematics teachers interacted with boys and girls by counting the number of questions they asked to girls and to boys. The sample was made up of 50 mathematics teachers and involved 20 primary schools in Beira city. Sidumo noted that the proportion of questions boys were asked compared to the questions asked to girls was 3.5:1. Sidumo also noted that half of the questions that girls were asked were not related to mathematics but to disciplinary problems and classroom organisation. An internal staff member assigned to examine the student's work was impressed by the findings. The surprise of the internal examiner indicated that some lecturers at the pedagogical university may not be aware of the potential sources of gender differences in mathematics learning outcomes in primary schools. Similarly, the analyses of Grade 6 and 7 mathematics textbooks conducted by Murimo and Forgasz (2007) revealed that male characters and male names have been used most often as illustrations and references in word problems than female characters and female names. Although gender differences in educational and occupational outcomes persist in Mozambique, it appears that the society takes them for granted.

In this study the relationships between Grade 7 pupils' beliefs and attitudes towards mathematics learning and parents' views, and family circumstances were evident. Primary school mathematics teachers need to be aware of these issues and to be able to use appropriate strategies to challenge them. To do this, teacher training institutions and teacher development programs must be prepared and responsive. Secondary school mathematics teachers also need to know the beliefs and attitudes towards mathematics learning that pupils bring from primary to secondary school so that they can take measures to address them. Research has shown that competence

beliefs, utility values, and achievement goals tend to decline with age, grade level, and subject domain (Jacobs et al., 2002). This means that if Grade 7 pupils have developed negative affective views towards mathematics learning to change the situation may be difficult later.

It is worth noting that although positive beliefs, and attitudes towards mathematics are addressed as legitimate and desirable objectives of mathematics education in Mozambique, they are not taught explicitly in mathematics classrooms. However, they may be developed inside and outside the classrooms. Thus, the teacher needs to be able to monitor these objectives regularly and by topic if necessary. Parsons et al. (2009) suggested monitoring 'topic confidence' because it is relatively unstable and easier to change than 'overall mathematics confidence'. Explicit discussion of children's views in the classroom might also contribute to students' understanding of the consequences of holding particular beliefs and attitudes on performance, further education, and careers. To conduct this kind of classroom discussion, the teachers will need to have access to the relevant literature in the field of mathematics education, and to have participated in similar discussions during teacher training or teacher development programs.

### **Limitations of the Current Study**

The results of this study are important to the context of Mozambique. However, the study had some limitations. The interviews, although important to understand the survey data, only involved ten parents and the principals from the five participating schools. The children were not interviewed and interviews could have been useful because there were children with difficulties in writing. Also, the models of gender differences in mathematics learning outcomes implicate several factors that were not considered in this study. For example, beside the variables that were examined, Leder's

(1990) model of gender differences in mathematics learning also includes schools (e.g., teachers, organisation, curriculum, textbooks, assessment, and peers). Higgins (1997) also pointed out that mathematics classroom experiences are critical in the formation and development of children's affective views towards mathematics. Thus, the school-related variables are important to examine in primary schools in Mozambique as the majority of primary school teachers have less than two years of professional qualification and others have no qualifications at all (Passos et al., 2012).

Other factors contributing to persistence of gender differences in education in developing countries not investigated in this study were recently reported by UNESCO (2012). UNESCO (2012) indicated that in developing countries the long walking distances to school influences school attendance particularly for girls; the lack of female teachers send negative messages to girls (and parents) that school is not a female-friendly environment. UNESCO (2012) also indicated that females and males in developing countries do not have the same chance of getting a job even if they have the same qualifications, and this discourages most parents from investing in the education of their daughters, as they are not sure whether there will be any economic return.

The translation of the survey instruments from English into Portuguese was important for most parents in Mozambique; however, there were parents who needed translation from Portuguese into native languages. Although there was always a family member available to translate the items for them, the quality of the translations from Portuguese into the vernaculars was out of the control of the researcher.

Another possible limitation of the study was that the participants were a convenient sample, that is, they were all volunteers from selected Mozambican schools from only one of the 11 provinces in the country. The sampling of schools was

considered representative with respect to geolocations across Mozambique. However, the findings may have been different if the research design had involved a representative, random sample of schools and participants from those schools. Ethics requires that school and individual participation must be voluntary. Pragmatically, true randomness is not possible.

Although the participating children volunteered to take part in the study, some of them were not good at writing, so it is possible that they were not good at reading the items on the survey forms. Thus, children with difficulties in reading and interpreting the Likert-type items may have provided responses not truly representative of their views. However, this bias was reduced as the sample size was reasonably high and mean scores were used to examine most of the quantitative data.

This is one of the few studies conducted in the context of Mozambique with the aim of examining the impact of parents' views, and family circumstances on Grade 7 children's beliefs and attitudes towards mathematics learning using surveys and interview methods. Several independent variables that have statistically significant relationships with Grade 7 students' affective views towards mathematics learning were identified; however, it is not clear whether the results would be replicated in other Mozambican provinces. Based on these limitations, some additional research questions have emerged from this study and they are discussed in the next section to guide future research.

## **Directions for Future Research**

The research findings and the limitations described so far call for more research attention in order to substantiate the conclusions drawn in this study. Gender disparities in enrolments in primary schools favouring boys are higher in the northern and central

provinces of Mozambique than in the south (Ministério de Educação, 2008a, 2010). In the south provinces of Inhambane, Gaza, Maputo Province, and Maputo Cidade, the trend is to have more girls in school than boys. Thus, if the present study could be replicated in all Mozambican provinces, the factors associated with children's beliefs and attitudes towards mathematics learning could be understood more broadly.

This study involved children whose ages ranged from 11 to 16 years and the impact of age on children's responses was highly statistically significant. The children aged 11 years reported more positive beliefs and attitudes towards mathematics learning than the older children. Based on this result it is worth investigating whether children from earlier years hold more positive beliefs and attitudes towards mathematics education and why they change as they get older.

The children's achievement in mathematics was not examined in this study; only perceptions of achievement were considered. In order to develop a model that best explains the variation of academic achievement and affective views future studies should also examine the children's achievement scores in mathematics and other subjects.

The educational aspirations of the majority of the children were high and so were the parents' educational aspirations for their offspring. However, as Professor Trevor Gale (personal communication, November, 01, 2012) indicated, aspirations can be transformed into reality only if appropriate resources exist in the environment of the learner, and if the learner knows what needs to be done to realise their aspirations. In this study the respondents were not asked what they need to do to ensure that their aspirations occur in the future. Thus, future studies should examine not only the

individuals' aspirations but also the knowledge of the steps to be taken to achieve the aspirations.

The advantages of a mixed methods research design that combined quantitative (surveys) and qualitative (interviews) data were evident in this study. The large amounts of the survey data that were examined using SPSS and Excel provided a general overview of the quantitative data. The interview data confirmed most of the survey results and helped explain the trends in the quantitative data. As some children had difficulties writing, and probably in reading the survey items, as did several parents, future studies should consider interviewing children as well. In using interviews, questions can be asked in a language that the participant understands better, such as the vernaculars.

The data from this study revealed no impact of home languages on children's beliefs and attitudes towards mathematics. But, given that understanding of the language of instruction (e.g., Portuguese) is crucial to the understanding of mathematics, as revealed in the TIMSS studies (Mullis et al., 2008), it is possible that children who speak languages other than the medium of instruction at home also have lower achievement, particularly in rural and remote regions of the country. Thus, to understand the role of home languages on pupils' educational outcomes this variable should be re-examined.

Several parents interviewed believed their children were not good at mathematics due to the teacher. The literature also suggests that students' achievements in mathematics can be influenced by the teachers' classroom actions, beliefs, and expectations for different groups of children in the classroom (Reyes & Stanic, 1988). To increase understanding of the problems associated with mathematics education in

primary schools, teachers' views and practices should be monitored regularly and support provided when necessary.

The children believed external sources were the most plausible reasons for their success in mathematics. Future studies should try to understand the kind of help from the teacher and from external sources that benefit the children. It is possible that motivational help – to encourage the child to try by herself/himself - would be more aligned with contemporary teaching methods that emphasise experimentation and discovery rather than memorising, and rule-following (Buxton, 1981; Villalobos, 2009).

Mathematics textbooks and other curriculum materials should be examined to determine the extent to which they address gender equity issues and reflect a multicultural society. To help identify equity issues that are relevant to examine in the curriculum materials in Mozambique, a checklist proposed by Forgasz (1996) may be useful.

The expectancy-value theory (Eccles et al. 1983) stresses the importance of students' perceptions of their parents' attitudes, values, and aspirations, and therefore studies have generally examined parental involvement in education using the students' reports rather than the parents' reports (e.g., Cheung & Pomerantz, 2012). In this study, parental involvement in education was determined using information from parents and school principals. Future research should also collect data from children not only to triangulate the data but also because the children's perceptions of their parents' actions influence their behaviour.

Through the Ministry of Women Affairs and Social Welfare, schools in Mozambique have established the Gender Issues committees but the activities of these committees that are aimed at ensuring equal educational outcomes were not identified.



However, the committees offer context and environment to introduce activities aimed at ensuring that all children produce equal learning outcomes in order to ensure that they have equal life opportunities.

## **Concluding Statement**

This study is unique in terms of the context in which it was conducted, participants (300 Grade 7 children, 225 parents and guardians of these children, and 5 principals of the participating schools), and the variables examined. The key roles that the age of the child, parental education, geolocation, number of siblings, and possession of selected economic resources play on Grade 7 girls' and boys' beliefs and attitudes towards mathematics learning have been identified. Variables such as home language, parental occupation, and possession of textbooks for reading and for mathematics, calculators, and cell phones did not explain the variation of scores on dependent variables. But this does not imply that these variables are not influencing educational outcomes. This is perhaps due to data collection problems and future research is necessary to re-examine these variables more carefully.

Consistent with the traditional views that mathematics is as a male domain, Grade 7 males and parents tended to gender stereotype mathematics learning as a male preserve. Grade 7 females, in contrast, tended to view mathematics learning as a gender-neutral domain. Also, in some countries the trend to view girls as equally mathematically capable if not better than boys is stronger than in other parts of the world. The perception that girls are more likely than boys to enjoy mathematics, to hold functional beliefs, and to be mathematically capable was noted among students in Australia (Leder & Forgasz, 2002a; Forgasz et al., 2004) and France (Martinot & Désert, 2007). Thus, the Grade 7 females' perceptions that mathematics learning is equally suitable for boys and girls noted in the current study replicate these previous

findings and reinforce the claim that females endorse the view that mathematics is a male domain less strongly than males (see Leder et al., 1996; Tiedemann, 2000).

As indicated by the United Nations, the time has come that all governments must invest in intervention programs as a strategy to bring about equity in education because equal opportunity in enrolments for females, males, and disadvantaged groups per se does not ensure equality in educational outcomes (UNESCO, 2012). Unless efforts are made to redress inequalities in education and labour market outcomes, Mozambique may not be able to compete with other countries, and internal social and political conflicts possibly will continue to characterise Mozambican society for generations to come. Without concrete actions there is no guarantee that the ‘status quo’ will change any time soon for the better.

The recent discoveries of large reserves of oil, gas, and mineral resources in several Mozambican provinces are examples illustrating how important mathematics, science, and technology are for the future of Mozambique. In order to seize the opportunities and increase the likelihood of being able to work in these sectors, the children and parents need to appreciate the importance and relevance of mathematics and related fields. If parents view mathematics as ‘a beast of seven heads’ for their children, as a field for ‘clever people’, or concerned with counting, calculating, and memorising tricks, they might inadvertently be putting ceilings on their children’s opportunities to access more rewarding jobs in the future. These beliefs have consequences not only at the individual level but also for the development of the country. Without mathematically competent citizens Mozambique will not be ready to respond to the challenges imposed by the technological and globalised world of the 21st century. As happens today in Mozambique, the country might continue depending on

foreign skilled labour and technology to explore its vast resources while the nationals continue living under the poverty line because they do not have the 'know-how'.

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# Appendices

## Overview

Six appendices accompany this thesis. Appendix 1 includes the letter of approval from the Monash University Human Research Ethics Committee (MUHREC) to conduct this research, permission letters to conduct the study in three districts of Sofala Province (Mozambique), explanatory statements and consent forms related to the study for three groups of participants: students, parents, and school principals.

The survey instruments for students and for parents are presented in Appendices 2 and 3, respectively.

Full transcripts of interviews conducted with one father, one mother, and one school principal are presented in Appendices 4, 5, and 6, respectively.

