The Interplay of Identity, Culture, School and Mathematics: A Caribbean Perspective

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The candidate confirms that the work submitted is her own and that appropriate credit has been given wherever reference has been made to the work of others.

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Abstract

This thesis looks at students' views of mathematics in the Caribbean setting of Antigua and Barbuda. The idea for studying this particular issue came about from a concern within the Caribbean that students were 'underachieving' in mathematics. This concern was in large part based on student performance in the Caribbean Examinations Council (CXC) Secondary Education Certificate (CSEC), examinations taken by students at the end of secondary school. It was thought that a study which looked at students' views of mathematics would get at answers for the perceived underachievement. Implicit in this was the notion that there would be a connection between students' views of mathematics and their performance in it in these school-leaving examinations.

Methodologically, the study employed a mixed methods approach to data collection and analysis in a case study of secondary schools in Antigua and Barbuda. The overall theoretical perspective taken was socio-cultural, and drew largely on the notions of the French sociologist Pierre Bourdieu of habitus, cultural capital and field in his theory of the social reproductive role of schools.

The study found that students as a group had positive views of mathematics. This finding was unexpected given the supposed 'underachievement' in the CXC/CSEC examinations. There were however statistically significant gender differences in students expressing positive views of mathematics, and the direction of this finding was consistent within and across data collection methods. Especially for girls, these positive views of mathematics appeared to be tempered by a perceived need for mathematics in order to gain access to desired spaces and places upon leaving school. Students' views *of* mathematics were less influenced by the factor of the type of school they were in, which, in Caribbean settings is a proxy for social class or the socio-economic circumstances of home backgrounds. There were though some differences between school-types in how students perceived they *could be* in a generalised approach to learning mathematics, and these differences appeared to 'matter' in eventual CXC/CSEC outcomes. Contrastingly, there were statistically significant differences in students' mathematics outcomes in the CXC/CSEC based on school-type, but not so by gender. Analyses of past CXC/CSEC mathematics outcomes based on school-type showed that an assessment of 'underachievement' in mathematics was not equally applicable across all school-types as students in single-sex schools did appear to 'achieve' as well in mathematics as they did in other subject areas, and markedly more so than their colleagues in mixed schools. These findings relating to students' gender and school-type meant that there was not the anticipated connection between students' views and their CXC/CSEC mathematics performance. Further, the factors of gender and school-type interplayed in complex ways on students' mathematics views and eventual performance. There is no one simple 'catch-all' phrase that adequately summarises the findings on these issues for all students, as the findings are different depending on which sub-group of students is being looked at, and which mathematics issue is being assessed. The 'best answer' for improving student outcomes in mathematics seems to lie in improving their social conditions, but this would leave gender issues unresolved.

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List of Abbreviations

A&B	Antigua and Barbuda
CEE	Common Entrance Examinations
CXC	Caribbean Examinations Council
CSEC	Caribbean Secondary Education Certificate
EQUATE	Achieving Equality in Education
GCE	General Certificate of Education
GSAT	Grade Six Assessment Tests
LCCI	London Chamber of Commerce and Industry
Mi, Si	Mixed school, Single-sex school
MoE	Ministry of Education
OECS	Organisation of Eastern Caribbean States
OERU	Organisation of Eastern Caribbean States Education Reform Unit
RA	Research Aim(s)
RQ	Research Question(s)
SA, A, N, D, SD	Strongly Agree, Agree, Neutral, Disagree, Strongly Disagree
WC, IC, MC	Working Class, Intermediate Class, Middle Class

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Chapter 1

Introduction: Caribbean Issues

1. INTRODUCTION: CARIBBEAN ISSUES

1.1 INTRODUCTION TO THE STUDY

This thesis is primarily concerned with Caribbean students' views of mathematics. The motivation for studying this particular issue came about from a concern within the Caribbean region that students' performance in mathematics was low. There has long been a notion of a link between what might be called students' attitudes to mathematics and performance in the subject (e.g. see Ma & Kishor, 1997, p27), and it was thought that a study which looked at students' views about mathematics may yield explanations for the perceived low performance. Whilst there is a general awareness of a perceived 'problem' in school mathematics in the Caribbean, much of what the 'problem' might be has been left up to un-researched theories or speculation at best. Note has been made of the influence of gender and social class issues in education generally, and of a need to encourage girls in mathematics (Berry, Poonwassie & Berry, 1999), but there appears to be limited understanding of the reasons or problems behind these issues. *What* factors contribute to students' mathematics performance, and how these factors may interplay in this performance are still largely unknown. In effect, this was an area within Caribbean education which was in need of systematic research. This opening chapter sets out the context for the study by outlining issues related to Caribbean territories and the structure of their educational systems. Also included in this chapter is a look at the common external assessment system which qualifies school leavers as it is the outcomes of these examinations which had formed a starting point for the study.

1.2 AN OVERVIEW OF SECONDARY EDUCATION IN THE CARIBBEAN

The structure of secondary education systems in the English-speaking Caribbean has been described as 'elitist' (World Bank, 1993, p87). This judgment is made on several bases, one of which is the existence of a variety of types of secondary schools with varying degrees of prestige associated (ibid, p87). Another such basis is the continued existence in some territories of Common Entrance Examinations (hereafter CEE) at the end of primary schooling, which then restricts access to secondary education to a selected sample of students. Whilst primary education has generally been universally available in the Caribbean for a number of years, secondary education has not. However, from this 1993 declaration there has been increased access to secondary education in most territories, with some e.g. Barbados, St. Kitts-Nevis offering universal secondary education (Jules, Miller & Armstrong, 2006, pxi&7). In their rhetoric, Caribbean heads of government have also announced plans for providing universal secondary education for all by the year 2015 as this is seen as one aspect of fulfilling initiatives for 'the ideal Caribbean person' (UNESCO, 2000), a profile which heads of government see as the way forward for development in the Caribbean.

Any discussion of the educational systems of the Caribbean cannot but recognise the influence of its colonial history on the structure and processes of these systems. These educational systems are 'inherited', as perhaps most systems are, but given the history of these territories, they are systems inherited not from 'fore-fathers' as much as from 'fore-masters'. Manley (1974, p21 – and also a former/late prime minister of Jamaica) described the educational system in Jamaica as being 'imported lock, stock and barrel from England without a moment's thought about its relevance to Jamaica's needs and aspirations'. Williams (late prime minister of Trinidad & Tobago, cited in Griffith, 2005, p983) said of his West Indian education 'I could discuss quite learnedly the Latin dictum, the plantation economy ruined Italy, but I had not the slightest idea how it had ruined the West Indies and was even then ruining Trinidad'. The early history of the education systems that these countries inherited had very much of an English bias, an English curriculum, to the extent that the students that these systems produced knew more about English culture, history, geography, society, and ways, and very little about the places in which they lived (Clarke, cited in Griffith, 2005, p983). About 30 years prior to the observations of these prime ministers a commission sent to the Caribbean by the British government to report on social conditions there in its report of the state of education noted that 'Curricula are on the whole ill-adapted to the needs of the large mass of the population and adhere far too closely to models which have become out of date in the British system from which they were blindly copied' (West India Royal Commission, 1945, p92). In his paper Griffith (2005) argued that this earlier English bias of Caribbean education systems served to be a fundamental failure of these systems in that they did not start at a place where students were, going from the known to the unknown. According to Griffith, when the education system is biased in this way, the students of the system often come to value the ways and culture which they are learning, and devalue that of the place where they are living.

There is therefore a sense in which the structure of these 'inherited' systems was just that much further removed from the norms and values (i.e. culture) of the majority. There was thus at the outset, a non-trivial misfit in cultures and social order of those who passed on, and those who would otherwise be seen as the 'beneficiaries' of the inheritance. Secondary education initially became the preserve of a select few by means of the also 'inherited' CEE, and these few arguably possessed characteristics which were a better fit with the requirements of the inherited culture of the system. In today's Caribbean, whilst secondary education is still not universally available across all territories, it has expanded, and is now available to a wider cross-section of the majority. But, as noted by Manley

(1974) this expansion has been of the system in its 'old form' (p142), and 'the politics of conservatism and tinkering' (p23) in the arena of education, which Caribbean policy makers have tended to prefer to do, has not necessarily served the majority well. '*Man can adjust by tinkering but he cannot transform*' (ibid, p23, emphasis in the original).

The year 1972 saw one of the most important steps taken within the Caribbean region to re-direct the focus of education. The Caribbean Examinations Council (hereafter CXC) was established in that year by an agreement amongst heads of government, and has been one of the most important steps to 'Caribbeanise' (Bailey, 1990, p9) the educational systems of the territories involved. This body was to be responsible for establishing an examination which would replace the British-based GCE O' level examinations. This move has seen a more inward, Caribbean focus in some curricula areas, for example, Literature and History. However, Griffith (2005) has noted that these changes have still kept much of the traditional character of the old system, with very much of an academic orientation. Essentially the characteristics possessed by the majority of the populations which the system is intended to serve are still not a fit for the educational systems currently being operated. There has been an expansion in access, but little flexibility in structure. This legacy is not unique – it is a history shared by many other countries of the world. However, the history of the peoples of the Caribbean is in some ways different to that of other former colonies of Britain, in that in addition to slavery and colonization, these people had been geographically uprooted. There is therefore a sense in which the inherited educational systems were even more foreign to these people also having to come to terms with removal (both physically and culturally) from what had been familiar to them, and might therefore be struggling to 'find' or re-establish this culture. Overly harsh criticisms of these Caribbean educational systems might thus be somewhat unfair, and especially if one further considers that from a wider, global perspective, these countries are relatively newly independent, Jamaica being the first to gain independence in 1962. In fact, some territories remain colonies of the UK (e.g. Anguilla, the British Virgin Islands (BVI), Montserrat). However, there is still room for criticism, and perhaps an awakening to a more critical evaluation of these inherited systems. Reform, I believe is not wanted for reform's sake, but one does get the sense that in some countries the inherited educational systems have been allowed to simply exist and go on relatively unexamined due to inertia, that is, a failure of those responsible for policy decisions to make changes, or indeed overhaul the inherited systems to something which may better serve the present and future needs of the main participants and stakeholders of the systems. An evaluation may in fact reveal that the present system is the 'best' of alternatives for these countries, but until such, the systems just simply continue to exist. However, the fact that these 'inherited systems' have been allowed to continue relatively undisturbed apart perhaps from a little 'tinkering' may denote a more ingrained acceptance, and valuing of the systems and products as is. The problems in education in the Caribbean exist more on a systemic level, and arguably arise mainly due to a lack of 'political will' for change (Robertson, 1999). Thus, according to Griffith (2005, p974), Caribbean educational systems in large part perform a ceremonial, rather than a technological function, in that they prepare a number of students for high status careers valued by the wider society, but not enough students with the knowledge skills needed for industrial development.

Defining the Caribbean

The present study is concerned with, at first, that part of the Caribbean which incorporates the 'English-speaking' territories, which share a relatively common history, having been or still are British colonies. This part of the Caribbean has also been referred to as the Anglo-phone Caribbean or the Commonwealth Caribbean. In particular, and at second, the study is concerned with those territories that sit candidates for the CXC Caribbean Secondary Education Certificate (hereafter CSEC) examinations, as much of the academic literature and press reports on student outcomes are related to student performance in these examinations. These territories are: Anguilla, Antigua & Barbuda (A&B), Barbados, Belize, the BVI, the Cayman Islands, Dominica, Grenada, Guyana, Jamaica, Montserrat, St. Kitts-Nevis, St. Lucia, St. Vincent & the Grenadines, Trinidad and Tobago (T&T), the Turks & Caicos islands. Most of these territories are now independent countries, but, as previously mentioned, a few are still colonies of the UK. Additionally, whilst most of these territories are small islands, two are countries in the Americas, namely Belize in Central America and Guyana in South America. The territories listed above have a combined population of just over 6 million (compiled from Jules et al., 2006, p8), with Jamaica being the most populous, at just over 2.6 million (~44% of total).

Figure 1.2-1: Map of the Caribbean

Source: http://www.spiceisle.com/radloff/Caribbean%20map%20(2).gif

1.3 CURRENT ISSUES IN EDUCATION IN THE CARIBBEAN

Education in the Caribbean continues to be plagued by a variety of issues, some similar to those of more developed Western countries, but others unique to the region and possibly products of their status as developing countries. Some of the main educational issues of concern in the Caribbean relate to restricted access to secondary education in some territories, the gender distribution of students in post-primary schooling, attrition and repetition rates of students (especially boys) at the secondary level, continued gender differentiation in subject choices at secondary, widening gaps in achievement based on gender and socioeconomic status, low school achievement (measured by the proportions of students leaving school with qualifications to gain access to tertiary education), particularly low achievement in mathematics, issues to do with teacher education, amongst others (see for example, Jules et al., 2006, px-xiii). The following quotes from Caribbean writers represent a selected synopsis of some of the more (current) prevailing issues in education in the Caribbean that are deemed relevant to the present study:

> In the Commonwealth Caribbean, on average, girls start schooling earlier, attend school more regularly, repeat fewer grades, are less likely to drop out and therefore stay in school longer, and achieve higher standards of educational performance than boys. (Miller, 1996, p11)

> The model of education inherited from European colonial history is more than dysfunctional for Caribbean goals of improvement. It ... contributes to the devastating class tensions across the region... Through different kinds of schooling, people are placed on a certain track in the education hierarchy... The nub of the problem is how to redesign education systems so that all institutions offer students dominant, critical and powerful literacies... This cannot be done by expanding the existing model of education, when such deep stratification is inherent to it... In the Caribbean, an estimated one in four children live in poverty, ... This explains in part why the CXC exams are taken by only a minority of Caribbean youth of school-leaving age and why, within this minority, results remain sharply uneven... there has been no appreciable change in the low proportion of passes, *particularly in mathematics and the sciences*, in most countries... it is clear that the form of the regional examination and the school system itself are doing them [Caribbean students] a disservice ... (Hickling-Hudson, 2004, p296-298, my emphasis)

The part of Miller's statement 'on average, girls... achieve higher standards of educational performance than boys' has been shown in some studies in the Caribbean to be true (e.g. Kutnick, Jules & Layne, 1997; Bailey, 2000, 2004), especially if one pays heed to the proviso, 'on average'. It is this issue too, i.e. the apparent disparities in educational achievement between the genders which has received much attention in the literature within the Caribbean region. However, Kutnick et al.'s (1997) study (conducted in Barbados, T&T and St. Vincent and the Grenadines) showed achievement to be more closely related with socioeconomic status than with sex per se, as boys from the higher socioeconomic groups did as well as their female counterparts of similar group status. For example, in a series of regression analyses conducted on Barbados primary school students' scores from class tests (raw and standardized scores) and the CEE, occupation of mother and/or father, a factor which the authors associated with socioeconomic status, consistently accounted for more of the variance in these scores than did the child's sex (p92-93). The authors reported that the results of similar regression analyses on secondary school data were more inconclusive due to the already inherent social class stratification of the secondary schools in Barbados, but the regression analysis using the students' CEE scores as the dependent variable again showed the child's sex to account for less of the variance (0.7%) in these scores than did secondary school-type (44%), and parental occupation (14.2%). Despite this there is a prevailing feeling within the region that boys (and men) are 'underachieving' academically (e.g. Miller, 1991; Kutnick et al., 1997; Berry, Poonwassie & Berry, 1999), a situation that mirrors perceived trends in Western societies (e.g. Cohen, 1998; Foster, Kimmel & Skelton, 2001; Whitelaw, 2001; Jackson, 2003).

It is not always clear in what terms 'underachievement' is construed within the Caribbean. In most cases when used with reference to boys, it seems to only be used as a comparative to what girls as a group have done in local or regional examinations the more popular of which are local CEE, and the external CXC/CSEC examinations at the end of secondary schooling. This perspective is also supported by Bailey & Brown (1999, p44), who reported that claims of male underachievement in the Caribbean are 'typically' made with reference to some comparison of male/female performance and participation. However, when used in reference to students underachieving in particular subject areas e.g. in mathematics, underachievement appears to be used in comparison to some expected standard which is never explicitly stated. Some writers have taken pains to point out that the problem as regards males and education in the Caribbean is more one of under-participation rather than underachievement (e.g. Bailey, 2004, p67) and that to some extent males under-participate in education not only because they see it as 'feminine' (Parry, 1997), but perhaps more importantly because they *can*, due to more favourable market conditions for them in terms of employment (e.g. Carty, 2002, p8; Bailey, 2004, p67-68). Bailey (2004) has also made the point that in the Caribbean where males do participate in higher (i.e. tertiary) education, they do as well as, if not better than females, and this particularly so at the most advanced levels.

Bailey (2000, 2004), and Craig (1998) have shown that whilst there has been a far greater participation by females in Caribbean educative processes, there continues to be a fairly traditional segregation of subject areas in which males and females participate. Evidence for this comes from CXC/CSEC data where perhaps apart from English and mathematics in some territories, students have free choice of subjects. Given that registration patterns for the CXC/CSEC examinations have consistently yielded more females than males, Bailey (2000, p7) has shown that the highest concentration of males are to be found in the sciences and technical/vocational subject areas, areas which she contends better positions them for the 'more lucrative forms of work in the formal and informal sectors of the labour market' (Bailey, 2004, p66). Thus, in the Caribbean, women participate in education more, and more women from lower socioeconomic classes can be found in the higher levels of education than their male counterparts because it is their best bet at some form of economic stability. In short, Caribbean women need education more than do the men. As noted by Miller (1991, p91)

> … uneducated women are among the most marginalized persons in Caribbean society… they … experience the double jeopardy of belonging to the lower strata of society and of being women. They are the lowest paid in the labour force, they experience the highest rates of unemployment, and they are the least protected workers.

The quote from Hickling-Hudson on p5, along with the findings of the Kutnick et al. (1997) study outlined on p5-6 do point to other factors that may be contributory to perceived underachievement than that based strictly on a child's sex. Socioeconomics are increasingly being seen within the Caribbean region as being associated with poor student outcomes, but as yet factors associated with socioeconomics have not been given as much attention as gender issues in particular male underachievement and supposed marginalisation (Miller, 1986). The continued focus on gender issues though has tended to obscure other more potentially intrusive sources of underachievement, such as class and/or socioeconomic status (e.g. Parry, 2004, p182).

In the world of education and the structure of these Caribbean education systems, based on the legacy of British ownership and colonisation, factors associated with socioeconomic status and/or class are played out in terms of the types of schools that exist, more specifically, the type of student who attends a particular type of school. Findings from a project in Jamaica will be used as an illustrative example of what is meant here. The project, called EQUATE – Achieving Equality in Education – was designed to compare the gender achievement of students. The project report noted that at the primary level, achievement results on the GSAT (Grade Six Achievement Tests, tests which replaced the CEE), a test designed to 'track' students for placement in particular secondary school-types, students in private primary schools usually did markedly better than students in public (government) schools (Management Systems Information – MSI, 2005). Statistics on the pass rates for the 2003 GSAT examinations in these school-types showed that for mathematics and English language, 74% and 79% respectively of private students were successful, whereas the comparable rates for students in public schools were 48% and 52% respectively. The report also noted that students with the lowest GSAT scores were 'consistently' (p10) placed in non-traditional secondary, all-age, and junior high schools, the exit point of which for the last two of these school-types is Grade 9, i.e. three years on from the GSAT examinations, and an incomplete secondary school experience. Other students from the GSATs, i.e. those with higher GSAT scores, were placed in traditional grammar and also in upgraded secondary schools, where they follow a curriculum which is mainly academic or a mixture of academic and vocational respectively. Hickling-Hudson (2002, p572) has noted that despite Jamaica having done away with the CEE, the educational system has continued to operate in such a way as to 'select out an elite minority–now about 25%–for the best secondary schools ... and to relegate the rest to schools to which no politician or professional would send their children'. The EQUATE report itself noted that student outcomes at the end of secondary school from the CXC/CSEC examinations reflected amongst other things the academic level of students at entry, which itself reflected the primary school-type students were coming from, and underlying all this, the socioeconomic background of students. Data on the success (i.e. pass) rates of students in the various types of secondary schools in the CXC/CSEC English and mathematics for the years 2001 and 2003 were given as:

Table 1.3-1: A Comparison of Success Rates in Mathematics and English Language by School-Type in Jamaica

Year	**2001**	**2003**	**2001**	**2003**	**2001**	**2003**
School-type	**Traditional schools**		**Upgraded schools**		**Technical schools**	
Mathematics	40%	51%	11%	17%	26%	27%
English Language	74%	65%	38%	27%	40%	30%

Source: Management Systems International (MSI), EQUATE Project Report

These results should also be interpreted in light of the fact that, according to the report, not all students in the last grade of exit from these secondary schools actually write the examinations, and for example, in 2003 only 46% of such students wrote the mathematics examinations, and 56% the English language examinations.

It may be somewhat surprising to put forward the notion of the Caribbean as a 'classed' society. On a global scale Caribbean countries are categorized as developing (Jules & Panneflek, 2000), and from the outside, as well as within, Caribbean peoples tend to be seen as homogenous, including with respect to economic status. Further, what is being put forward in this study as 'class' or social class may well be better defined as socioeconomic status (SES), or even occupational status; the preferred label used seems to depend on which country the research was carried out in. For example, the preferred term in the British literature seems to be social class whereas that in the American literature seems to be SES. Reyes & Stanic (1992), writing from an American perspective, noted that the fundamental difference between the two terms class and SES 'seems to be' (p27 footnote) one where class is a social construct (and more intangible), whereas SES refers to some measure of family income/wealth (and therefore something more amenable to measurement, more tangible). However, in the review of the Caribbean literature to date, especially with respect to education, writers have tended to use the terms interchangeably, often associating what might otherwise be seen as socioeconomic status, that is, poverty and wealth (non-poverty) with a hierarchy, i.e. of low or high social class respectively. These writers have also associated 'class' with such indicators as: family status, whether married or single-parent i.e. mother only (e.g. as cited in Barrow, 1999), race or shade (e.g. Cuales, 1999), and specifically within the education system, type of school, which has local variants according to country. A possible explanation could be that in the Caribbean there is a more straightforward relationship between socioeconomic status and class than might be the case in more developed countries.

Thus, much of the concern about education within the Caribbean remains with such general issues as gender (i.e. disproportionate participation and achievement by boys) as outlined above, access, and quality. Within more recent times the discussion has moved on somewhat towards more subject-related issues, such as what has been deemed especially low performance results in mathematics and science as these are seen to have implications for the capacity of the Caribbean region for technological development (e.g. Jules et al., 2006, p27). However, published *studies* particularly focused on mathematics education (or other subject-based studies) are scant (e.g. cf. comment of Downes, 2004, p108), and reports of underachievement say in mathematics continue to be mentioned in passing in such studies. Much of the discussion about 'poor' results or underachievement in this subject area is played out via speculative comments in newspapers. Headline articles such as (1) 'Mathematics Paralysis' (Hill, 2003, *Antigua Sun*); (2) 'Why are so many of us not good at maths?' (Gilchrist, 2004, *Jamaica Observer*); (3) 'Math remains CXC's weakest link' (Williams, 2005, *Antigua Daily Observer*) point to a perceived problem in this subject area. In the article connected to headline (1) the writer in commenting on a perceived continued year-on-year poor achievement of students in the CXC/CSEC mathematics, noted that there had not been any public outcries and no apparent efforts to look into, address or remedy the situation – a sort of 'carry on regardless' attitude. He speculated that the reason for this was because people have accepted the poor mathematics pass rates as their due, giving it space to 'fit' in with who they are. In the article connected with headline (2), the writer, a mathematics lecturer at a Teachers' College in Jamaica and a CXC examiner noted that many students were hampered in learning mathematics because their parents did not expect them to do well as they themselves had not done well. He was quoted in the article as saying 'We tend to pass this on, a kind of 'head-nuh-good' phenomenon'. He further commented that if mathematics teachers were not kept abreast with advances in mathematics and mathematics education, and remained stagnant in terms of their professional development, then essentially they would have fallen behind as the rest of the world would have moved on (widening gap).

One study that did look specifically at mathematics education within the region was Wilson's (1978) study of the implementation of the Caribbean Mathematics Project (CMP) in the early 1970s in the Eastern Caribbean region. This project was mainly aimed at mathematics teacher development. Wilson described the mathematics situation prior to the project's implementation as 'rote-learning of arid arithmetical techniques, and practice ad nauseam of the "Four Rules"... any connection with real life was purely accidental.' (p357). Whilst the project enjoyed some success, e.g. in raising the awareness and interest in mathematics of teachers by involving them in curriculum planning, there were also other areas in which the project failed. One example of the failure is at the classroom level where there was a continued reliance by teachers on teaching via a textbook and a failure to connect mathematics to anything outside itself. On a wider scale, Wilson noted that problems related to socioeconomics continued to plague mathematics learning, and that whilst students felt that mathematics was important it remained to them a 'mysterious subject' (p379) unrelated to everyday living.

In the Caribbean, although there have been laments about the poor performance of students in mathematics (also the sciences, and sometimes English language), the trend has been for males to do better in mathematics than females (in terms of the proportion of their cohort who are successful), and for females to do better in English Language than males in the CXC/CSEC examinations. What is perhaps interesting here is that in relation to mathematics outcomes, underachievement is seen as a problem that attaches to both sexes, i.e. that both boys and girls are seen as underachieving (e.g. Harewood, as given in Layne, 2002, p21) *even though* a gender break-down of the statistics shows that boys have consistently done better than girls (e.g. see Figure 1.3-1 below). CXC/CSEC results averaged across all subjects do show that proportionately more girls are successful in these examinations than boys, but this result is not consistent in every subject area. For the May/June Examinations for the years 2000-2005 this trend for mathematics is 'true' for all passing grades (I-III, Grade I being the highest) as a percentage of their respective cohort, and although the difference is small in terms of percentage points, consistently a greater proportion of males achieve each of the passing grades than do females. This suggests that the pattern of males performing better than females in mathematics is a non-trivial outcome, and more than an artefact of particular years or groups of students. This pattern though is reversed for English Language and also across all General subjects (see

Section 1.4 for an explanation of this term; an illustration of these results is given in Figures 1.3-2 and 1.3-3), although percentage point differences are greater. For both sexes the modal grade in mathematics is Grade V, whereas it is Grade IV for English Language and Grade III over all General subjects.