## **Appendix 1 Ethics forms**

- Appendix 1
- Letter of approval from the Monash University Research Ethics Committee.
  - Permission letters to conduct the study in three districts of Sofala Province: Education, Youth and Technology Services of Beira, Dondo, and Buzi.
  - Explanatory statements related to the study: students, parents, and school principals.
  - Informed consent forms: students, parents, and school principals.
-



## Human Ethics Certificate of Approval

Date: 3 February 2011

Project Number: CF10/2580 - 2010001437

Project Title: Parents' influence on boys' and girls' beliefs and attitudes toward mathematics in the context of Mozambique

Chief Investigator: Assoc Prof Helen Forgasz

Approved: From: 3 February 2011 To: 3 February 2016

---

### Terms of approval

1. The Chief investigator is responsible for ensuring that permission letters are obtained, if relevant, and a copy forwarded to MUHREC before any data collection can occur at the specified organisation. **Failure to provide permission letters to MUHREC before data collection commences is in breach of the National Statement on Ethical Conduct in Human Research and the Australian Code for the Responsible Conduct of Research.**
2. Approval is only valid whilst you hold a position at Monash University.
3. It is the responsibility of the Chief Investigator to ensure that all investigators are aware of the terms of approval and to ensure the project is conducted as approved by MUHREC.
4. You should notify MUHREC immediately of any serious or unexpected adverse effects on participants or unforeseen events affecting the ethical acceptability of the project.
5. The Explanatory Statement must be on Monash University letterhead and the Monash University complaints clause must contain your project number.
6. **Amendments to the approved project (including changes in personnel):** Requires the submission of a Request for Amendment form to MUHREC and must not begin without written approval from MUHREC. Substantial variations may require a new application.
7. **Future correspondence:** Please quote the project number and project title above in any further correspondence.
8. **Annual reports:** Continued approval of this project is dependent on the submission of an Annual Report. This is determined by the date of your letter of approval.
9. **Final report:** A Final Report should be provided at the conclusion of the project. MUHREC should be notified if the project is discontinued before the expected date of completion.
10. **Monitoring:** Projects may be subject to an audit or any other form of monitoring by MUHREC at any time.
11. **Retention and storage of data:** The Chief Investigator is responsible for the storage and retention of original data pertaining to a project for a minimum period of five years.



Professor Ben Canny  
Chair, MUHREC

cc: Mr Adelino Evaristo Murimo

Postal – Monash University, Vic 3800, Australia  
Building 3E, Room 111, Clayton Campus, Wellington Road, Clayton  
Telephone +61 3 9905 5490 Facsimile +61 3 9905 3831  
Email [muhrec@adm.monash.edu.au](mailto:muhrec@adm.monash.edu.au) [www.monash.edu/research/ethics/human/index/html](http://www.monash.edu/research/ethics/human/index/html)  
ABN 12 377 614 012 CRICOS Provider #00008C



REPUBLIC OF MOZAMBIQUE  
SOFALA PROVINCE  
GOVERNMENT OF BEIRA CITY

**EDUCATION, YOUTH AND TECHNOLOGY SERVICE OF BEIRA CITY**

Beira, this 13<sup>th</sup> of August 2010

To  
**Mr. Adelino Evaristo Murimo**  
=Australia=

Dear Sir

Hereby the Directorate of Education, Youth and Technology Service of Beira city informs that you are authorized to perform the data collection of the grade 7 students, their parents, mathematic teachers, and 3 school headmasters teaching grade 7 in Beira city for the execution of research work for the Doctorate degree in mathematics teaching.

Yours very truly.

The DEYTC Director

Stamped by DEYTS  
Signed/  
(Teixeira José Basilio)  
=N2 Teacher=



[Emblem of Rep. of Moz]  
REPUBLIC OF MOZAMBIQUE  
SOFALA PROVINCE  
GOVERNMENT OF BUZI DISTRICT

Dear Sir  
Adelino Evaristo Murima

=Australia=

Dondo, 25 / 11 / 2010

Our Ref/ 1104/019/ 2010

Subject: *Authorization for data collection*

Hereby the District Service of Education, Youth and Technology of Dondo informs you that you are authorized to perform the data collection work for research purposes.

Stamped

The Director  
Signature  
(Luis Tembe)  
NI Teacher

SWORN TRANSLATOR



Checked  
The Administrator of Buzi District  
Signed & Stamped  
Joaquim Jose Arota

[Emblem of Rep. of Moz]  
REPUBLIC OF MOZAMBIQUE  
GOVERNMENT OF BUZI DISTRICT  
DISTRICT SERVICES OF EDUCATION, YOUTH AND TECHNOLOGY

To:  
Mr. Adelino Evaristo Murima

Buzi, November 19, 2010

AUSTRALIA

Our Ref/ 713/900/GAB/P3/2010

Subject: Authorization

According to Mr. Adelino Evaristo Murima's application, requiring a research on Grade 7, Mathematics Teaching, at Buzi, II Primary Education, the District Services of Education, Youth and Technology has the honor to inform you that your request has been granted.

Stamped  
The Headmistress  
Signature  
(Leonor Antonio Langa)  
N2 Teacher

SWORN TRANSLATOR  
TRADUTOR JURADO  
S. P. A.  
CHISSICO  
TEL. 323801  
Beira





Explanatory Statement for Students

2010-August -26

**Parents' influence on boys' and girls' beliefs and attitudes toward mathematics in the context of Mozambique**

My name is **Adelino Evaristo Murimo**. I am a full time student at Monash University, Australia, doing research towards a Doctor of Philosophy Degree in Education in the Faculty of Education under the supervision of Associate Professor **Helen J. Forgasz**. This means that I will be writing a thesis which is equivalent of a 300 pages by the end of 2013. The purpose of this study is to find out what you think and how you feel about mathematics.

The overall study seeks to understand the girls' and boys' beliefs and attitudes toward mathematics. As you know, mathematics is a core subject of the school curriculum and most students have difficulties with the subject. The findings of the study might help educational planners in addressing informed policies aimed at improving mathematics learning for girls and boys in our schools.

**Research site and power relations**

The study will be conducted in Beira, Buzi, and Dondo and will involve 300 students (150 girls and 150 boys), their parents (150 mothers, 150 fathers) or principal caregivers, mathematics teachers, and the school principals. We have been granted permission from the Ministry of Education Authorities to conduct this research in your

school given that you accept to work with us and your parents authorize you to participate in our study. I used to be a teacher long ago, but now I have not any role associated with the Ministry of Education. I am a student like you and I represent Monash University, Australia.

### **Potential participants of this study**

To participate in this study you need to study in grade 7 in 2011, and you need to be enrolled in one of the government schools authorized for this research (i.e., 3 schools in Beira, 1 school in Buzi, and 1 school in Dondo). If you consent to participate you will have to sign a consent form, and because you are under 18 years old, your parent will need to authorize your participation in the study by signing a consent form too. Before you accept to participate you must explain your parents the aims of the study and ask them whether they are interested in taking part in the study as well. You will be accepted to participate only if your parents (mother or father) or your guardian will participate in the study.

### **Inclusion and exclusion criteria**

You will be included in the study only if your parent (mother or father) will be able to come to school to fill a questionnaire. If you are interested in the study but your parents are not, you should bring a guardian who often responds for your school issues.

### **Data collection**

Data collection for this study will commence in February 2011. Before any data collection begins we will visit your school and talk to you for a period of one week. In this period we will explain you the aims of our study and you will sign a consent form. In the second week we will ask you to come to school to complete a survey. You may come to school in the morning or afternoon depending on your class time. You will have two occasions to complete the questionnaires. You will complete the questionnaires in our presence so that we can help you in case you have difficulties.

### **Consent form**

At the beginning of the study you will be given a consent form to fill out. A consent form is a written record of your decision to take part in the research study. Only if you consent to participate you will be included in the study.

### **What does the research on students involve?**

A questionnaire/survey will be used to collect your background data, your self-perception of ability, your confidence in mathematics learning, your perceived usefulness of mathematics, stereotyping of mathematics, and attribution style in mathematics. We will ask you about your family and things you have in your home. For example, we want to know if you have electricity, piped water, TV set, and a Radio in your home. We also want to know the language that you speak at home most often, the level of education of your parents, and their jobs.

### **Time**

You will be asked to complete a survey on two occasions. On occasion 1 you will spend 45 minutes completing the first part of the Survey Booklet. On the second occasion you will be given another 45 minutes to complete the second part of the Survey Booklet. The overall survey is prepared for 90 minutes. You will not take the questionnaires home as we want you to fill them in our presence. In this way you will have a better opportunity to ask us questions in case of difficulties.

### **Inconvenience/discomfort**

The questions included in the survey are not likely to cause you distress or inconveniences. However, if something serious occurs during the completion of the surveys we will ask assistance from the schools or local health services. If the surveys contain questions you consider inadequate we encourage you to let us know or to write a comment at the end of the questionnaire on the space provided.

### **Sphere of interests**

By examining the students' beliefs and attitudes toward the study of mathematics, my interest is building hypotheses on the role played by the 'significant others'. That is, I want to know how parents, teachers, and school principals influence differently the girls' and the boys' beliefs and attitudes toward mathematics learning in Sofala Province.

## **Payment**

There is no payment or reward for your participation. Non-participation will not affect your academic results; that is, you will not be penalised or disadvantaged in any form. In the unlikely event that you feel discomfort we strongly encourage you to discontinue and contact us.

## **Storage of data**

Storage of data collected will adhere to the University regulations and be kept on University premises in a locked filing cabinet for 5 years.

## **Confidentiality and anonymity**

Data will be deidentified prior to any publication of the study. False names will be used for individual participants and school names, data transcripts, and publications. Only the supervisor and I will have access to raw data.

## **Can I withdraw from the research?**

Participation in the study is voluntary and you are under no obligation to consent to participation. If you consent to participate, you still may withdraw at any time. However, collected information will be used as deidentified data after the researchers have received express permission from you.

## **Results**

Deidentified findings will be published in thesis, journal articles and conference papers. The final submission of this work is expected to be by 2013; hence the final thesis will be accessible from December 2013. If you would like to be informed of the research findings, please contact Adelino Evaristo Murimo

( [REDACTED] or alternatively, [REDACTED] )

## Queries

|   |  |
|---|--|
| <p>If you would like to contact the researchers about any aspect of this study, please contact the Chief Investigator:</p>  | <p>If you have a complaint concerning the manner in which this research &lt;CF10/2580 - 2010001437&gt; is being conducted, please contact:</p>   |
| <p>Associate Professor Helen Forgasz<br/>Associate Dean Clayton<br/>Faculty of Education<br/>Monash University<br/>Wellington Road<br/>Victoria 3800<br/>Room: G09<br/>Phone: [REDACTED]<br/>Fax: [REDACTED]<br/>[REDACTED]</p> | <p>Zacarias Alexandre Ombe<br/><br/>Director of the Pedagogical University,<br/>Beira Delegation, Mozambique<br/><br/>Postal 2025<br/><br/>Tel: [REDACTED]<br/><br/>Fax: [REDACTED]<br/><br/>Email: [REDACTED]</p> |



## Explanatory Statement for Parents

2010-August -26

# **Parents' influence on boys' and girls' beliefs and attitudes toward mathematics in the context of Mozambique**

My name is **Adelino Evaristo Murimo**. I am a full time student at Monash University, Australia, doing research towards a Doctor of Philosophy Degree in Education in the Faculty of Education under the supervision of Associate Professor **Helen J. Forgasz**. This means that I will be writing a thesis which is equivalent of a 300 pages by the end of 2013. The purpose of the study is to find out your opinion about boys' and girls' mathematics learning.

The overall study seeks to understand the girls' and boys' beliefs and attitudes toward mathematics. As you know, mathematics is a core subject of the school curriculum and most students have difficulties with the subject. The findings of the study might help educational planners in addressing informed policies aimed at improving mathematics learning for girls and boys in our schools.

### **Research site and power relations**

The study will be conducted in Beira, Buzi, and Dondo and will involve 300 students (150 girls and 150 boys), their parents (150 mothers, 150 fathers), mathematics teachers, and the school principals. We have been granted permission from the Ministry of Education Authorities to conduct this research in your child's school given that you authorize us to work with your child. I used to be a teacher in Mozambique for many years. Now I am not associated with the Ministry of Education. I am a student and I represent the Monash University in Australia.

### **Potential participants of this study**

We would like to work with at least one parent or guardian of each child who completed our surveys. If you are the mother, father or principal caregiver of one of the grade 7 children, we invite you to participate in this study.

### **Inclusion and exclusion criteria**

You will be included in the study only if your child has completed the questionnaire and you signed a consent form. If you are interested in the study but your child did not complete the questionnaire you may participate in an interview but you may not complete a questionnaire because the survey was elaborated to match data from the parent and the child.

### **Data collection**

Data collection for this study will commence in February 2011. Before any data collection begins we will visit your child's school during one week. In the first week we will send you the information kit detailing the study. In the second week your child will complete a survey. In the third week we will invite you to come to school to complete a survey. You may come to school in the morning or afternoon depending on your availability. You will complete the questionnaires in our presence so that we can help you in case of difficulties. If are invited to participate in an interview, interviews will be conducted in the third week.