Figure 1.3-1: Gender Comparison of Caribbean CXC/CSEC Mathematics Pass Rates

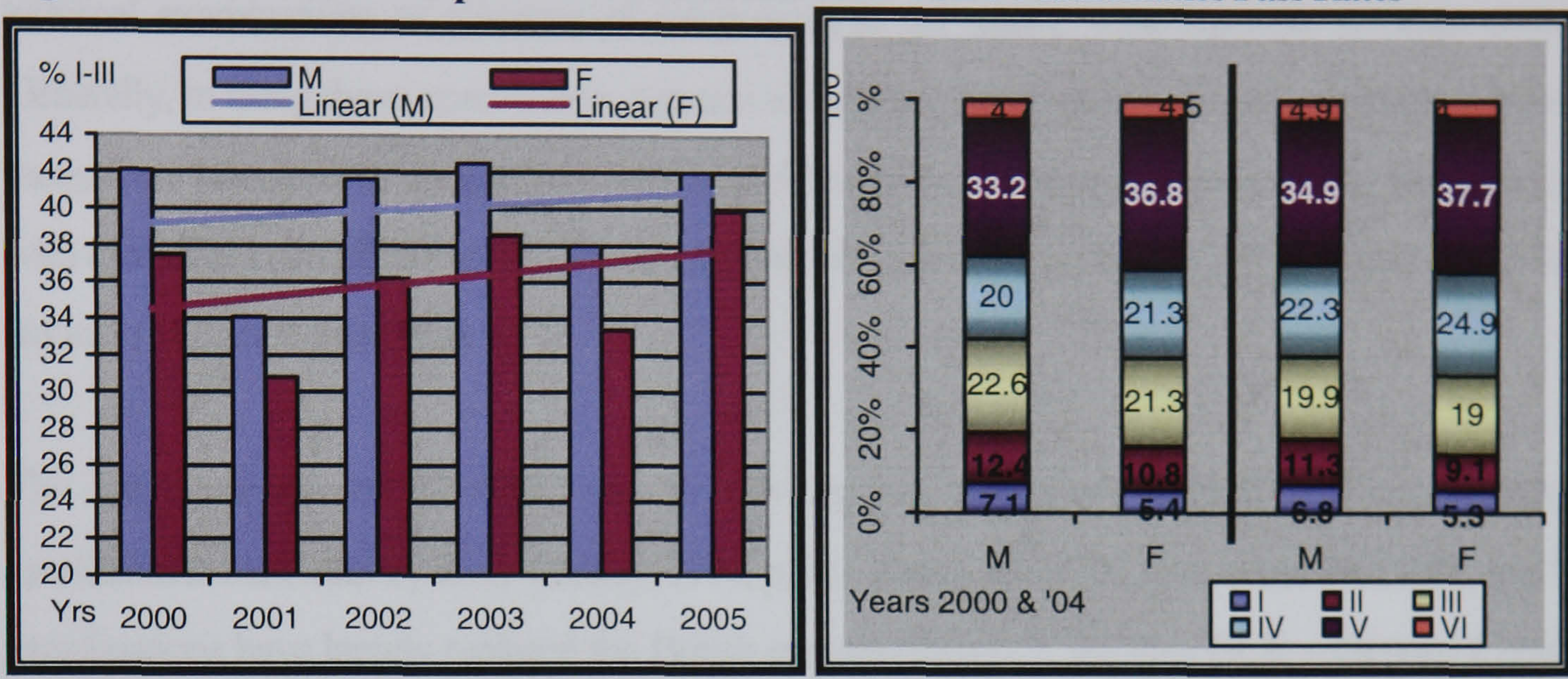


Figure 1.3-2: Gender Comparison of Caribbean CXC/CSEC English Language Pass Rates

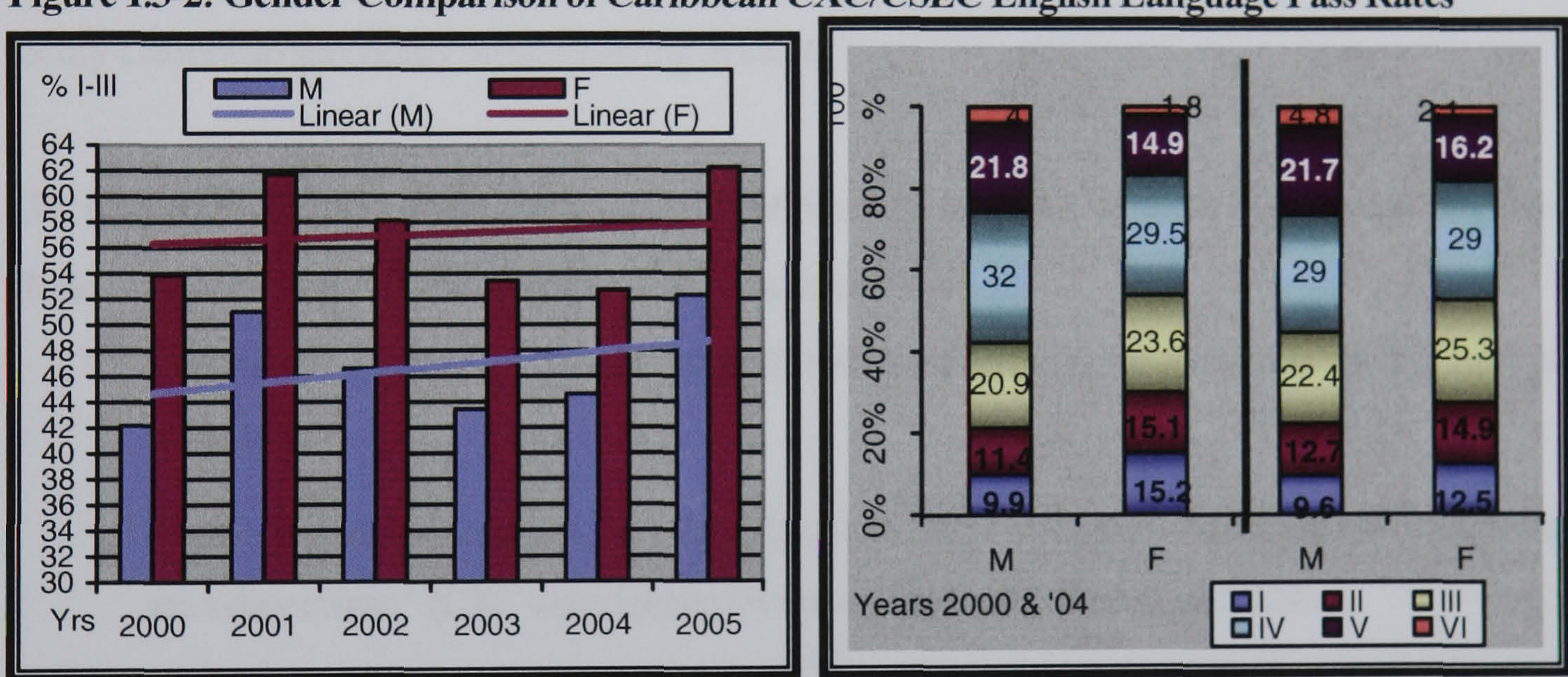
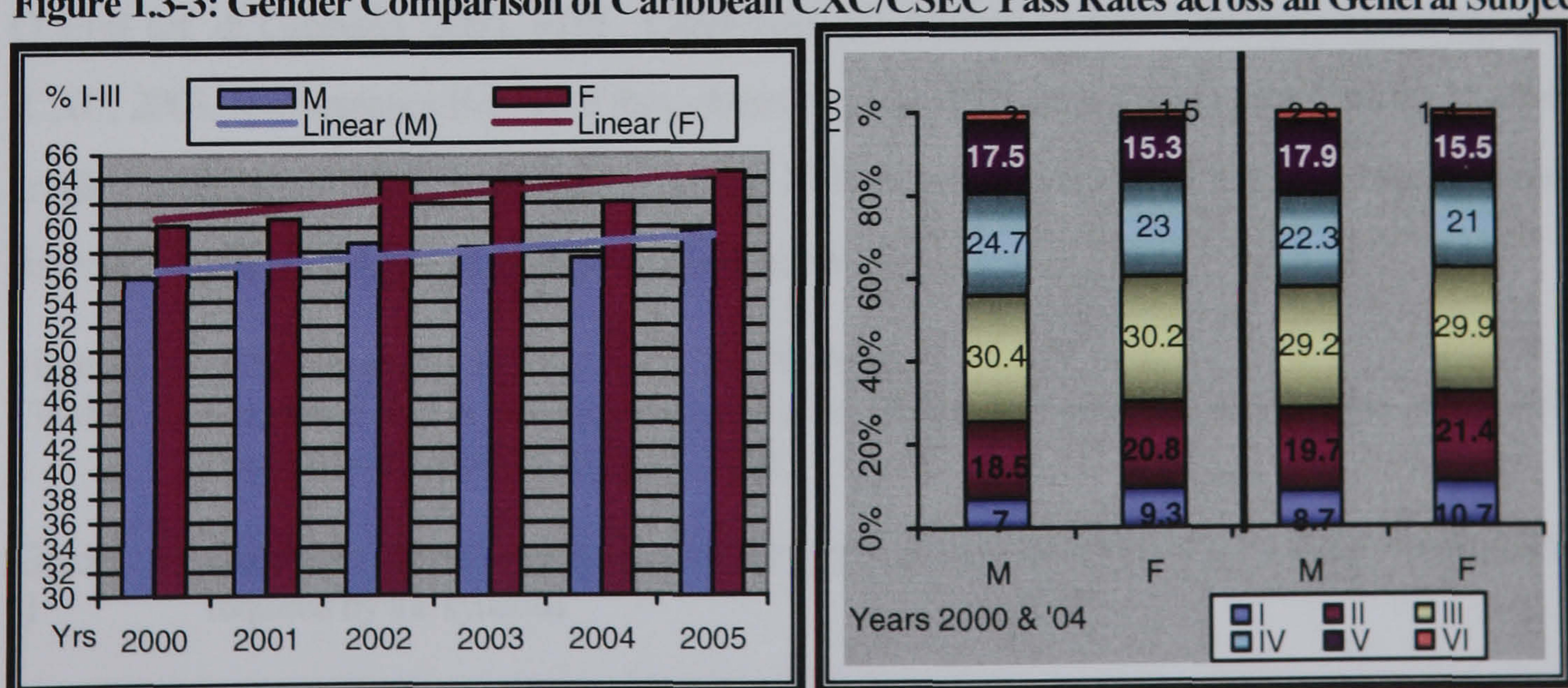


Figure 1.3-3: Gender Comparison of Caribbean CXC/CSEC Pass Rates across all General Subjects



Source: CXC Statistical Bulletins, 2000 - 2005

1.4 About the CXC CSEC

It seems necessary to give a brief background of the CXC/CSEC examinations and specifically that in mathematics, as they are the main yardstick used within the Caribbean for assessing student achievement (di Gropello, 2003, p17), and have also been used in this study as such. This, i.e. using terminal examinations as a means of assessment is not unlike what happens in other countries. Generally, in using these examination statistics as a measure of student achievement, the examinations themselves have been treated as relatively unproblematic, and again, this study has largely gone along with that trend in that it did not specifically question the relevance or validity of the examinations for the student population they serve.

The initial purpose of the CXC was to 'develop and implement a Caribbean examination for candidates at the Ordinary level' (Bailey, 1990, p58). Through the CXC has come the CSEC and these examinations have largely replaced the British examinations (e.g. the then GCE – General Certificate of Education, LCCI – London Chamber of Commerce and Industry) which had formally been used to certify Caribbean secondary school-leaving students.

The CXC/CSEC offers three levels (called proficiencies) at which subjects may be written, General, Basic, and Technical. The descriptors of these levels are:

- General and Technical – 'provide students with the foundation for further studies and entry to the workplace.'
- Basic – 'provides students with the knowledge, skills and attitude usually associated with completing a secondary course.' (CXC webpage http://www.cxc.org/Exams/Exams_CSEC.htm)

Success at the General and Technical proficiencies is seen as being equivalent to a pass at the GCE O'level (cf. di Gropello, 2003, p19). Candidates are deemed to have 'attained satisfactory grades' (CXC, 2003, Mathematics Report) if they obtain Grades I-III in any of these proficiencies on a 6-point grading scale (this grading scale revised for the 1998 examinations from a previous 5-point scale). A description of each grade on this scale is given below:

Figure 1.4-1: The 'meaning' of the CXC/CSEC Grades

Grade I	Candidate shows a comprehensive grasp of the key concepts, knowledge, skills and competencies required by the syllabus
Grade II	Candidate shows a good grasp of the key concepts, knowledge, skills and competencies required by the syllabus
Grade III	Candidate shows a fairly good grasp of the key concepts, knowledge, skills and competencies required by the syllabus

Grade IV	Candidate shows a moderate grasp of the key concepts, knowledge, skills and competencies required by the syllabus
Grade V	Candidate shows a limited grasp of the key concepts, knowledge, skills and competencies required by the syllabus
Grade VI	Candidate shows a very limited grasp of the key concepts, knowledge, skills and competencies required by the syllabus

Source: CSEC certificate

After a somewhat slow beginning, the General[1] proficiency of the CXC/CSEC examinations does now enjoy relatively widespread acceptance in the Caribbean based on the number of subject entries for this proficiency of the examinations (going from 311 571 in 1994 to 467 066 to 2003). However CXC has had some problems with subscription to its Basic proficiency (going from 35 241 in 1994 to 20 603 in 2003). The Basic proficiency offers, as its name suggests, qualifications at a lower level than the General (or Technical) proficiency. The Basic level was never offered in some subject areas, e.g. the single sciences, and CXC has had to discontinue offerings of the level in some other subject areas, e.g. Caribbean History and Principles of Business, due to 'continuing patterns of very low and declining entries over the past ten years.' (CXC webpage http://www.cxc.org/discontinued.htm). The subject areas which continue to 'enjoy' some level of success in terms of the number of candidates registering for the Basic proficiency are Mathematics, English Language (called English A in CXC language), Social Studies and Spanish, all with overall candidate numbers over 1000 (CXC Stats Bulletin, 2003). Of these subjects, Mathematics is the subject area with the highest number of candidate entries at this proficiency level (e.g. 9201 in 2003; cf. to number at the General proficiency, 83 459, and also to numbers in English A for the same year, 4365 at Basic and 83 563 at General). Perhaps part of the problem with 'success' at the Basic proficiency is that there is no real feel for what this success is equivalent *to* based on what was known before. The General and Basic proficiencies of the examinations are considered by CXC as two separate examinations, and the grading/assessment of these examinations is treated as such – there is no overlap of the grades of either proficiency. There is some loosely held perception in society that a Basic Grade I is equivalent to a General Grade II or III, but there is no official CXC document or statement declaring this. And, whilst it is known that a 'pass' (as seen from the table above, CXC itself does not use the terms 'pass' or 'fail') at the General proficiency is equivalent to, and will be accepted outside the region as an O' level pass, there is no such external yardstick by which success at the Basic proficiency level can similarly be measured (i.e. there is no equating of it with e.g. the LCCI examinations, or even with the General proficiency of the

[1] The Technical proficiency also enjoys a level of acceptance, more so than the Basic proficiency.

CXC/CSEC examinations). Thus, and perhaps a possible consequence of this, obtaining a pass in a subject area at the Basic proficiency offers a student very little by way of advancement post-secondary school, as it is not widely accepted for entrance to tertiary education nor for employment in the more sought after job markets (di Gropello, 2003, p20; Jules, Miller & Armstrong, 2006, pxii footnote 2). In effect, a qualification at the Basic proficiency has little currency to a student beyond the school gate.

There is another aspect of the replacement that ought to be noted as it impacts on the context in which an assessment of students' achievement should or ought to be interpreted. According to Ernest (1984) who carried out an evaluation of the implementation of the CXC/CSEC (in mathematics) in its early years, the Basic and General proficiencies of the syllabus in each subject area were intended to cater '*jointly* to the top *40%* of the secondary school population' (p397-98, my emphasis), a feature which was at the time considered to be advantageous to the region's students in that there was now an examination that included and hence could potentially certify a much wider student population than the top 15-20% of the former GCE (ibid, p398). It was therefore never the intent of the examining board that these examinations, including the Basic proficiency, should cater to the full 100% of the surviving secondary student population, as is the present case in some territories, e.g. A&B. Further, according to di Gropello (2003, p20), the intent in the design of the proficiency levels had been for a 'typical' candidate to sit a combination of subjects in a mix of the offered proficiency levels. The pattern of subject entries, however, has shown a different usage, with the number of subject entries at the General and/or Technical proficiency increasing, whilst that at the Basic proficiency decreasing. Thus, perhaps in a bid for hard evidence of qualifications, the examinations, and in particular that of the General proficiency in English and mathematics have been progressively used by an even wider population than CXC initially intended, so that examination pass rates in mathematics, for example, have fallen from those in the early years of the examinations (e.g. cf. pass rates given in Ernest, 1984, p405 Table III, which average 64% over the four years given with that of more recent years which have consistently been between 30-40% region-wide). The pattern of subject entries at the different proficiency levels also signals what is valued by the wider society in terms of academic qualifications.

And Mathematics

According to the CXC mathematics examinations syllabuses (General and Basic proficiency levels), the rationale for and principles guiding the syllabus are that 'Mathematics as taught in Caribbean schools should be:

(i) relevant to the existing and anticipated needs of Caribbean society;

(ii) related to the ability and interest of Caribbean students;

(iii) aligned to the philosophy of the educational system.' (CXC 2001, p1, Mathematics syllabus effective for May/June 2003 examinations)

In the syllabus design, there is a 'Core' which is intended to provide 'the minimal skills, knowledge and abilities necessary for any citizen in our contemporary society.' (ibid, p3) The Core represents the Basic proficiency of the mathematics syllabus. Additional to the Core are a set of specific objectives intended for those persons who will be

(a) 'pursuing careers such as agriculturalists, engineers, scientists, economists;

(b) proceeding to study Mathematics at an advanced level;

(c) engaged in the business and commercial world.' (ibid, p3)

The Core along with these additional objectives (and an optional section) make up the General proficiency of the syllabus. Thus, in content the Basic proficiency is a proper subset of the General proficiency. According to the syllabus, 'The Basic Proficiency is designed for persons likely to enter first level occupation. [It] allows coverage of fundamental concepts and principles of Mathematics which are applicable to everyday life. The General Proficiency ... is designed for students who are likely to pursue studies in Mathematics beyond the secondary level.' (ibid, p3) Whilst this version of the syllabus has given some idea of occupations for which the General proficiency is designed, it is not specific as to what is meant by 'first level occupation' as used in reference to the Basic proficiency. Earlier syllabuses had been more forthcoming in this respect, e.g. from the 1998 version, 'The Basic Proficiency syllabus is intended for students who are likely to go into vocations (e.g. secretarial work) or professions (e.g. law) not requiring Mathematics beyond the secondary school level' (CXC 1998, p3, Mathematics syllabus effective for May/June 2000 examinations). Given the previous discussion, it is believed that this change, i.e. of not specifying occupations suited by following a course in the Basic proficiency of the examinations has not been made on an ad hoc basis, as increasingly some students are finding it difficult to exchange a qualification in this proficiency of the examinations into the suggested job in the labour market, as mathematics, and in particular the General proficiency of the examinations, is used more and more by some employers as a 'critical filter' (cited in Schoenfeld, 2002, p13)

This aspect of the examinations, i.e. the two-tiered hierarchical proficiency structure, has to some extent been problematised by some students (e.g. see Section 5.4) and teachers in the study, signalling that this aspect of school mathematics has enhanced relevance for them. One teacher, in describing her school experience as a student of the General/Basic 'divide' referred to it as a process of separating the sheep from the goats. Whatever CXC's intent with the two-tier structure of these examinations, stakeholders, i.e. society, Ministries of Education (MoEs), schools, teachers, students have turned it into a further process of 'ability grouping' and with that the inherent attached prestige and stigmas. In two schools visited during fieldwork activities, the policy was to enter students for the CXC/CSEC examinations at the General proficiency, or not enter them at all, and this included in the subject areas of English and mathematics – i.e. it was preferable to leave school without any qualifications in that subject area than to have 'passed' it at the Basic level. Outside of an overall academic ability grouping though, it was in mathematics that students were most likely to once again experience this ability re-grouping. And, whilst Caribbean mathematics educators generally agree that the Basic level examinations for this subject are worthwhile, and are 'enough' for students doing further studies in non-mathematics related areas or for those opting to go into the world of everyday work (as the syllabus had intended), the outside post-secondary school realities for entry to tertiary institutions or for the desired jobs are demanding more.

1.5 Rationale for the Study

With considerations of the foregoing in mind, this study aimed at acquiring a comprehensive appreciation of current students' views of mathematics, how those views might have been shaped by such factors as identity, culture, school, or other factors, and how those views and/or factors may be influencing students' approach to learning and performance in mathematics. Students' performance in mathematics was taken as a measure of their success or failure in the CXC/CSEC mathematics, specifically at the General proficiency level as this is the level that has currency beyond school. The term 'views' was chosen to reflect a catch-all word to include attitudes, feelings, emotions, beliefs, as well as cognitive aspects, etc. as relates to students' perceptions of mathematics. 'Views' also represented a less messy construct than that of attitudes, beliefs, etc. as given in the literature, and this it was thought allowed more flexibility in suiting the needs of the study, as the focus of the study did not include attempts to disentangle the particularity of the notions behind these constructs *per se*. Views, it was thought, allowed access to these constructs without having to deal specifically with their associated 'messiness'. The specific research aims and questions which guided the collection of data were:

Aims: To determine

(a) the views of mathematics that students hold;

(b) the involvement of identity, cultural, school or other issues in forming those views; and

(c) the ways in which (a) and (b) may be related in students' (i) approaches to learning, and (ii) performance in mathematics.

Research questions:

1. What factors are involved in students' (a) views about mathematics; (b) approaches to learning mathematics; (c) performance in mathematics?

2. How do these factors interrelate (or are interrelated in) students' views about, approaches to learning and performance in mathematics – i.e. 1. (a), (b), and (c) above?

3. In what ways do these factors reflect issues of identity, culture, school or other issues?

These research aims and research questions will be expanded upon in Chapter 3, Section 3.1.

The comprehensive appreciation of students' views would come from using one of the territories as a case study, getting a broad feel therein for student views, and then narrowing to looking at how expressed views may have taken form and/or been shaped by those factors identified, or others. It is acknowledged that current students have not constituted the population from whom previous assessments of underachievement in mathematics have been based, but it was thought that given the consistency of these previous outcomes in mathematics, there was some consistency of structure in the mathematics teaching-learning process that was contributing to these consistent outcomes and so therefore that some 'answer' could be found amongst present student cohorts. The territory that formed the basis of the case study was A&B, and it is this territory that forms the focus of the findings presented in this thesis. Some aspects of fieldwork activities were also conducted in St. Kitts-Nevis in order to get some sense of the transferability of findings in A&B to other Caribbean contexts. The specific findings from St. Kitts-Nevis will not be presented here, but these findings did serve to provide a perspective from which the A&B data were viewed. In nature, the study is largely exploratory, seeking to 'find out what is happening' (Robson, 1993, p42). It was felt that such a study within the Caribbean region would be timely, and worthwhile.

1.6 Structure of the Thesis

The remainder of the study is set out as follows: Chapter 2 sets out the theoretical framework which initially guided data collection, and that which has since guided how the data were analysed and interpreted. Chapter 3 delineates the research aims, questions, and the methodology and methods employed to address these. Chapters 4, 5 and 6 present findings from the study. Chapter 4 outlines findings from documentary data. The documentary data largely do not involve data on students from the sample which participated in the study (although in some cases they do), however the findings from this data source are given to provide a context for the study, giving a feel for the milieu in which the study is set. Chapter 5 presents background details for the participating student sample, which also includes the views of parents and teachers of their child's/students' mathematics. Chapter 6 outlines findings regarding the views about mathematics of the participating students themselves, and these findings are combined with micro-level interpretations along the way. Chapter 7 presents an integrated macro-level discussion of the study's findings, drawing specifically on ideas from the theoretical framework set out in Chapter 2. The presentation of the study is concluded in Chapter 8. This chapter provides a summary of the main findings of the study, constraints and limitations of the study, contributions of the study to the field and ideas for ways forward.

Chapter 2

Literature Review

2. LITERATURE REVIEW

The analytical tools and theoretical perspectives from a review of the literature that have guided this study can be looked at based on the stage of the study, whether pre- or post- data collection. Whilst some issues and constructs prior to data collection have remained post data collection, others have emerged from data analysis. This chapter sets out some of the theoretical perspectives that initially guided data collection and also some of those that have since guided data analysis, and it attempts to do so whilst keeping the Caribbean context in mind. The following point though ought to be re-emphasized; an analysis of the findings of this study that incorporates an analytical framework which (a) adequately reflects the Caribbean context (b) gives due consideration to issues related specifically to mathematics and its learning in that context, and moreover (c) considers these 'mathematics' issues from the perspective taken in this study, has been problematic. As mentioned in the previous chapter, such published studies in the Caribbean academic literature are scant.

2.1 PRE-DATA COLLECTION CONCEPTUALISATIONS

This subsection sets out to provide some perspective on how key words of the study title were initially conceptualised and further developed during the course of the study, and also how they have been defined or used in the academic literature.

The word 'interplay' of the study title was chosen to describe the possible relationship amongst the factors in the title, suggesting that these factors (and/or others) play off each other, contributing to an overall process. Interplay was chosen to represent what was seen as a fluidity amongst the factors behind whatever the 'problems' are in mathematics education in the Caribbean. Other words, e.g. intersection, tend to represent what was thought as a more fixed relationship of a way things always/actually are. In addition, intersection suggests that these same 'things' (or factors) might meet or influence each other in a similar way at every meeting, whereas interplay suggests that a variety of 'things' i.e. factors meet, approach a meeting, or give way to more or less of each other which may influence or not achievement in mathematics.

In choosing the concept of 'identity' in the study title, it was thought that there might be some internal coherence of student views at the level of the individual student regarding their relationship to mathematics and its learning. That is, there might be some common views individual students held about conceptions of themselves as learners of mathematics that might cause them to engage with or not, accept or reject the subject as a discipline. Holland, Lachicotte, Skinner & Cain (1998, p3) initially broadly defined identity as people's understanding of themselves whereby they tell others who they are, they tell themselves who they are, and then they act in ways so as to make this latter true. These self-understandings that people form are a product of their experiences, the living of that experience in particular cultural worlds and social activity within those worlds. Thus formed, identities are 'hard-won standpoints' (ibid, p4) from which individuals form self-understandings of themselves and for themselves. For this study, the cultural world may be seen as mathematics learning, the experiences students have in learning mathematics. The authors do go on to outline and develop varying perspectives on identity. From the perspectives they have outlined, the aspect of identity that has emerged as being most relevant to the findings of the present study, the relationships students form with mathematics and its learning is more akin to a positional (relational) identity (ibid, p127) manifested in ways more distinct from the study findings via a gender identity. Holland et al (1998) define positional identity as having to do with:

> … the day-to-day and on-the-ground relations of power, deference and entitlement…[it] is a person's apprehension of her *(sic)* social position in a lived world: that is, depending on the others present, of her greater or lesser access to spaces, activities, genres, and, through those genres, authoritative voices, or any voice at all. (p127-28)

From the findings of the present study, this emerging aspect of identity, i.e. positional identity, was a product of students' self-understandings formed from their lived experience of learning mathematics. This experience was mostly though not exclusively gained in the classroom, and it was influenced by factors both within and outside it. Students in some cases appeared to take on positions and identities in relation to their understandings of themselves in mathematics that they may have subconsciously perceived to be expected of them by significant others (e.g. their parents and mathematics teachers). That this identity was 'positional' is supported by evidence that suggested that in some cases these identities were not who some students would otherwise ordinarily be. That is, in addition to Holland et al's broad definition of identity given above, positional identity presented the adjunct as applicable to this study of students being told who they were in relation to mathematics learning, whether implicitly, e.g. through grades, but also more explicitly, e.g. in some cases, by ability grouping, and then acting in ways so as to make that positioning true. Lerman (2001) makes this point more poignantly of the potentiality of social (e.g. school) processes for markedly influencing students' developing identities:

> given the age range covered by compulsory schooling, participants' identities are at their most formative, and children are particularly vulnerable to the regulating effects of social practices…the school classroom is particularly affected by other practices since they are often of greater significance to the students than the intentions of the school and the teacher. (Lerman, 2001, p99)

This aspect of identity, positional identity, then presents a wider focus than just on the individual, bringing in also the environment or context in which the individual exists. Wenger (1998) sees the general notion of identity as 'a pivot between the social and the individual' (p145), arguing that the individual does not exist in isolation of his/her community, and an analysis that concentrates on the individual without reference to the community in which this individual exists ultimately presents a distorted view as it 'hides their mutual constitution' (p146). It was with this consideration in mind, and in an effort to not isolate the individual from the society in which he/she exists that 'culture' and 'school' were also included in the study title.

The concept of culture has had a long and contested history in education and educational research. Its applicability to mathematics education though is less well established, and it is only in more recent times that there has been an acknowledgement of some association between mathematics and culture as mathematics as a discipline has long been viewed as both culture and value-free (e.g. see in Bishop, 1988, p179-181). The conceptions of culture that are seen as being most useful to the purposes of this study have to do with relationships, people to their past, to their present, amongst themselves. Culture has to do with people's habits, ways of thinking and being, and indeed the ways they know how to think and be; it mediates how actions are guided, what self-understandings/identities people acquire, what particular events are more likely and possible, how social relations are structured; however, it is people who produce and change culture (Foster, Lewis & Onafowora (2003, p262). Culture provides a means via which people know how to be in the world (Ladson-Billings, 1997, p700). Through culture the past is brought to the present, but it is in the present that culture can be changed. Varenne & Mc Dermott (cited in Boaler, 2002) used the metaphors for culture as 'the habits we acquire [and]... the houses we inhabit'. This metaphor brings across the idea that culture has to do with the pieces of history, ways of being, etc. people take on from the environment or social milieu in which they grow up, but, having taken these on, how it is that they may use the acquired culture to shape their present. Whilst culture presents a useful framework within which the findings of this study can be analysed, it is also useful to bear in mind the caveat delineated in Bloomer & James (2001) of avoiding using culture as the cause or explanation for everything, as people do possess agency. Agency, as has been useful for this study, has to do with 'the realised capacity of people to act upon their world... to act purposively and reflectively... to... remake the world in which they live' (Inden, cited in Holland et al, 1998, p42). In the study, culture via Bourdieu's notion of 'cultural capital' (1997/1986, p47) has emerged as an explanatory framework via which the marked differences in students' mathematics outcomes could be accounted for. This explanatory framework will be expanded on in Section 2.2 to follow.

Although the idea of agency is not explicitly outlined in the study's title, it is there implicitly in the incorporation of the idea of identity and its initial conceptualisation as having to do with the relationships students form with mathematics, how they may choose or not and the ways they do so, to engage with mathematics and its learning. That is, there was an idea that students do possess the capacity to be agentive in their mathematics learning experience. Holland et al. (1998) see human agency as a sort of by-product of identities. For them, human agency is mediated through the 'hard-won standpoints', or identities people form in particular cultural worlds, so that agency is also always enacted in particular cultural worlds through the identity (relationship) an individual has formed in that cultural world. Put in the context of this study, the ways in which students act within and upon their learning of mathematics – the ways in which they (are able to) display agency, is structured by (mediated through) the identity they have formed in relation to that cultural world of mathematics and its learning. Holland et al. (1998) also go on to conceptualise agency as a means of self-direction (p5), of gaining control over one's behaviour (p38), and further suggest that human action as agency is relatively conscious action (p40), in that the individual is aware of the action they are taking.

Children spend a significant proportion of their formative years in school, and school quickly becomes a routine day-to-day activity. Thus, school, and particularly school-type from the researcher's experience of education in the Caribbean, was anticipated to be an important factor in students' mathematics achievement. However, schools and the underlying structures that support them have come to be a much more significant factor in the findings of the study than had initially been thought. As Rutter, Maughan, Mortimore, Ouston, & Smith (1979, p1) found in their study of 12 London secondary schools, schools do play an important role in students' academic and non-academic development, and in this respect, school-type does indeed matter. That Rutter et al's finding might be considered somewhat dated, and that it was found for educational conditions in a British context does not decrease the relevance or applicability of their general finding to the Caribbean context, especially, as outlined in Chapter 1, how 'British' these Caribbean educational contexts continue to be.

And mathematics – the aim here is to note some general issues related to the subject as a discipline. Mathematics occupies parallel status to that of English language in the school curriculum given the relative frequency with which general education policy documents tend to twin the two. Outside of school too there is a general perception that in addition to proficiency in language, some level of mathematics proficiency is also looked for by employers. With respect to achievement, it has also been noted that subjects like mathematics (and science) are more likely to show up differences between schools than subjects like English Language (and Social Studies), the rationale being that mathematics and science are largely learnt at school whereas English Language and Social Studies are more likely to be affected by home influences, e.g. books available at home, watching television, general family conversation, etc. (e.g. Rutter et al, 1979 in their review of American and British literature on school effects, Van de Werfhorst, Sullivan & Cheung, 2003 in their literature review). So, it has been argued, all things at school being equal, mathematics at school presents the opportunity for levelling the playing field in terms of achievement outcomes for students with differing home advantages in contrast to subjects such as English Language which are more susceptible to home influences (e.g. Van de Werfhorst et al, 2003, p43).

The order of factors chosen in the study title was also deliberate, going, it was seen, from the level of the individual, i.e. the personal experience of students – from the aspect of identity, to the wider social milieu of which they are a part – culture, narrowing to the regulating effects of school processes, and within these, processes connected to the learning and teaching of mathematics. That is, the idea was to tie things together from the specific (identity) to the general (culture), narrowing to an intermediary (the school), and then hopefully relating these back to the specific (mathematics, and its learning and teaching).

2.2 Post-Data Collection Considerations

A conceptual tool that has played a major role in guiding the perspective taken post data collection has been Bourdieu's notion of 'cultural capital'. This is how Bourdieu described the origins of the term:

> The notion of cultural capital initially presented itself to me, in the course of research, as a theoretical hypothesis which made it possible to explain the unequal scholastic achievement of children originating from the different social classes by relating academic success, i.e., the specific profits which children from the different classes and class fractions can obtain in the academic market, to the distribution of cultural capital between the classes and class fractions. (Bourdieu, 1997/1986, p 47)

In the present study, there had been a consistency to prior CXC/CSEC mathematics outcomes of students based on the type of school they attended (e.g. see Section 4.2). Further, within this consistency of outcomes was the finding that 'underachievement' in mathematics was not equally distributed across the student population, and that relative to each other, there was one group of students whose mathematics achievement was consistently markedly above the national (and Caribbean) average so that the assessment of underachieving in mathematics was for them not fairly applicable. It was in seeking a possible theoretical basis on which this general finding could be explained that the term cultural capital was 'found' and incorporated in this study. Cultural capital, and other related concepts within Bourdieu's theory of practice provided a 'hypothesis' for explaining the marked differences in the mathematical outcomes of previous students, and further offered a basis to account for some of the general patterns of the approaches some students took to working on mathematical questions, a finding coming through from data collected during fieldwork.

In using the term 'cultural capital', Bourdieu was reclaiming the word 'capital' from what he saw as the usual and limited economic sense of its use, seeing capital in all its forms as 'accumulated labor *(sic)*' (ibid, p46) which has an inherent time element. 'Capital' conveys the notion of trade, that with this capital, a person is able to enter into a form of exchange that then provides (or gives access to) other desired resources. Bourdieu identified three forms of cultural capital, an embodied, an objectified and an institutionalized form. Embodied cultural capital has to do with the 'long-lasting dispositions of the mind and body' (ibid, p47), and is capital (accumulated labour) a child acquires through the family via a prolonged investment of time. Cultural capital in its objectified state is perhaps the most tangible of the three, having to do with a person's accessible resources such as books, paintings, etc., which could be viewed as a person's access to economic resources – economic capital. Institutionalized cultural capital has to do with (educational) credentials. Embodied cultural capital is the form of cultural capital which is thought to be most useful for this study, but given that the three forms are not mutually exclusive, it is not to the exclusion of the other two. With cultural capital in its embodied form, the child brings with him/her the accumulated labour of a familial investment of time that he/she can use in school to trade *on* for the profit of educational achievement. But, unlike some forms of trade which involve a direct exchange, giving up one thing for another, this form of cultural capital is an investment, and the returns are additional, i.e. other forms of capital (institutionalized capital, for example) to that already acquired. Thus, a child's embodied cultural capital may serve as an investment in the sense that depending on the circumstances, the child can make use of that capital to negotiate other privileges, or it may allow easier access to other forms of capital, and in school, this could mean educational achievement.

Bourdieu's notion of cultural capital represents one part of his theory of practice and cultural reproduction. Within this theoretical framework are also the notions of habitus and field, and these three are seen as being dependent on each other for operationalisation. Habitus has to do with a person's predispositions, how they are likely to behave in certain circumstances, with these predispositions emanating from a person's embodiment of history (Bourdieu, 1977, p78). Bourdieu has variously defined habitus, the following is one such:

habitus… the system of dispositions to a certain practice is an objective basis for regular modes of behaviour and thus for the regularity of modes of practice… the effect of the habitus is that agents who are equipped with it will behave in a certain way in certain circumstances. (Bourdieu, 1990, p77).

Thus, a person's habitus makes certain modes of behaviour – and thinking, possible as well as making other modes less likely to occur in certain circumstances (Bourdieu, 1977, p77). These 'certain circumstances' in which the habitus operates might be considered as the immediate environment or context – that is, what Bourdieu has labelled 'field' (e.g. Bourdieu, 1991).

There seems to be a large overlap area between what Bourdieu has described as *embodied* cultural capital, and what he in other writings has labelled habitus, coming through from his referral to 'dispositions' in describing the nature of both. It may be that at times, and in certain circumstances, habitus may well function as embodied cultural capital, and vice versa. Bourdieu has alluded that embodied cultural capital may at times be read as habitus, when in a section of his seminal work *The Forms of Capital* in which he was delineating his conceptualisation of embodied cultural capital he wrote: 'This embodied capital, external wealth converted into an integral part of the person, into a habitus…' (1997, p48). It could be that Bourdieu's conception of embodied cultural capital is what he has more consistently described as related to habitus, that is the idea of a person's dispositions to certain types of behaviour, ways of thinking, being, etc. which are a product of the family's time investment, accumulated labour (see also in Moore, 2004, p451 where there is a suggestion that the terms are much the same). The key point appears to be linked with the idea of embodiment; habitus is naturally taken as embodied, whilst cultural capital has more often been taken as external to the person – a person's external resources/possessions, i.e. more associated with the objectified form of cultural capital. However, according to Bourdieu, cultural capital can also be embodied, i.e. internal to the person. An allowance to conceptualise a person's dispositions in this way, that is, as embodied cultural capital (in addition to habitus) offers the benefit that goes along with the metaphoric use of capital, i.e. what it is a person has to offer or trade *on* in particular circumstances i.e. fields (for this study learning in mathematics classes) that may allow for that capital to serve as an affordance.

These key concepts of Bourdieu's theoretical framework, cultural capital, habitus, and field, have been related in the following way: The field is seen as a sort of game, which in the context of this study may be taken as mathematics classes/learning mathematics. Cultural capital is the some*thing* – resource, wherewithal, familial disposition or inclinations, all of which may also be considered as cultural, that a person needs in order to be able to perform well in the game and to be successful in it; it is the some*thing* a person has to trade *on* in the game. Habitus is a disposition, an inclination to play the game, to participate in the field; in other words, it is the enactment in the field of cultural capital (Sensevy Gérard, personal communication, 2006; see also Grenfell & James, 1998, p25). So, it may well be that a person possesses an inclination, the habitus to participate in a particular field but may not possess, or may not have yet acquired, or has limited access to the type of cultural capital – the resource needed to trade *on* in that field that guarantees a good performance in that field; it is also conceivable that such a situation could operate in the reverse, that is, that a person has the type of cultural capital needed to perform well in a particular field, but does not have the inclination – habitus – to participate in that field.

Bourdieu's theory of social reproduction though does come with 'academic baggage'. It has been criticized as being deterministic (e.g. Connell et al, cited in Lareau, 1997, p714; Giroux, cited in Grenfell & James, 1998, p16) in that the notion of reproduction suggests that individuals have little autonomy in directing their life trajectories, and that these are more or less pre-determined based on the family into which one is born. Grenfell & James (1998, ch.2) have argued that these critiques are unfounded, and represent a mis-reading or inadequate consideration of all of Bourdieu's work in that Bourdieu did recognise that individuals have agency, i.e. the capacity to act on or control the course their life took. Habitus, 'the system of dispositions to a certain practice … in certain circumstances' is the 'stuff' that mediates the relations between cultural capital, that is, the resources that an individual has to trade on, both the accumulated labour of assets and embodied via familial investments of time, and field – the 'certain circumstances'; in other words, habitus is the 'stuff' that mediates what an individual is inclined to do in certain circumstances with the resources he/she has. The definition of habitus as a disposition to certain actions suggests that actions attributable to the habitus tend to occur as it were without thinking, that is, at a subconscious level (e.g. Bourdieu, 1990, p12). Agentive human action on the other hand carries with it a greater degree of consciousness, of intentionality (Pickering, 1995, p17); the human action in agency occurs at a greater level of awareness. But Bourdieu has identified the field as a place of struggles (Bourdieu & Wacquant, 1992, p101). This conceptualisation of field carries with it, depending on the individual, his/her habitus (inclinations) and the nature of his/her cultural capital in relation to the particular field, the potential for being a site of agentive action. It seems to be the case that when the habitus encounters a field to which it is relatively attuned, human actions in such a field occur naturally – 'a subconscious and pre-reflexive fit… an intentionality without intention' (Bourdieu, 1990, p108), that is as it were, a going with the flow, i.e.

> when habitus encounters a social world of which it is the product, it is like a "fish in water": it does not feel the weight of the water and it takes the world about itself for granted. (Bourdieu & Wacquant, 1992, p127)

However, when the habitus and field are not attuned, an inherent tension is created and human action therein may become more agentive. According to Bourdieu, the habitus operates in a field only as long as it is logical for it to do so (1990, p79); the nature of the habitus may itself be reinforced or modified by a particular field (Bourdieu & Wacquant, 1992, p133). Thus, the habitus may be 'superseded' in a particular field by what he termed 'rational and conscious computation' (Bourdieu, 1990, p108), but that the potential for this – this 'recourse' as he has termed it – to occur is itself structured by the social and economic resources of the individual – possibly read as cultural capital. It would seem then from this perspective that when an individual acts 'thinkingly' in a particular field, it is potentially no longer the habitus that is operating, but something else. But despite these formulations of habitus as (sub-conscious) dispositions, Bourdieu does also suggest that the habitus can be transformed and indeed controlled via an 'awakening of consciousness and socioanalysis' (ibid, p116), which, if one accepts the view of agency as that of having control over one's behaviour via purposeful and reflexive actions (e.g. see Holland et al.'s, 1998 conceptualisation given in Section 2.1, p22), then allows for the possibility of locating agency *within* (conscious) habitus.

For Bourdieu, habitus was a mediating, rather than a structuring concept (e.g. Bourdieu, 1973, p72; see also Bourdieu & Wacquant, 1992, p120), as his conception of habitus provided for him the dialectic between the structuring practices of a field and an individual's own structured practices of embodied history. That is, habitus mediated what individuals do, how they used what resources they have (cultural capital, including embodied cultural capital) in certain fields. In certain fields there was an inherent tension so that an individual did have the capacity in such fields to act on his/her world, i.e. agency inhabited the notion of habitus. However, the extent to which individuals could (or knew how to) appropriate agency in their life trajectories was in large part a product of the structures into which they were inculcated and the extent to which they were aware – conscious – of how their habitus may be structuring their practices in certain fields. Some persons, based on their early family history and the embodiment of that history are better positioned to make use of existing structures to (educational) advantage, and so increase the chances of ensuring continued ownership of that agency; but they may not do so. Another related criticism is that the cultural capital theory positions children from the lower economic strata of societies in terms of a deficit model, highlighting what they lack against an arbitrary middle-class yardstick (e.g. see in Fritzberg, 2001). Cooper & Dunne (2000, p5) argued that whilst this criticism was at times justified, simply ignoring the theory then discarded a proper sociological explanation for differences in student achievement based on the relations between a child's available cultural resources acquired in the home and which are present before he/she starts school, and what the school required of that child in order for him/her to be successful.

Another criticism that has been brought to bear on Bourdieu's theoretical concepts, including that of cultural capital, relates to their inherent vagueness (e.g. see in Reay, 2004a, p438; DiMaggio, 1979, p1468). It is at times difficult to get a hold of what the 'it' that is cultural capital is, how it may be recognised. Dimaggio (ibid.) made the point that Bourdieu used the idea of capital in relation to so many things and that so many capitals abound (e.g. cultural, symbolic, linguistic, amongst others), that the metaphor becomes no more than 'a weak figure of speech'. It seems though that Bourdieu intended for his theoretical concepts to be sufficiently vague in order for them to do their work as he saw them as '*open* concepts designed to guide empirical work' (Bourdieu, 1990, p107). He had described the nature of habitus as possessing a certain 'vagueness and indeterminacy' (1990, p77) in that whilst habitus may predict modes of behaviour, as it is not based on rules or laws as it does not have their 'fine regularity' (ibid., p77), but ascribes to a more 'practical logic' (ibid, p78) – agency – as may be required in the context of the field. In a sense Bourdieu himself has given licence for his concepts to be used not necessarily as a set of pre-defined tools, but as adaptable to the flow of a particular study. Thus, it is in their vagueness that cultural capital, habitus and Bourdieu's other theoretical tools are potentially at their most useful, as this vagueness allows a researcher scope for using the concepts in ways that best fit the purpose of their study, but this ought to be within the confines of the notions *being useful* for the study.

Given the foregoing, studies have operationalised cultural capital in a variety of ways both quantitatively (e.g. DiMaggio, 1982; Dumais, 2002), and more recently it seems, qualitatively (e.g. Lubienski, 2000; Weininger & Lareau, 2003; Reay, 2004b). Reay (2004b) has noted though that the operationalisation of cultural capital within educational research has tended to focus on high status participation in culture and aspects that might be seen as more associated with the objectified form of cultural capital e.g. attending theatre, going to the museum, etc, attempting via various quantitative means to 'measure' 'it', but has argued that these conceptualisations are limited, in that they tend to overlook a qualitative dimension which can serve as an explanatory framework for understanding how day-to-day micro-processes in schools perpetuate social inequities. Lareau & Weininger (2003) have argued for a broader, qualitative conception of cultural capital, as a focus on the quantitative aspect marginalizes one of the more pervasive ways in which cultural capital may work in education. In this study the 'idea' of cultural capital has thus been conceptualised in this broader, more qualitative way which incorporates a consideration of the 'micro-interactional processes whereby individuals' strategic use of knowledge, skills, and competence comes into contact with institutionalized standards of evaluation' (ibid., 2003, p569). This qualitative conceptualisation of cultural capital arguably shifts the focus from objectified forms to the embodied form, and, as noted previously, is felt to be the form most suited for this study. Thus the perspective used in relation to cultural capital has more to do with the ways of thinking and being that students bring to bear in their approach to doing mathematics and how these ways of thinking and being represent a fit or mis-match with expected standards in relation to achievement in mathematics. It is felt that this perspective of cultural capital is more appropriate for the context of the study.

But, how might cultural capital and Bourdieu's reproduction theory serve as bases via which differences in educational – and mathematical – achievement can be explained? In Bourdieu's own words:

> The educational system reproduces all the more perfectly the structure of the distribution of cultural capital among classes… in that the culture which it transmits is closer to the dominant culture … By doing away with giving explicitly to everyone what it implicitly demands of everyone, the educational system demands of everyone alike that they have what it does not give. This consists mainly of linguistic and cultural competence which can only be produced by family upbringing when it transmits the dominant culture… (1973, p80, 84)

Thus, according to Bourdieu, schools and educational systems assume homogeneity of student background culture, and one predicated on that of the dominant (i.e. more middle-class) culture. This is the starting point of schooling, so that children for whom this assumption is unfounded are disadvantaged at the start, and chances are will continue to be further disadvantaged as schooling progresses. If this statement is considered in light of the account given in the previous chapter of Caribbean inherited educational systems then an even greater disjuncture may be seen to emerge. Language or linguistic competence will be used as an example here of this disjuncture in the Caribbean setting. Craig (1998, p50) has noted that in the 'English-speaking' Caribbean countries, primary education has failed to adequately deal with the fact that for a majority of the children whom it serves their first (i.e. home) language is a creole or dialect of English, which is often markedly different from the expected 'standard' English – the language of instruction, a situation which he saw as contributory to the observed low proficiency of students who finish primary school, and a perpetuation of this situation for those who advance to secondary school. These Caribbean educational systems still bear in their structures the marks of their British legacy of education. To that point, the language of instruction is largely a 'standard' version of English.

Thus, there are inherent problems within the Caribbean with regard to the issue of language and education (Craig, 1971, 1998; Pollard, 1983; Youssef, 2002). Within the 'English-speaking' Caribbean, there has only within the past 20-30 years been some recognition on the part of governments and education policy makers that 'standard' English, the official language of instruction in schools, is not the native (first) language of a majority of the population, that a majority of students come to school speaking a dialect version of English (or a mixture of English and French based creoles, based on the colonial legacy of the particular territory). These dialect versions of the standard language have been called Creole, patois, broken English or simply dialect. With regard to the English-based versions, these have been described as 'strikingly different from the language of instruction in all subjects' (Berry et al., 1999, p19). In Jamaica the situation of the language of instruction in schools and that spoken by the majority of the people (and hence students) has been described as follows:

> the majority of the population of Jamaica speak a dialect English, whose structure, grammar, vocabulary and intonation differ, sometimes considerably, from standard Jamaican English, the language of instruction in schools. For many Jamaican children this latter language has a status different from that of either a foreign or a mother tongue: they can decode it, but cannot reproduce it. (Austin & Howson, 1979, p164, identified as given in Young, 1977).

However, an official course of action as relates to the use of language in the teaching-learning process coming out of this growing recognition has been slow to make its way to the level of the classroom (Berry et al. 1999, p19; Youssef, 2002, p182), and where it has done so, it has hardly gone beyond that for instruction in the English language subject itself. Further, where some policy does exist, it appears to be more one of tolerance of the creole during what is seen as a transitional period for students to the standard English (e.g. the 1975 educational policy with regard to language of Trinidad and Tobago, from Craig, cited in Youssef, 2002). Generally, Creole in the English-speaking Caribbean is regarded even by those who speak it as of lower status than the 'standard' English, i.e. an in-correct or 'broken' form of English, which has no place within the school classroom with its overall emphasis on correctness. This perception is further complicated by the fact that the general perception of the people in these countries is to consider themselves as English-speakers (e.g. as noted by Mair, 2002, p35 with regard to the majority population of Jamaica). These perceptions have largely influenced regional educational policies in the past in this regard, and 'have militated against implementation of very much bilingual education' (Youssef, 2002, p183). Thus, an otherwise largely creole-speaking group of Caribbean young children go to primary schools in the Caribbean and meet there instruction in a language with which they are mostly unfamiliar. This situation too is not without 'social class' implications.

Thus, whilst education and schools offer the possibility for students to improve their social and economic status (i.e. improve their class positions), they have also been recognised as places that (re)-produce the social order (see also Ostrove & Cole, 2003; Smith, 2003). One way in which educational systems have been able to 'get away' with this practice, according to Bourdieu, is through a process of legitimating that which would otherwise have been looked at as a social injustice, i.e. by seeming to award on merit what it in generality awards for social position:

> By making social hierarchies and the reproduction of these hierarchies appear to be based upon the hierarchy of 'gifts', merits, or skills... or, ... by converting social hierarchies into academic hierarchies, the educational system fulfils a function of legitimation which is more and more necessary to the perpetuation of the 'social order' as the evolution of the power relationship between classes tend more completely to exclude the imposition of a hierarchy based upon the crude and ruthless affirmation of the power relationship. (Bourdieu, 1973, p84)

This process in education has been allowed to pass seamlessly into an established way of doing things, i.e. culture, so that there is a failure to recognise the process for what it might otherwise be considered to be. According to Moore (2004, p451), it is through this 'misrecognition' that cultural capital is able to do its work in education, by allowing to appear as natural what is in effect a socially conferred disposition or habitus. This notion of misrecognition is another of the tenets of Bourdieu's reproduction theory (Bourdieu, 1990, p111-112; Bourdieu & Wacquant, 1992, p167-168). Misrecognising something requires recognising it as something else. Through this process, misrecognition and alternate recognition, the something can, and in this case the social differentiating function of schools does, gain legitimacy. One way in which education systems and schools allow for this persistence of inherited social inequalities is in their practice of grouping students by 'abilities'. It is certain that the quality of learning is influenced (among many other things) by with whom one learns (Linchevski & Kutscher, 1998), especially if learning is conceived as participation in a community of practice (Wenger, 1998; Smith, 2003).

The work of habitus and embodied cultural capital in a field has so far been described in terms of a mediating device. Hutchins has conceptualised mediation as follows:

> ... mediation ... [refers] to a particular mode of organizing behavior with respect to some task by achieving coordination with a mediating structure that is not itself inherent in the domain of the task. That is, in a mediated performance, the actor does not simply coordinate with the task environment; instead, the actor coordinates with something else as well, something that provides structure that can be used to shape the actor's behavior. (Hutchins, 1997, p338)

From a Vygotskyian perspective, the idea of mediation provides the link (the lubricant) that connects a person with his/her history, culture – ways of being/doing things, and other individuals – the social (see Abreu, 2000). Embodied cultural capital may not be a mediational means in the sense of Wertsch's (1998, p25-72) characterization of these. In particular, it lacks the materiality of such means, and also may not 'fit' Cole's (1996) levels of artefacts even at the third, most immaterial/intangible of these. It is a central tenet of this thesis however that cultural capital, especially in its embodied form, leads to certain types of behaviour, and an inclination to make (differential) use of certain types of cultural tools or mediational means. In the mathematics classroom a student's embodied cultural capital seems to matter particularly, as it predisposes students to act/behave in certain ways. Thus, embodied cultural capital could be viewed as context in the sense given by Cole (1996, p132-135), as that which interweaves and that which surrounds – it is an inherent, intangible, easy to forget but always omnipresent, background variable of schooling and mathematics experiences.

But how does mathematics, and mathematics education fit into this theory of cultural re-production? What plays out in the seeming micro-world/field of the mathematics classroom is what in effect is being played out in the macro-world of the educational system in which mathematics learning and teaching exists. Mathematics is generally considered an elite subject, and the elite educational system in which it exists in the Caribbean appears (at least in this study) to exacerbate its 'difference' from other subjects, and through mathematics to unmask the social/cultural differences (as a general pattern) in students. Mathematics and what it is that is taught in schools appears (in this study at least) to be more 'foreign' to some students than others, and whilst it may be true that most of what mathematics students learn is learnt in school, it is inarguably also true that some students due to the embodied capital they bring with them to school, are better positioned to make sense and use of the mathematical knowledge and teaching (style) that they meet in school than other of their colleagues. For some students then, learning mathematics as taught in schools is more akin to enculturation, or reinforcing building on something that is already there, whereas for others it is a process of acculturation, that is, having to acquire and take on something which is different to the ways they know to be (e.g. in Bishop, 1988). So, although mathematics may offer the potential to 'level the playing field' of learning in school for students in that it is a subject which is largely learnt at school, in other ways it more efficiently un-evens that field.

Chapter 3

Research Questions, Methodology and Methods

3. RESEARCH QUESTIONS, METHODOLOGY AND METHODS

This chapter outlines the general aims and research questions which guided the planning, decision making, data collection and analysis for the study. There are five main sections in this chapter. The first of these outlines and expands upon the research aims and questions first presented in Section 1.5 of Chapter 1. This is followed by the chosen methodology for addressing the research aims and questions, and the rationale for this approach to gathering data. The third section describes the research methods chosen for data collection, going through the rationale for the chosen methods, the planning and implementation of the said methods. Section 3.4 addresses how validity and reliability were planned for in the study. The chapter concludes with a section which describes the data analysis process.

3.1 AIMS OF THE STUDY AND RESEARCH QUESTIONS

During the planning stage for the study and prior to undertaking fieldwork, many of the decisions regarding choice of research approach, methodology, and methods were influenced and guided by Jo Boaler's work on students' experience of mathematics, especially as outlined in her unpublished 1996 thesis *Case Studies of Alternative Approaches to Mathematics Teaching: Situated Cognition, Sex and Setting*. Going into the present study, there was an implicit loosely held 'theory' or hypothesis that the consistency of past mathematics examination results in the Caribbean and A&B were products of some underlying corresponding consistency. Some possible sources of this corresponding underlying consistency could be that of students' views of mathematics, which potentially involved such factors as identity, culture, school, amongst others, and also that of the underlying mathematics education process being operated or in which mathematics education existed.

The following (with students in A&B as the main participants of the study) were the aims and research questions with which the study was undertaken and which guided the plan and execution of data collection methods and analysis:

Aims: To determine

(a) the views of mathematics that students hold;

(b) the involvement of identity, cultural, school or other issues in forming those views; and

(c) the ways in which (a) and (b) may be related in students' (i) approaches to learning, and (ii) performance in mathematics.

Research questions:

1. What factors are involved in students' (a) views about mathematics; (b) approaches to learning mathematics; (c) performance in mathematics?
2. How do these factors interrelate (or are interrelated in) students' views about, approaches to learning, and performance in mathematics – i.e. 1. (a), (b), and (c) above?
3. In what ways do these factors reflect issues of identity, culture, school or other issues?

The research aims (hereafter RA) and research questions (RQ) outlined above put the focus of the study very much onto the students. What follows expands more on the RA and RQ. With respect to the aims, having obtained some sense of what students' mathematics views are via RA(a), RA(b) is essentially an exploration of what (things, people, etc.) may have influenced students having those views or how it is students may have come to hold the expressed views, with a speculation that factors having to do with identity, culture, school amongst others may be possible sources. RA(c) seeks out whether there is a relation between students' mathematics views, how they may have come to hold those views and (i) how it is they approach learning and/or doing mathematics and (ii) their performance in the subject. The term 'approaches to learning mathematics' is seen to entail aspects of the student's 'preferred' style of learning/doing and knowing mathematics, e.g. by rote or memorization, by understanding/thinking through problems. The term also includes what might be considered observable deportment (behaviours and mannerisms) in mathematics classes, engagement or not in classroom activities, whether these be group or individual work, or whole-class teaching, and their reactions to work given, to include class-work, home-work, tests, etc. 'Preferred' is given in quotation marks to allow for the possibility that observed students' style of learning/doing mathematics may not always be their choice, but what it is they have to do in order to be 'effective participants of the community of their *school* mathematics classroom' (Boaler, 1999, p269, my emphasis).

The RQ are somewhat more complex than the research aims. RQ1 implies two questions, as in order to determine the factors involved in students' mathematics views, approaches and performance there is an inherent need to find out what are these views, approaches and performance. Having 'found out' these latter, then finding out the factors involved is an exploration into some aspects of RA(b) outlined above, that is, the what, how or where of students coming to have the views they express, the approaches they demonstrate, and ultimately the mathematics performance they attain. Mathematics performance here is, strictly speaking, taken as the grades students obtain in the CXC/CSEC examinations, specifically whether they are successful or not in these. However, students' perception of their in-school mathematics performance would also be instructive. RQ2 is a complex question in that it could be interpreted in a number of ways. These ways include (1) the relations amongst students' mathematics views, approaches and performance, (2) how the factors identified from RQ1 may interrelate students' mathematics views, approaches and performance, (3) the relations amongst the factors involved in students' mathematics views, approaches and performance, (4) a combination of these. All of these are slightly different questions; RQ2 provides a platform for discussing some of the findings from the study. To this end the intent of RQ2 is more of a combination of (1), (2) and (3) just given than a restriction to any one of these variants of interpretations. The order of the sub-parts of RQ1 do suggest somewhat of a hierarchical nature of influence and therefore has possible implications for RQ2, but RQ2 asks about 'relations' as a recognition that this may not be the case, although the students' 'ultimate' mathematics performance is last, based on the timeline of the study. RQ2 and RA(c) essentially are a means of tying up the findings of the other RQ and RA, providing a lens through which the notion of 'interplay' from the study's title can be accessed, and a basis for discussion. RQ3 is, like RA(b) a speculative assessment of what some of the factors of RQ1 might be. More will be given in Subsection 3.3-1 about how these RA and RQ were matched to particular research methods.

3.2 METHODOLOGY

The study was conceptualised as a multi-site case study. The case study aspect was seen as 'an empirical investigation of a particular contemporary phenomenon within its real life context using multiple sources of evidence' (Robson, 1993, p5). To this end the study looked at the context and process of mathematics learning and teaching within the Caribbean, focusing on A&B as the case, with its secondary schools constituting the multi-site aspect. The overall orientation/perspective of the study may be described as sociocultural, that is, a perspective designed to explore 'the relationships between human action, on the one hand, and the cultural, institutional, and historical situations in which this action occurs, on the other' (Wertsch, del Río & Alvarez, 1995, p11). The study's main focus was to provide perspectives on the area of study from the learners' viewpoint, although this would necessarily bring in factors related to the teaching amongst others. As mentioned previously (Section 1.5), given the consistency of Caribbean and A&B outcomes in mathematics, it was hypothesized that these consistent outcomes were products of consistent underlying processes, and that therefore explanations/theories related to the context and process of mathematics learning and teaching could be found within present student cohorts, *even though* they had not at the time of fieldwork produced the given results. Based on the RA and RQ, an approach which was broadly exploratory and open in nature was required in order to get at issues that might be relevant to (valid for) the main study participants. The RA and RQ also required some broad-based understanding of mathematics through the students' eyes (their views – the emic dimension), with a narrowing of focus onto such concepts as identity, school and cultural factors as these may or may not be relevant. Thus, it was felt that these aims would best be addressed via a combination of data collection methods which would give some access to this broad-based understanding (macro-level) with a closer more narrow focusing on processes (micro-level), that is, via a judicious combination of quantitative and qualitative data collection methods, i.e. a mixed methods approach (Creswell, 2003, p15). The overall study could not be described as ethnography in its classical sense (e.g. see Hammersley & Atkinson, 1995, p1) due to the time constraints of the study. However, some aspects of the study and the way in which data collection evolved during the course of fieldwork were ethnographic in nature (Hammersley, 1992, p2), for example, my presence in schools. As researcher I made several visits to all of the study schools (save one) which was beyond that required for simply fulfilling the planned data collection task.

The epistemological position taken in the collection, analysis, and interpretation of data, was one of 'subtle realism' (Hammersley, 1998, p66), the key points of which Hammersley characterized as follows:

- 'No knowledge is certain, but knowledge claims can be judged in terms of their likely truth.
- 'There are phenomena independent of us … of which we can have such knowledge.'

It was felt that this perspective would provide the framework needed to allow a mixture of quantitative and qualitative analysis of the data collected. Whilst there is a belief in the existence of multiple realities of a phenomenon as constructed and interpreted in the minds of the individuals concerned, it is believed that for any phenomenon shared in by the individuals as a group, there would be commonalities of experience in varying degrees, and these would converge, or nearly so, to some reduced area. Thus, it was believed that social phenomena can 'exist' independent of mind constructions or interpretations, and that 'there are some lawful, reasonably stable relationships to be found among them. The lawfulness comes from the sequences and regularities that link phenomena together' (Huberman & Miles, 1998, p182).

It seems necessary at this point to say something about the use of a mixed methods approach, and in particular quantitative methods within what is essentially a case study. The idea of combining quantitative and qualitative methods in conducting research in the social sciences, including education, has been gaining momentum in recent years. However, this approach to doing research is not without criticism, much of which is based on the supposed incompatibility of the associated worldviews as they are underpinned by fundamentally different paradigms or belief systems (Tashakkori & Teddlie, 1998, p3). In this paradigm view, quantitative methods are the preserve of positivism, whilst qualitative methods are those of constructivism (*ibid.* p3). There are a range of characterizations of these paradigms, but essentially, positivists believe that

> *ontologically*... there exists an objective reality driven by immutable natural laws, and *epistemologically* ... a duality between observer and observed that makes it possible for the observer to stand *outside* the arena of the observed (Guba & Lincoln, cited in Pring, 2000a, p46-7).

Alternately, constructivists believe in a

> ...relativist rather than a realist ontology, and on a monistic, subjective rather than a dualistic, objective epistemology. (Guba & Lincoln, cited in Pring, 2000a, p46).