### **Consent form**

At the beginning of the study you will be given a consent form to fill out. A consent form is a written record of your decision to take part in the research study. Only those who consent to participate will be included in the study.

### **What does the research on parents involve?**

In this study we will ask your child about his/her family members and things you have at home, such as electricity, TV set, piped water, and radio. As a parent or guardian we will ask what you think about the academic orientation of your child and

what you think about females' and males' mathematics learning. We also want to know how often you attend meetings at school and help your child with homework.

### **Time**

You will spend 90 minutes filling a questionnaire at school. Interviews will last no more than 45 minutes.

### **Inconvenience/discomfort**

The questions included in the survey and/or interviews are not likely to cause you distress or inconveniences. However, if something serious occurs during the completion of the surveys or interview we will ask assistance from the schools or local health services. If the study contains questions that you consider inadequate we encourage you to let us know or to write a comment at the end of the questionnaire on the space provided.

### **Sphere of interests**

By examining parents' views about mathematics learning for their sons and daughters, our interest is building hypotheses on formation and development of differential beliefs and attitudes towards mathematics learning for girls and boys.

### **Payment**

There is no payment or reward for your participation. Non-participation in the research will not affect your child's academic results and will not be penalised or disadvantaged in any form. In the unlikely event that you feel discomfort we strongly encourage you to discontinue and contact us.

### **Storage of data**

Storage of data collected will adhere to the University regulations and be kept on University premises in a locked filing cabinet for 5 years.

### **Confidentiality and anonymity**



Data will be deidentified prior to any publication of the study. Pseudonyms will be used for individual participants and school names, data transcripts, and publications. Only the supervisor and I will have access to raw data.

### **Can I withdraw from the research?**

Participation in the study is voluntary and you are under no obligation to consent to participation. If you consent to participate, you still may withdraw at any time. However, collected information will be used as deidentified data after the researchers have received express permission from you.

### **Results**

Deidentified findings will be published in thesis, journal articles and conference papers. The final submission of this work is expected to be by 2013; hence the final thesis will be accessible from December 2013. If you would like to be informed of the research findings, please contact Adelino Evaristo Murimo

( [REDACTED] or alternatively, [REDACTED]

### **Queries**

|   |  |
|---|--|
| If you would like to contact the researchers about any aspect of this study, please contact the Chief Investigator:   | If you have a complaint concerning the manner in which this research < CF10/2580 - 2010001437> is being conducted, please contact:   |
| Associate Professor Helen Forgasz<br>Associate Dean Clayton<br>Faculty of Education<br>Monash University<br>Wellington Road<br>Victoria 3800<br>Room: G09<br>Phone: [REDACTED]<br>Fax: [REDACTED]<br>[REDACTED] | Professor Zacarias Alexandre Ombe<br><br>Director of the Pedagogical University,<br>Beira Delegation<br><br>Postal 2025<br><br>Tel: [REDACTED]<br><br>Fax: [REDACTED]<br><br>Email: [REDACTED] |



## Explanatory Statement for School Principals

2010-August, 26

# **Parents' influence on boys' and girls' beliefs and attitudes toward mathematics in the context of Mozambique**

My name is **Adelino Evaristo Murimo**. I am a full time student at Monash University, Australia, doing research towards a Doctor of Philosophy Degree in Education in the Faculty of Education under the supervision of Associate Professor **Helen J. Forgasz**. This means that I will be writing a thesis which is equivalent of a 300 pages by the end of 2013. I am interested in knowing your personal opinion and experience about females' and males' mathematics learning.

The overall study seeks to understand the girls' and boys' beliefs and attitudes toward mathematics. As you know, mathematics is a core subject of the school curriculum and most students have difficulties with the subject. The findings of the study might help educational planners in addressing informed policies aimed at improving mathematics learning for girls and boys in our schools.

### **Research site and power relations**

The study will be conducted in Beira, Buzi, and Dondo and will involve 300 students (150 girls and 150 boys), their parents (150 mothers, 150 fathers), mathematics teachers, and the school principals. We have been granted permission from the Ministry of Education Authorities to conduct this research in your school given that you accept to work with us. I used to be a teacher trainer at Chingussura/Inhamizua Teacher Training School (1986-1998). Presently, I am representing Monash University, Australia, and have no association with the Ministry of Education in Mozambique.

### **Potential participants of this study**

As the principal you are entitled to participate in an interview where you will be asked questions related to teachers, parents, and students' performance in your school. There will be no right or wrong answer. We only want to know your views about several issues related to mathematics learning for boys and girls in your school.

### **Inclusion and exclusion criteria**

You will be included in the study only if you are the school principal or teach the subject of mathematics in the school and have signed a consent form.

### **Data collection**

Data collection for this study will commence in February 2011. Before any data collection begins we will visit your school during one week. In the first week we will send you the information kit detailing the study. In the second week we will work with your students. In the third week we will invite you to a short interview. The interview will be conducted in your school when you are available.

### **Consent form**

At the beginning of the study you will be given a consent form to fill out. A consent form is a written record of your decision to take part in the research study. Only those principals who consent to be interviewed will participate in the study.

### **What does the research on school principals involve?**

Basically, it will be a short conversation to know your personal opinion about parents' involvement in the education of their children. No other person will be present during the interview. If you consent, the interview will be audio-recorded to facilitate data collection. No one will know what you have said during the interview other than my supervisor and I.

### **Time**

The interview will last approximately 45 minutes.

### **Inconvenience/discomfort**

The questions asked during the interviews are not likely to cause you distress or inconveniences. However, if something serious occurs during the conversation we will ask assistance from the school staff or local health services. If we ask you questions that you consider inadequate let us know.

### **Sphere of interests**

We are interested in parents' involvement in the education of their children. Our aim is to build hypotheses about the level of family commitment to the education of their children.

### **Payment**

There is no payment or reward for your participation. Also, you will not be penalised or disadvantaged in any form if you decide not to participate in the study. In the unlikely event that you feel discomfort we strongly encourage you to discontinue and contact us.

### **Storage of data**

Storage of data collected will adhere to the University regulations and be kept on University premises in a locked filing cabinet for 5 years.

### **Confidentiality and anonymity**

Data will be deidentified prior to any publication of the study. Pseudonyms will be used for individual participants and school names, data transcripts, and publications. Only the supervisor and I will have access to raw data.

### **Can I withdraw from the research?**

Participation in the study is voluntary and you are under no obligation to consent to participation. If you consent to participate, you still may withdraw at any time. However, collected information will be used as deidentified data after the researchers have received express permission from you.

## Results

Deidentified findings will be published in thesis, journal articles and conference papers. The final submission of this work is expected to be by July 2013; hence the final thesis will be accessible from December 2013. If you would like to be informed of the research findings, please contact Adelino Evaristo Murimo

( [REDACTED] or alternatively, [REDACTED] )

## Queries

|   |  |
|---|--|
| If you would like to contact the researchers about any aspect of this study, please contact the Chief Investigator:   | If you have a complaint concerning the manner in which this research < CF10/2580 - 2010001437> is being conducted, please contact:   |
| Associate Professor Helen Forgasz<br>Associate Dean Clayton<br>Faculty of Education<br>Monash University<br>Wellington Road<br>Victoria 3800<br>Room: G09<br>Phone: [REDACTED]<br>Fax: [REDACTED]<br>[REDACTED] | Professor Zacarias Alexandre Ombe<br><br>Director of the Pedagogical University,<br>Beira Delegation<br><br>Postal 2025<br><br>Tel: [REDACTED]<br><br>Fax: [REDACTED]<br><br>Email: [REDACTED] |



Consent form for students

**Parents' influence on boys' and girls' beliefs and attitudes  
toward mathematics in the context of Mozambique**

I agree to take part in the Monash University research project specified above. I have had the project explained to me, and I have read the Explanatory Statement, which I keep for my records. I understand that agreeing to take part means that:

I agree to complete questionnaires asking me about mathematics learning for girls and boys

I understand that my participation is voluntary, that I can choose not to participate in part or all of the project, and that I can withdraw at any stage of the project without being penalised or disadvantaged in any way.

I understand that any data that the researcher extracts from the questionnaire / survey for use in reports or published findings will not, under any circumstances, contain names or identifying characteristics.

Participant's name:

Signature:

Date:



**Consent form for parents regarding child's participation in the study**

**Parents' influence on boys' and girls' beliefs and attitudes  
toward mathematics in the context of Mozambique**

I agree for my daughter/son to take part in the Monash University research project specified above. I have had the project explained to me, and I have read the Explanatory Statement, which I keep for my records. I understand that agreeing to my child taking part means that:

I agree that my daughter/son will complete questionnaires asking her/him about mathematics learning for females and males.

I understand that her/his participation is voluntary, that she/he can choose not to participate in part or all of the project, and that she/he can withdraw at any stage of the project without being penalised or disadvantaged in any way.

I understand that any data that the researcher extracts from the questionnaire / survey for use in reports or published findings will not, under any circumstances, contain names or identifying characteristics.

Participant's name:

Signature:

Date:



**Consent form for parents and school principals**

**Parents' influence on boys' and girls' beliefs and attitudes  
toward mathematics in the context of Mozambique**

*NOTE: This consent form will remain with the Monash University researcher for their records*

I agree to take part in the Monash University research project specified above. I have had the project explained to me, and I have read the Explanatory Statement, which I keep for my records. I understand that agreeing to take part means that:

I agree to complete questionnaires/survey ☐ Yes ☐ No

I agree to be interviewed by the researcher ☐ Yes ☐ No

I agree to allow the interview to be audio-taped ☐ Yes ☐ No

I agree to make myself available for a further interview if required

☐ Yes ☐ No

and I understand that my participation is voluntary, that I can choose not to participate in part or all of the project, and that I can withdraw at any stage of the project without being penalised or disadvantaged in any way.

And I understand that any data that the researcher extracts from the questionnaire or interviews, for use in reports or published findings will not, under any circumstances, contain names or identifying characteristics.

And I understand that I will be given a transcript of data concerning me for my approval before it is included in the write up of the research.



And I understand that any information I provide is confidential, and that no information that could lead to the identification of any individual will be disclosed in any reports on the project, or to any other party.

And I understand that data from the audio-tape will be kept in a secure storage and accessible to the research team. I also understand that the data will be destroyed after a 5 year period.

Participant's name:

Signature:

Date:

## Appendix 2

### Survey Instruments for Students


Dear student,

Participation in this study is voluntary. There is no remuneration for participating and there is no penalisation for non-participating. Once you have accepted to participate, you can withdraw at any time if you like. To do so. Your name will not be used in any form in our reports.

The purpose of this questionnaire is finding out your views about mathematics learning for girls and boys. Do not worry because there are no right or wrong answers. We only want to know your opinion. The questionnaire is organised in six parts. You must complete each part before moving to the next part.

#### PART 1: STUDENT BACKGROUND

From question 1 to 12, we want to collect general information about you, your home, and your family. In most questions you will only have to choose the appropriate box by crossing

lines like this: 

But, in few other cases, you will have to write words or numbers.