Underpinned by these paradigms, such weighty concepts as ontology – the nature of reality (Tashakkori & Teddlie, 1998, p7), and epistemology – what constitutes warrantable and acceptable knowledge about the social world (Bryman, 1988, p5, 104), amongst others (e.g. see Hammersley, 1992, ch.9; Pring, 2000b, p248) are differently, and divergently so conceptualised in quantitative and qualitative approaches to research. From this paradigm view then, any decision to 'mingle' quantitative with qualitative approaches would require a researcher to simultaneously hold two irreconcilable worldviews of how knowledge in the social world can be and is construed.

On the other hand, this dualistic incompatibility of the two research approaches as presented in theory has been challenged as research in practice does not fit neatly into the either/or dichotomy, where a rejection of the tenets of one paradigm then necessarily placed a researcher wholesale within the other paradigm, a position held by some, e.g.

> we *are* dealing with an either-or proposition, in which one must pledge allegiance to one paradigm or the other (Guba, cited in Bryman, 1988, p107-108).

> The adoption of a paradigm literally permeates every act even tangentially associated with inquiry, such that any consideration even remotely attached to inquiry processes demands rethinking to bring decisions into line with the worldview embodied in the paradigm itself. (Lincoln, 1990, p81)

However, compare Hammersley's perspective in this respect:

> ... what is involved is not a simple contrast between two opposed standpoints, but a range of positions sometimes located on more than one dimension... there is no necessary relationship between adopting a particular position on one issue and specific positions on the others. Many combinations are quite reasonable... selection among these positions ought to depend on the purposes and circumstances of the research, rather than being derived from methodological or philosophical commitments. (Hammersley, 1992, p172)

As viewed by Hammersley, (see also Bryman (1988) and Brannen (1992)), this paradigmatic-perspective was unsustainable in practice, and further, it was *secondary* to pragmatic considerations. Further in this respect, Firestone (1990) has noted that present day positivists (post-positivists) and constructivists/interpretivists do 'agree at the most basic level about the impossibility of certainty' (p113), bringing the paradigms much closer together epistemologically than previously, and where there was disagreement at this level, in practice the disagreements were more ones of degree and emphasis, rather than being divergently incompatible (p114). It is this latter perspective that has been adopted in this study.

It should perhaps be borne in mind that those promoting a compatibility thesis are not collapsing quantitative and qualitative approaches into one paradigm; they do agree that there are distinctions between the two approaches. Rather, one of the key points they seem to be making is that the distinctions are not as clear cut as presented by some, and what is available is more similar to a range of options in research approaches, and not just two such. But, some caution must also be exercised here. Whatever the benefits of combining quantitative and qualitative methods in a research approach are, they should be adjudged in relation to the purpose and context of the research questions and process (Bryman, 1992, p69). There is always a potential danger of simply combining methods for its own sake, and ending up with data that are incomprehensible – a 'mixed-up' method (Datta, cited in Tashakkori & Teddlie, 1998, p6, 43), a risk that exists in single-style approaches, and arguably may be heightened in a willy-nilly combined approach.

'Approach', as has been used here (i.e. mixed methods approach) refers to a broad, holistic context of research, to include the conceptualisation, design, data collection, analysis, and report of the study (cf. Creswell, 2003, p18), i.e. what might otherwise be called the methodology. Characteristics of quantitative and qualitative research approaches offer their separate advantages and disadvantages. As an example within this study, an initial student questionnaire was used which yielded an overall sample of 286 students. The relatively large sample size in this context has the potential advantage of giving breadth and some feel for more general issues or patterns that might be valid for students, providing some indicator of areas for further, more in-depth exploration (though this in a limited way given the time constraints of fieldwork activities). Also, but with a cautionary consideration of sampling procedures used, this quantitative strategy could potentially mean that the data collected therein are in some ways representative of the student population from which it is drawn. However, in doing so, i.e. going for breadth, the student questionnaire gives up the capability of exploring much beyond surface structures of human behaviour, forcing respondents into pre-determined sets of closed responses (although in this study the student questionnaire did include a number of qualitative (i.e. open) questions). This approach, though broad-based, is far less flexible and open to getting at emic perspectives. Qualitative approaches on the other hand, for example the student interviews in the study which followed the questionnaire, used a much smaller purposive sample group of 40 students and yielded invaluable data which went towards providing depth to some of the student responses in the questionnaire and a better overall understanding of the school mathematics experience, i.e. processes from the students' viewpoint. The student interviews were also more flexible and open in structure, thus giving students scope to bring out issues that were relevant to them. This last, i.e. interviews, allowed what quantitative methods are prone to disallow, that is, a closer examination of the underlying meaning students associated with their behaviour, but it does mean that statistical generalizations are precluded due to smallness of sample size and how the sample was chosen. In essence, the strengths of one approach are often the inherent weaknesses of the other, and vice versa (Bryman, 1992, p59; Jackson & Niblo, 1999). Thus it was that with a consideration of the nature of the study, RA and RQ, it was thought that a mixed methods approach would better address these methodological issues which may otherwise obscure what is 'found', offering the potential to get at a more holistic synergic perspective of the area of study. That is, the choice of a mixed methods research approach for this study was more based on pragmatic considerations and less so on theoretical and/or philosophical ones, as it was thought that an astute and principled combination of the two research approaches could potentially explode limitations, to minimize the weaknesses and maximize the strengths of either.

Based on the RA and RQ (see Section 3.1) it was felt important that in the reporting of findings the views of the study's participating students would be brought out as well as my interpretations of these. The reporting of students' views was felt to be crucial since as the researcher, I am not an outsider, having been myself a student in the educational system of A&B, and having worked in the system as a (mathematics and chemistry) teacher for upwards of 15 years. Whilst this researcher experience has its advantages, there are also inherent disadvantages, for example that of taking things for granted, not taking note of things/processes that would otherwise have been noted by an outsider, perhaps imposing pre-conceived notions and theories on data collection, analysis and interpretation. There perhaps is no 'true' way of eliminating this. However, I have been variously and continuously 'surprised' by the data and findings, both whilst collecting the data and also during analysis. Some examples of these surprises 'found' during data analysis include the fact that more students than would have been expected stated that they did like mathematics, that there were highly statistically significant gender differences in students' reports of liking mathematics, that whilst some students thought that mathematics was inherently difficult in and of itself, there were some who thought that the teacher was 'making maths difficult', amongst others. Additionally, the week spent in the neighbouring country of St. Kitts-Nevis did bring more awareness as to aspects of the educational system and mathematics education in A&B that were otherwise being taken for granted, e.g. the proportionate distribution of school-types, re private and government-owned or mixed and single-sex, the use made of results at the 11+ stage (i.e. CEE), the accessibility of sitting the CXC/CSEC mathematics examinations (both proficiencies) to students at the end of secondary schooling, amongst others. As an example, the existence of school-types that was 'the order of things' (Bourdieu & Wacquant, 1992, p168) in A&B was much less of a factor in the education system of St. Kitts-Nevis.

3.3 Study Methods

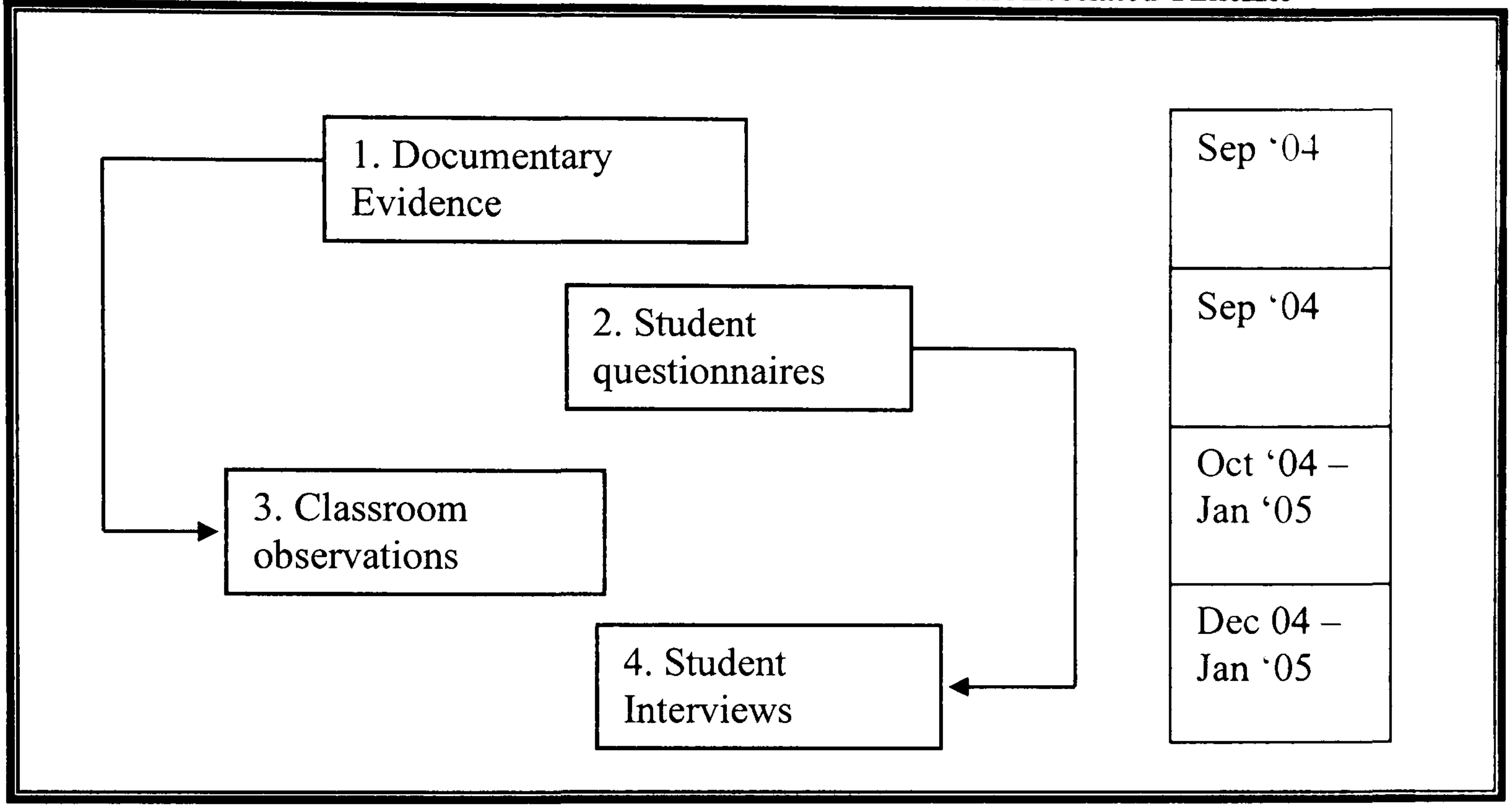
This section outlines the methods employed during fieldwork to collect the data, and the rationale behind choices made. An overview of the context of secondary schools in A&B is given in order to locate a context for the participating schools Information is provided on the main participants – the students of the study, and then follows with other participants in the study. There are four further subsections within this section, which describe in turn the methods used to collect data, the participating schools, the student participants and other main participants in the study.

3.3-1 The Main Study Methods

Within the chosen research approach, the study employed a variety of methods to collect data, specifically to address the RA and provide answers to the RQ. As in the Robson definition given previously in Section 3.2 a case study necessarily employs a number of data sources (see also Yin, 1998, p233). The methods used in this study included obtaining various documentary data, interviews with teachers, mathematics teachers, other (mathematics) educators, principals, MoE officials, students, questionnaire surveys of students, mathematics teachers and parents, observations of mathematics classrooms, and a general presence of observing the day-to-day running of (some) schools. The mass of data collected was beyond that originally planned, but these data have been useful in that they have served as background to a better understanding of the way the educational system works, where mathematics fits within this system, and how mathematics education is conceptualised and allowed to be in the Caribbean. Ultimately, a narrower focus had to be found, and, much of the analysis of data has concentrated on the data collection methods deemed most relevant in addressing the RA and RQ. Figure 3.31-1 outlines the main data collection methods and approximate time-line in which they were carried out for methods which directly involved or related to getting data on or from students. The arrows indicate what earlier method was used to inform choices made in later methods. Following

Figure 3.31-1 is an overview of each of these methods in turn, providing a rationale for the choice of method and where appropriate how the research instrument was developed and trialled. The subsection concludes with a look at the link between the data collection method(s) and the RA and RQ that were best informed by that method.

Figure 3.31-1: An Overview of Main Data Collection Methods with Associated Timeline



Documentary Evidence

The inclusion of the collection of documentary data for the study was seen as pivotal in allowing for the situating of the more immediate context of the study as it would provide information on what had happened before, i.e. a historical dimension. Such data would allow for a focus on specific issues that had been operating prior to the study, providing a sort of longitudinal dimension to the study (Robson, 1993, p274) giving information as to what previously obtained in terms of mathematics outcomes via the CXC/CSEC in schools. A comparison of these mathematics outcomes with other subjects, for example the other compulsory subject English A and overall outcomes across all subject areas would also juxtapose the situation with mathematics against what happens in other subjects in schools and so ascertain the degree of importance of 'mathematics' itself as a factor. Thus, although these other subjects are not a focus of the study, documentary data on them would allow for some orientation to locating the mathematics outcomes within a wider context of student achievement. Documentary evidence was collected by hand in some cases from MoE documents, or where possible/allowed, documents were photocopied. Some of these documents were MoE documents (usually photocopied), whilst others were CXC/CSEC documents (usually collected by hand). The MoE documents collected related to a variety of data, including CEE and post-primary examination results for a number of years, data on student numbers in schools and sex break-down, amongst others. The CXC/CSEC documents obtained were in the main related to previous years' student outcomes in mathematics, English Language and across all General proficiency subjects, these broken down by student sex and individual schools. Where some of these CXC/CSEC documents were unavailable at the MoE, the data were collected from individual schools during fieldwork. There are therefore some gaps in data for some years, as the information was simply unavailable.

Documentary data were also collected for the participating student sample on their CXC/CSEC mathematics (and English) performance in the May/June 2006 CXC CSEC examinations, which is the time when, all being well, the target student sample should have sat these examinations. These documentary data were collected in September/October 2006 with the assistance of the MoE in A&B and a teacher colleague. These documentary data thus formed the basis for addressing those RA and RQ having to do with students' mathematics performance, specifically RA(c) and RQ1(c).

The Questionnaires

As noted in Subsection 3.2, student questionnaires were to serve as a means for obtaining a broad-based feel for the mathematics views and experience of current students. In addition to the student questionnaires, the study design did also include questionnaires for a sample of the participating students' parents/guardians and also mathematics teachers in the participating schools. It was felt that the views of parents/guardians and teachers would serve to provide a better understanding of students' views and experience of mathematics, and may go some way towards addressing RA(b) and RQ1(a)&3, i.e. those having to do with how students may have come to have the views and experience that they report. In addition, the inclusion of parents/guardians and teachers as participants in the research process allowed the means for obtaining confirming and/or disconfirming data through the use of multiple sources, potentially adding to the presentation of a more coherent picture, and also allowed for a way to consider reliability of particular findings across respondent sources. All three of the respondent questionnaires can be found in Appendix A. What follows deals specifically with the student questionnaire.

The student questionnaire was divided into four main sections (see Appendix A1). These dealt with in turn

I. information related to the students themselves, to include their academic choices, after school activities, aspirations, amongst others;
II. information related to students' home background;
III. information on students' views of school;

IV. information on students' views of mathematics.

Sections I and II of the questionnaire were designed to obtain background details on the students themselves and information on their parents/guardians or with whom they lived. Section III was included in order to be able to make some assessment of whether students' views about mathematics (asked later in Section IV) were related to their views about school. In Section IV the ideas for choice of questions were influenced and guided by those used in Boaler (1996) and Kloosterman & Stage (1992), along with some consideration of the A&B educational context. For example, questions about mathematics being compulsory and mathematics at CXC/CSEC where designed with the A&B educational context in mind. The choice of questions was designed to elicit students' mathematics views, and also to get at factors which could be considered as in the environment of their mathematics learning and thus may have been influential in their having the expressed views – specifically to address RA(a)&(b) and RQ1(a)&3. A mixture of question types was used, to include closed question (e.g. dichotomous Yes/No categories provided, other closed types with a greater range of categories, Likert-scale type), and also open questions. Some open questions followed closed dichotomous questions, requesting students to give a reason for their response; other open questions did not have a prior sub-question.

During the development phase of the research instruments (February to June 2004), a student questionnaire had been trialled (with the help of a teacher colleague in A&B) with a group of 21 fourth form students in one secondary school in A&B. Based on the students' responses along with the comments of my teacher colleague, some questions were revised and others were deleted. As an example, a question asking students to rank five activities in mathematics (getting the right answer, working at a fast pace, doing a lot of exercises, remembering rules, thinking through how to solve a problem) in order of importance on a 5-point scale using the numbers 1, 2, 3, 4, 5 was discarded as a number of students (8/21) had used a smaller scale, e.g. 3-point scale, as they had re-used some numbers. The final student questionnaire was relatively long. Whilst this might be a turn-off from responding and so could affect return rates (e.g. Cohen, Manion & Morrison, 2003), the proposed mechanism of administering the questionnaire (see Subsection 3.3-3) would mean that I would essentially have a captive audience, hence minimizing the problem of non-return of questionnaires from the students.

Classroom Observations

Classroom observations were intended to complement and also allow further exploration of insights gained from the questionnaire data. Specifically, classroom observations it was felt would inform RA(c) and RQ1(b)&2, that is, those related to students' approaches to learning mathematics. Thus, classroom observations offered another perspective on understanding what students have said by observing what they do, and this in the setting where the 'phenomenon' takes place.

Classroom observations were to involve me as researcher in a marginal participatory role (Robson, 1993, p318) in a selected sub-sample of the participating students' mathematics classes. This role offered the benefit of entering the classroom world of the students on both a micro and macro level. On a micro-level, the role offered the possibility of being amongst the students and coming to understand their thought processes in carrying out solutions to mathematics problems, and generally being better able to understand their mathematics world on a more in-depth level. On a macro-level the role also allowed the possibility of my being able to 'stand back' from this world in order to see the bigger picture of classroom events, thus ensuring that I do not become so immersed in the details that the overall structure of classroom events is missed. In addition, observation

> ... maximizes the inquirer's ability to grasp motives, beliefs, concerns, interests, unconscious behaviors, customs, and the like; ... allows inquirer to see the world as his [*sic.*] subjects see it, to live in their time frames, to capture the phenomenon in and on its own terms, and to grasp the culture in its own natural, ongoing environment; ... provides inquirer with access to the emotional reactions of the group introspectively ... allows the observer to build on tacit knowledge, both his own and that of members of the groups. (Guba & Lincoln, as quoted in Lincoln & Guba, 1985, p273)

The plan during classroom observations was to record the seating plan of the classroom, topic being taught, activities, identify student groups, student behavioural and verbal responses, listen to student 'talk' as they worked through mathematics questions. That is, classroom observations were to be in nature a process of 'persistent observation' (Lincoln & Guba, 1985, p304) in an effort to discern a trend of the usual pattern of events of the mathematics classroom. The design of the observation schedule (see Appendix B) was theoretically informed by the Flanders (1970) Interaction Analysis System (given in Robson, 1993, p211) and was practically informed by my observations of Tom Roper's first year undergraduate mathematics classes during March 2004.

Classroom observation data were collected mainly via field-notes. In total, an average of 10 approximately 70-minute sessions (double period) were observed for the three participating schools and approximately 30% of these were audio-video recorded. During fieldwork, observations were also carried out in mathematics classes other than that of the main target classes (more on how schools were chosen for observations will be given in Subsection 3.3-3). I also 'hung out' in two of the classrooms in which the main observations were carried out, for example, being present in the classrooms at times without the mathematics teacher, during break periods, during other 'down days' when the regularity of classes had been suspended, in one classroom during a period when parents were invited in to talk about their child's progress. I also 'hung out' in some school staff rooms, which afforded the opportunity to learn more about the ethos of the school, and gain insights into the difficulties faced by teachers other than mathematics teachers.

Student Interviews

Student interviews were included in the study design in order to probe deeper reasons behind the information gathered from the questionnaires (e.g. Cohen et al., 2003, p268). The interview schedule (Appendix C) was designed to be semi-structured, with open-ended questions (i.e. no pre-determined set of responses). Whilst there was a set of prepared questions/areas that would be probed, the semi-structured nature allowed the flexibility for pursuing issues that students brought up themselves as these issues would have more relevance to them. The content of the interview schedule was informed by those used in Boaler (1996) as well as that in Kloosterman (1997). Based on the set out given in Kloosterman (1997), it was decided to design the schedule around a set of areas with a list of accompanying questions to be probed; the set of areas were linked to particular aspects of the RA and RQ it was thought that the responses would inform.

The interview schedule had not been trialled prior to entry to the field. It was hoped that given the planned timeline of conducting the interviews during the fieldwork period, that is, as the last of the major data collection methods, the opportunity would arise for trialling of the questions prior to implementation with the actual participating student groups. The opportunity for trialling of the full schedule was had with two student groups. After these trials and also in conjunction with data from classroom observations and student questionnaires it was decided to revise some questions, delete others and also to include in particular an algebra item. As example, it was decided to include a question concerning the change in mathematics teacher from one Form to another as this had been an issue raised by one of the trial group of students. The inclusion of the algebra item came from an initial analysis of questionnaire data where a number of students identified this area usually as their least favourite thing about their mathematics classes, although a few students did give it as a topic area they liked. In the trial interviews also a group of students had identified algebra as an area of mathematics they did not like/did not understand. The specific question which was used (simplifying an expression, see start of Subsection 6.2-1) was chosen based on my knowledge of an area within algebra that was part of the syllabus for lower secondary mathematics and hence would be an area that the participating students at this level (Fourth Form) would have been taught before.

The initial plan for student interviews was for a group interview (Cohen et al, 2003, p287). Group interviewing was chosen as it allowed for the possibility of discussions to ensue (ibid, p287), and this could glean insights not normally forthcoming in a one-to-one situation (Fontana & Frey, 1998, p54). Additionally it was felt that the students would be more comfortable and more forth-coming in a group situation amongst their peers than in a one-to-one situation with a 'stranger'. However, given the time constraints of the study, there was some limitation of the extent to which student interviews could probe deeper issues raised in student questionnaires, as some of these issues did not come to light until much further into the analysis of interview data, which occurred after the fieldwork period.

Student interview data were audio-taped and transcribed in full. Transcription also tried to preserve as much as possible the group dynamics of the interview by identifying the student speaking. Issues of language, i.e. the dialect of English used by students were also preserved as much as possible during transcription, as language, and the disjuncture that existed between the form a non-trivial proportion of students (subconsciously) tended to speak (i.e. a language disposition, pointing to what may be seen as a 'linguistic habitus' (Bourdieu & Wacquant, 1992, p145)) and that spoken by teachers has come to be a main finding of the study.

Table 3.31-1 concludes this subsection by presenting an overview of how the RA and RQ were matched to the (main) data collection methods.

Table 3.31-1: Matching RA and RQ to the Research Methods

RQ	1. Factors involved in students' mathematics			2. Interrelations	3. Issues factors reflect
	(a) views	(b) approaches	(c) performance		
RA	(a) Views	(c) Relations			(b) 'Things' involved in views
Methods	Stq	Cl Obs	DE	Stq	Stq, (Tq, Pq)
	Interviews	Interviews	Stq	Interviews	Interviews
				Cl Obs	ClObs
				DE	DE

Key: Stq=student questionnaire, Tq=teacher questionnaire, Pq=parent questionnaire, Cl Obs=classroom observations, DE=documentary evidence

3.3-2 The Study Schools

At the planning stage of the study the targeted student sample had been students of one fourth form class (penultimate year of secondary school) of each of the 13 main secondary schools in A&B. These schools may be categorized/typed in two ways, that is, as single-sex/mixed, or private/government-owned. There are four main private schools of which two are single-sex, one of each sex. The four private schools are fee-paying schools. There are nine government schools, of which two are single-sex.

The four single-sex schools have traditionally been the schools of choice in A&B. The two government-owned single-sex schools are the schools usually 'chosen' by the top CEE students (see Section 3.5 and 4.1 for more on this). Then, for those parents who can afford it, the private single-sex schools are the schools of choice, and some parents do send their children to those schools even if the child had been a top CEE student. Traditionally, private schools have tended to be affiliated with a church, and the two single-sex schools are (Catholic). These two schools along with the other two government-owned single-sex schools are among the oldest secondary schools in the country and are relatively traditional in outlook. Their curriculum is mainly academic-based. The two government-owned single-sex schools had prior to being government-owned been affiliated with the Anglican Church (and in some ways still are). They are both over 100 years old. The two private single-sex schools are on average over 60 years old. In terms of location, all four single-sex schools are located in the city or near its outskirts. All of these schools participated in the study. In this study, they have been labelled as Si for single-sex, followed by a number; thus they are identified as Si1 – Si4.

Private mixed schools have not always been associated with a church. There have been a number of these schools, but they tend to have a relatively small student population, and perhaps because of this are subject to economic conditions and often only exist for a relatively short period of time. Thus, private mixed schools have tended to be relatively unstable and some have been seen as schools of last resort (i.e. when a child for a variety of reasons cannot gain/has not gained access to one of the other school-types). Of the two longest opened private mixed schools, one is church-affiliated, and has perhaps been the most stable of these school-types, but it is also fairly new in terms of being on the secondary school scene in A&B. The other private mixed school at the time of data collection was just going through a period of change of ownership, and the new owners were church-affiliated. The previous owners had not been so. Neither of these schools participated in the study. More on this will be given in Subsection 3.3-3.

The government mixed schools may be considered as second choice schools for students. These schools offer a more diverse curriculum than that of the single-sex schools, based on a mixture of academic and technical/vocational subjects. These schools are also newer, being on average about 45 years old. Three of these schools are sub-urban, and the other four schools are located in rural communities. All of these schools participated in the study. In this study these schools have been labelled as Mi1 – Mi7.

3.3-3 The Student Participants

In the implementation stage of the study (i.e. during fieldwork), fourth form students of 11 of the 13 main secondary schools constituted the respondent participants for the student questionnaire and also provided the sample from which parents for the parental questionnaire were accessed. These students were also to form the pool from which subsequent students for interviews were chosen. The fourth form students were ideally to have been an intact grouping of how students were taught mathematics, which it was anticipated would be either an overall form class grouping, or a grouping specifically formulated for mathematics learning/teaching. Further, where more than one grouping (i.e. class) at the fourth form level existed, it was planned that a 'middle ability' academic grouping (if so grouped) would be chosen, this selection done in tandem with the school's mathematics head of department (HOD). Whilst the initial plans were operationalised in the main, on the ground pragmatics meant that there were some deviations. These deviations are as follows:

- As noted in Subsection 3.3-2, neither of the two private mixed schools participated in data collection methods 2-4 (from Figure 3.31-1) as there were some problems of access during the time of the fieldwork. This does mean that 11 of the main secondary schools participated, but that the views of students in private mixed schools were not obtained;
- In one mixed school the 'top general ability' group of four such groups was used as this was the group chosen by the mathematics HOD, even after the request for a middle group. As it was a grouping based on overall ability rather than mathematics ability, it was thought that they could be considered as a 'mixed ability' mathematics group;
- In another mixed school there were only two fourth form classes grouped according to general ability, and the lower of these groups was chosen by the teacher identified by the principal;
- In one single-sex school, the grouping chosen by the principal was an intact class, which in this instance did not represent how the students were taught for mathematics. This single-sex school was also one chosen for classroom observations, and this meant that the classroom being observed did contain some students who had not participated in the student questionnaire.

At this point more will be said about the first point given above. Documentary data were collected for all main secondary schools, and this does include the private mixed schools. These documentary data were included in analyses made of overall CXC/CSEC results for schools in A&B in Section 4.2 of Chapter 4 and also in Section 6.4 of Chapter 6 which outlines the CXC/CSEC results for the participating student sample of this study. However, as access to the private mixed schools was not gained, the subsequent data collection methods, i.e. questionnaires, interviews, and classroom observations do not include the views of these students and by extension, (mathematics) teachers and parents. This is a weakness of the study. At the time of fieldwork one of these schools was in a relatively disruptive and unstable state as it was going through a period of change of ownership, which had implications for where students were to be housed, amongst other things, so I decided that my presence would only further serve to complicate these matters. For the other private mixed school, although several attempts had been made to gain access, these were unsuccessful, and when approximately two months into fieldwork no success in gaining access had been achieved, I decided to stop trying.

The fourth form year of secondary school was chosen mainly because it would target students in the school system who would have had on average the longest experience of school mathematics, and therefore might be more attuned to their views about mathematics, i.e. their views might be considered as more 'well established' and so be more 'fixed'. Whilst the students of the fifth form would also potentially better offer this possibility, it was felt that an intervention for a study would be more disruptive to their schooling given the time constraints and pressures on them of the upcoming CXC examinations in 8-10 months time. With these considerations in mind, the fourth form sample therefore represented what might be considered a purposive, typical-case sample (e.g. Cohen et al, 2003, p103&143) i.e. a sample specifically chosen for its mix of students whom it was anticipated would be most able to delineate their views of mathematics based on their having one of the most prolonged and current experience of its learning, and also for its potential typicality. It should be noted here that at the level of individual students, the participating student sample was non-random, although at the level of main secondary schools, the inclusion of 11 of the 13 main secondary schools represents 85% of the population of schools.

At its broadest, the study obtained via questionnaire data the views of 286 students of 11 of the 13 main secondary schools. This student sample was made up of 117 males and 169 females, 41% and 59% of the sample respectively. The sex distribution of the sample is mentioned here in order to give some comparison with the sex distribution of candidates who have entered for the CXC/CSEC examinations in A&B over the previous five years, which has consistently seen an approximate 1:2 ratio of males to females[2]. As example in 2004 there were 518 males and 1071 females, i.e. 33% and 67% respectively

[2] These data for A&B represent all persons writing the examinations, and so would include both in-school and out-of-school candidates. An analysis of in-school to out-of-school candidates for the CXC/CSEC show that an even higher proportion of out-of-school females compared to males than is the situation in-school (re)sit these examinations. More will be said on this matter in Section 4.2 of Chapter 4.

from A&B entered for these examinations; Caribbean-wide entrants for the CXC/CSEC of that year were 48 108 males and 84 066 females or 36% and 64% respectively (CXC, 2004). MoE documents from A&B for the academic year 2003-04 had the sex distribution of students in the nine government secondary schools at 43% male, 57% female. At the start of data collection, the mean age of the student sample was 15¾ years, with the sample of males being on average ½ year older than the sample of females (16 and 15 ½ years respectively). T-tests results show there to be a significant difference between the mean age of the males and females ($t=4.438$, $df=274$, $p<0.001$). There was also a significant difference between the mean age of students in mixed and those in single-sex schools (16 years and 15⅓ years respectively; $t=5.274$, $df=274$, $p<0.001$). It will be pointed out that these tests of significance were done on a non-random sample of students. However significance testing has been used in the analysis of data as an aid in the interpretation of findings and also as a means of keeping checks on inferences. More attention will be given to this matter in Section 3.5. There were 177 students from mixed schools and 109 from single-sex schools (62%:38% respectively) and 42 students from private schools and 244 from government schools (15%:85% respectively). Other background statistics on the overall student sample will be given in Chapter 5, Section 5.1.