1. Name:-----

|              |                                   |                                   |                                  |
|--------------|-----------------------------------|-----------------------------------|----------------------------------|
| 2. Residence | Beira<br><input type="checkbox"/> | Dondo<br><input type="checkbox"/> | Búzi<br><input type="checkbox"/> |
|--------------|-----------------------------------|-----------------------------------|----------------------------------|

|            |                                   |                                    |
|------------|-----------------------------------|------------------------------------|
| 3. You are | A boy<br><input type="checkbox"/> | A girl<br><input type="checkbox"/> |
|------------|-----------------------------------|------------------------------------|

|        |             |
|--------|-------------|
| 4. Age | _____ years |
|--------|-------------|

|                                  |              |
|----------------------------------|--------------|
| 5. Number of people in your home | _____ people |
|----------------------------------|--------------|

|                       |                |               |
|-----------------------|----------------|---------------|
| 6. Number of siblings | Brothers _____ | Sisters _____ |
|-----------------------|----------------|---------------|

7. The language most frequently spoken in your home.

|                                  |  |                                  |                                     |
|----------------------------------|--|----------------------------------|-------------------------------------|
| Sena<br><input type="checkbox"/> | Portuguese<br><input type="checkbox"/> | Ndau<br><input type="checkbox"/> | Other<br>(Please, specify)<br>_____ |
|----------------------------------|--|----------------------------------|-------------------------------------|

8. Things that you have in your home.

|   |   |  |                                       |                                      |  |
|---|---|--|---------------------------------------|--------------------------------------|--|
| Electricity<br><input type="checkbox"/> | Piped water<br><input type="checkbox"/> | Television<br><input type="checkbox"/> | Radio<br><input type="checkbox"/>     | Computer<br><input type="checkbox"/> | Internet<br><input type="checkbox"/>   |
| Car<br><input type="checkbox"/>         | Well<br><input type="checkbox"/>        | Telephone<br><input type="checkbox"/>  | Motorbike<br><input type="checkbox"/> | Bicycle<br><input type="checkbox"/>  | Water tank<br><input type="checkbox"/> |

9. Things that you have this trimester.

|   |                 |                          |
|---|-----------------|--------------------------|
| 1 | • Exercise book | <input type="checkbox"/> |
| 2 | • School bag    | <input type="checkbox"/> |
| 3 | • Pencil        | <input type="checkbox"/> |
| 4 | • Ruler         | <input type="checkbox"/> |

|    |                        |                          |
|----|------------------------|--------------------------|
| 5  | ● Pencil eraser        | <input type="checkbox"/> |
| 6  | ● Pen                  | <input type="checkbox"/> |
| 7  | ● Pencil sharpener     | <input type="checkbox"/> |
| 8  | ● File folder          | <input type="checkbox"/> |
| 9  | ● Reading textbook     | <input type="checkbox"/> |
| 10 | ● Mathematics textbook | <input type="checkbox"/> |
| 11 | ● Pair of compasses    | <input type="checkbox"/> |
| 12 | ● Protractor           | <input type="checkbox"/> |
| 13 | ● Calculator           | <input type="checkbox"/> |
| 14 | ● Laptop               | <input type="checkbox"/> |
| 15 | ● Cell phone           | <input type="checkbox"/> |
| 16 | School uniform         | <input type="checkbox"/> |
| 17 | Right angle ruler      | <input type="checkbox"/> |

10. About how many books are there in your home?

|   |  |   |  |  |
|---|--|---|--|--|
| 0 – 10<br>Books<br><input type="checkbox"/> | 11 – 25<br>Books<br><input type="checkbox"/> | 26 – 100<br>Books<br><input type="checkbox"/> | 101 – 200<br>Books<br><input type="checkbox"/> | More than 200<br>Books<br><input type="checkbox"/> |
|---|--|---|--|--|

11. The highest level of education completed by these people.

|                                    | Father                   | Mother                   | Older Brother            | Have no older brother    | Older sister             | Have no older sister     |
|------------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| University                         | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Upper Secondary<br>(Grade 11 – 12) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Lower Secondary<br>(Grade 8 – 10)  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Upper Primary (Grade 6<br>- 7 )    | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Lower Primary (Grade 1<br>– 5)     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Never attended school              | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Do not know                        | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

12. The jobs of these people.

| Father | Mother | Older brother | Have no older brother    | Sister | Have no older sister     |
|--------|--------|---------------|--------------------------|--------|--------------------------|
| _____  | _____  | _____         | <input type="checkbox"/> | _____  | <input type="checkbox"/> |

## PART 2: HOW GOOD ARE YOU?

1. On this page you will find 10 subjects that you are studying this year. For each subject we want to know how good you think you are. Read the name of each subject, and think about it for a while. Think whether you are excellent, good, average, below average, or weak in each subject. Now complete the table below.

|                                       | Excellent                | Good                     | Average                  | Below<br>average         | Weak                     |
|---------------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| Portuguese                            | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Visual and<br>Technology<br>education | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| English                               | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Natural sciences                      | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Social sciences                       | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Physics education                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Mathematics                           | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Musical education                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Moral and civic<br>education          | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Artwork                               | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

2. Select the highest level of education that you intend to complete before leaving schooling

| Grade 7                  | Grade 8                  | Grade 9                  | Grade 10                 | Grade 11                 | Grade 12                 | University               |
|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

Why did you choose this level of education?

---

3. Which profession would you like to have when you are about 30 years of age?

- 
4. Why are you interested in this profession?
- 

### PART 3: CONFIDENCE IN LEARNING MATHEMATICS

On this page there are 12 statements. There are no right or wrong answers for these statements. The statements were written in a way that allows you to indicate the extent to which you agree or disagree with the ideas expressed. Suppose the statement is:

**Example:**

*If I had the highest score in a mathematics test (i.e., 20 marks), I would not tell anybody*

As you read the statement you will know whether you agree or disagree with it. If you strongly agree that if you had the highest score in a mathematics test you would not tell anybody, then you would cross the box indicating *Strongly agree*. If you agree with the statement but with some reservations, that is, if you do not fully agree, then you should select *Agree*. If you disagree with the idea, indicate the extent to which you disagree by selecting *Disagree* or *Strongly disagree*. But, if you neither agree nor disagree, that is, if you are uncertain, you choose *Unsure*. Now complete statements 1 to 12.

|   | Strongly<br>agree        | Agree                    | Unsure                   | Strongly<br>Disagree     | Disagree                 |
|---|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| Mathematics has been my worst subject.  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| I am no good at mathematics.  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| I do understand most of the subjects, but mathematics is exceptionally too hard for me. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

|   |                          |                          |                          |                          |                          |
|---|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| I will not understand mathematics in grade 12 <sup>†</sup> .                  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| For some reason even though I study, mathematics seems unusually hard for me. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| I am not the type of person to do well in mathematics <sup>†</sup> .          | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| I will understand mathematics in grade 8 <sup>†</sup> .                       | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| I can get good grades in mathematics.   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Generally I have felt secure about attempting mathematics.                    | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| I am sure that I can learn mathematics.                                       | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| I have a lot of self-confidence when it comes to mathematics.                 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| I am sure I will take mathematics courses at university <sup>†</sup> .        | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

Note. <sup>†</sup>Items differ slightly from the original ones.

(Adapted from Fennema & Sherman, 1976).



## PART 4: PERCEIVED USEFULNESS OF MATHEMATICS

### Instructions:

On this page there are 14 statements about you. Read each statement carefully. Indicate the extent to which you agree or disagree with each statement.

|                 |  | Strongly agree           | Agree                    | Unsure                   | Disagree                 | Strongly disagree        |
|-----------------|--|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| 1 <sup>+</sup>  | Solving mathematics problems is interesting for me.                  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 2 <sup>+</sup>  | I would be upset to be just an average student in mathematics.       | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 3 <sup>+</sup>  | Understanding mathematics has many benefits for me.                  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 4 <sup>-</sup>  | I do not need mathematics in my everyday life.                       | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 5 <sup>-</sup>  | Mathematics symbols confuse me.                                      | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 6 <sup>-</sup>  | Solving mathematics problems is too difficult for me.                | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 7 <sup>+</sup>  | Earning high grades in mathematics is important to me.               | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 8 <sup>+</sup>  | It is interesting to learn new topics in mathematics.                | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 9 <sup>+</sup>  | Mathematics fascinates me.   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 10 <sup>-</sup> | Mathematics is not useful for me.                                    | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 11 <sup>+</sup> | If I get below 18 on the next mathematics test I will be worried.    | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 12 <sup>-</sup> | Mathematics is the most difficult subject for me.                    | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 13 <sup>+</sup> | I like to use protractors, compasses, and rulers in mathematics.     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 14 <sup>-</sup> | I have to study much harder for mathematics than for other subjects. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

[Adapted from Luttrell et al. (2010) and Aiken (1974)].

## PART 5: GENDER STEREOTYPING OF MATHEMATICS

On this page there are 30 statements. For each statement, you are asked to select ONE of the following responses

BD = BOYS DEFINITELY more likely than girls

BP = BOYS PROBABLY more likely than girls

ND = NO DIFFERENCE between boys and girls

GP = GIRLS PROBABLY more likely than boys

GD = GIRLS DEFINITELY more likely than boys

### PRACTICE EXAMPLE

**Like dodging mathematics classes** BD BP ND GP  
GD

If you think boys are probably more likely than girls to like dodging mathematics classes, you should select BP. In contrast, if you think girls are probably more likely than boys to do so, you should select GP. If you think there is no difference between boys and girls when it comes to dodging mathematics classes, then you should select ND.

Now answer each question as quickly as you can.

|   |  |                                |                                |                                |                                |                                |
|---|--|--------------------------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|
| 1 | Mathematics is their favourite subject.                      | BD<br><input type="checkbox"/> | BP<br><input type="checkbox"/> | ND<br><input type="checkbox"/> | GP<br><input type="checkbox"/> | GD<br><input type="checkbox"/> |
| 2 | Think it is important to understand the work in mathematics. | BD<br><input type="checkbox"/> | BP<br><input type="checkbox"/> | ND<br><input type="checkbox"/> | GP<br><input type="checkbox"/> | GD<br><input type="checkbox"/> |
| 3 | Are asked more questions by the mathematics teacher.         | BD<br><input type="checkbox"/> | BP<br><input type="checkbox"/> | ND<br><input type="checkbox"/> | GP<br><input type="checkbox"/> | GD<br><input type="checkbox"/> |
| 4 | Give up when they find mathematics problem too difficult.    | BD<br><input type="checkbox"/> | BP<br><input type="checkbox"/> | ND<br><input type="checkbox"/> | GP<br><input type="checkbox"/> | GD<br><input type="checkbox"/> |
| 5 | Have to work hard in mathematics to do well.                 | BD<br><input type="checkbox"/> | BP<br><input type="checkbox"/> | ND<br><input type="checkbox"/> | GP<br><input type="checkbox"/> | GD<br><input type="checkbox"/> |
| 6 | Enjoy mathematics.   | BD<br><input type="checkbox"/> | BP<br><input type="checkbox"/> | ND<br><input type="checkbox"/> | GP<br><input type="checkbox"/> | GD<br><input type="checkbox"/> |

|    |  |                                |                                |                                |                                |                                |
|----|--|--------------------------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|
| 7  | Care about doing well in mathematics.                                      | BD<br><input type="checkbox"/> | BP<br><input type="checkbox"/> | ND<br><input type="checkbox"/> | GP<br><input type="checkbox"/> | GD<br><input type="checkbox"/> |
| 8  | Think they did not work hard enough if they do not do well in mathematics. | BD<br><input type="checkbox"/> | BP<br><input type="checkbox"/> | ND<br><input type="checkbox"/> | GP<br><input type="checkbox"/> | GD<br><input type="checkbox"/> |
| 9  | Parents would be disappointed if they did not do well in mathematics.      | BD<br><input type="checkbox"/> | BP<br><input type="checkbox"/> | ND<br><input type="checkbox"/> | GP<br><input type="checkbox"/> | GD<br><input type="checkbox"/> |
| 10 | Need mathematics to maximize future employment opportunities.              | BD<br><input type="checkbox"/> | BP<br><input type="checkbox"/> | ND<br><input type="checkbox"/> | GP<br><input type="checkbox"/> | GD<br><input type="checkbox"/> |
| 11 | Like challenging mathematics problems.                                     | BD<br><input type="checkbox"/> | BP<br><input type="checkbox"/> | ND<br><input type="checkbox"/> | GP<br><input type="checkbox"/> | GD<br><input type="checkbox"/> |
| 12 | Are encouraged to do well by the mathematics teacher.                      | BD<br><input type="checkbox"/> | BP<br><input type="checkbox"/> | ND<br><input type="checkbox"/> | GP<br><input type="checkbox"/> | GD<br><input type="checkbox"/> |
| 13 | Mathematics teachers think they will do well.                              | BD<br><input type="checkbox"/> | BP<br><input type="checkbox"/> | ND<br><input type="checkbox"/> | GP<br><input type="checkbox"/> | GD<br><input type="checkbox"/> |
| 14 | Think mathematics will be important in their adult life.                   | BD<br><input type="checkbox"/> | BP<br><input type="checkbox"/> | ND<br><input type="checkbox"/> | GP<br><input type="checkbox"/> | GD<br><input type="checkbox"/> |
| 15 | Expect to do well in mathematics.  | BD<br><input type="checkbox"/> | BP<br><input type="checkbox"/> | ND<br><input type="checkbox"/> | GP<br><input type="checkbox"/> | GD<br><input type="checkbox"/> |
| 16 | Distract other students from their mathematics work.                       | BD<br><input type="checkbox"/> | BP<br><input type="checkbox"/> | ND<br><input type="checkbox"/> | GP<br><input type="checkbox"/> | GD<br><input type="checkbox"/> |
| 17 | Get the wrong answers in mathematics.                                      | BD<br><input type="checkbox"/> | BP<br><input type="checkbox"/> | ND<br><input type="checkbox"/> | GP<br><input type="checkbox"/> | GD<br><input type="checkbox"/> |
| 18 | Find mathematics easy.   | BD<br><input type="checkbox"/> | BP<br><input type="checkbox"/> | ND<br><input type="checkbox"/> | GP<br><input type="checkbox"/> | GD<br><input type="checkbox"/> |
| 19 | Parents think it is important for them to study mathematics.               | BD<br><input type="checkbox"/> | BP<br><input type="checkbox"/> | ND<br><input type="checkbox"/> | GP<br><input type="checkbox"/> | GD<br><input type="checkbox"/> |
| 20 | Need more help in mathematics.   | BD<br><input type="checkbox"/> | BP<br><input type="checkbox"/> | ND<br><input type="checkbox"/> | GP<br><input type="checkbox"/> | GD<br><input type="checkbox"/> |
| 21 | Tease boys if they are good at mathematics.                                | BD<br><input type="checkbox"/> | BP<br><input type="checkbox"/> | ND<br><input type="checkbox"/> | GP<br><input type="checkbox"/> | GD<br><input type="checkbox"/> |
| 22 | Worry if they do not do well in mathematics.                               | BD<br><input type="checkbox"/> | BP<br><input type="checkbox"/> | ND<br><input type="checkbox"/> | GP<br><input type="checkbox"/> | GD<br><input type="checkbox"/> |
| 23 | Are not good at mathematics.   | BD<br><input type="checkbox"/> | BP<br><input type="checkbox"/> | ND<br><input type="checkbox"/> | GP<br><input type="checkbox"/> | GD<br><input type="checkbox"/> |
| 24 | Like using calculators to work on mathematics problems.                    | BD<br><input type="checkbox"/> | BP<br><input type="checkbox"/> | ND<br><input type="checkbox"/> | GP<br><input type="checkbox"/> | GD<br><input type="checkbox"/> |

|    |   |                                |                                |                                |                                |                                |
|----|---|--------------------------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|
| 25 | Mathematics teachers spend more time with them. | BD<br><input type="checkbox"/> | BP<br><input type="checkbox"/> | ND<br><input type="checkbox"/> | GP<br><input type="checkbox"/> | GD<br><input type="checkbox"/> |
| 26 | Consider mathematics to be boring.              | BD<br><input type="checkbox"/> | BP<br><input type="checkbox"/> | ND<br><input type="checkbox"/> | GP<br><input type="checkbox"/> | GD<br><input type="checkbox"/> |
| 27 | Finds mathematics difficult.                    | BD<br><input type="checkbox"/> | BP<br><input type="checkbox"/> | ND<br><input type="checkbox"/> | GP<br><input type="checkbox"/> | GD<br><input type="checkbox"/> |
| 28 | Get on with their work in class.                | BD<br><input type="checkbox"/> | BP<br><input type="checkbox"/> | ND<br><input type="checkbox"/> | GP<br><input type="checkbox"/> | GD<br><input type="checkbox"/> |
| 29 | Think mathematics is interesting.               | BD<br><input type="checkbox"/> | BP<br><input type="checkbox"/> | ND<br><input type="checkbox"/> | GP<br><input type="checkbox"/> | GD<br><input type="checkbox"/> |
| 30 | Tease girls if they are good at mathematics.    | BD<br><input type="checkbox"/> | BP<br><input type="checkbox"/> | ND<br><input type="checkbox"/> | GP<br><input type="checkbox"/> | GD<br><input type="checkbox"/> |

(Adapted from Leder & Forgasz, 2002a).

## PART 6: CAUSAL ATTRIBUTIONS IN MATHEMATICS

### Instructions:

In this activity you are going to read about events that have happened or could have happened to you during your mathematical tasks. For each event you are given four possible causes. We want to know the extent to which you agree or disagree with each possible cause as a plausible reason if events had really happened to you. Each event and the four possible causes appear as a group.

Event A is an example for you.

### PRACTICE EXAMPLE

EVENT A: *The least common (LCM) that you worked out was wrong.*

|   | Possible causes:                               | Strongly agree           | Agree                    | Unsure                   | Disagree                 | Strongly disagree        |
|---|--|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| 1 | You did not have time to review your homework. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 2 | Nobody was able to help you.                   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 3 | LCM is very difficult to work out.             | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 4 | You were just unlucky.                         | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

Event A says, “The least common multiple (LCM) that you worked out was wrong”. Numbers 1, 2, 3, and 4 are possible causes for your mistake. Read each statement and indicate the extent to which you agree or disagree that the reasons mentioned caused the mistake if it had really happened to you. Do the same for events B, C, D, and E.

EVENT B: *You got 18 out of 20 marks in a mathematics test*

|   | Possible causes:                                    | Strongly agree           | Agree                    | Unsure                   | Disagree                 | Strongly disagree        |
|---|---|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| 1 | The test was easy.                                  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 2 | You spent a lot of time preparing for the test.     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 3 | The teacher is very good at explaining mathematics. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 4 | You have talent for mathematics.                    | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

EVENT C: *You got only 7 out of 20 marks in a final mathematics exam.*

|   | Possible causes:                                       | Strongly agree           | Agree                    | Unsure                   | Disagree                 | Strongly disagree        |
|---|--|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| 1 | The exam was too difficult.                            | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 2 | The teacher did not want to help you.                  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 3 | You are not good at mathematics.                       | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 4 | You were very busy with other activities in that week. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

EVENT D: *You simplified very well a fraction.*

|   | Possible causes:   | Strongly agree           | Agree                    | Unsure                   | Disagree                 | Strongly disagree        |
|---|--|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| 1 | Someone is helping you to understand mathematics at home.                                | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 2 | You are very good at numbers.  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 3 | The problems about fractions included in your mathematics textbook are very interesting. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 4 | You study mathematics quite a lot.   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

EVENT E: *You do not know how to divide two fractions.*

|   | Possible causes:   | Strongly agree           | Agree                    | Unsure                   | Disagree                 | Strongly disagree        |
|---|--|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| 1 | Mathematics that you study in grade 7 is very difficult.   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 2 | The teacher is not good at explaining mathematics.         | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 3 | You do not have time to study mathematics at home.         | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 4 | You have been a weak student at mathematics since grade 1. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

(Adapted from Fennema et al., 1979).

**Thank you for participating in this study. If you have any comment about this study or about any item, please write here:**

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## Appendix 3 Survey Instruments for Parents

Dear Parent/Guardian,

Participation in this study is voluntary. There is no remuneration for participating, and there is no penalisation for non-participating. Once you have accepted to participate, you can withdraw at any time if you like. Your name will not be used in any form in our reports.

The purpose of this questionnaire is finding out your views about mathematics learning for girls and boys. Do not worry because there are no right or wrong answers. We only want to know your opinion. The questionnaire is organised in six parts. You must complete each part before moving to the next part.

### PART 1: PARENT BACKGROUND

From question 1 to 9 we want to collect general information about you, your home, and your child. In most questions you will be asked to choose an appropriate box by crossing lines like this:



But, in few other cases, you will have to write words and numbers.

1. Your name: \_\_\_\_\_

|              |                                   |                                   |                                  |
|--------------|-----------------------------------|-----------------------------------|----------------------------------|
| 2. Residence | Beira<br><input type="checkbox"/> | Dondo<br><input type="checkbox"/> | Búzi<br><input type="checkbox"/> |
|--------------|-----------------------------------|-----------------------------------|----------------------------------|

|                |                                  |                                    |
|----------------|----------------------------------|------------------------------------|
| 3. Your gender | Male<br><input type="checkbox"/> | Female<br><input type="checkbox"/> |
|----------------|----------------------------------|------------------------------------|

4. Your age: \_\_\_\_\_ years

5. Name of your child: \_\_\_\_\_



6. Please indicate your relationship with this child

|                                    |                                    |                                     |                                    |                                       |
|------------------------------------|------------------------------------|-------------------------------------|------------------------------------|---------------------------------------|
| Father<br><input type="checkbox"/> | Mother<br><input type="checkbox"/> | Brother<br><input type="checkbox"/> | Sister<br><input type="checkbox"/> | If other,<br>please specify)<br>_____ |
|------------------------------------|------------------------------------|-------------------------------------|------------------------------------|---------------------------------------|

7. Please indicate the language most frequently spoken in the child's home.

|                                  |  |                                  |                                   |
|----------------------------------|--|----------------------------------|-----------------------------------|
| Sena<br><input type="checkbox"/> | Portuguese<br><input type="checkbox"/> | Ndau<br><input type="checkbox"/> | If other, please specify<br>_____ |
|----------------------------------|--|----------------------------------|-----------------------------------|

8. Please indicate your highest level of education

|                                 |                          |
|---------------------------------|--------------------------|
|                                 |                          |
| University                      | <input type="checkbox"/> |
| Upper Secondary (Grade 11 – 12) | <input type="checkbox"/> |
| Lower Secondary (Grade 8 – 10)  | <input type="checkbox"/> |
| Upper Primary (Grade 6 - 7 )    | <input type="checkbox"/> |
| Lower Primary (Grade 1 – 5)     | <input type="checkbox"/> |
| Never attended school           | <input type="checkbox"/> |

9. Please indicate your main profession in the last 12 months.

\_\_\_\_\_

## PART 2: HOW GOOD IS YOUR CHILD?

1. On this page you will find 10 subjects that your child studies this year. For each subject we want to know how good you think your child is. Read the name of each subject and think about your child as a learner of the subject.

Next, indicate whether your child is *excellent*, *good*, *average*, *below average*, or *weak* in each subject.

|                                       | Excellent                | Good                     | Average                  | Below<br>average         | Weak                     |
|---------------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| Portuguese                            | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Visual and<br>Technology<br>education | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| English                               | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Natural sciences                      | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Social sciences                       | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Physics education                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Mathematics                           | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Musical education                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Moral and civic<br>education          | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Artwork                               | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

2. Please, select the highest level of education that you want your child to complete before leaving schooling

| Grade 7                  | Grade 8                  | Grade 9                  | Grade 10                 | Grade 11                 | Grade 12                 | University               |
|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

3. Why did you select this level of education?

---

4. Which profession do you aspire for your child in the future?

5. Why do you prefer this profession for your child?

### PART 3: PARENT INVOLVEMENT IN EDUCATION

On this page there are 16 statements about you as a parent or guardian of the child named \_\_\_\_\_. There are no right or wrong answers. The statements were written in a way that you can indicate how often you perform the activities.

Suppose the activity was:

*You usually tell your child how good you are at mathematics*

If you never, or if you rarely tell your child how good you are at mathematics you should select 'Rarely'. If you tell sometimes, frequently, or nearly always, then you should select the appropriate box. Now indicate how often you do the following activities.

|   |   | Rarely                   | Sometimes                | Frequently               | Nearly<br>always         |
|---|---|--------------------------|--------------------------|--------------------------|--------------------------|
| 1 | Help child to understand mathematics homework.                                | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 2 | Attend meetings at school.  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 3 | Reward child for good grades.   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 4 | Contact teacher or principal to get information.                              | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 5 | Talk to other parents about school problems.                                  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 6 | Attend parent workshops or training at school.                                | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 7 | Do creative activities with child (e.g., building a barn in the yard to store | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

|    |   | Rarely                   | Sometimes                | Frequently               | Nearly<br>always         |
|----|---|--------------------------|--------------------------|--------------------------|--------------------------|
|    | agricultural products, playing games,<br>or fixing damaged things).                           |                          |                          |                          |                          |
| 8  | Ask child about day at school.  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 9  | Talk to teacher about child's<br>accomplishments.   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 10 | Attend meetings organised by the<br>commission of parents.                                    | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 11 | Participate in social events at school<br>(e.g., school day, open day).                       | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 12 | Buy and bring home learning<br>materials (e.g., newspapers,<br>magazines, books, games).      | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 13 | Talk to teacher about disciplinary<br>problems involving the child.                           | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 14 | Talk to child about the importance of<br>school.  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 15 | Limit house chores for the child (e.g.,<br>cooking, fetching water, trading,<br>babysitting). | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 16 | Limit child's entertainment time<br>(e.g., TV watching, playing, fishing,<br>hunting).        | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

(Adapted from Manz et al., 2004).

## PART 4: PERCEIVED USEFULNESS OF MATHEMATICS

### Instructions

On this page there are 14 statements. There are no correct or wrong answers for these statements. They were written in a way to allow you to indicate the extent to which you agree or disagree with the ideas expressed. Suppose the statement is:

*Mathematics will give my child more opportunities to get a job in the future*

As you read the statement you will know whether you agree or disagree with the idea expressed. For example, if you strongly agree that *Mathematics will give your child more opportunities to get a job in the future*, you should select *Strongly agree*. If you agree just a little, you should select *Agree*. If you disagree with the idea indicate whether you *Disagree* or *Strongly disagree*. If you are uncertain about the idea, choose *Unsure*.

|    |   | Strongly<br>agree        | Agree                    | Unsure                   | Disagree                 | Strongly<br>disagree     |
|----|---|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| 1  | Solving mathematics problems is interesting for my child.             | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 2  | My child would be upset to be just an average student in mathematics. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 3  | Mathematics will bring many benefits for my child.                    | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 4  | My child does not need mathematics in his/her everyday life.          | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 5  | Mathematics symbols confuse my child.                                 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 6  | Solving mathematics problems is too difficult for my child.           | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 7  | Earning high grades in mathematics is very important for my child.    | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 8  | It is interesting to my child to learn new topics in mathematics.     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 9  | Mathematics fascinates my child.                                      | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 10 | Mathematics is not useful for my child.                               | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

|    |   |                          |                          |                          |                          |                          |
|----|---|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| 11 | If my child gets a score below 18 on the mathematics test he/she will be worried. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 12 | Mathematics is the most difficult subject for my child.                           | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 13 | My child likes using protractors, compasses, and rulers in mathematics.           | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 14 | My child has to study much harder for mathematics than for other subject.         | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

[Adapted from Luttrell et al. (2010) and Aiken (1974)].