The student questionnaire was administered by me (the researcher); in most cases this took place during a double-period time-table slot (70 minutes) in which students would otherwise have been having a mathematics class. This mode of administering ensured a more or less 100% return rate. It also allowed for me to give a short introductory talk which informed students about the study, and also allowed additional information not (directly) addressed in the questionnaire to be gained. On average students took about 45 minutes to complete the questionnaire, with completion times ranging from about 30 minutes to one hour.

The choice of schools (classrooms) for observation was made based on documentary data of CXC/CSEC mathematics results (see Figure 3.31-1, Subsection 3.3-1). From these data individual schools with a previous record of good, median and poor results were chosen, with an attempt to also incorporate examples of the different school-types, i.e. single-sex boys, single-sex girls, mixed, private/government school. Theoretically, choosing schools from good/median/poor mathematics results by private/government and also single-sex boys/single-sex girls/mixed schools presupposes a possible pool of 18 combinations. In fact, there were only 13 main secondary schools in total to choose from, and of these 11 took part in the study. From an analysis of the previous CXC/CSEC data on mathematics results (e.g. see Figure 4.2-4(b) in Section 4.2 for the years 2000, 2002, 2004), it was clear that in fact some of these theoretical possibilities of schools did not exist. In effect, whatever school of whatever type, tended to have results in mathematics that could be categorized as consistently good or consistently poor; the consistently median school did not exist. This then reduces the number of possible combinations to 12. Table 3.33-1 outlines the number of schools in each school-type which did exist in the population of schools.

Table 3.33-1: School-types in Population of Schools against History of CXC/CSEC Mathematics Results

Mathematics Results/School-type		**Mixed**	**Single-sex boys**	**Single-sex girls**
Good	**Private**	0	1	1
	Government	0	1	1
Poor	**Private**	2	0	0
	Government	7	0	0

Documentary data included all these schools. Questionnaire and interview data included all schools except the two private mixed schools. For classroom observations four schools from the pool included in questionnaires and interviews were initially chosen, but in the end three were used mainly due to time and the feasibility of time-tabling overlaps of when mathematics was being taught to the target fourth form class, which would have affected getting to all of the schools at least once per week as planned. The three schools included in classroom observations were two government schools, one single-sex and one mixed, and one private single-sex school. In one of the single-sex schools chosen for the observation phase a 'lower ability' class was selected. In order to preserve the anonymity of schools (and teachers and students) in relation to observation data, the student sex of the single-sex schools has not been identified here but these schools did include one of the single-sex boys' and one of the single-sex girls' schools. Taken together, the three schools in which observations were carried out, namely Mi5, Si2 and Si3 did meet all of the criteria set out above. More about the specific schools and classrooms in which observations were conducted will be given in Subsection 6.2-2 which gives findings from observation data.

As mentioned in Subsection 3.3-1, the interview schedule was semi-structured, and thus allowed for flexibility in getting at student views and issues that were relevant to them, and not directly addressed in other areas of the study. This aspect, the flexibility of the interviews, does come out in the interview transcripts of each school. In several of the schools the interview took on a life of its own, with students addressing issues directly relevant to them, but especially of note are interviews conducted in a mixed school (Mi4) and one in a girls' single-sex school (Si3). So, although students in all schools were asked a series of similar questions, there were also questions which were unique to (particular) schools because of the way the interview unfolded.

For the interviews, an attempt was made to select three students from each participating school using data given in questionnaires, based on a student consistently indicating that he/she liked mathematics, disliked mathematics, and a third student chosen as a 'waverer', i.e. a student whose responses appeared to indicate at some times a like, and others a dislike for mathematics. There was also an attempt in mixed schools to get a group which reflected the school's gender mix. It was thought that this mix of students would have different views of mathematics and would therefore generate the sort of group dynamics that would form the basis for getting more of the hoped for discussion (see Subsection 3.3-1 on Student Interviews), i.e. 'the articulation, explication, and defence of their own views' (Davis, 1996, p39) as opposed to a question-answer session going. These plans, particularly that for getting a mix of males and females in mixed schools, did not always work as in some cases student(s) failed to show up. After the first case of this which occurred in the third school in which the interview was conducted (Mi2), it was decided to incorporate 'emergency' students, that is, to select additional student(s) in case one/some did not turn up. This though did mean that the group dynamics of students of potentially different mathematics views was not always maintained, and as it was boys who generally failed to turn up, that the hoped for mix of males and females in mixed schools was also not always maintained. It also meant that in some cases where all of the selected students did turn up, more than three students formed the group. Fontana & Frey (1998, p55) identified one of the problems of conducting group interviews as domination of responses by one person. Whilst conducting the group interviews during fieldwork, where it was noted that a student was less active in responding, an attempt was made to address the question to that student after obtaining responses from other participants. Generally it was found that the student would be willing to express his/her view. One interview in a mixed school was much abbreviated due to time constraints, and this interview also involved all the members of the class (Mi3, 10 students, smallest class size of the schools). There was also one interview which involved only one boy, as three other boys selected for the interview failed to show up. In total, six students (all boys) from four schools failed to show up for interviews. A total of 40 students (14 boys, 26 girls) participated in interviews. On average, interviews lasted for about 40 minutes, ranging from about 20 minutes (that involving the one boy participant) to about one hour. In all cases the interviews took place at the schools.

A few characteristics will be outlined about the interviewed students so that an assessment of their typicality to the overall sample can be made. For the boys who showed up for interviews, 9/14 (64%) had responded *Yes* to the questionnaire item *Do you like maths?* Comparatively 79% of all the sample boys had done so (see Table 6.11-1 in Subsection 6.1-1; also a fuller discussion of student responses to this item is given in Subsection 6.1-2.) Of these boys, 2/11 (18%) went on to pass mathematics in the

CXC/CSEC two years later (three boys could not be matched). The sample proportion for boys for this statistic is 48% (see Table 6.41-1(a), Subsection 6.4-1; also see a fuller discussion in Subsection 6.4-1). This result is skewed as the sample of interviewed boys contains six boys from the school where the entire class was interviewed, and all these boys had not been successful in the CXC/CSEC mathematics. All the boys who did not show up for interviews had responded *Yes* to the questionnaire item *Do you like maths?* Four of these boys went on to pass mathematics in the CXC/CSEC (again, this result is skewed as 3/6 boys were from single-sex schools; see more on the strength of this factor on mathematics outcomes in Subsection 6.4-1). The other two boys could not be matched. For interviewed girls 13/26 (50%) had responded *Yes* to *Do you like maths?* Comparatively 55% of all the sample girls had done so (Table 6.11-1, Subsection 6.1-1). Of these girls, 7/21 (33%) had passed the CXC/CSEC mathematics (one girl was absent from the examinations, one girl could not be matched, and three girls had written the Basic proficiency of the examinations). The sample proportion for girls on this statistic is 48% (see Table 6.41-1(a)).

3.3-4 Other (Main) Participants

The study also obtained data via questionnaires from mathematics teachers in the study schools and a sample of the study students' parents/guardians on, respectively, their views of their students' and child's mathematics, and also a little about their own school experience of learning mathematics. The teacher questionnaire had been piloted during the planning stages of the study also with the help of a teacher colleague in A&B, but the parent questionnaire had not been piloted. The pilot sample of teachers consisted of eight teachers. Unlike the target teacher sample for the study, the pilot teacher sample included teachers from various stages of the education system involving both secondary and primary teachers. The main result of piloting the teacher questionnaire was to reduce the number of open questions, in some cases replacing these with closed questions. One such had to do with item 3 on the teacher questionnaire (Appendix A3) where a list of topic areas as given in the CXC/CSEC syllabus was provided in favour of simply asking teachers to give their favourite and least favourite topic to teach. During the planning stages of the study, the questionnaires for the three respondent groups (students, teacher, parents) were to be trialled in stages so that problems identified in one trial would inform the structure and content of other questionnaires. This meant that the student questionnaire had been trialled and reviewed before trialling of the teacher questionnaire, and similarly for the parent questionnaire. This though meant that there was limited time for the trialling of the parent questionnaire. In planned trials of the parent questionnaire it had been hoped to also trial the means of administering of the questionnaire, that is, via the student. However after the trialling and review of the teacher questionnaire, the time of the school year in A&B would have meant that students would mostly not be in school (having just completed June end-of-year examinations), and so it was decided not to trial the parent questionnaire due to the unavailability of students. However, the review of the teacher questionnaire was used in deciding on the final structure of the parent questionnaire.

For the teacher questionnaires, on average, three questionnaires were given to the mathematics HOD (or a teacher identified by the principal) to distribute to his/her choice of mathematics teachers in the school. A total of 27/34 (79% return rate) teachers returned questionnaires. The 27 teachers were made up of 16 males and 11 females. Parent questionnaires were distributed through the student. On average every third student questionnaire also contained a parent questionnaire. It was agreed with students that they would get a parent/guardian to complete these in time for a later date when I would return for collection. Via this method 50/91 (55%) of parents responded to and returned questionnaires. In total, nine males and 40 females completed parent questionnaires (one person did not indicate their sex). Although the questionnaire was directed at parents/guardians, for the remainder of the thesis respondents to the parent/guardian questionnaires will be referred to as parents. Data collected from mathematics teachers and parents have been used as part of the background details on students and their mathematics. Findings from these are presented in Section 5.2.

3.4 VALIDITY AND RELIABILITY CONSIDERATIONS

There are a number of different types of reliability and validity (see Hammersley, 1987; Cohen et al, 2003, ch5), and hence a variety of ways in which they can be attended to based on the type of study. The terms have been defined as: reliability 'a synonym for consistency and replicability over time, over instruments and over groups of respondents.' (Cohen et al., 2003, p117), and validity '… truth: the extent to which an account accurately represents the phenomena to which it refers.' (Hammersley, 1998, p62). The two have been related as follows: '"reliability" or the stability of methods and findings is an indicator of "validity", or the accuracy and truthfulness of the findings.' (Altheide & Johnson, 1998, p287). This relationship makes reliability a necessary though insufficient condition for validity (Robson 1993, p67). There are therefore a variety of ways in which a study can plan for ensuring validity, and hence, reliability. Robson though has warned against attending only to validity in a study based on the argument that by default reliability is also attended to; findings of poor validity could be due to unreliable findings (ibid, p73-74).

Thus validity and reliability considerations were planned for in a number of ways in the present study. The validity or the 'truthfulness' of the study's findings was planned for via the incorporation of multiple data collection methods and respondent sources (e.g. see in Robson, 1993, p69; Cohen et al. 2003, p112-115). The findings of the study (Chapters 4, 5 and 6) are also presented in an integrated way which is thought maximises the multi-dimensionality of these data collection methods. This is especially so in Chapter 6 which presents the main findings from the study's student sample. In that chapter data are presented from various data collection methods and cross-referenced to previously presented findings and respondent sources in order to give a coherent holistic picture of the 'state of play' as found during the fieldwork period. Reliability was planned for by asking what might otherwise be seen as essentially the same and/or similar questions at different points. For example in the student questionnaire students were asked *Do you like maths?, Do you enjoy your school maths class?* and to indicate the extent of agreement or disagreement with the statement *I like maths*. Cronbach's alpha on these three items was 0.816 (264 cases, the two extreme categories on either side of a 5-point scale collapsed for the last two of these items). The interview schedule also incorporated some similar questions asked of students in questionnaire data in an attempt to establish a sense of the stability of 'findings' over data collection methods. In this case study, the researcher could be seen as *the* research instrument in some of the data collection methods (e.g. classroom observations), and thus many of the questions that surround reliability as consistency attaches to her. For this reason where possible and feasible, data were collected via other additional instruments, for example audio-recording student interviews and audio-visual recording of some classroom observation sessions.

3.5 How the Data were Analysed

This section sets out the journey of analyzing and making sense of the data. It begins with a description of the overall data analysis process. This is followed by a rationale for what subgroups of students were used for comparative data analysis. The analysis process for questionnaire and interview data is then outlined in detail. The section concludes with the selection criteria used for the inclusion of excerpts from data collection methods that directly involved the student sample in the presentation of the findings.

Although the notions of identity, culture, school, were aspects of the study that were of interest to me, data analysis proceeded in a way as to find out what was there, what it was that the students had to say. The staggering of data collection methods over a 5-month time period did give some (though limited) time for me to read through the information collected from one data method or source, with a view to its informing what to look for in a later method or how to go about the data gathering in later methods or on later occasions. There was a period of simply reading and re-reading through the collected data, for example those from questionnaires, reviewing classroom observation notes, in order to get some initial feel for what students, parents and teachers had to say, what was happening in the classrooms. Subsequent re-readings of collected data were somewhat more focused with the RA and RQ in mind, and an assessment of the extent to which these may have been addressed.

Thus, the data analysis process involved a continual to-ing and fro-ing amongst the various forms of data collected and also amongst the different respondent groups to see how the data from these various methods and respondent sources supported, explained, or not, the data from/on students. This has yielded a picture which reflects the mixed methods methodology of the study, and has the advantage of showing a more holistic picture of the mathematics situation as is in schools. The findings of the study will be presented in a way similar to that in which data analysis did proceed, in an attempt to show this holistic picture and give a more integrated perspective of the various issues that arose from the data rather than presenting data from the various methods separately.

Management of the data analysis process has been supported by computer software. The Statistical Package for the Social Sciences (SPSS) aided in the analysis of questionnaire data, whilst the software package MAXqda designed to aid in the management of text in qualitative data analysis has been used with interviews and to a limited extent with observation field-notes. Analysis of qualitative aspects of questionnaire data was also supported by MAXqda, and some of these were then transferred into SPSS. Documentary evidence has largely been analyzed by hand.

Given the concerns within Caribbean education with gender issues in achievement, it was thought useful to analyse the data using gender groupings. Also, given the discussion outlined in Chapter 1 having to do with the stratification of schools in Caribbean education systems, it was thought useful to find some way via which the data could be analyzed to reflect the issue of social class. From the literature it was thought that an analysis which looked at types of schools would be the way in here, and from experience in the A&B education system, it was thought that at the secondary level this would be better reflected in the school-type of single-sex/mixed schools rather than private/government schools. Also, given the limitation of there being no students from private mixed schools in the student sample which participated in the study, the school-type grouping of single-sex/mixed made more sense in the circumstances, as amongst other things it would serve to preserve in some way the anonymity of schools as there would be four single-sex schools here, whereas if the private/government grouping was used there would only be two schools, both single-sex, one of either sex. This school-type grouping, used in tandem with the gender grouping of male/female, yielded in some cases analysis based on a 4-group comparison, i.e. boys in single-sex, boys in mixed, girls in single-sex, girls in mixed, schools. It should be noted and as given in Subsection 3.3-3 that documentary data were obtained for all secondary schools, including the two private mixed schools. Thus, and as mentioned in that previous Subsection, some analyses of school-type as private/government were conducted using the statistical results of CXC/CSEC data. Findings from these analyses are given in Section 4.2, and also as relates specifically to findings from the present student sample in Subsection 6.4-1.

Thus, the school-type grouping of single-sex and mixed was used to serve as an indicator of social class, as it was expected that there would be proportionately more students from higher socioeconomic backgrounds in the single-sex schools. The single-sex grouping though does bring together two potentially disparate groups i.e. students in government (free) and students in private (fee-paying) schools (a total of four schools, two such from each of these groupings) which could have economic and arguably social implications. The structure of the educational system in A&B is such that it was thought that despite this, the students in these two school-types would be sufficiently similar in terms of socioeconomic background to allow the validity of such a grouping, and further for it to serve as an indicator of social class (see Section 1.3, p8-9 on the possibility/validity of conflating these two concepts within Caribbean societies). The rationale for this is as follows: the CEE results are ranked with the top students gaining places to the government secondary school of their choice, which most often are the two government single-sex schools. These schools are amongst the oldest and most traditional schools in A&B, and are regarded locally as 'exclusive' (see Williams, 2005). As CEE results usually show a greater success rate for private primary schools compared to government primary schools, a greater proportion of top students who gain places at the government single-sex schools would have come from private primary schools compared to the proportion of private primary students who gain places at the government mixed schools. For example, results from the 2000 CEE in A&B showed that of the 205 students who gained places at the two government secondary single-sex schools, 124 or 60% of these came from private primary schools. The 2000 CEE were taken by 897 government primary and 480 private primary students. Of these, 495 (55%) of government primary students were successful in the CEE, whilst 414 (86%) of private primary students were. Thus the 124 private primary students also represented 30% of successful private primary students (or 26% of all private primary students), whilst the remaining 81/205 students who gained a place in the two government single-sex schools, i.e. students from government primary schools represented 16% of successful government primary students (or 9% of all government primary students; data obtained from Weston, 2000). Similarly, results from the 2001 CEE show that in the ranking of the 875 successful students in these examinations, the top 62 places were taken by 47 private primary school students which represented 76% of the top 62 places. According to the MoE report (Weston, 2001) most of these 62 students gave the secondary school of their choice as the two single-sex government schools. The two years cited here for results of the CEE examinations, 2000 and 2001, also represent the years in which most of the student sample used in this study started secondary school (see Section 5.1 for more on this). Thus, however construed, it seems that there is some underlying process at work in selection of successful students for secondary school that works to make a seemingly equal process unequal. The validity of the expectation of students from higher socioeconomic backgrounds in single-sex schools will be dealt with in more detail in Section 5.1. Also, more on the CEEs is given in Section 4.1.

With regard to data from the 'live' student sample who participated in the study, given the structure of the study, an initial survey of collected data started with that from questionnaires, beginning usually with a look through questionnaires to note student responses to certain questions in particular. In this initial survey of the questionnaire responses, it was noted that some students who had replied one way or another to *'Do you like maths?'* then responded to other questions in a way that indicated that they had at times liked mathematics, or that they liked some topics and not others, or that they liked mathematics depending on the 'circumstances'; further they also later gave what could be seen as an ambiguous response to the Likert-scale type item 'I like maths.' This group of students was informally called 'the waverers', and it was responses to this question in particular which formed the basis for the choice of students for the student interviews, as outlined in Section 3.3-2 earlier. It was during this period of going through the questionnaires that it was noted that a number of students singled out algebra in particular usually as an area of discontent with mathematics (though a few did refer to liking it), and hence it was decided to include an algebra question/task in the interview schedule, which initially had not included a direct 'mathematics' question.

Student responses to closed questionnaire items were entered into SPSS for data analysis. This process began during the fieldwork period, and also continued after leaving the field. As closed items were mainly nominal (dichotomous) or ordinal and related to students' views, it was decided that the best statistical test which could consistently be used on such data would be chi-squared tests (Cohen et al., 2003, p80-81). P-values for all tests of significance were done using two-tailed tests, which, based on the argument given in Argyrous (2005, p228-229) provide a more rigourous criterion for tests of significance. So, additional to simple frequency counts, student responses were also analyzed mainly by gender, by school-type, and on the 4-group basis outlined earlier, in search for relations/associations between students' expressed views and their gender and/or school-type.

At this point more will be said about the use of significance testing and chi-square in the analysis of closed questionnaire data in this study. The chi-square test indicates whether there is an association/relationship between two variables (Fields 2005, p689). The test belongs to the family of non-parametric significant tests which are generally considered to be less powerful than the parametric versions of such tests (Cohen et al, 2003, p318). Significance testing indicates the likelihood (probability) of a particular observed result in a sample to have occurred 'by chance'. Herzon & Hooper (1976, p208) highlight the point that this is the sole meaning of significance testing, so that the researcher then should interpret the importance of his/her findings in the context of the research. The alpha ('cut-off') level of significance that has been chosen for the reporting of statistically significant results in this study is the 5% level, although since SPSS provides the specific p-values these have been reported. This means that for this study, a result is taken to be statistically significant if the p-value for the chi-square test indicates a 1/20 (or less) likelihood of the result having occurred by chance.

An important assumption of tests of significance (and so also the chi-square test) is that the sample should be randomly selected, so that each individual in the population had an equal chance of being selected. In the analysis of questionnaire data for this study significance testing via the use of the chi-square test was employed. As noted in Subsection 3.3-3, the study's student sample was not randomly selected, but rather chosen for its potential representative-ness. Bryman & Cramer (2001, p101) have pointed out that whilst significance testing is ideally based on random samples, the problem of non-response and low response rates from such random samples narrows the difference in representative-ness between random samples and otherwise convenience samples. Garson (2007) has also noted that significance testing is often employed as a crude 'rule of thumb' on non-random samples.

The above discussion brings us back to the study's student sample, how it was selected, also bringing into question the dimensions of the population being considered. There are at least two levels at which the population could be looked at in this study. At a first (and more general) level the population for inclusion in the study was secondary schools. There are various points of consideration in this selection. The focus on schools does mean it is the mathematics views of *students* that are being studied, and the fact that it is secondary schools also means it is the views of those students who have been successful enough to be in/at this level of schooling. In A&B this within the decade of the 2000's has meant that approximately 35% of primary school students would have been (initially) excluded (see in Section 4.1) as they would not have successfully negotiated the CEE. At this population level, the study included 11/13 (85%) of A&B's main secondary schools, that is, almost the entire population of schools. A notable drawback however is that the two missing schools were both of the same type (private mixed schools), and this does mean that views of students in a key type of school were missing. It should however be noted that all documentary data on performance in the CXC/CSEC included these schools (e.g. in Section 4.2 and also Subsection 6.4-1). Figure 4.2-4(b) in Section 4.2 shows that at least in mathematics, the results of students in these schools are more like those of students in the government mixed schools than they are of students in the private single-sex schools. At a second (and more specific) level, the study sought to include students in secondary schools who were most likely to complete this (secondary) stage of schooling and so sit for the CXC/CSEC examinations. This was so as it is largely this sub-group of youths upon which the year on year 'talk' of underachieving in mathematics has been based. It is for this reason (along with that given earlier in Subsection 3.3-3) that students of the fourth form were chosen. This then does mean that in A&B the population from which the sample was drawn is a rather 'select' group of youths/students as in addition to being in secondary school they would have also had to have survived at least three years of this stage of schooling to still be present to the fourth form (see Chapter 4 for more on this). The sample itself was not a random selection of these fourth form students, as there had been a desire in the planning stages of the research to have an intact class of students. It was felt that having such a class would aid the process of administering questionnaires, was more likely to yield a return rate close to 100%, aid in the contacting of and access to students later for interviews, and also help with access to a classroom for observations.

Given these cautionary notes, what rationale can be given for the use of significance testing for the selected sample? In one sense, I was/am interested in exploring within this sample (chosen for its potential 'typicality') the existence of group differences and/or similarities. The interest was in two main areas, group differences/similarities of background variables (these explored in Section 5.1), and group differences/similarities of mathematics views (these explored mainly in Subsection 6.1-1). I am not interested in causations, and so have tried to state these differences or similarities without using the word *because;* but I am interested in the existence or not of associations, especially as a means of attending to RQ 2&3. Arguably, these interests could be fulfilled without the use of significance testing. However, I would like to highlight within this sample where (i.e. for which questionnaire items) and between which groups such differences or similarities are found. This is not to discount an interest in extrapolations to the population; however the reader does need to bear in mind that the sample is non-random.

There are other considerations to be borne in mind in the use and interpretation of chi-square values and the associated significance testing. As with all significance testing, the likelihood of obtaining statistically significant results with chi-square increases with the value of n so that large values of n are more likely to yield statistically significant results even for otherwise small differences between groups (e.g. Herzon & Hooper, 1976, p293). Additionally, the value of chi-square does not say anything about the *strength* of an association (e.g. Herzon & Hooper, cited earlier; Bryman & Cramer, 2001, p168), just that there is (or not) an association. These issues amongst others have seen significance testing becoming a contested area in social research in more recent times (e.g. Cohen, 1994; see also literature review in McLean & Ernest, 1998 and Volker, 2006). In this matter, the academic literature has more recently been advocating that research which makes use of significance testing ought also to incorporate in the reporting of results some means whereby the strength of the association or the size of the effect can be assessed (e.g. see in McLean & Ernest, 1998, p16; Cohen et al, 2003, p197; Field, 2005, p33). For significance testing involving chi-square, values of phi (φ) or Cramer's V can be used to provide this measure of the strength of the association. These are correlation statistics for nominal/categorical data but which are independent of n, as they involve a calculation which divides the chi-square value by n (e.g. $\varphi = \sqrt{(\chi^2/n)}$) (Herzon & Hooper, 1976, p293). Phi is used for cross-tabulations yielding 2x2 contingency tables and Cramer's V for larger tables. As they are both measures of correlation, they vary in value between 0, indicating no association, to 1 indicating perfect association (see also in Herzon & Hooper, 1997, p288). (Field (2005, p693) has noted that the contingency coefficient also provides a measure of the strength of the association for larger tables, but that it hardly ever attains the maximum value of 1 and that Cramer's V provides a correction for this). Cohen (1988, p82-83) outlined a guideline for interpretation of these correlation coefficients (again, although one ought to consider such interpretation in the context of their particular research) as: 0.10 indicating a small effect, 0.30 indicating a medium effect, and 0.50 indicating a large effect (see also in Field, 2005, p32). Cohen (1988) further made the point that in the field of educational psychology correlation values of 0.5 are 'about as high as they come' (p81).

P-values for phi and Cramer's V are the same as those reported for chi-square. As with other correlation statistics, squaring their values gives an indication of the amount of variation in one variable that can be attributable to the other variable (although, Volker, 2006 has noted that this is only strictly the case for 2x2 contingency tables and so for phi). Thus a phi-value of 0.3 (for a medium effect) would indicate that 9% ($0.3^2 \times 100$) of the variation in one variable is attributable to the other variable under consideration. Gliner, Vaske & Morgan (2001, p293) cited Rosenthal as arguing that a consideration of these otherwise seemingly small percentages tends to leave an underestimated impression of the strength and potential importance of the association. Another consideration in the use and interpretation of chi-square has to do with the matter of low cell counts in the cross-tabulation contingency tables generated in the analysis. For the results of the test to be reliable, at least 80% of the cells in the contingency table must have frequencies of five or more (Cohen et al, 2003, p365). In the reporting of the results of significance testing in this study, chi-square results have not been reported for contingency tables that do not meet this criterion. Additionally, estimates of the strengths of association or effect size have in the main been reported only for chi-square tests returning a significant result, this in keeping with Robinson & Levin's perspective (cited in McLean & Ernest, 1998, p18). In Subsection 6.4-1, in addition to the phi or Cramer's V measures of strength of association, odds ratio measures obtained from the results of simple logistic regression analyses have also been employed. In this context, this measure has been used to provide an estimate of the relative likelihood or odds of a student passing mathematics based on which group he/she belonged to over a number of background (and other) variables. Again, these tests have only been done for variables that already yielded a significant result for chi-square.

Student responses to open questionnaire items were word processed and then entered into MAXqda. With the aid of that software program, open questionnaire items were analyzed on an item-by-item basis. A code (Miles & Huberman, 1994, p56), i.e. a label which was thought preserved the meaning of responses, was assigned to students' responses. Codes were chosen either by using an 'en vivo' label which used students' own words or phrases, or by using a word/phrase which summarized the ideas in the response. The coding used for open questionnaire items was mainly descriptive in nature (ibid., p57). Thus, the development of codes began in situ with the labelling of responses to a particular questionnaire item within a particular school; these labels were then carried forward to responses for the same item within other schools, with other labels added as might be needed. At the end of that process, codes which had low frequencies were then retrieved with the aid of the data analysis package and the particular response re-examined in light of other codes used in order to determine whether the ideas in the response could reasonably fit one of these other codes. It was in this way that codes were refined. Students gave responses to open questions that could be (and were) labelled with more than one code, so that the number of codes for a particular open question could outnumber the number of students in the sample. Dealing with the open questions in this way brought out that there were some labels/codes that were being re-used in other questionnaire items, and that the 'issue' labelled by this code was consistent across questions and individual students.

The coding scheme used with two questionnaire items will be used as illustrative examples of the foregoing. The two items illustrated here were chosen as their findings are discussed in more detail in Section 6.1. The scheme presented in Table 3.5-1 was used to code students' reasons for their response to the first questionnaire item that directly addressed their views of mathematics, that is, *Do you like maths?* (Section IV of Appendix A1).