## PART 5: GENDER STEREOTYPING OF MATHEMATICS

On this page there are 30 statements. For each statement you are asked to choose ONE of the following responses

BD = BOYS DEFINITELY more likely than girls

BP = BOYS PROBABLY more likely than girls

ND = NO DIFFERENCE between boys and girls

GP = GIRLS PROBABLY more likely than boys

GD = GIRLS DEFINITELY more likely than boys

### PRACTICE EXAMPLE

**Like dodging mathematics classes**

BD    BP    ND    GP    GD

If you think boys are probably more likely than girls to like dodging mathematics classes, you should select BP. In contrast, if you think girls are probably more likely than boys to do so, you should select GP. If you think there is no difference between boys and girls when it comes to dodging mathematics classes, then you should select ND.

Now answer each question as quickly as you can.

|   |  |                                |                                |                                |                                |                                |
|---|--|--------------------------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|
| 1 | Mathematics is their favourite subject.                      | BD<br><input type="checkbox"/> | BP<br><input type="checkbox"/> | ND<br><input type="checkbox"/> | GP<br><input type="checkbox"/> | GD<br><input type="checkbox"/> |
| 2 | Think it is important to understand the work in mathematics. | BD<br><input type="checkbox"/> | BP<br><input type="checkbox"/> | ND<br><input type="checkbox"/> | GP<br><input type="checkbox"/> | GD<br><input type="checkbox"/> |
| 3 | Are asked more questions by the mathematics teacher.         | BD<br><input type="checkbox"/> | BP<br><input type="checkbox"/> | ND<br><input type="checkbox"/> | GP<br><input type="checkbox"/> | GD<br><input type="checkbox"/> |
| 4 | Give up when they find mathematics problem too difficult.    | BD<br><input type="checkbox"/> | BP<br><input type="checkbox"/> | ND<br><input type="checkbox"/> | GP<br><input type="checkbox"/> | GD<br><input type="checkbox"/> |
| 5 | Have to work hard in mathematics to do well.                 | BD<br><input type="checkbox"/> | BP<br><input type="checkbox"/> | ND<br><input type="checkbox"/> | GP<br><input type="checkbox"/> | GD<br><input type="checkbox"/> |
| 6 | Enjoy mathematics.   | BD<br><input type="checkbox"/> | BP<br><input type="checkbox"/> | ND<br><input type="checkbox"/> | GP<br><input type="checkbox"/> | GD<br><input type="checkbox"/> |
| 7 | Care about doing well in mathematics.                        | BD<br><input type="checkbox"/> | BP<br><input type="checkbox"/> | ND<br><input type="checkbox"/> | GP<br><input type="checkbox"/> | GD<br><input type="checkbox"/> |

|    |  |                                |                                |                                |                                |                                |
|----|--|--------------------------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|
| 8  | Think they did not work hard enough if they do not do well in mathematics. | BD<br><input type="checkbox"/> | BP<br><input type="checkbox"/> | ND<br><input type="checkbox"/> | GP<br><input type="checkbox"/> | GD<br><input type="checkbox"/> |
| 9  | Parents would be disappointed if they did not do well in mathematics.      | BD<br><input type="checkbox"/> | BP<br><input type="checkbox"/> | ND<br><input type="checkbox"/> | GP<br><input type="checkbox"/> | GD<br><input type="checkbox"/> |
| 10 | Need mathematics to maximize future employment opportunities.              | BD<br><input type="checkbox"/> | BP<br><input type="checkbox"/> | ND<br><input type="checkbox"/> | GP<br><input type="checkbox"/> | GD<br><input type="checkbox"/> |
| 11 | Like challenging mathematics problems.                                     | BD<br><input type="checkbox"/> | BP<br><input type="checkbox"/> | ND<br><input type="checkbox"/> | GP<br><input type="checkbox"/> | GD<br><input type="checkbox"/> |
| 12 | Are encouraged to do well by the mathematics teacher.                      | BD<br><input type="checkbox"/> | BP<br><input type="checkbox"/> | ND<br><input type="checkbox"/> | GP<br><input type="checkbox"/> | GD<br><input type="checkbox"/> |
| 13 | Mathematics teachers think they will do well.                              | BD<br><input type="checkbox"/> | BP<br><input type="checkbox"/> | ND<br><input type="checkbox"/> | GP<br><input type="checkbox"/> | GD<br><input type="checkbox"/> |
| 14 | Think mathematics will be important in their adult life.                   | BD<br><input type="checkbox"/> | BP<br><input type="checkbox"/> | ND<br><input type="checkbox"/> | GP<br><input type="checkbox"/> | GD<br><input type="checkbox"/> |
| 15 | Expect to do well in mathematics.  | BD<br><input type="checkbox"/> | BP<br><input type="checkbox"/> | ND<br><input type="checkbox"/> | GP<br><input type="checkbox"/> | GD<br><input type="checkbox"/> |
| 16 | Distract other students from their mathematics work.                       | BD<br><input type="checkbox"/> | BP<br><input type="checkbox"/> | ND<br><input type="checkbox"/> | GP<br><input type="checkbox"/> | GD<br><input type="checkbox"/> |
| 17 | Get the wrong answers in mathematics.                                      | BD<br><input type="checkbox"/> | BP<br><input type="checkbox"/> | ND<br><input type="checkbox"/> | GP<br><input type="checkbox"/> | GD<br><input type="checkbox"/> |
| 18 | Find mathematics easy.   | BD<br><input type="checkbox"/> | BP<br><input type="checkbox"/> | ND<br><input type="checkbox"/> | GP<br><input type="checkbox"/> | GD<br><input type="checkbox"/> |
| 19 | Parents think it is important for them to study mathematics.               | BD<br><input type="checkbox"/> | BP<br><input type="checkbox"/> | ND<br><input type="checkbox"/> | GP<br><input type="checkbox"/> | GD<br><input type="checkbox"/> |
| 20 | Need more help in mathematics.   | BD<br><input type="checkbox"/> | BP<br><input type="checkbox"/> | ND<br><input type="checkbox"/> | GP<br><input type="checkbox"/> | GD<br><input type="checkbox"/> |
| 21 | Tease boys if they are good at mathematics.                                | BD<br><input type="checkbox"/> | BP<br><input type="checkbox"/> | ND<br><input type="checkbox"/> | GP<br><input type="checkbox"/> | GD<br><input type="checkbox"/> |
| 22 | Worry if they do not do well in mathematics.                               | BD<br><input type="checkbox"/> | BP<br><input type="checkbox"/> | ND<br><input type="checkbox"/> | GP<br><input type="checkbox"/> | GD<br><input type="checkbox"/> |
| 23 | Are not good at mathematics.   | BD<br><input type="checkbox"/> | BP<br><input type="checkbox"/> | ND<br><input type="checkbox"/> | GP<br><input type="checkbox"/> | GD<br><input type="checkbox"/> |
| 24 | Like using calculators to work on mathematics problems.                    | BD<br><input type="checkbox"/> | BP<br><input type="checkbox"/> | ND<br><input type="checkbox"/> | GP<br><input type="checkbox"/> | GD<br><input type="checkbox"/> |
| 25 | Mathematics teachers spend more time with them.                            | BD<br><input type="checkbox"/> | BP<br><input type="checkbox"/> | ND<br><input type="checkbox"/> | GP<br><input type="checkbox"/> | GD<br><input type="checkbox"/> |



|    |  |                                |                                |                                |                                |                                |
|----|--|--------------------------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|
| 26 | Consider mathematics to be boring.           | BD<br><input type="checkbox"/> | BP<br><input type="checkbox"/> | ND<br><input type="checkbox"/> | GP<br><input type="checkbox"/> | GD<br><input type="checkbox"/> |
| 27 | Finds mathematics difficult.                 | BD<br><input type="checkbox"/> | BP<br><input type="checkbox"/> | ND<br><input type="checkbox"/> | GP<br><input type="checkbox"/> | GD<br><input type="checkbox"/> |
| 28 | Get on with their work in class.             | BD<br><input type="checkbox"/> | BP<br><input type="checkbox"/> | ND<br><input type="checkbox"/> | GP<br><input type="checkbox"/> | GD<br><input type="checkbox"/> |
| 29 | Think mathematics is interesting.            | BD<br><input type="checkbox"/> | BP<br><input type="checkbox"/> | ND<br><input type="checkbox"/> | GP<br><input type="checkbox"/> | GD<br><input type="checkbox"/> |
| 30 | Tease girls if they are good at mathematics. | BD<br><input type="checkbox"/> | BP<br><input type="checkbox"/> | ND<br><input type="checkbox"/> | GP<br><input type="checkbox"/> | GD<br><input type="checkbox"/> |

(Adapted from Leder & Forgasz, 2002a).

## PART 6: CAUSAL ATTRIBUTIONS IN MATHEMATICS

### Instructions:

In this activity you are going to read about an event that could have happened with your child. You will also read four possible causes of that event. We want to know the extent to which you agree or disagree with each possible cause if the event had really occurred with your child. Each event and the four possible causes appear as a group. The event A is an example for you to understand this activity.

### PRACTICE EXAMPLE

EVENT A: *Your child worked out incorrectly the least common multiple (LCM).*

|   | Possible causes:                                 | Strongly agree           | Agree                    | Unsure                   | Disagree                 | Strongly disagree        |
|---|--|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| 1 | Your child did not have time to review homework. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 2 | Nobody was able to help your child.              | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 3 | LCM is very difficult to work out.               | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 4 | My child was just unlucky.                       | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

Event A says “Your child worked out incorrectly the least common multiple (LCM)”. Numbers 1, 2, 3, and 4 are possible causes for your child’s mistake. Read each statement and

indicate the extent to which you agree or disagree that the reasons mentioned caused the mistake if it had really happened to your child. Do the same for events B, C, D, and E.

EVENT B: *Your child got 18 out of 20 marks in a mathematics test.*

|   | Possible causes:   | Strongly agree           | Agree                    | Unsure                   | Disagree                 | Strongly disagree        |
|---|--|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| 1 | The test was easy.   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 2 | Your child spent a lot of time preparing for the test.       | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 3 | Your child's teacher is very good at explaining mathematics. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 4 | Your child's has talent for mathematics.                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

EVENT C: *Your child got only 7 out of 20 marks in a final mathematics exam.*

|   | Possible causes:  | Strongly agree           | Agree                    | Unsure                   | Disagree                 | Strongly disagree        |
|---|---|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| 1 | The exam was too difficult.                                 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 2 | The teacher did not want to help your child.                | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 3 | Your child is not good at mathematics.                      | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 4 | You child was very busy with other activities in that week. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

EVENT D: *Your child simplified very well a fraction.*

|   | Possible causes:   | Strongly agree           | Agree                    | Unsure                   | Disagree                 | Strongly disagree        |
|---|--|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| 1 | Someone is helping your child to understand mathematics at home.                                 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 2 | Your child is very good at numbers.  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 3 | The problems about fractions included in your child's mathematics textbook are very interesting. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 4 | Your child studies mathematics quite a lot.  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

EVENT E: *Your child does not know how to divide two fractions.*

|   | Possible causes:  | Strongly agree           | Agree                    | Unsure                   | Disagree                 | Strongly disagree        |
|---|---|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| 1 | Mathematics that your child studies in grade 7 is very difficult. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 2 | The teacher of your child is not good at explaining mathematics.  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 3 | Your child does not have time to study mathematics at home.       | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 4 | Your child has been a weak student at mathematics since grade 1.  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

(Adapted from Fennema et al., 1979).

**Thank you for participating in this study. If you have any comment about the study, or about any item, please write here:**

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## **Appendix 4 Example of an Interview Transcript: Father**

### **INTERVIEWEE DETAILS**

Gender of the parent: Male  
Relationship with child: Father  
Occupation: Businessman  
Education: Secondary  
Age: 53  
Gender of the child: Boy  
Geolocation: Urban

R: RESEARCHER; F: FATHER

**R: Good morning, and thank you so much for coming to this interview. The interview will take about 45 minutes. During the interview we are going to talk about education of your son. Can we start?**

F: No problems. I am ready to answer any question that you like.