Table 3.5-1: List of Codes - Reason for Response to *Do you like maths?*

Code	**Meaning**	**No. of responses**
	Positives (Response *Yes*)	
Favourite/enjoy/fun	These words, or student simply says that they like it	51
Important/useful	Either these words used, or reference to need in other subjects, career/job, everyday life	43
Challenging	This word	22
Easy	This word	20
Understand	This word; the idea conveyed	17
Use brains/think	References to brains, thinking, mind	16
Performance	A perception of a good performance	10
Teacher+	Any positive inference related to a teacher	10
Interesting	This word	9
Other	Response does not fit any of the categories above	6
	Negatives (Response *No*)	
Hard/difficult/ complicated	These words. Do NOT include confusing/mixed up, don't understand	62
Don't understand	These words. Do NOT include confusing/mixed up	28
Confusing/mix up	This/these word/s	13
Use brains/think	References to brains, thinking, mind	8
Teacher-	Any negative inference related to a teacher	7
Performance	A perception of a poor performance	6
Boring/not interesting	These words/ideas conveyed	6
Other	Response does not fit any of the categories above	4

A similar scheme was developed for students' responses to other open questionnaire items, on an item by item basis. As example, the scheme used to code students' responses to *What would you (personally) say maths is?* is given in Table 3.5-2:

Table 3.5-2: List of Codes - Response to *What would you personally say maths is?*

Code	Meaning	No. of responses
Important/useful	These words; idea of need/necessity whether in other subjects, to get a job, etc.	62
Numbers/counting/basic operations/computations	These words; references to 4 basic operations	55
Hard/difficult/complicated/hard to understand	This/these word/s	42
Way to use brain/think	These words; references to mind, thinking, using brains	34
Way of life	Idea conveyed of maths permeating everyday life	30
Problem solving	References to use as means of solving in problems, whether in maths, other subjects, everyday life	21
Dk	(I) don't know	14
Rules/formulas	Anything to do with procedures, equations, rules, formulas	13
Frustrating/annoying	These words; idea of its being bad	12
Not interesting/not fun	These words; idea of tedium	10
Challenging	This word; conveying idea of easy yet hard, etc.	10
Easy/easy to understand	This/these word/s	8
Favourite/enjoy/fun /interesting	These words; idea conveyed of its being favourite, etc.	7
Confusing/mixed up	These words	6
For bright people	These words; something to do with intelligence, ability	5
Science	This word; references to systematic nature	5
Other	Response does not fit any of above categories	6

The ideas behind some codes were re-used under the same or a similar label in subsequent coding (e.g. from the two lists presented, challenging, ideas of using brains). There was however a conflating of some categories in the coding of questionnaire items from one item to another. The main reason had to do with the way in which the question was asked, and therefore, how it was that students responded. For example, in using the label hard/difficult/complicated to code students' responses to *Do you like maths?* care was particularly taken to not combine responses which gave as reason 'it is hard' from those that said 'I don't understand'. This it was felt preserved the idea behind the reason students gave for their responses, as a student who said that he/she did not understand was not necessarily saying that mathematics was difficult (although this may well be the case). Thus, a response of 'because it is hard and I don't understand' would have been coded twice under 'hard/difficult/complicated' and 'don't understand'. However, in coding responses to *What would you (personally) say maths is?*, there were a number of students who described mathematics as 'hard to understand', which was not a response given to *Do you like maths?* Describing mathematics as hard to understand gave the double sense that mathematics was hard and also that the student did not understand it, and so it was thought that it made sense, in coding responses to this later question, to combine the ideas behind mathematics as hard/difficult etc. with that of the student not understanding mathematics. A secondary reason for conflating some codes from one item to another had to do with practicalities in the refining of codes, i.e. the number of students who had given a response which fitted the meaning of a particular code; where the number was low, a code was then combined with another that could be interpreted as conveying similar ideas. As example, the codes 'Favourite/enjoy/fun' and 'Interesting' were used separately for *Do you like maths?*, but combined for *What would you personally say maths is?* due to low frequencies.

The transcripts of student interviews were entered into MAXqda to aid in the management of the data analysis process. These data were analyzed in a more holistic way than had been done with the coding of open questionnaire items. In practice this meant that interviews were read and re-read, and although some coding was done, analysis was more of a form between that of making marginal notes and memo-ing in the sense given by Miles & Huberman (1994, p67, 72). This process of making marginal notes/memo-ing student interview data was in nature analytical rather than descriptive, as it was essentially my interpretations of what students said, making sense of students' responses, and relating later notes/memos back to previous ones and/or finding relationships amongst sets of notes/memos and associated texts.

Analysis of interviews was aided by the structure of the interview schedule which had a pre-categorization of 'expected' responses, so, for example, it was relatively simple to gather together students' responses to the question which dealt with their views of their parents' expectations of their mathematics performance. The process however was not always that simple, as students did not always respond to questions in a way that fitted the given category or addressed the intended RA and RQ. Via this approach to analysis it was noted that some similar issues/themes did appear to repeat themselves both within and across interview groups, and also that some of these issues/themes resonated with issues that had been raised and noted in questionnaire data. These issues were then collected together under a label or code. That is, a code was assigned to a passage only after a consideration of the notes/memos and associated text under a label which summarized what it was felt was happening, what it was students were saying. Labels used as codes for interview data were at a more interpretive level (Miles & Huberman, 1994, p57) than those used to code open questionnaire data, and in general, a larger amount of text was coded with a particular label. As example, within questions related to how students study mathematics and/or study for a mathematics test (see Section 4 of Appendix C) designed to address RQ1(b), a category labelled 'maths approach' was assembled. Within this category there was a subcategory labelled 'learning by the rules', which had to do with an approach to studying mathematics described by some students, which involved memorization of formulas for an equation, steps of a procedure. A more complete scheme via which interview data were analysed can be found in Appendix E. Although the process of assigning codes in the analysis of open questionnaire items and interview data was different, it was felt that the nature of the data gathered from these two methods called for and facilitated the different processes used.

Analysis of data from observations was conducted in a similar way to that done with student interviews, but this was less detailed. In practice, findings from observation data were used in large part to support findings from other data collection methods. The exception to this use comes in Subsection 6.2-2 which outlines specifically data to do with classroom processes in the learning and teaching of mathematics.

It should be noted that the codes and coding schemes used for analysis of open questionnaire items, interviews and classroom observations field-notes were generated from the data themselves. Although I did have knowledge of pre-existing coding schemes (e.g. that available in Boaler, 1996), an approach was employed to the analysis and coding of these open data sources that would try as much as possible to use words or terms that retained the sense of what the respondents had said. This in some cases meant that the respondents own words were used as codes.

In presenting the findings of the study, as had been found for the data analysis, some selection had to be made about which results to present. Decisions made in selection had to do with which results it was felt best addressed the RA and RQ. During data analysis (especially that of questionnaire data), it was found that students' responses to some questions did not always address the intended RA and/or RQ, whilst their responses to some other question(s) may have done so. Based on this it was decided to present findings in a way that used whatever data source(s) best exemplified or brought out the particular finding and by extension dealt with the RA and/or RQ. This strategy does necessarily bring into question issues regarding selection. With regard to the selection of excerpts (questionnaires and interviews) used in the presentation of findings in Chapters 5 and 6, in addition to excerpts being chosen based on the degree to which they illustrate the point being made, where a set of such excerpts are presented the following criteria were used: For open questionnaire items the codes surrounding the issue being dealt with were retrieved for all schools using facilities of MAXqda. From the list of retrieved segments excerpts were chosen that would reflect a mix of the 11 participating schools and also the gender mix of the sample. A similar procedure was used in the selection of excerpts from interviews. In this way care was taken that the chosen excerpts did not reflect the views of students in only one or a sub-sample of the schools, and also that the views of both boys and girls were presented.

Care was also taken in particular with questionnaire excerpts that the excerpts presented were not the views of one individual student. Observation excerpts were chosen mainly as supporting data, except for those used in Subsection 6.2-2 which deals specifically with RA(c)(i) and RQ1(b), i.e. students' approaches to learning/doing mathematics. The three longer excerpts presented in that subsection came from the third classroom session observed in each of the three participating schools in which observations of mathematics classes were carried out. As mentioned in Subsection 3.3-1 an average of 10 observation sessions were carried out in the three schools (12 sessions in Si2, nine in Si3, and 10 (formal) sessions in Mi5). The third observation session in each case occurred more than one month into fieldwork activities, and it was thought that students would have become more accustomed to my presence in their school and classrooms as I would have been in their school on two previous occasions for observation sessions, in addition to being there for administering of questionnaires and for the collection of parent questionnaires amongst other occasions. The third session also occurred at a point before any video-recordings of classroom sessions had taken place, and so potentially reduced chances for students and teachers to 'play up' for the camera. The three shorter excerpts were chosen for the extent to which they illustrated that the conduct of the individual classrooms of each of the longer excerpts was 'typical' of what usually happened in those classes.

The overall data analysis process has been a consuming one. It has involved many re-reads of the collected data, specifically the questionnaires, interview and observation data. It has also involved re-listening to the audio recordings of the student interviews, re-watching and re-listening to the audio-visual recordings from classroom observations. This approach to analysing the data has meant a complete immersion in the data. Also ongoing with the data analysis has been a continual reading of the literature to aid in interpreting and making sense of findings from these data. Thus it is felt that the findings to be presented and the interpretations made of these in the chapters to follow are a valid representation of the phenomenon studied.

Chapter 4

Findings: Documentary Sources

4. FINDINGS: DOCUMENTARY SOURCES

This chapter sets out the findings from the study from documentary sources. As mentioned in Subsection 3.3-1, data from documentary sources provided the backdrop for a consideration of the educational context of the study by providing insights into what had gone before. One feature of including documentary evidence as a data collection method for this study is that data thus gathered would not in the main involve data on the study's main participants. However, some of the primary school data would have involved students who were also participants in the study, particularly data related to student performance in the CEE of 2000 and 2001 as those were the years in which the highest proportion of the study's student sample entered secondary school (80% of sample in total, see Table 5.1-1(a), Section 5.1), and hence the years in which they took the CEE examination. Additionally, data on the performance of students in the 2006 CXC/CSEC examinations do involve a proportion of the student sample which participated in this study, as, given that the fieldwork period of the study involved participants who at the start of the 2004-05 school year were fourth form students, then they would have sat these examinations (all being well) in May/June of 2006. The study's student sample makes up approximately 26% of the population of students for the 2006 CXC/CSEC results. More specifically on the performance of the study's student sample in the CXC/CSEC will be given in Section 6.4.

4.1 THE A&B EDUCATIONAL CONTEXT – HAPPENINGS AT PRIMARY SCHOOL

A&B operates an educational system which includes government (i.e. free) and private (i.e. fee-paying) schools at both primary and secondary levels. Primary education is universal and freely available in government schools. In 2002 there were 34 government and 27 private primary schools in the country (compiled from Weston, 2002). Private primary schools cater for approximately 35% of the primary school cohort. Access to secondary education, even including government secondary schools, depends on student performance in the CEE, which students sit at the age of 11-12 years. Students who fail these examinations get a second chance for entry to secondary schools by continuing on for at least three years in select government primary schools (called post-primary or junior secondary schools, of which there are 13). Their access to secondary education is then determined by their performance on the Post-primary examinations. MoE data for the government primary schools for the 2003-2004 academic year put the male-female student ratio at 4393:3693 or 54% male. This proportion is somewhat skewed in favour of boys as it includes information for schools that also function as post-primary institutions, and based on the CEE results (given in more detail below), proportionately more boys fail these examinations than do girls, and so more boys stay on in post-primary schools. The

2003-2004 MoE data on the government primary schools which function only as primary schools show that there is a more equal distribution of the sexes in those schools.

MoE statistics on the CEE (1992-2004) show a consistent pattern of more girls passing these examinations than boys. The statistics also show that the pass rate fell below 50% in six of these years for boys and only one of these years (1999) for girls. Except for the years 1996 and 1999, the overall pass rate has been above 50% in these examinations over this 13-year period. The CEE are administered in four subject areas, English, Mathematics, Science and Social Studies. The pass rates in the CEE according to a MoE official are based on students attaining a certain number of marks in the subject areas administered (50% for English, Science and Social Studies, and 45% for Mathematics), and not on the number of available places in secondary schools. Overall pass rates for the primary school population (both government and private schools) are given for the years 1992-2004 in Table 4.1-1.

Table 4.1-1: Overall Common Entrance Examination Results

Year	Male			Female			Total		
	T	P	%	T	P	%	T	P	%
1992	506	239	47.2	542	321	59.2	1048	560	53.4
1993	559	251	44.9	590	329	55.8	1149	580	50.5
1994	585	262	44.8	654	378	57.8	1239	640	51.7
1995	607	300	49.4	665	466	70.1	1272	766	60.2
1996	657	254	38.7	656	365	55.6	1313	619	47.1
1997	585	320	54.7	739	496	67.1	1324	816	61.6
1998	589	314	53.3	682	454	66.6	1271	768	60.4
1999	602	213	35.4	707	338	47.8	1309	551	42.1
2000	645	381	59.1	734	528	71.9	1379	909	65.9
2001	692	364	52.6	736	511	69.4	1428	875	61.3
2002	729	372	51.0	813	601	73.9	1542	973	63.1
2003	737	414	56.2	760	526	69.2	1497	940	62.8
2004	734	448	61.0	832	608	73.1	1566	1056	67.4
Mean			49.9			64.4			57.5

T= Number of students Taking, P= Number of students Passing

A break-down of the passes in terms of school-type i.e. government or private was obtained for the years 2000 and 2002, and a further break-down in terms of gender was available for 2002. Results for both these years show that students from private schools performed markedly better than those from government schools, with pass rates of 86% and 55% respectively in 2000, and 83% and 51% in 2002. The school-type and gender break-down for the year 2002 is given in Table 4.1-2:

Table 4.1-2: **Overall Primary School Common Entrance Results for 2002**

School-Type	Government		Private		Totals:	
Student Numbers	**Taking**	**Passing**	**Taking**	**Passing**	**Taking**	**Passing**
Male	493	183 37.1%	251	188 74.9%	744	371 49.9%
Female	494	317 64.2%	322	285 88.5%	816	602 73.8%
Totals	987	500 50.7%	573	473 82.5%	1560	973 62.4%

As 2002 was the only year for which such a gender and school-type break-down was obtained, the typicality of the results of Table 4.1-2 is not known. That said, it does seem to show that gender is not the only factor which determines student access to secondary education. The overall pass rate data for 2000 and 2002 given previously show that a private primary school education markedly increased the chances of a student gaining entry to secondary school compared to a government primary school education. Moreover, for 2002, that this factor, i.e. type of primary school, was a better predictor of a student gaining entry to secondary school than the student's gender, in particular of the student being a girl (i.e. ~83% of students from private schools gained entry to a secondary school, whereas ~74% of girls gained entry to secondary schools). Certainly, boys attending private schools did better than girls in government schools, and did seem to 'achieve' in terms of the proportion of their cohort gaining access to secondary education, although they did not do as well as girls in private schools. Boys attending government primary schools however do appear to be particularly disadvantaged in terms of their chances of success in the CEE. The factor of school-type is not without socioeconomic implications; private primary schools *are* fee-paying schools, and so can be used as a crude guide to the economic status of the students' parents, i.e. ability to pay. Jules et al (2006, p12) for example have noted that in some Caribbean countries there was a 'tendency… for richer echelons to attend private schools which are deemed of better quality than some of the public schools'. Other fieldwork data lend support to this view of private and government (public in the terms of Jules et al) primary schools. According to one official in the MoE in A&B:

> The trend being noticed is that parents, if they have a little money, are now sending their children to private primary schools. The children in government primary schools are now the poor Antiguans or the foreigners. (In A&B 'foreigner' is used to mean anyone not from A&B, including other Caribbean nationals.)

A school-type and gender break-down for mathematics was obtained for the years 2001 and 2002, and these are illustrated in Tables 4.1-3(a) and (b):

Table 4.1-3(a): Primary School CEE Results for Mathematics 2001

School - type	Government		Private		Totals:	
Student numbers	Taking	Passing	Taking	Passing	Taking	Passing
Male	478	247 51.7%	226	185 81.9%	704	432 61.4%
Female	465	351 75.5%	258	192 74.4%	723	543 75.1%
Totals	943	598 63.4%	484	377 77.9%	1427	975 68.3%

Table 4.1-3(b): Primary School CEE Results for Mathematics 2002

School - Type	Government		Private		Totals:	
Student Numbers	Taking	Passing	Taking	Passing	Taking	Passing
Male	481	185 38.5%	251	183 72.9%	732	368 50.3%
Female	494	306 61.9%	320	274 85.6%	814	580 71.3
Totals	975	491 50.4%	571	457 80.0%	1546	948 61.3%

Source: Weston, 2001, 2002[3]

Some of the comments given previously can also be applied to the results in mathematics for these two years, i.e. that school-type is a better predictor of examination success than is gender, in particular, being a girl. However, girls as a group achieve proportionately more passes than boys as a group for both years. This result for mathematics over the two years shown is not always uniform across school-types, and in 2001 boys from private schools had the best success rate of the four categories of students, i.e. males, females in government schools; males, females in private schools. Over the transition from primary to secondary school however this advantage of girls as a group in the mathematics examinations at the end of primary school is not maintained in A&B by the end of secondary, as CXC/CSEC results for A&B show that proportionately more boys pass these examinations in mathematics than do girls, although the difference is not always marked, and in 2004 this 'trend' was not maintained (see in Section 4.2). This pattern of gender differences in mathematics performance in favour of males increasing with student age has been noted in the academic literature on this topic (e.g. Ercikan, McCreith, & Lapointe, 2005, p5).

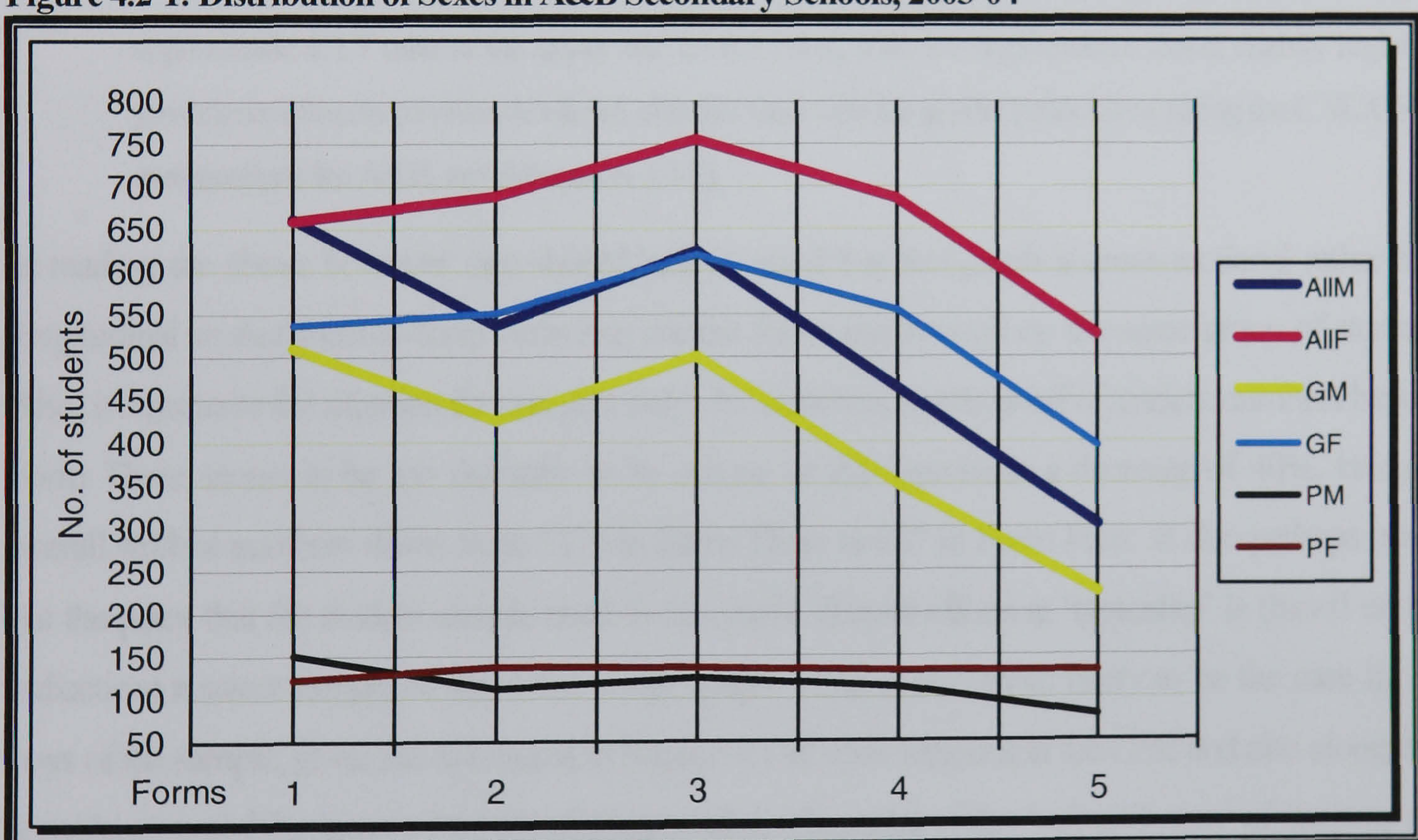
[3] It will be noted that the number of students sitting the mathematics CEE for the years 2001 and 2002 differs from that reported in Tables 4.1-1 and 4.1-2 which report numbers for students sitting the overall CEE in those years. As noted, students sit the CEE in four subject areas, which are administered over two days. For the year 2002 subject reports for English Language and Science indicate that 1542 and 1541 students respectively wrote these subjects, whereas that for mathematics shows 1546. It may be that there are slightly different numbers of students writing individual subjects for a variety of reason, including, for example, illness; data from 2001 and 2002 seem to indicate that the number which is considered as representative of the overall total is the number of students writing English Language.

The post-primary examinations are taken by a smaller cohort of students, usually ranging between 400-500 over the 16-year period 1989-2004. MoE statistics show an even bleaker picture of success with the mean pass rate over that period being 44.9%. Additionally, whilst there has been evidence of an overall improvement in success rates at the CEE within the last approximately eight years of the period shown in Table 4.1-1, there seems no clear pattern to success rates in the post-primary examinations. The data, not shown here, also indicate that in absolute terms more boys than girls sat these examinations in 12 of the 16 years, and in one-half of these 16 years there were more boys than girls successful (41.7% and 48.8% mean success rates respectively over the 16-year period).

4.2 THE A&B EDUCATIONAL CONTEXT – HAPPENINGS AT SECONDARY SCHOOL

Figure 4.2-1 provides a cross-section of the distribution of boys and girls in secondary schools in A&B at the start of the school year 2003-2004.

Figure 4.2-1: Distribution of Sexes in A&B Secondary Schools, 2003-04



Key: M = male, F = female, G = government schools, P = private schools, All = both government and private schools. Source: Personal communication, MoE document

There are several points of note in this figure.

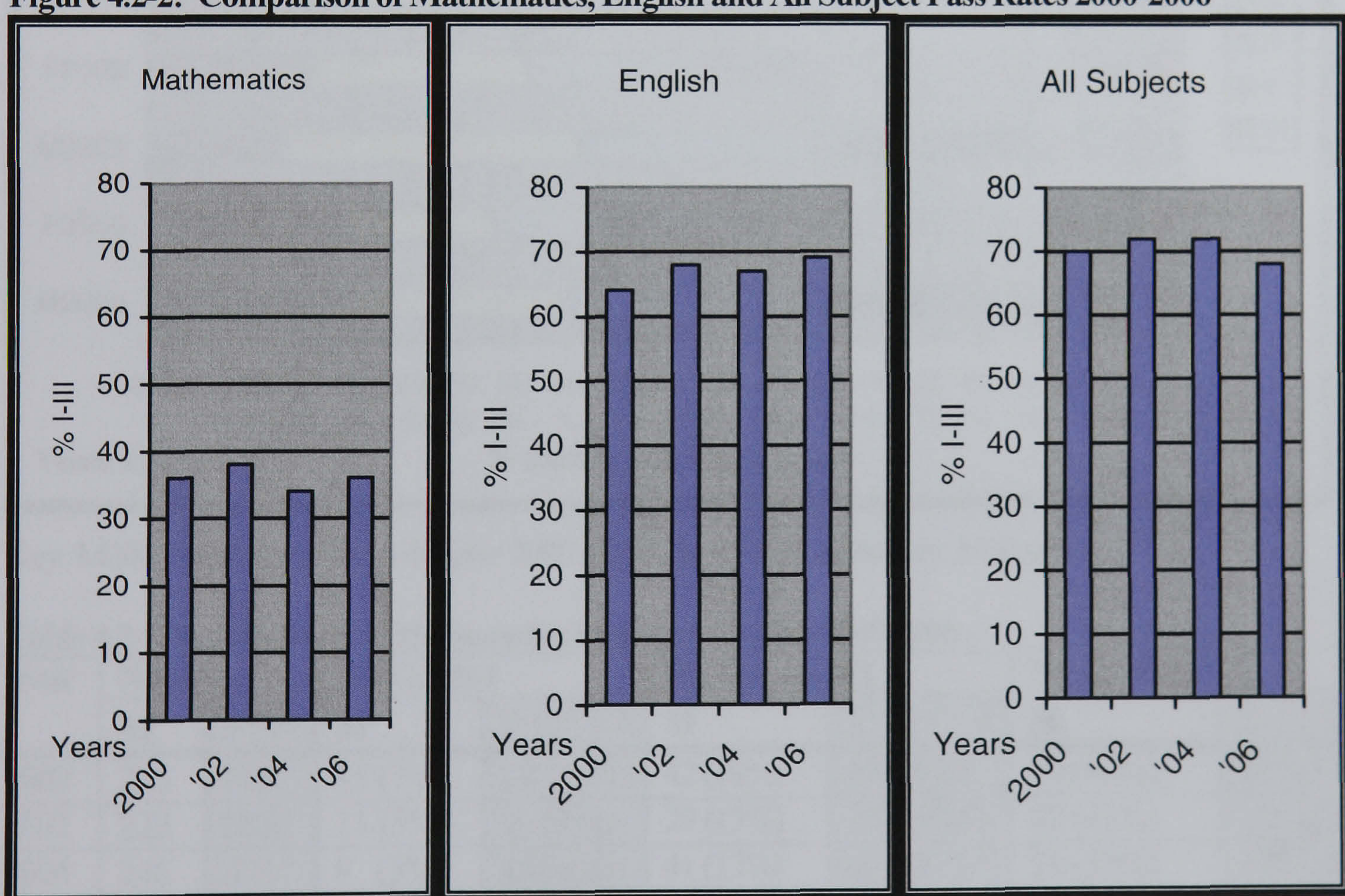
- In 2003, nearly 1500 students sat the CEE, of which 940 were successful. However the total number of students in Form One secondary schools in A&B exceeds 940, being 1320, an excess of 380 students. One possible explanation for this excess could be students repeating Form One. Another could be because some private schools may admit students on bases other than the results of the CEE.

- ✧ The cross-section also shows that overall there were approximately equal numbers of boys and girls in Form One of the secondary schools, although there were more girls in the government schools and more boys in the private schools. The overall graphs also show that there is a dip in the number of boys at Form Two – more pronounced in the government schools, but is also the case in the private schools, whilst the number of girls increases in both private and government schools, and it is the point at which the number of girls in private schools exceeds the number of boys. This thus appears to be a crucial stage at which boys may be 'lost' to the system, in not surviving the first year of secondary school.
- ✧ The overall graphs also show a rise in the number of students in all secondary schools in Form Three, which most likely represents the input of students into government schools from the Post-primary examinations, this confirmed by the relative stability of student numbers in the private schools, which do not ordinarily admit these students.
- ✧ However, beyond Form Three, at both Forms Four and Five, there seems to be a dramatic fall-off of the number of students in secondary schools, both for boys and girls; the only group which seems to be relatively unaffected by this 'phenomenon' is girls in private schools. Thus, at the start of the 2003-2004 school year, whilst there is a 1:1 ratio of boys and girls in Form One of all secondary schools, there is an approximate 1:1.7 ratio at the upper end (Form Five), with the disproportion being slightly higher in government than in private schools (cf. also this ratio with the gender proportions sitting the CXC/CSEC examinations for A&B, see Subsection 3.3-2).

In reading the above however, one should bear in mind that this graph is cross-sectional rather than longitudinal so that form-to-form variations are not following through on the same group of students. Also, it represents the situation for one year only. Nonetheless, the drop-off of student numbers beyond Form Three seems to be too dramatic to be unique as this represents a decrease of 40%, bringing overall student numbers down from 1379 in Form Three to 827 in Form Five. It also perhaps brings out the point that the student sample used in this study, despite efforts at 'typicality' is (based on this indication) a select sample of the A&B youth cohort. This is also more likely to be the case for the boys of the sample, given the discussion in Section 4.1 of what happens in the CEE and also along with considerations of the apparent trends of Figure 4.2-1. The point of the 'selected-ness' of students and particularly of boys reaching the Fifth Form ought to be considered in reading the analysis of CXC/CSEC data that follows in this Section, and also in making sense of the findings and interpretations of the chapters to follow.

As mentioned in Chapter 1, it is also generally held in A&B that students are particularly underachieving or underperforming in mathematics. If one considers what the pass rate is in mathematics compared to English Language and also across all subject areas, then there perhaps is some warrant for the expressed concerns for mathematics. Figure 4.2-2 shows that pass rates in mathematics, English Language and across all subject areas for the General proficiency of the CXC/CSEC examinations have been relatively consistent over the period looked at. The figure also shows that whilst overall pass rates for students in schools have been relatively similar in English as they are across all subject areas, there is a notable and marked difference when these are compared to what happens for mathematics. In particular, the pass rates in mathematics are lower, usually approximately one-half that in English Language and all subject areas. (Note: As mentioned in Subsection 3.3-1, p42 and also on p63 at the start of this chapter, 2006 data in the figures that follow in this Section include data on the study's student sample which represented approximately 26% of the school student population; all data in figures and tables given in this Section are for students in the main secondary schools in A&B and not for island/country-wide statistics. The examinations are also taken by out-of school persons, who could be adults or other teenagers not in a formal school setting. These settings most often are evening classes or classes conducted outside of the normal school hours. In 2002, mathematics was taken by 577/740 (78%) of students in the main secondary schools; similar figures for 2004 and 2006 were 640/827 (77%) and 797/1054 (76%) respectively.)

Figure 4.2-2: Comparison of Mathematics, English and All Subject Pass Rates 2000-2006



The next set of figures and the table following give a more de-segregated look at underlying features of the mathematics results over the same time period.