**R: That is great. Are you comfortable if I record our conversation? If you do not mind, I would like to record it to help me remember what we talked about.**

F: I have no problem. You can ask anything that you like and you can record if you want.

**R: That is right. My first question is: When you were a child, which school subject did you like most?**

F: Me? Well, mathematics. I liked mathematics.

**R: Did you like mathematics?**

F: Yes, I did.

**R: Can you tell me why did you like mathematics?**

F: Well, it is because I was very good at it. I was very good at numbers.

**R: Imagine a scale ranging from 0 to 20 marks, how good were you at mathematics?**

F: I could habitually hit something like 14, 17 or even 18.

**R: You were really good! I have asked the same question to many parents and they said they were not good at mathematics. You are different. In your opinion, which factors contributed to you to be that good at mathematics?**

F: I liked mathematics because I enjoyed calculating with numbers: adding, subtracting, multiplying, and dividing using big numbers.

**R: What sort of calculations?**

F: Addition, subtraction, multiplication, and division. I liked calculating with big numbers.

**R: How big the numbers were?**

F: They were too big; numbers that could cross from one side to the other of the blackboard. I was able to divide that number by another also very big number.

**R: By hand?**

F: Yes, by hand because we knew the tables of all the four basic operations. It is not like today that children know nothing.

**R: Now I want to ask you this question: Do you think that the teaching of mathematics has changed over time?**

F: Yes, it has changed. It has changed a lot. People nowadays do not study; they have no time to investigate. They go to school just to show off.

**R: What are the reasons for that?**

F: Look! It is because the students think mathematics is too difficult, and make no effort to understand it.

**R: Why?**

F: It is because of the current teaching methods used in schools.

**R: How different are the current teaching methods from the other methods used in your time?**

F: Nowadays teachers do not teach; they leave children struggling by themselves; teachers do not force children to write nicely; they do not demand the children to memorise the material.

**R: Do you usually discuss with your son about his academic progress?**

F: Yes, I do.

**R: What does he tell you about his results?**

F: He always complains that the teacher is not good, or the teacher does not explain the subject well. He says a lot of things about his teacher: teacher did this, teacher did that, and so forth.

**R: Does he like mathematics?**

F: No, he doesn't; he hates mathematics.

**R: Why?**

F: That is what I told you already. He hates mathematics because he is not good at it. He always complains saying that the teacher does not explain well. He makes no effort to try to understand the subject. He does not investigate. But I have a daughter who is very good at mathematics.

**R: Do you have a daughter who is very good at mathematics?**

F: Yes. She is very good at mathematics.

**R: What is her Grade?**

F: She is in Grade 12 this year. She is very good at numbers. She even explains mathematics to her classmates. They usually come to my home and I see her explain things to them..

**R: Does she also like working with 'big' numbers as the father?**

F: Yes she does. She is the only child who is similar to me. She is good at calculations.

**R: Which profession would you like for her in the future?**

F: A doctor?

**R: What sort of doctor?**

F: A hospital doctor.

**R: Why?**

F: That would be good. As a doctor she can open her own clinic or she can work for several clinics and start her life.

**R: Do you think she will be a good hospital doctor?**

F: Yes, she will. Why not? She is already good at school.

**R: Let's talk again about your son. You said that he is not good at mathematics, but your daughter is. Is that what you said?**

F: That is right. He hates mathematics because he knows he is not good at it.

**R: Which differences do you see between your son and your daughter that may probably influence their performances in mathematics?**

F: The difference I see is that, the girl spends more time preparing lessons at home, and the boy never opens his books. He is only interested in computers, electricity, and to play football with his friends.

**R: Does your daughter understand about electricity, computers, and football as well?**

F: No. I haven't seen her touching that sort of things.

**R: Why is that?**

F: Maybe she does not like.

**R: Would you be happy to see her engaged in that sort of things?**

F: It is her problem and not mine.

**R: Imagine a scale ranging from 0 to 20 marks, where would you place your son in mathematics?**

F: 11, 10; most of the time below 10.

**R: And your daughter?**

F: She starts from 14 and goes up.

**R: Just like the father?**

F: Yes, she likes mathematics as I do.

**R: In your point of view, what is mathematics?**

F: Mathematics is about rules and procedures that when well understood and followed carefully they improve reasoning skills and memory.

**R: That is fine. Now I am going to ask you a different question. I have here three statements, A, B, and C. Statement A says: *Girls are better than boys at mathematics*; Statement B says: *Boys are better than girls at mathematics*; and statement C says: *There is no difference between girls and boys when it comes to learning mathematics*. Which statement do you agree most?**

F: Statement B.

**R: What does statement B say?**

F: Boys are better.

**R: Why do you think so?**

F: Boys are better. Since the colonial times boys were superior at mathematics.

**R: Why?**

F: Well, I don't know whether I am trapped by the old times.

**R: What do you mean by 'trapped by the old times'?**

F: I am saying that in the past boys were better than girls at school.

**R: What about nowadays?**

F: Things have changed.

**R: In which ways?**

F: Today we don't know who is better.

**R: If I change the subject to Portuguese which statement would you choose?**

F: I would choose statement C.



**R: What does statement C say?**

F: There is no difference between boys and girls at Portuguese.

**R: Why do you say that?**

F: There are many people who are good at writing and speaking Portuguese either women or men.

**R: What about English?**

F: None is good.

**R: Why?**

F: Because they do not speak it. They do not practice.

**R: Do you think mathematics is important for your son?**

F: Yes, it is important.

**R: Why?**

F: Mathematics opens capacity and improves reasoning. Mathematics is about intelligence. People who know mathematics are clever.

**R: Do you think mathematics is important to get a job?**

F: No, it is not important to get a job.

**R: Why do you think so?**

F: There are many people out there with a university degree without a job. Well, if you have a job already and you also know mathematics, your mathematical skills can help you to do your work much better.

**R: How?**

F: You can make calculations, for example, to check if the salary employer paid is correct.

**R: Which profession would you like for your son in the future?**

F: An Engineer.

**R: Why?**

F: He likes electricity, computers, and football.

**R: Do you think mathematics is important to learn about computers?**

F: No. It is not important.

**R: Do you think parents should influence the child's career choice?**

F: I think parents have to suggest occupations for their children because they have a better vision about things due to their life experience. If the child does not accept the vision of the parent, thus, anything that goes wrong with the child, the child has no right to blame the parent.

**R: Why do you think so?**

F: Because parents have a better vision about things due to their experience. If a child does not abide to the parent vision it is the child who is going to have problems in life.

**R: Why are there children who abide and children who do not abide to their parents' vision?**

F: That question cannot be answered. That issue has to see with the nature of the human being. Parents make efforts for good of their children but the children disobey and decide to follow their own path. There is nothing else that parents can do because children have rights to pursue their dreams as well.

**R: What can parents do to avoid this problem?**

F: What can parents do? There is nothing that they can do. Just to keep watching. Maybe one day you will be lucky and have an obedient and well behaved child.

**R: Schools have just released the academic records for the first trimester. Have you seen your child's marks?**

F: I didn't see yet but I know that he got low marks. He is a weak student and lazy.

**R: Are you happy with that?**

F: No, I am not happy. He doesn't apply himself. His personality is not good.

**R: Do you use to help him with his homework?**

F: I am a busy person. But he has his older siblings who can help him in case of necessity.

**R: I am now going to ask you a different question. Do you think men and women should have equal rights and duties in our country?**

F: Gender equity is fine because it is written in our constitution but it involves consideration of cultural issues as well. Many women when they reach high positions in life they spoil their marriages. They start to despise their husbands. When they have money the first thing they do is buying a house without their husband's knowledge. There is much destruction of marriages in this country because of that aspect of gender equality. But, in other countries where people are considerate and educated enough there are no such problems. In such societies people keep their marriages progressing normally, and women do not lack respect for their husbands.

**R: And what is your opinion? Do you support or do not support gender equity in Mozambique?**

F: I support, but it should not be in excess.

**R: What do you mean by 'not in excess'?**

F: In excess?

**R: Yes.**

F: It is because every time, and everywhere you go, you hear that women have right to this, have right to that. There is no need to repeat the same message a million times. We all know that already. It is written in our constitution.

**R: Are you happy that the policy is written in our constitution?**

F: Yes, I am happy.

**R: Before we finish our very interesting conversation would you like to comment on something?**

F: Yes, I just want to add that, I notice nowadays, as compared to the old times, that girls feel more protected, and are making efforts, and they are really progressing in life. It is really a revolution. It never happened before. There are many women studying nowadays. Women who were unable to study when they were girls are now finding space in education system.

**R: What is your opinion about that?**

F: I think it is important.

**R: Why do you think so?**

F: It is important for themselves and for our society in general.

**R: In which ways do you think education of women is important for our society in general?**

F: They can contribute to the development of the country.

**R: How?**

F: They can get a good job and help their family.

**R: If you have nothing else to say, I thank you very much for participating in this interview.**

F: Thank you.

## **Appendix 5 Example of an Interview Transcript: Mother**

### **INTERVIEWEE DETAILS**

Gender of the parent: Female

Relationship with child: Mother

Occupation: Farmer

Education: Primary

Age: 47

Gender of the child: Boy

Geolocation: Remote

**R: RESEARCHER; M: MOTHER**

**R: My name is Adelino. I am a student overseas. I am here to collect data as part of my studies. Just to help me remember everything that we are going to talk about, I would like to record the interview using my recorder. The recorder is mine and nobody will have access to it. Are you comfortable that I record our conversation?**

M: There is no problem. You can record if you like.

**R: That is much easier for me. Thank you so much. Today we are going to talk about education of your child. Do not worry about your answers because there is no right or wrong answer. I only want to know what you think about some issues related to education of your child. Can we start?**

M: We can start.

**R: Is your child a girl or a boy?**

M: A boy.

**R: How old is he?**

M: 14.

**R: What is the job of your husband?**

M: He works for the district post office. Today he went to work, but tomorrow he will be available.

**R: There is no problem as you came. I can speak with the mother, father, or both, .it does not really matter. It will be very good to hear your opinion as a mother as well. The first question I am going to ask you is: When you were a girl was there any school subject that you liked most?**

M: The subject that I liked most?

**R: Yes, your favourite subject.**

M: When I was a girl I liked political education.

**R: Political education?**

M: Yes.

**R: Do they still teach that subject in schools nowadays?**

M: No. They don't teach it anymore.

**R: Why did you like political education very much?**

M: I liked to hear the stories the teacher told us about the national heroes, liberated zones, and the Independence Day.

**R: Did you like any other subjects as well?**

M: I also liked biology; Biology and Portuguese.

**R: You also liked Biology and Portuguese. Did you also like Mathematics?**

M: No. I totally disliked mathematics.

**R: Why did you totally dislike mathematics?**

M: Hum, I was not good at mathematics. I never understood all those numbers. The problem was not about the teachers because in that time the teachers had patience and explained mathematics detail by detail. The problem was 'me'. It is not like today that the teachers do not explain things well.

**R: Imagine a scale ranging from 0 to 20, what was your usual place in mathematics?**

M: 9 or 10. I never scored more than 10 in mathematics. I was always below 10.

**R: In your view, why were you not that good at mathematics?**

M: There was no reason. I was the problem. I was a weak student. I cannot blame the teachers because in that time the teachers explained mathematics very well. The teachers were very good and were considerate.

**R: Why do you blame on you?**

M: Because I could try to understand mathematics but it was practically impossible to dominate.

**R: Was there anything in particular that prevented you from dominating mathematics?**

M: Nothing prevented. I just have no inclination to numbers.

**R: Do you think that the teaching of mathematics has changed over time?**

M: Yes, it has changed. It has changed quite a lot.

**R: In which aspects that you think changes have occurred?**

M: In the past the teachers explained mathematics very well, and they used blackboards to explain content quite often. Nowadays, teachers rarely use blackboard. They often say: 'open your mathematics textbook to page 122 and do all the tasks that you find there'. That is not good for the children because the child needs to see all the steps clearly.

**R: Why do the teachers do that?**

M: Nowadays the teachers enter into the classroom and write few things that they never explain. The children also keep watching and playing because they do not have a serious learning activity. There is no serious work going on in the classroom.

**R: Does your child like mathematics?**

M: No. May son is very weak at mathematics. I am even better than him. But he is good at servicing cars with his father.

**R: Can your child fix a car?**

M: Yes, he can. He is very good at fixing electric parts of the car.

**R: On a scale from 0 to 20 where would you place his ability to fix cars?**

M: 18.

**R: Where did he learn that?**

F: His father repairs cars affter post-office hours.

**R: Hum, and how good is he at mathematics?**

M: 10. It can be 10 or below. He does not understand anything about mathematics.

**R: Which school subject do you think he is very good at?**

M: He is very good at Portuguese, and 'EVT'.

**R: What is 'EVT'?**

M: Visual and technology education. Here we call it EVT.