Figure 4.2-3(a): Comparison of Passes in Mathematics by Gender 2000-2006

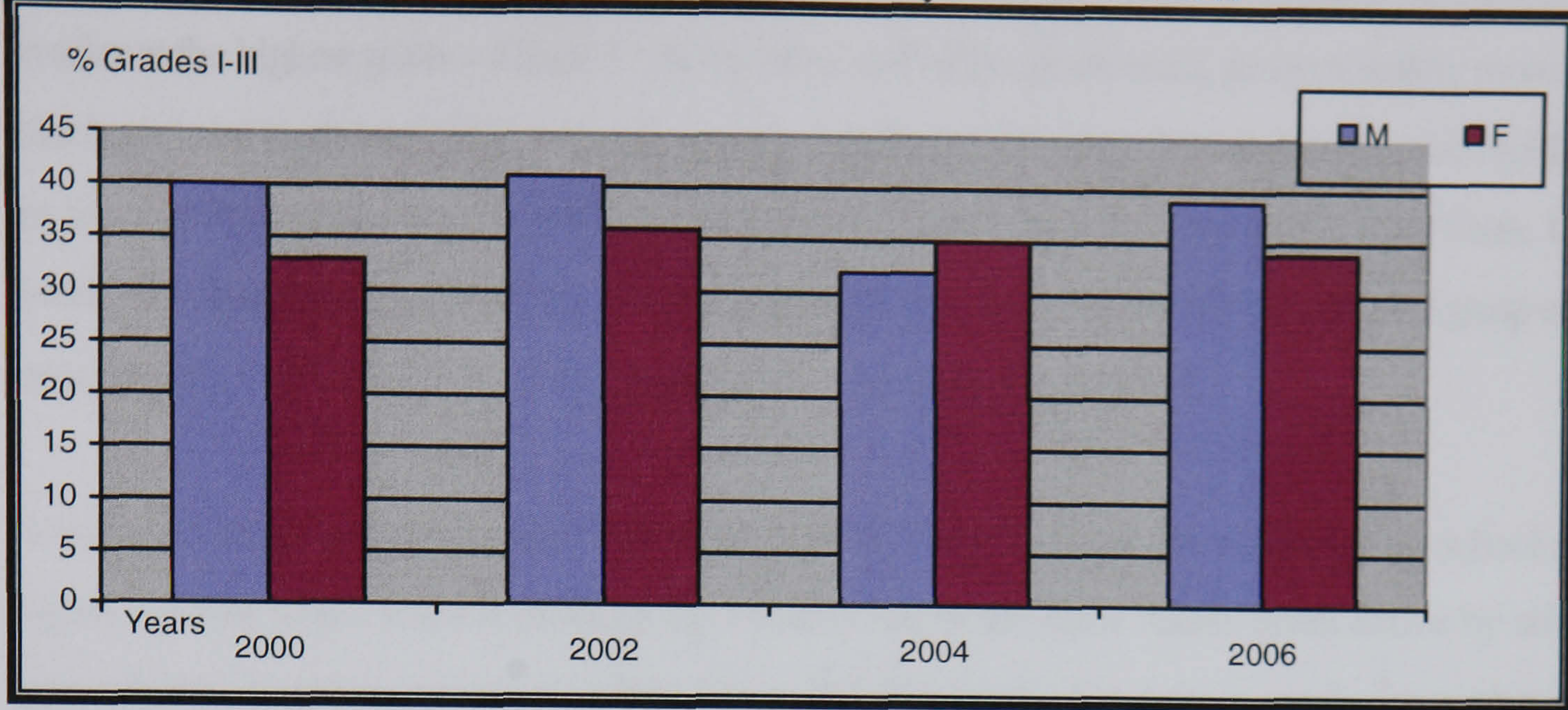
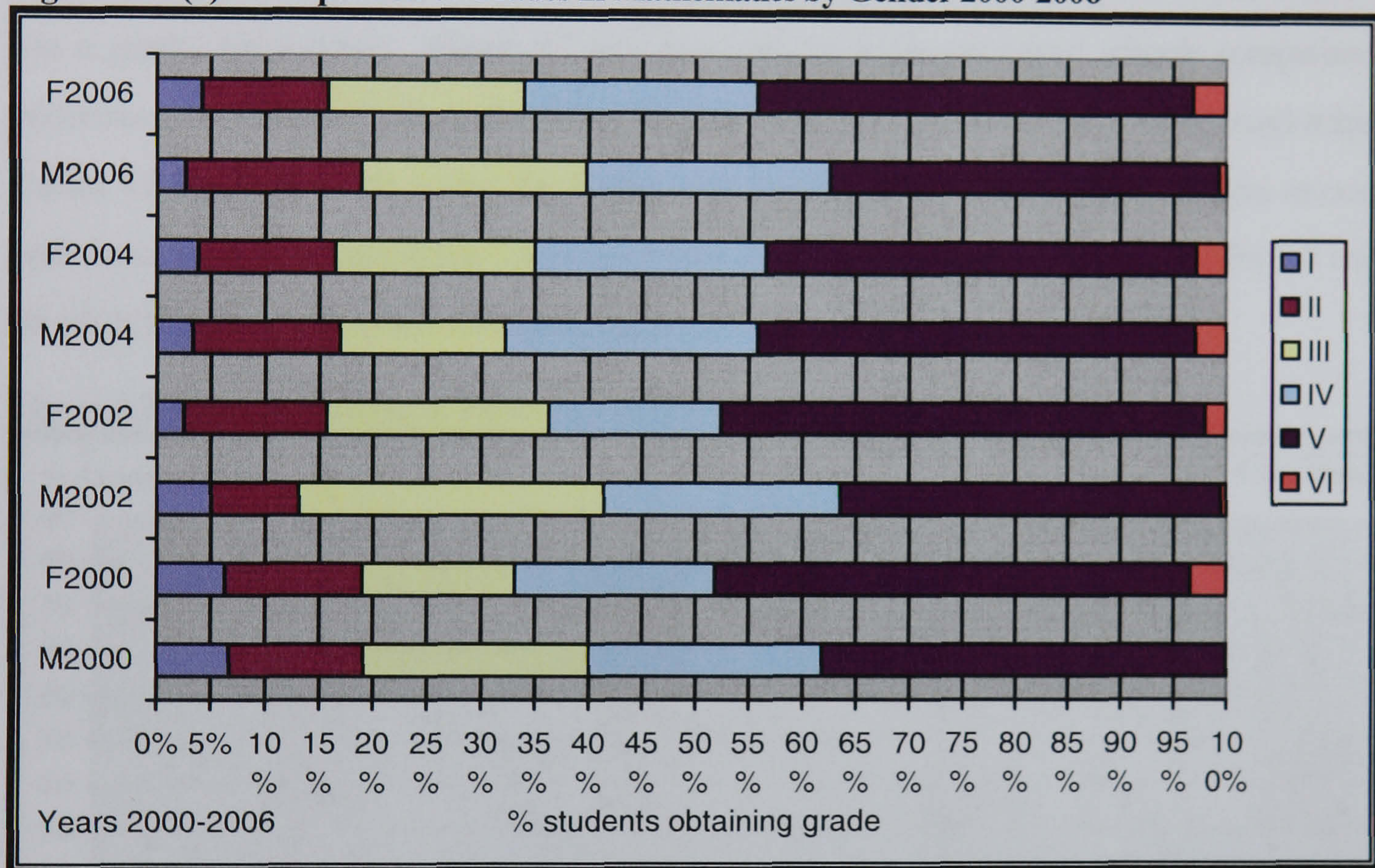


Figure 4.2-3(b): Comparison of Grades in Mathematics by Gender 2000-2006



Key: M2000 refers to males in the year 2000, F2000 to females in the year 2000, etc.

Table 4.2-1: Break-down of Mathematics Passes by Gender 2000-2006

Year	No. sitting		No. Grade I		No. Grades I-II		No. Grades I-III	
	M	F	M	F	M	F	M	F
2000	225	268	15 (7%)	17 (6%)	42 (19%)	51 (19%)	90 (40%)	89 (33%)
2002	222	355	11 (5%)	9 (3%)	29 (13%)	56 (16%)	92 (41%)	129 (36%)
2004	246	394	8 (3%)	15 (4%)	41 (17%)	65 (16%)	78 (32%)	138 (35%)
2006	311	486	8 (3%)	20 (4%)	58 (19%)	77 (16%)	122 (39%)	165 (34%)

The gender comparison of student passes in mathematics shows there to be more similarity than difference between the sexes in these. There is also some pattern to the passes and grades obtained; year on year proportionately more boys have tended to be successful than girls (this result compares to that for Caribbean averages, Figure 1.3-1, Section 1.3), although the proportionate differences are smaller at the highest grade – Grade I. At the other end of the grade scale, proportionately more girls than boys have received the lowest grade – grade VI (Figure 4.2-3(b)). Figure 4.2-3(b) also highlights the fact that the modal grade for both boys and girls is Grade V, which, if one recalls from Table 1.4-1, Section 1.4, is a grade described by CXC as awarded when a 'Candidate shows a limited grasp of the key concepts, knowledge, skills and competencies required by the syllabus'.

However, a much greater marked difference is seen if one looks at the outcomes by school-type. Figure 4.2-4(a) which follows provides the break-down of the same results given above by school-type, whether single-sex or mixed, whilst Figure 4.2-4(b) breaks down these results for mathematics further, looking at school-type in terms of single-sex, mixed, private, government, incorporating within this a gender break-down. Figure 4.2-4(c) provides the single-sex/mixed schools comparison of performance outcomes across mathematics, English Language and all (General proficiency) subjects. Tables 4.2-2(a)&(b) which follow the figures give the student numbers and percentages associated with the mathematics and English Language results for the figures shown. (Recall, Grades I, II and III are taken as passes, with Grade I being the highest.)

Figure 4.2-4(a): Comparison of Passes in Mathematics by School-type 2000-2006

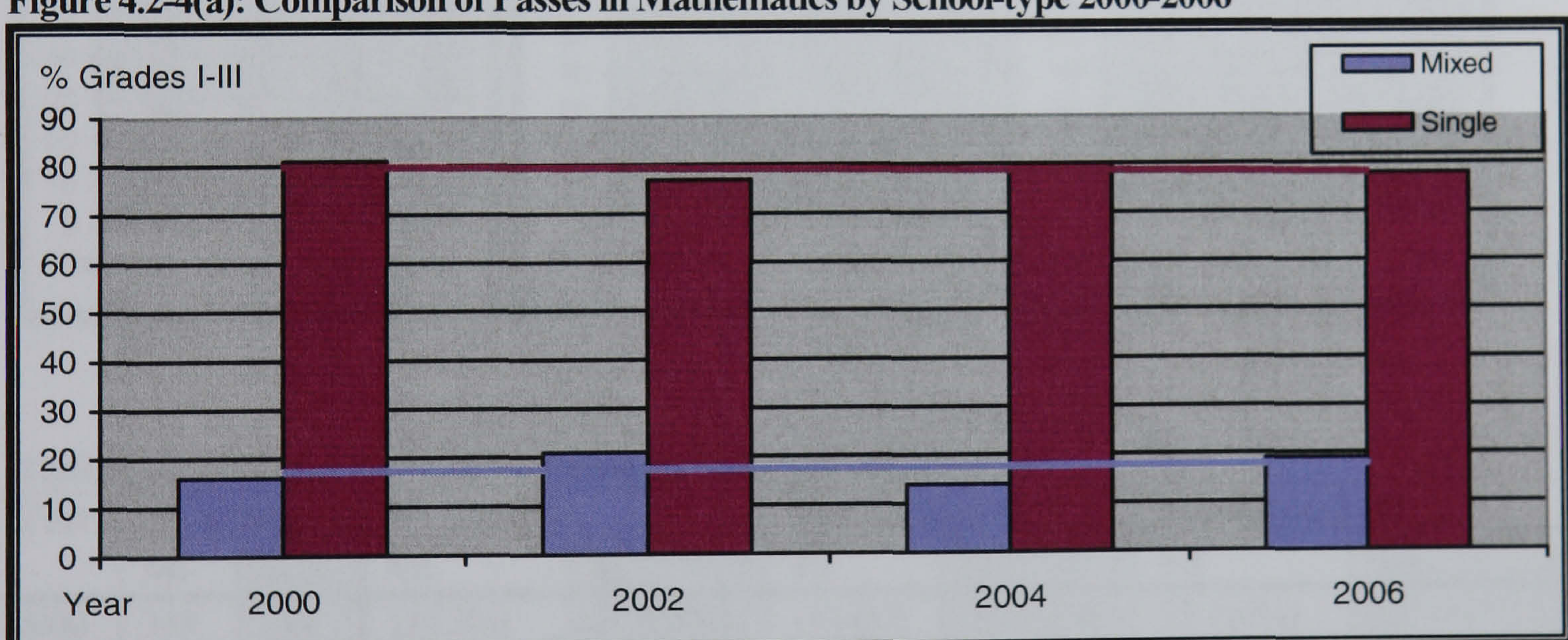
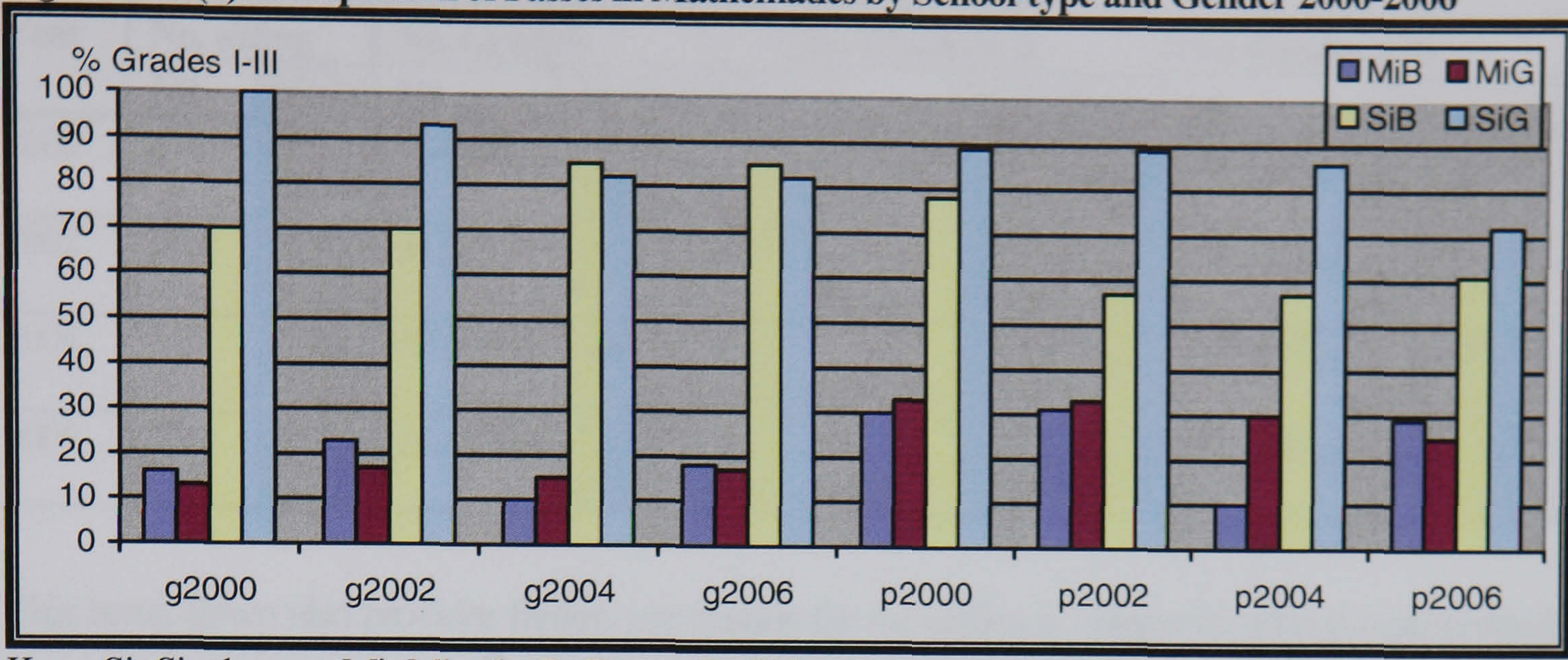


Figure 4.2-4(b): Comparison of Passes in Mathematics by School-type and Gender 2000-2006



Key: Si=Single-sex; Mi=Mixed; B=Boys; G=Girls; g=government schools; p=private schools; So, SiB=Single-sex boys, and g2000 refers to the sub-groups in government schools in the year 2000.

Figure 4.2-4(c): Comparison of Passes in Mathematics, English and across All Subjects by School-type 2000-2006

Table 4.2-2(a): Break-down of Mathematics Passes by School-type

Year	No. sitting		No. Grade I		No. Grades I-II		No. Grades I-III	
	Mi	Si	Mi	Si	Mi	Si	Mi	Si
2000	338	154	1 (0.3%)	31 (20%)	14 (4%)	79 (51%)	53 (16%)	125 (81%)
2002	399	178	2 (0.5%)	18 (10%)	9 (2%)	76 (43%)	84 (21%)	137 (77%)
2004	439	201	0 (0%)	23 (11%)	14 (3%)	92 (46%)	60 (14%)	160 (80%)
2006	562	235	8 (1%)	20 (9%)	27 (5%)	68 (29%)	104 (19%)	183 (78%)

Table 4.2-2(b): Break-down of English Language Passes by School-type

Year	No. sitting		No. Grade I		No. Grades I-II		No. Grades I-III	
	Mi	Si	Mi	Si	Mi	Si	Mi	Si
2000	474	234	45 (9%)	120 (51%)	111 (23%)	175 (75%)	240 (51%)	215 (92%)
2002	502	235	41 (8%)	92 (39%)	131 (26%)	154 (66%)	294 (59%)	205 (87%)
2004	512	241	52 (10%)	108 (45%)	131 (26%)	172 (71%)	286 (56%)	215 (89%)
2006	594	257	50 (8%)	82 (32%)	167 (28%)	169 (66%)	352 (59%)	234 (91%)

This break-down also provides further justification for the choice to categorise school-type as single-sex or mixed, rather than say government-owned or private in the broader analysis to follow of data from the student sample which participated in the study. These desegregated results feature several trends:

With regard to the mathematics results:

- there has been a bigger difference between the schools if they are single-sex or mixed, rather than if they are government or privately owned;
- students in government single-sex schools have, on average, had better results than students in private single-sex schools, but this pattern is reversed for students in mixed schools;
- the gender patterns which have been more or less consistent in the overall aggregate statistics do not hold as consistently in the desegregated statistics. In particular, there has been on average more difference between boys and girls in single-sex schools (especially so for those in private schools where the difference has been in favour of girls) than there has been between boys and girls in mixed schools whether government or private. For students in private schools on a whole, the pattern has tended to be for proportionately more girls to be successful than boys.

The following should be noted regarding single-sex schools and gender differences in the mathematics results. It is believed that the pattern of girls in private single-sex schools having better results than boys in private single-sex schools is related to the practice in girls' single-sex school (both government and private-owned) of sitting some students for the Basic proficiency of the mathematics examinations, a practice which does not occur in any of the boys' single-sex schools[4]. (The possible implications of this practice on the relationship students then form with mathematics – their mathematics identities – will be discussed in Subsection 6.3-2). The results given above are for the General proficiency of the examinations only. In the private girls' single-sex school the number of students sat for the Basic

[4] The boys' private single-sex school does sit fourth form students for this Basic proficiency level of the examinations as a sort of practice for the General proficiency which they then sit one year later.

proficiency has over the period 2000-2006 tended to be about one-half of the students sitting the examinations; the girls' results would most likely be more similar to that of the boys if more of them sat the higher tier – General proficiency – of the examinations. This is in fact the effect occurring in the government single-sex schools, where, for the period 2000-2006 shown in Figure 4.2-4(b) proportionately more girls have sat the General proficiency of the examinations (40%, 68%, 87% and 98% respectively of the cohort sitting the General proficiency of the examinations), thus decreasing the difference between their results and those of the boys.

Regarding the comparison of mathematics results to those in English Language and across other subject areas the following points are notable:

- *between* school-types, that is single-sex versus mixed schools, there are differences in these outcomes for mathematics, English, and across all subjects with single-sex schools enjoying greater success in all these areas, but the differences related to mathematics are more marked;
- *within* school-types, whilst the outcomes for mathematics, English and all subjects are relatively similar for single-sex schools, there are marked differences between those for mathematics compared to English and all subjects for the mixed schools;
- the relative consistency of these two points given for the given years.

From the comparison that the single-sex/mixed break-down provides it is seen that with regard to Figure 4.2-4(c), what had emerged as an overall marked difference in mathematics outcomes compared to that in English Language and across all subject areas (e.g. as in Figure 4.2-2) is only 'true' for mixed schools. In particular, it seems from these outcome data that whatever the problem might be regarding student *outcomes* in mathematics, its validity as a 'problem' is more widespread in mixed than in single-sex schools. Further, it is mathematics that makes more visible the idea that there might be a 'problem'.

Data from the 2004 and 2006 mathematics results also showed an interesting gender pattern in the (re-) taking of mathematics by persons outside of schools. These are most likely to be adults perhaps finding that they need mathematics in order to advance in ways they want to. In 2004, whilst 640 students – 246 males and 394 females – from the main secondary schools sat the General proficiency of the mathematics examinations, 827 persons in A&B – 303 males and 524 females – actually sat these examinations. This puts the male:female ratio of out-of-school persons writing mathematics at 1:2.3 (187 out-of-school persons, 57 males and 130 females), markedly higher than the in-school ratio of 1:1.6. Similar data for 2006 showed that 797 students – 311 males and 486 females – in the main secondary schools wrote the General proficiency of the mathematics examinations, whilst a total of

1054 persons in A&B – 366 males and 688 females – actually wrote the examinations. The male:female ratio of out-of-school persons for that year was then 1:3.7, whereas the in-school ratio was 1:1.9. Thus, for these two years, out-of-school females in much greater proportion to their male counterparts are taking, and also quite likely re-taking the General proficiency of the mathematics examinations. It may well be the case that these females are finding themselves in the position of having to take this examination in order to fulfil career aspirations or advancement. Although this is speculative, it does seem to strengthen the argument of women in the Caribbean needing education, including mathematics, more than men. In both these years the overall out-of-school and in-school pass rates for mathematics were similar, being 33% and 34% respectively in 2004, and 32% and 36% respectively in 2006.

Chapter 5

Findings: Setting the Context for the Study's Student Sample

5. FINDINGS: SETTING THE CONTEXT FOR THE STUDY'S STUDENT SAMPLE

This chapter outlines findings which serve as background information on the study's student sample. The background data to be presented concerns details of the 'education history' and also home social conditions of the students, which is followed by data on what a sub-sample of their parents/guardians and teachers had to say about their mathematics. The findings come mainly from questionnaire data from the students, parents and teachers. These findings are presented in two main sections. The background information is presented in order to give the reader a context through which the responses and other findings from the student sample to be presented in Chapter 6 can be viewed. As such, the present chapter perhaps indirectly, begins the process of addressing mainly the RA and RQ having to do with how it is students have come to form the view of mathematics that they report, i.e. RA(a)&(b) and RQ1(a)&3.

5.1 THE STUDENT SAMPLE – BACKGROUND DETAILS

The following outlines some background information on the student sample. The information comes from data which students provided in the questionnaire. Table 5.1-1(a) outlines general background information for the whole sample, broken down by school-type and student sex.

Table 5.1-1(a): Student Background Data

Background	Variable	Male (117)	Female (169)	Mixed (177)	Single-sex (109)	Total (286)
Primary school-type (267)	Government Private	53% 47%	64% 36%	74% 26%	35% 65%	56% 38%
		NS		χ^2=38.244, df=1, p<0.001, phi=0.378		
Year entry secondary school (273)	2001 2000 1999	35% 34% 19%	56% 30% 6%	41% 32% 14%	59% 32% 5%	48% 32% 11%
		Only three most frequent years shown here. Chi-square statistics not calculated as cell counts for other years are low.				
Adult at home (283)	2-parent Mother only Other	55% 42% 3%	48% 42% 10%	41% 49% 10%	66% 30% 4%	50% 42% 8%
		NS		χ^2=16.317, df=2, p<0.001, Cramer's V=0.240		
Parent occupational level (224)	WC IC MC	40% 36% 24%	49% 40% 11%	63% 33% 4%	21% 47% 32%	35% 30% 12%
		χ^2=6.689, df=2, p=0.035, Cramer's V=0.173		χ^2=50.628, df=2, p<0.001, Cramer's V=0.475		
Parent education level (149, only 52% of sample)	≤Primary Secondary Tertiary	10% 47% 33%	21% 44% 46%	26% 52% 22%	5% 36% 59%	17% 46% 37%
		NS		χ^2=25.039, df=2, p<0.001, Cramer's V=0.410		

Key: WC = working class; IC = intermediate class; MC = middles class; Number of students in brackets

In addition to this background information, 48% of the students in the sample had chosen subject areas concentrated in the Business areas (at least two of e.g. POA (Principles of Accounts), POB (Principles of Business), OP (Office Procedures), IT (Information Technology)), followed by 44% in the Humanities (at least two of e.g. Literature, History, Spanish, French, etc.), and 36% in the Sciences (at least two of e.g. Biology, Chemistry, Physics, AG (Agricultural Science), IS (Integrated Science), etc.). However, there were gender differences here, with the highest proportion of boys in Science areas (48%), whilst the highest proportion of girls was in Business areas (57%). Between school-types, the highest proportion of students in single-sex schools was in the Humanities (62%), whilst in mixed schools the highest proportion of students was in Business areas (45%). From proportions, there was a higher proportion of students in mixed schools than in single-sex schools in Sciences (41% to 36%), but the science subjects of students in mixed schools tended to be a combination of AG and IS, whilst those in single-sex schools were the single sciences of Chemistry, Physics, and Biology. The reason for this is undoubtedly due in part to the difference in curriculum offered in these schools, as whilst students in mixed schools can do the single sciences as well as AG and IS, AG in particular is not offered in the single-sex schools. Another point of interest had to do with the Domestic Science subjects done by girls between these school-types. Girls in single-sex schools tended to do one of these subject-types (e.g. Food & Nutrition, Home Management, Clothing & Textiles, etc.), and so only 1% of these girls had subject choices which could be categorised in this group (i.e. had selected more than one subject in this group), whereas 22% of girls in the mixed schools had chosen at least two subjects from this group.

The results of the CEE suggested that there would be a higher proportion of boys in secondary schools who had come from a private primary school than for girls. The corresponding statistic from the student sample for this study supports this, although the difference is not statistically significant. Table 5.1-1(a) does show a relatively consistent pattern of proportionately more boys in the sample coming from what might be considered as more advantaged backgrounds than girls, except perhaps for the statistic on parent educational level. The sample only picked up 20 students (7% of sample) who reported that they entered secondary school as a post-primary student. With regard to school-type, in addition to the statistically significant chi-square results here, the measures of strengths of association also show most of these differences to range between medium and high. That is, in the context of this study (and given the results and discussion of Chapter 4), these are potentially substantive differences between the students in these two school-types.

Table 5.1-1(b) following further breaks down the single-sex school grouping into government single-sex and private single-sex in order to provide a comparison of these same student background details in terms of the percentages. This exercise was done specifically to compare as a group the students of the government single-sex school to students in the government mixed schools and those in the private single-sex schools. It was thought that this would provide a sense of which of these two other student groups the government single-sex students were most similar to in terms of their background details.

Table 5.1-1(b): **Student Background Data – Comparison of Student Proportions**

Background	Variable	GovMi (177)	GovSi (67)	PrivSi (42)
Primary school-type (267)	Government Private	74% 26%	50% 50%	11% 89%
Parent at home (283)	2-parent Mother only Other	41% 49% 10%	62% 33% 5%	71% 24% 4%
Parent occupation level (224)	WC IC MC	63% 33% 4%	26% 56% 18%	13% 34% 53%
Parent education level (149)	≤Primary Secondary Tertiary (Don't know)	26% 52% 22% (89)	8% 40% 53% (21)	0% 29% 71% (27)

Key: GovMi = government mixed; GovSi = government single-sex; PrivSi = private single-sex; Numbers of students in brackets

From Table 5.1-1(b), on an overall basis, except for year of entry to secondary school, the government single-sex school students as a group appear to occupy a space between the other two student groups. However, this is not a half-way between space as differences generally (except for primary school-type) place this student group closer to the group of students in private single-sex schools than to those in mixed schools. Similar data for past student groups were not available, nor is it known how these results for the present student sample extrapolate to the existing student population, but, given the context at secondary school set out in Section 3.3-1, it is believed to be not too dissimilar.

Caribbean familial structures have long been recognised as not fitting the norm of that of Western nuclear families (e.g. see in Barrow, 1999, p152). Indeed, Caribbean society has been described as matrifocal (e.g. see in Mullings, 2005, p6), this based in part on the relatively large proportion of households headed by women (Mullings gives as example 2000 statistics for Jamaica which puts this proportion at 46%). Miller (1991, p69) cited from Messiah's analysis of the 1970 census for the Commonwealth Caribbean which noted that even in households where there was a 2-parent structure, one-half of these were headed by the woman based on the person identified as being responsible for conducting its (economic) affairs. In a student attitude survey carried out in the Organization of Eastern Caribbean States (OECS) territories in the late 1990s, a random sample of 462 secondary students from A&B schools showed that 42% of them came from 2-parent households and 41% came from Mother-only households (Hinds, Richardson, Ernest, Kishchuk & Sproule, 1999, piii). In that survey, and also for this study, students were not asked about the marital status of parents as it is also not uncommon for 2-parent households to be made up of 'common law' unions. However, within these societies there has also been a recognised link between Mother-only households and social status and economic wellbeing, i.e. that this often signalled lower class and was an indicator of poverty (e.g. Louat et.al., cited in Mullings, 2005, p6; Barrow, 1999, p152).

In relation to Table 5.1-1, parental occupational level was used as an indicator of class status using the information students provided on the occupation of the adult(s) with whom they lived. Where a student came from a 2-parent home and both parents worked, the level which gave the highest occupational level was taken (this strategy was also utilised for parent educational level). A guide for categorising occupations to a socioeconomic level (i.e. class) came from that given in Cooper & Dunne (1998, p142-143), with some consideration of Caribbean/A&B contexts. Occupations categorised as working class included for example cooks, cashiers, farmers, construction workers, mechanics; those categorised as intermediate class included nurses, teachers, police, other civil servants, secretaries, bank clerks, etc.; those categorised as middle class included doctors, lawyers, engineers, persons in management positions, senior civil servants, e.g. principals, etc.

Information on parental educational level was included in the questionnaire to act as an additional indicator of the socioeconomic status of students. However there was a large proportion of students who responded either that they did not know what their parents' educational level was, or did not respond at all to the question (80 and 57 students respectively, or 48% in total of the sample). The information is included in the table as where it is available it does again show a highly significant statistical difference between the students in the two school-types, but any further in-depth interpretation of this datum should bear this proviso in mind. In total, there were only 128 students (44% of the sample) who provided information on both parent/guardian occupation and educational level. A cross-tabulation of these results does show an association between the occupational level and educational level of the parent/guardian.

Table 5.1-2: Association between Parents' Education and Occupation – Number of Students

Educational level	**Occupational level**			Total
	MC	**IC**	**WC**	
≤primary	0	2	19	21
secondary	6	19	29	54
tertiary	15	31	7	53
	21	52	55	128

Key: MC = middle class; IC = Intermediate class; WC = working class. Table constructed from those students who provided the information.