**R: I see. Now, I am going to show you three statements. The statements are labelled as A, B, and C. Statement A says: *Girls are better than boys at mathematics*; Statement B says: *Boys are better than girls at mathematics*; Statement C says: *There is no difference between girls and boys when it comes to learning mathematics*. Which statement A, B, and C do you agree most?**

M: There is no difference. It depends on the memory of each person.

**R: Why do you say that?**

M: Because I see in my home my youngest daughter is now in Grade 6 and she is very good at mathematics and she helps the brother who is in Grade 7. The brother does not understand anything about numbers although he is more advanced than the sister.

**R: Which statement would you choose if the subject was Portuguese?**

M: Well, my daughter had initially serious difficulties with Portuguese, but the school suggested us to force her to read more. Now she reads more, and the difficulties have diminished.

**R: So, which statement would you choose?**



M: The same. There is no difference because she is improving despite having difficulties initially.

**R: Do you think mathematics is important for your son?**

M: Yes, it is.

**R: Why?**

M: Mathematics is important because it helps us to make calculations.

**R: What sort of calculations?**

M: All sorts of calculations; for example, to check if the change that you received is correct or not.

**R: What else can you do with mathematics?**

M: Counting. It also helps us to count things.

**R: What about jobs? Do you think knowing mathematics helps people to get jobs?**

M: Yes, it does.

**R: How?**

M: Companies like people who are good at mathematics.

**R: Which kind of job would you like your son to have in the future?**

M: For Yuran? (Name changed)

**R: Yes. This boy we are talking about now.**

M: Hum ... I would like him to be an engineer.

**R: Why?**

M: Because he is good at drawing.

**R: What sort of drawings?**

M: He likes drawing things that he sees. He can draw trees, houses, people, and many things he sees out there?

**R: I see. And which employment would you like for your daughter?**

M: She can do anything that she likes.

**R: Why do you say ‘anything that she likes’?**

M: Because she is good at school. As she is good she can handle anything that pleases her.

**R: Do you think parents should influence their children’s career choices?**

M: It is not good to interfere because a child is also a person. The children should do whatever they like and want to do.

**R: In your opinion what is mathematics?**

M: What is mathematics?

**R: Yes, when we talk about mathematics, what comes into your mind?**

M: Mathematics ... Mathematics is a basic subject that teaches us to count and to make calculations.

**R: Counting and calculating?**

M: Yes, counting and calculating. That is it. You make calculations if you don’t want to count. Calculation is a process of counting things fast.

**R: Are you happy with the school progress of your son?**

M: Yes, I am.

**R: Why?**

M: He is doing well in most subjects. He only has problems with mathematics.

**R: Do you usually help him with his mathematics homework?**

M: He always asks me to explain him something but there are many things from the textbooks that I also don’t know. I always tell him that in my time we did not study these things. Things have changed a lot. Now they study mathematics

but in my time we studied arithmetic. Mathematics was studied only in secondary schools. It is very complicated for me to help my child because things are not the same.

**R: Now, I am going to change the topic. I am going to ask you a different question. Do you think men and women should have the same rights and duties?**

M: Yes, they should have because there is no difference.

**R: Why?**

M: There is no reason to discriminate. Women are also human beings (Laughs).

**R: Do you think in Mozambique we have reached that level?**

M: Yes.

**R: Is there anything else that you would like to add to our conversation today?**

M: No.

**R: Then thank you very much for your time and for our very interesting conversation. I learned a lot from you today. I wish your child's success in education. Thank you once again, and see you next time.**

M: Thank you too.

## **Appendix 6 Interview Transcripts: School principals**

Principal of school D

Name: Mucauro (Pseudonym)

Gender of the principal: Male

Age: 35

Years of experience as school principal: 4

Geolocation: Rural

R: RESEARCHER, P: PRINCIPAL

**R: Last week I tried to communicate with you and ...?**

P: Yes, yes, first of all, I would like to say sorry because the whole last week I did not come here. I was selected to be part of the team that accompanied the President of the Republic during his visit to our district. We were honoured this time that the President came to our district and I was part of the team that accompanied him. No communications were allowed and all our mobile phones were shut down.

**R: That is alright. Your secretary told me about that too.**

P: Yes, the President stayed with us the whole week, but now I am free. Today we can talk as much as we can.

**R: I am here today to hear your point of view about a number of issues related to your school. Are you comfortable that I record our interview so that I can easily retrieve it?**

P: There is no problem. I am ready.

**R: How long are the principal of this school?**

P: I am the principal of this school for about four years now.

**R: Had you been a principal in another school?**

P: Not exactly, but I was the head of education and planning department here in the district.

**R: In this same district?**

P: Yes, in this same district. I am working in this district for many years.

**R: For how long?**

P: For about two years or so.

**R: How would you describe the kind of relationship between teachers and pupils in your school?**

P: It is good. It is a positive relationship.

**R: Why do you say that?**

P: It is a positive relationship at the pedagogical point of view. Also, the pupils attend our extra-curricular activities; the pupils have no problem, they do what the school requires them to do; we have no regrets about the pupils.

**R: How would you describe the kind of relationship between teachers and parents?**

P: In relation to parents and teachers, the kind of relationship can be considered positive, but the teachers complain all the time. They say that parents never come to school when asked.

**R: Why do parents never come to school when asked?**

P: The reason is not easy to know. Maybe parents are very busy and are unable to comply with the dynamic of our school.

**R: Does this school differ from the other schools of this district in some way?**

P: Well, this is the main primary school of the district and we cover Grade 1 through Grade 7 while the other schools cover from Grade 1 to 5.

**R: What does the school do to sensitize parents to collaborate with the school?**

P: We try to make them understand the importance of their presence in the school, but they give priority to other activities such as farming and fishing for their family subsistence.

**R: How would you compare the achievement of girls and boys in your school?**

P: The achievement of girls and boys is satisfactory.

**R: Are there any subject in which girls outperform boys or boys outperform girls?**

P: We haven't conducted any study to investigate that issue. The only thing that we know is that when the exam in a particular subject is too difficult, it tends to be too difficult for everyone, girls and boys; no one escapes; no student will say the exam went well for me. But, in general terms, we think that the majority of girls have lower achievement than the majority of boys but we did not investigate to know that.

**R: Is there any study that has attempted to answer a similar question in any school in this district? I am asking you this question considering that you have worked as the head of education and planning department in this district.**

P: No. I am not aware about that. We only have general impressions and we make our decisions based on our general impressions.

**R: What are some possible reasons for poor performance of girls and boys in some subjects in your school?**

P: That question is complicated to answer as well. However, in my personal point of view, I think that girls here in our district do a lot of housework. If you could visit some houses out there you would be sorry for the girls. Girls here are not as free as boys. Maybe this contributes to their relative underachievement. I don't know, I am just thinking. It is a very complex issue, and cannot be solved by the school principal. It has to see with the local customs.

**R: Does the school discuss these issues with the community?**

P: No, because this things are sensible and the school is just a small part of a complex organisational system.

**R: Are there any reasons preventing parents to comply with the dynamics of the school?**

P: I say this because there are many children who come to this school without uniform and without any school material such a pencil or a piece of paper. All the children are given textbooks at the beginning of each year but three months later most children have lost their textbooks or their textbooks have several missing pages. Parents do not help the child to maintain the textbooks in good condition maybe because they do not cost money to them. Most parents in this community are very negligent. For me, according to my understanding, parents are blamed for some of the issues related to low quality of education. I say this because in this school we have two distinct groups of students. We have one group made up of brilliant students in all subjects, and we also have a group of underachievers who are unable to read and write their names. For me, these

groups of students represent differential level of responsibility of parents in the education of their children.

**R: Do you have the demographic information of the parents from each group of pupils?**

P: We have files that contain information of all parents and guardians but we do not discriminate.

**R: Using the information from the files how would you describe the parents of each group?**

P: We have not done this kind of analysis yet.

**R: But are there any characteristics of the parents that seem to facilitate the children's learning?**

P: There are negative aspects but there are also some positive aspects.

**R: Can you tell me about the positive aspects?**

P: We have the school council. When the school council meets, parents and guardians are invited. We resolve our school problems with the help of some parents. Parents also contribute financially to pay our school guard. We thank parents for the acquisition of some furniture for children this year. Last year all children were sitting on the floor. Because of these actions I can say that parents are being useful to the school.

**R: Are there parents who do not contribute to pay the school guard?**

P: Yes, unfortunately many parents don't want to contribute.

**R: Do you know why they don't contribute?**

P: We don't know exactly, but we have three kinds of parents: parents who afford and accept to pay 100% of the amount that we stipulate; parents who inform the school about their problems and we agree to discount 50% of the amount; and parents who do not contact the school and do not contribute. Unfortunately, the majority of parents belong to this group – they don't approach the school to explain their problem and there is nothing that we can do to reverse the situation. We also cannot punish the child because this is a public and not a private school.

**R: In your view, to what extent are parents committed to education of their children?**

P: Unfortunately, it is only now that I am thinking about this issue seriously. Honestly I have not thought about it before. I think that parents are interested in the education of their children because here in the district there are many parents who attempt to enrol children at the age of 4 or 5 years. We refuse to do so because of the age restrictions, but they find a way to adulterate the birth certificate of the child by increasing the age. In grade 7 classrooms you may find several children whose birth records indicate 12 years of age but, in reality, they are 10. I believe that parents in this district are starting to understand the importance of the school. The only complaint that we make is that when parents leave their children here they go away permanently and never come back. They know that education is important for their children but they ignore the costs of getting good quality education. Parents leave children under the responsibility of the school as we were guardians and this is wrong.

**R: Why do parents do that?**

P: I don't know. I really don't know.

**R: On a scale from 0 to 20 where would you place the level of parental engagement in the education of their children?**

P: I give them 14 marks.

**R: I want to understand better this issue. Do you mean that parents are interested in the education of their children but they are not involved enough?**

P: Yes, they fail to do so because they do not accompany the growth and the difficulties of their children once they are enrolled. It is like they get rid of the child using the school.

**R: Does the school have a committee of parents?**

P: Yes, it does.

**R: What is the role of this committee?**

P: The task of the committee of parents is questioning the way we manage and administer the school. The committee also helps us in case of problems. We have many problems here, and I think you saw that all children sit on the floor and the teachers stand up the whole lesson. It is because all chairs and desks were stolen during the school break.

**R: Are you satisfied with the work of the committee of parents?**

P: Yes, I am satisfied. I am really very satisfied.



**R: Why?**

P: Because whenever we want them, they come to help us in the solution of problems that we face, and we have many problems in this school. We have already identified some parents who are willing to help us.

**R: Does the school have a committee that deals with gender issues?**

P: Yes, it does.

**R: What does it do?**

P: The committee responsible for gender issues has been established here to ensure that girls assume leadership responsibilities in the school and in their classrooms. It also educates girls in order to avoid dropouts and premature pregnancies.

**R: Are you satisfied with the work of this committee as well?**

P: Yes, I am very satisfied.

**R: I just met a lady outside who told me she was an HIV activist assigned to this school. I suppose she has an appointment with you because she is here since early morning. What is her activity in this school?**

P: Hum, the lady you saw outside, in coordination with the committee of gender issues, delivers lectures to children. She sensitises girls and boys to avoid unprotected sexual relationships in order to avoid HIV and other diseases. She was assigned to this school to do this job. It is like teaching any other subject that we have in our curriculum.

**R: Do the children respond favourably to the lessons?**

P: We think the children are responding positively because there are some important changes. Today is normal that no girl is pregnant in a full year, and this makes me believe that our campaigns are producing desirable outcomes.

**R: I saw many children outside organised in a very long queue. What is going on?**

P: They are queuing for free lunch. All children in rural and remote schools are entitled to free lunch after their classes. This is their lunch time; it is served during the break between the first and the second shift.

**R: Who supplies the free lunch?**

P: The lunch is donated by the *Joint Aid Management* in coordination with the Ministry of Education.

**R: Are parents happy with this kind of support?**

P: Of course the community is extremely satisfied with the free lunch for children and this is also one of the reasons why some parents attempt to enrol children aged 4 and 5 years and we refuse to do so. Sometimes parents falsify ages of the children to enrol them to benefit from free lunch while studying.

**R: Do you have anything else that you would like to comment on?**

P: On behalf of the teachers from *Malengapanze* primary school (name changed), I would like to thank you for the issues that you raised to us. Our understanding is that we need to sensitise parents and guardians in order to approach the school. We are not confident in conducting the education process without the collaboration of parents. What we have noticed so far is that parents do not know and do not care about what happens to their children at school. We have a committee of parents that represents all parents but it is not enough. We would like to see all parents engaged in the education of their children. That is very important to us.

**R: Thank you very much for your comments, for your time, and for your collaboration. I appreciate a lot to have worked here in your school. The experience I gained during these three months is valuable.**

P: Thank you.