Again, that students do not know the educational level reached by their parents is not necessarily unusual in this context; in the Hinds et al (1999, piii) student attitude survey students were asked for their Mother's educational level, and the authors reported that in the nine territories[5] surveyed 25-50% of the students did not know what this was. Thus, whilst parental educational level has been used in other studies as an indicator of socioeconomic status, in this study due to the proportionately large amount of missing data a social class grouping was made solely on the basis of parental occupational level.

The entry year to secondary school in the context (Table 5.1-1(a)) was used to serve as an indicator of repetition rates for the present student sample. At the time of data collection, if a student had not repeated any previous classes, then he/she should have given entry year as 2001. The data from the student sample show that approximately as many of them had repeated as had not repeated a class, and in particular that this was more prevalent amongst students in mixed schools and also amongst boys. The background data on this student sample then does appear to support Miller's claim given earlier (Section 1.3, p5) concerning repetition rates, but also more specifically highlights a social class bias of which students repeat classes in Caribbean schools.

5.2 Parents and Teachers

This section sets out the findings from questionnaires administered to parents/guardians and teachers and also from interviews held with teachers about students and mathematics. Although the parent and teacher questionnaires included questions about the parent or teacher's own school experience of mathematics, the findings presented here will be confined mainly to their comments/responses concerning their view of their children/students' school mathematics experience/performance. Parents and teachers it was felt also formed part of the environment in which students' mathematics learning took place. There are two subsections to follow, one each for parents and teachers. These subsections both start with background information as provided by the parents and teachers, and this is followed by data on their views of their child's or students' mathematics performance, and a brief discussion of these. The findings to be presented potentially could provide insights for how it is students may have come to have the mathematics views they express, (classroom) approaches they demonstrate and performance they ultimately attain i.e. the subsections which follow potentially address RA(a)&(b) and RQ1&3.

[5] The survey was conducted of what is known as the Eastern Caribbean countries, which are the smaller of the English-speaking Caribbean countries. These include Anguilla, A&B, BVI, Dominica, Grenada, Montserrat, St.Kitts-Nevis, St. Lucia, St. Vincent & the Grenadines.

5.2-1 Parents

The student sample which returned completed parent questionnaires consisted of 18 males and 32 females (36%:64%), which reflects a sub-sample containing proportionately more girls than that in the population from which it was drawn (41%:59%). There were 30 students from mixed schools and 20 from single-sex schools (67%:33%, whole sample 62%:38%). The 50 parent questionnaires completed and returned represents 17% of the student sample. Questionnaires were completed by eight fathers, 36 mothers and five other relatives/guardian (one respondent did not complete this section). In total, nine males and 40 females completed parent questionnaires. On average, parents/guardians who responded for a child in a single-sex school were older than those who responded for a child in a mixed school (12/19 or 63% of respondents for a child in a single-sex school were in the age range 40-49 years; 13/29 or 45% of respondents for a child in a mixed school were in this age range, but also notably, 12/29 or 41% were between 30-39 years).

The questionnaire administered to parents sought mainly to elicit their views of their child's school mathematics. Parents were thus asked some questions in the parent questionnaire that were similar to those asked of their child in the student questionnaire. One such question, *Do you like maths?* was asked in order to ascertain the degree of correlation between the parent's response to this question, and that of the child. Fifty-eight percent of the parent sample responded *Yes* to *Do you like maths?* with 89% of the males (i.e. eight males) and 50% of the females saying so, a gender difference which was statistically significant (χ^2=4.464, df=1, p=0.035). For the corresponding student sub-sample, 57% had responded *Yes* to *Do you like maths?*, with 71% of the males and 50% of the females saying so, a gender difference which was not statistically significant. However when the students' responses were compared to that of their parent/guardian there was not a significant correlation; 21 students (matched pairs, almost ½ the sample-size) had given the opposite response to that of their parent/guardian.

Parents were asked to rate their child's mathematics performance, a question which the students had also been asked (of themselves) in the student questionnaire. Chi-square tests showed a statistically significant difference between overall parent ratings and that of the child (χ^2=16.347, df=4, p=0.003, collapsed table with Very Good and Good collapsed, Unsatisfactory and Poor collapsed), usually with parents' ratings being somewhat less positive than that given by the child. Table 5.21-1(a) outlines the comparison of the parent and child's rating between the larger sub-groups of the child's gender and school-type, whilst Table 5.21-1(b) looks at the cross comparisons within these sub-groups, and also includes the actual CXC/CSEC mathematics outcome for this sub-sample of students.

Table 5.21-1(a) Comparison of Parents' and Children's Ratings of the Child's Mathematics Performance

Rating	Cf	Male/18	Female/32	Mixed/30	Single-sex/20	Total/50
VG+G	Parent Student	7 (39%) 13 (72%)	9 (28%) 11 (34%)	9 (30%) 15 (50%)	7 (35%) 9 (45%)	16 (32%) 24 (48%)
Sat	Parent Student	7 (39%) 5 (28%)	7 (22%) 9 (28%)	5 (17%) 6 (30%)	9 (45%) 8 (40%)	14 (28%) 14 (28%)
UnSat+P	Parent Student	4 (22%) 0 (0%)	16 (50%) 12 (38%)	16 (53%) 9 (20%)	4 (20%) 3 (15%)	20 (40%) 12 (24%)
Chi-square tests	Parent Student	χ^2=3.830, df=2, p=0.147 χ^2=10.188, df=2, p=0.006, Cramer's V=0.451		χ^2=6.868, df=2, p=0.032, Cramer's V=0.371 χ^2=2.902, df=2, p=0.234		

Key: VG = Very Good, G = Good, Sat = Satisfactory, UnSat = Unsatisfactory, P = Poor. Number of respondents shown; percentages are given as a proportion of the group responding

Table 5.21-1(b): Comparison within the Sub-groups of Parents' and Children's Ratings, along with Actual CXC/CSEC Outcome

Rating	Cf.	Mixed		Single-sex	
		Male/8	Female/22	Male (10)	Female/10
VG+G	Parent	3	6	4	3
	Student	6	9	7	2
Sat	Parent	2	3	5	4
	Student	2	4	3	5
UnSat+P	Parent	3	13	1	3
	Student	0	9	0	3
CXC passed		2/7	6/18	7/9	6/9

From Table 5.21-1(a), as their children had done (see also Table 6.13-3(a), Subsection 6.1-3, overall proportionately more of the parents of sons gave them a better mathematics performance rating than had the parents of daughters (e.g. 4/18 or 22% of parents of sons rated the mathematics performance of their sons as Unsatisfactory or Poor, whereas 16/32 or 50% of parents of daughters had done so), although the difference was not significant. Specifically, on the un-collapsed table, 3/4 parents had rated their son's performance as Very Good, whilst at the other end of the scale 3/4 parents had rated their daughter's performance as Poor. Parents whose child was in a single-sex school gave their child an overall better performance rating than did parents whose child was in a mixed school. The pattern of expectations of a gendered mathematics performance is maintained within school-type, with parents' mean rating of their sons' mathematics performance being better than that of their daughters within both mixed and single-sex schools (e.g. from Table 5.21-1(b) in mixed schools, 3/8 (38%) of parents rated their son's performance as Unsatisfactory or Poor, whereas 13/22 (59%) had done so for their daughters; in single-sex schools, 1/10 (10%) parent had done so for his/her son. whereas 3/10 (30%) of parents had done so for their daughters). Overall, the rating parents gave to their child's mathematics performance was a better predictor of the child's eventual success in the CXC CSEC mathematics than was the child's own rating of his/her performance.

Parents were also asked to attribute a reason for the mathematics performance rating they gave their child (open item). Forty-three parents gave 50 individually coded reasons, the most frequent of which was a negative attribution directed at the child her/himself, coded as a lack of effort on the child's part, this response given by 15 parents. The attribution was given in relation to 4/16 boys and 11/27 girls. The following are examples of responses from parents in this regard:

> *He does not apply himself (9M, Mi3*[6]*, Mother responding; Mother's rating Unsatisfactory; Son's rating Very Good)*
>
> *Not studying hard enough. (22F, Si1, Mother responding; Mother's rating Unsatisfactory, Daughter's rating Satisfactory)*

Further to this finding, it appeared to be the case that parents were more prepared to attribute the mathematics performance of daughters in terms of a lack of something or something the child did not do than they were for sons. As example, additional to that given above, five parents attributed their daughters' performance to a lack of understanding, lack of confidence and not listening, whilst these reasons were not given for sons. Conversely, six parents attributed their sons' performance to their understanding, their 'natural' ability/intelligence, their listening and their liking for mathematics, whilst these reasons were given in relation to two girls, one each for liking mathematics and for listening. Two of the four parents who had rated their child's mathematics performance as *Very Good*, had been the ones to attribute the performance to their child, in these cases both sons, to 'natural' ability/intelligence. The one parent who had given a daughter a Very Good mathematics rating had attributed this to *'her mother's lectures'*. Other attributions given by parents included ones having to do with the goals/career plans of their son/daughter, given by eight persons, and also attributions related to the teacher or teaching methods, also given by eight persons, with four each giving positive and negative reasons.

Despite parents' reported perception of their child's mathematics performance, most parents (47/49 responding) responded *Yes* to whether they expected their child to pass their CXC mathematics, with one parent responding *No* and another responding Maybe (this category had not been provided on the questionnaire). Table 5.21-2 outlines the reasons (with frequencies) parents gave for their expectation of their child's CXC mathematics performance for those who responded to that question. Once again here the sub-groups of gender and school-type are given in reference to the child.

[6] This tag is an identifying label. In these excerpts of responses from the parent questionnaire, the identifying label used has been described in terms of the child/student. In this label, the first tag refers to an assigned sequence number for the student followed by whether the student was male or female; the second tag refers to the student's school. As example, in the excerpt just given, 9M refers to the 9th student who in this case was male; this student was in mixed school 3.

Table 5.21-2: Parents' Reasons for Expectations of Child's CXC Mathematics Success

Reasons	Male/16	Female/28	Mixed/25	Single-sex/19	Total/44
Cap/ability	8	10	7	11	18
Goals/career	4	9	10	3	13
With extra help/classes	1	6	7	0	7
With effort	2	3	0	5	5
Teacher+	1	1	0	2	2
Other	1	2	3	0	3

As in attributing reasons for their child's mathematics performance, there was a 'gendering' of parents' reasons for expectations of their child's success. Of the parents who responded who had sons, 8/16 or 50% identified their sons as having the ability, capability or potential to do so (cap/ability in Table 5.21-2), whilst 10/28 or 36% of parents who had daughters had done so. A notable finding here is that of markedly more parents seeing the mathematics success of daughters as being dependent on them having extra help than do so for their sons. There was also evidence of some reasons given here being skewed depending on which school-type the child was in.

Parents were asked to give the most frequent comment about mathematics they heard from their child. The most frequent responses were associated with the child saying that he/she did not understand (given by 14 parents in reference to two sons and 12 daughters), that mathematics was difficult/hard (given by 13 parents from four sons and nine daughters), and also comments connected to the teacher all of which were negative, usually that the teacher did not explain properly (given by nine parents from four sons and five daughters). One parent alluded as did some students (see later in Subsection 6.1-4) that teachers were *making the mathematics difficult*, saying: *'The comment my child expressed about maths is the way the teacher, who is teaching sometime maybe (sic) it difficult to understand' (7M, Mi6, Mother responding).* Related to this item, parents were asked what comment about mathematics they usually gave to their child. The most frequent response had to do with a form of encouragement, for example that the child should try/try to understand (given by 24 parents). This was followed by comments associated with the importance of mathematics usually for a future benefit connected to possible career paths (16 parents), and then other less frequent responses, to include promises of sending the child to extra lessons, that the child should ask in class when he/she did not understand. that the child needed to listen/pay attention in class and that mathematics was not difficult.

Although the sample size of parents is small, and the gender break-down of the students for the responding parents is skewed, there is some evidence of a gendered attribution of parents of their child's mathematics performance that is similar to that reported in the literature. For example, Räty, Vänskä, Kasanen & Kärkkäinen (2002) in their review of the literature noted that parents were more likely to attribute the 'good' mathematics performance of sons to a 'natural talent' (p122), whilst the 'good' performance of daughters was more likely to be attributed to effort. Their own research in a Finnish context with seven-year old children had yielded similar findings, and they do go on to make the point that natural talent as a reason for success was more highly valued than was effort, as effort was associated with 'diligence' and 'conformity' (p127). The findings of this aspect of the study does suggest that regarding mathematics performance parents have higher expectations of sons than of daughters, and also of children in a single-sex school than of those in a mixed school. For the participating parent sample, the findings related to 'gendered' expectations are also 'true' within the school-types.

5.2-2 Teachers

As noted in Subsection 3.3-3, 27 teachers (16 males and 11 females, i.e. 59% of sample is male) completed the mathematics teacher questionnaire. Of these, 17 teachers (63% of teacher sample) were in mixed schools and 10 teachers (37% of teacher sample) were in single-sex schools. This distribution of respondent teachers between the school-types reflects well the distribution of sample students between these same school-types (from Subsection 3.3-2 this was 62% and 38% respectively). However, it is notable that the gender distribution of mathematics teachers does not represent the gender distribution of the student sample, nor does it represent the gender distribution of teachers in secondary schools. MoE documents for A&B for the academic year 2003-04 reported the overall male-female distribution of teachers in 10 of the 11 government secondary schools as 105:236 (personal communication), i.e. 30% of secondary teachers were male, so that the gender distribution of mathematics teachers who participated in the teacher questionnaire in this study is not the norm for teachers in secondary schools in general in A&B. It is believed though that the gender make up of the study's teacher sample does reflect the gender make up of the mathematics teachers in the secondary schools. Questionnaires were returned from at least two teachers in all the schools in the sample, with five schools returning three questionnaires. In some schools the number of questionnaires returned represented all the mathematics teaching staff the school had, and in some other schools, only one or two mathematics teachers had not been given questionnaires to complete. So whilst the make up of the secondary school student population is disproportionately female, (e.g. statistics given in Subsection 3.3-2 for the 2003-04 academic year for the nine government secondary schools puts this at 2008:2664, or 43% male), the staff make up in mathematics is in favour of males.

On a wider Caribbean basis, Parry (2004) has noted the under-representation of male teachers in the teaching profession in the Caribbean, citing that this has been proffered by some as a reason, i.e. the lack of male role models in schools, for reported male underachievement. In Parry's study (2004) which came from data collected in 1994-1995, she interviewed a sample of 82 subject teachers (mainly English Language, Biology and Physics) from 17 secondary schools across Jamaica, Barbados, and St. Vincent & the Grenadines. The highest concentration of male teachers was in Physics, with 15/20 of the Physics teachers who participated in the study being male.

In the present study, although the numbers are small, in terms of background statistics, the only significant difference between mathematics teachers in the two school-types related to the age of the teachers, with teachers in mixed schools being on average younger than teachers in single-sex schools. However, on all other aspects related to qualifications there was not a significant difference between teachers in the two school-types. That said, there were differences and a pattern to these. On average, teachers in single-sex schools had been in teaching and had taught mathematics for a longer period than had teachers in mixed schools. With respect to teaching mathematics, seven teachers in single-sex schools had been doing so for 11-20 or over 20 years (five and two teachers respectively) whilst in mixed schools eight teachers (seven and one respectively) had done so. Seven teachers in single-sex schools had been teacher trained, whilst eleven of the teachers in mixed schools had been. Twenty of the respondent teachers were teaching at the mid to upper end (i.e. Forms 3-5) of the secondary schools (from Subsection 3.3-3, the sample of teachers who responded to questionnaires was the choice of the mathematics HOD). Twenty-four teachers responded to the item requesting a description of a mathematics workshop they had attended in the previous three years, with 13/24 saying that they had not attended any such workshop. Table 5.22-1 provides additional information on the sample teachers' qualifications for overall educational level completed and also their last completed level of mathematics.

Table 5.22-1: Educational Level of Mathematics Teacher Sample

Education level/ School-type	**Last completed stage of education**		**Last completed stage of mathematics**	
	Mixed /17	**Single-sex /10**	**Mixed /16**	**Single-sex /7**
University	9	8	4	4
Teacher training	3	1	4	1
A' level	5	1	6	1
Secondary	0	0	2	1

The findings to be presented here will be focused on teachers' perceptions of students' mathematics performance. On the questionnaire teachers were asked directly to state which group of students in their experience performed better in maths, boys or girls. This was followed by the open question *In your experience, what characteristics or patterns of behaviour have you noticed in the ways in which boys and girls go about doing maths in the classroom?* Teachers' responses to this open question followed on from their responses to the previous closed question. Thirteen teachers identified boys, eight teachers gave responses of neither group or that they had only ever taught boys/girls, whilst six teachers identified girls. One-half of the teachers who identified girls as performing better than boys came from one school, a mixed government school (Mi1) in a rural area of A&B, and these three teachers represented the full teacher sample from that school. Compared to each other, a greater proportion of male teachers identified girls as performing better at mathematics, and a greater proportion of female teachers identified boys as performing better. Table 5.22-2 shows the break-down of responses to the closed question.

Table 5.22-2 Mathematics Teachers' Perceptions - Who performs better at Mathematics?

Students' sex / Teachers' sex	Boys	Girls	Neither/ Don't know
Female/11	6 (55%)	2 (18%)	3 (27%)
Male/16	7 (44%)	4 (25%)	5 (31%)
Total/27	13 (48%)	6 (22%)	8 (30%)

Percentages are given as a proportion of the number of teachers of that sex

Not all teachers replied to the related open question, but the following are the responses given by those who did:

Those identifying boys:

Questionnaire Excerpts 5.22-1

boys tend to be independent, working on their own, girls have to be coached, and pampered a little along the way (M, Mi6[7])

girls choose longer methods to work the same problem (F, Si1)

boys are more interested and participate more, ask questions. Girls are more passive and easily accepts (sic) things without questioning (M, Si3)

boys tend to try to apply concepts to things familiar to them (F, Mi3)

boys who are proficient are very showy. Boys who have no idea of what to do are noisy and distracting. Girls are quiet workers when they know what to do and the others noisy or put heads on desks (F, Mi7)

boys try before they say that they don't understand (F, Mi5)

girls are more particular… (state steps) (M, Mi5)

girls tend to be stressed and they give up when problems seem too difficult (M, Si2)

boys most of them, usually seem to try to work in a group while girls although few work in groups, mainly work on their own and are the ones who usually ask for assistance (F, Mi2)

girls in secondary school are generally more diligent, but don't seem to go beyond secondary level in maths (M, Mi2)

Those identifying girls:

Questionnaire Excerpts 5.22-2

girls are more disciplined with their practice. Boys depend more on natural ability (M, Mi4)

girls perform better, in the Caribbean, goals and purpose are missing – Every subject in school suffers – Girls are better at human relationships – this allows them to do better period. (M, Mi7)

[7] The identifying labels here are given in terms of the teacher, with the sex of the teacher given followed by the school in which the teacher worked.

girls are more thorough while boys are less thorough (F, Mi1)
girls (without a doubt), there is a greater interest amongst girls (M, Mi1)
girls outperform boys in mathematics, the girls are more cooperative and show much greater interest in mathematics sessions; girls are more persistent than boys (M, Mi1)

At a first glance there does not seem to be any particular clear cut pattern in these responses. Something said in favour of one group, is often negated or discounted by another teacher, for example, some teachers consider girls to be more persistent/diligent in their work, whilst others consider girls as giving up before beginning, or giving up more easily. Alternatively, what may be seen as persistence or diligence, i.e. thoroughness, by one teacher, is seen as choosing the long way around (long methods) by another. One teacher sees boys as more interested in mathematics, whilst two teachers stated this of girls. One teacher sees girls as being more cooperative, another suggests that boys are more so. Arguably, it could be in this case that teachers interpreted the question in different ways, and on the matter of cooperation, a valid question is with whom are students cooperating. Classroom observations and some student interview data do suggest that girls were more cooperative with teachers than were boys, that is, they were more likely to behave in ways that would best suit the expected conduct of most of the classroom mathematics teaching observed, e.g. taking notes, appearing to be attentive to the teacher, but that boys were more cooperative about working with each other or nearby classmates than were girls.

Upon a more in-depth look there do seem some areas of commonality of how some teachers see both groups of students. Girls are seen as diligent/persistent, but generally more passive and accepting of classroom norms, and needing more encouragement in doing work, although this last does not seem to fit the diligent/persistent profile. One teacher actually used the word 'pampered', suggesting that girls needed to be 'babied' more, that is, be told exactly what to do at each stage. This is somewhat supported by the teacher who said that girls are 'more particular' i.e. they wanted to know what each step was in working problems. Although this could be interpreted in different ways, e.g. they only desired to know the rote of what they were doing, or alternatively that they wanted to know the whys of each step of a given procedure, the teacher who gave this response seemed to see it as a disadvantage to how girls approached learning mathematics as he identified boys as performing better than girls. Because girls are less inclined to work in groups, they appeared to some teachers to compensate for this by being more prone to asking them (teachers) for assistance. Although the first teacher's statement in Questionnaire Excerpt 5.22-1 was given as boys working 'on their own' the teacher does not specify whether this was with others (as may be the case, as this often was the way boys were observed to work during classrooms observations), but what seems to be a finding here is for teachers to see as 'weaker' students who (continually) asked them (teachers) for assistance. As parents had done, a majority of these teachers had higher expectations of the mathematics performance of boys than of girls.

There are some corollaries here in these teachers' views to what has been written in the academic literature about gender differences in approaches to learning mathematics. One such is that given by Rodgers (1990). Reporting from a study set in Northern Ireland which investigated reasons why females had continued on to study A-level mathematics, Rogers had this to say about findings associated with the likes and dislikes of students:

> girls preferred … more straightforward types of problems where they could follow recognized procedures and had most difficulty where the initial formulation of the problem was not so obvious to them. Boys preferred problems in which they encountered variety and which they found easy to visualize and disliked what they considered to be boring and repetitious. (p33)

Rodgers noted that these findings supported those reported in the literature having to do with early experiences of learning mathematics. She reported the literature as saying that primary experiences in mathematics classrooms 'predispose[d]' (compare with the way this word was used in the literature review of Section 2.2 in relation to embodied cultural capital or habitus) girls to develop a step by step procedural style of learning which then did not serve then well in learning mathematics at more advanced levels including secondary school. Rodgers quoted from a teacher interviewed in her study who said 'I think girls tend to be more at home with a routine. They like to learn a trick and go off and do tricks like that with other problems.' (ibid, p33).

So it was that girls have been constructed by the mathematics teachers in the study as being 'compliant' (see also Jones & Myhill, 2004, p547 and their use of this term), and perhaps they are. But this might be as much of a taught (and hence learned) behaviour for some girls rather than an inherent characteristic (e.g. Boaler, 2000). The observed classroom behaviour during mathematics of some girls was mediated by what they perceived to be the 'right way' of behaving in such classes, doing what they thought was expected of them (e.g. see Interview Excerpt 6.16-4, Subsection 6.1-4). Boys, on the other hand, whilst not generally constructed by these teachers as 'troublesome' (e.g. as in Jones & Myhill, 2004), the profile given by some teachers does suggest that their behaviour was at times less than 'ideal'. But boys were not doing anything out of the ordinary as, as will be outlined and discussed in Subsection 6.2-2 and Section 6.3, the behaviour of *both* girls and boys largely followed lines of expectations. However, it may be that it is some of these 'less than ideal' characteristics that have allowed boys to do better (in terms of performance) in mathematics (ref. Section 4.2). In fact, it is characteristics that would otherwise make girls the 'ideal student'. e.g. working on their own as is generally expected in these classrooms, that seem to be what works against them in the teaching-learning process for mathematics. It would appear that to some extent, in these mathematics classes, girls might indeed be 'paying the price for sugar and spice' (Boaler, 2002, p127).

As on the parent questionnaire, the teacher questionnaire also contained some similar questions as had been asked on the student questionnaire. One such question was *Do you think every secondary school child can do maths to CXC level?* The direction of teachers' responses was similar to that given by the students themselves, with 14 teachers (52%) saying *Yes* (the way students' responded is outlined in Table 6.11-1 Subsection 6.1-1, and Table 6.32-1 in Subsection 6.3-2; an extended discussion of the students' responses is also given in Subsection 6.3-2). There was not a significant difference given for this response based on the teacher's gender, or what school-type he/she taught in. Also, one of the most frequent reasons given by teachers for their response was similar to that given by students, which, from the teachers who responded *No* (13/27) had to do with a view that a person/student had to be made for mathematics. This reason was given by seven teachers, and included such responses as:

Questionnaire Excerpts 5.22-3
some students were just not made for maths (M, Si4)
some students will never be able (no matter what) to handle mathematics at CXC level because of their interests and 'make up' (F, Mi5)
mathematical abilities are not uniformly distributed throughout the population (M, Mi2)

As well as this reason, five teachers also gave as their reason for responding *No* that mathematics was being poorly taught, some identifying or implying in particular the primary stage of education and/or a poor foundation in the fundamentals, e.g. '*based on the fact that most students do not receive a solid foundation in the concepts or in some cases are taught incorrectly (misconceptions) largely contribute to this*' (M, Mi1). This teacher elaborated as follows on the aspect of the teaching of mathematics in the section on 'other comments': '*mathematics teaching should not be for individuals who "think they can teach it". It should be reserved for individuals who are well knowledgeable in all the concepts of mathematics, individuals who have attained a sound 1st degree in mathematics and computer science and who love mathematics and most importantly are able to impart it*' (his underlining). Thus it was that amongst some mathematics teachers themselves, there was a perception that the subject was not being properly taught by 'other' teachers, with one teacher implicating in particular teachers at the primary *and* lower secondary level. The following finding does in some way lend support to some of what this teacher had to say. As on the student and parent questionnaires, the mathematics teacher questionnaire also included the question *Do you like maths?* For the present study's teacher sample, 26 teachers responded *Yes*, with the teacher who responded *No* being one who was teaching at the lower secondary level. Additionally, during the piloting of the teacher questionnaire. 2/8 mathematics teachers had responded *No* to this question, both of whom were teaching mathematics at the lower secondary level. In other data obtained during the fieldwork phase, I had gained access to information on the mathematics qualifications of that year's (2004-05) intake of trainee primary teachers. These teachers would have already been teaching in primary schools usually for at least two years prior to being selected for teacher training. Of that sample, 9/22 (41%) had passed mathematics at the CXC/CSEC level, and one of these had also passed mathematics at A-levels (personal communication). This in A&B was not an unusual situation. In an interview with a teacher educator at the teacher training college, the educator noted that most of the primary teachers who go through the training do not have a certification/qualification in mathematics. The probable reason why the present study did not pick up more teachers who were in some way disaffected with mathematics may have been due to the fact that most teachers of the sample were teaching at the upper end of the secondary school and therefore potentially more qualified in their knowledge of mathematics content.

For the teachers in the study who did respond *Yes* to *Do you think every secondary school child can do maths to CXC level?* (14/27) one of the more frequent reasons for their response had to do with the aspect relating to its teaching; such reasons were given by four teachers, usually to say that any child could do mathematics to CXC level *if* properly taught, e.g. *'I think that if mathematics is properly taught anybody can learn it'* (M, Si2). The most frequent reason for responding *Yes* though had to do with a view, expressed by seven teachers, that all students were fundamentally able. Some of these teachers further acknowledged that students were different and so would require a variety of teaching methods/approaches in order to learn successfully, and that teachers needed the skills in order to cater to these differences. Thus, in assessing their response to this questionnaire item on secondary school children being able to do mathematics to CXC level, teachers implicated 'the other teacher', but not themselves, in students' deficiencies in learning mathematics.

One other finding from the teacher questionnaire will be outlined here, as it has implications for the learning-teaching process as pertains to what students had to say. The questionnaire included an item where a range of topic areas were given (more or less in line with that given in the CXC/CSEC mathematics syllabus) and teachers asked to choose their favourite and least favourite to teach (No.3 on the teacher questionnaire, see Appendix A3). One of the somewhat surprising findings of responses to this question was that the most frequent topic area chosen by teachers as their favourite to teach was algebra, this chosen by nine teachers. Of these, five teachers had given as reason for algebra being their favourite topic to teach a response coded as the teacher liking that area or that it was easy. Three teachers had identified algebra as their least favourite to teach, with two of these teachers specifically giving a reason related to the student, that students had difficulty understanding algebra. In identifying the areas of mathematics that were their least favourite to teach, teachers did give as their most frequent reason a response that had to do with the students, that students found that area difficult and did not understand the area (this reason given by 10 teachers, the main topic areas identified here being Matrices & Vectors and Trigonometry & Geometry). That said, it is notable however that algebra was a topic identified by a number of students both in questionnaire and interviews as an area of mathematics they did not like, and indeed it was for this reason that the revision of the interview schedule included an algebra item (Subsection 3.3-1). With respect to the difficulty of the subject, in response to a 5-point Likert scale type item, nine teachers indicated some measure of agreement that the subject was difficult (one strongly agreeing, and eight agreeing), but what was instructive was that five teachers disagreed and a further 10 teachers strongly disagreed that mathematics was difficult. This may be an area of concern with regard to the teaching of mathematics. What some teachers enjoyed in teaching, is not enjoyed in learning by students. In particular, some secondary teachers seem to be failing students at the point of being able to see mathematics as difficult on behalf of students.

Chapter 6

Findings and Interpretations: Data from the Student Sample

6. FINDINGS AND INTERPRETATIONS: DATA FROM THE STUDENT SAMPLE

This chapter brings the focus onto the study's students. In presenting the findings it incorporates in the first three sections data from the three main data collection methods that directly involved 'live' students, that is, questionnaires, classroom observations and interviews. The final section (6.4) of this chapter deals specifically with the mathematics CXC/CSEC performance of the students and thus also incorporates documentary data. In doing so it attempts to address RA(c) and RQ1(c). As in Section 5.2, in presenting the findings some degree of selection had to be made given the mass of collected data. However, an attempt has been made to include in Appendix D a more complete set of codes and responses to items, particularly from the student questionnaire, in order to present a more detailed account of what the students had to say. Section 6.1 attempts to address mainly RA(a) and RQ1(a), that is, those having to do with students' views of mathematics. In addressing students' views, some other of the RA and RQ are also addressed, e.g. aspects of RA(b) and RQ1 having to do with what things/factors may have influenced students' mathematics views, how it is students may have come to have the expressed views. Section 6.2 attends specifically to RQ1(b) and RA(c), that is, aspects having to do with students' approaches to doing and learning mathematics. As for their views, addressing students' approaches to doing mathematics also brings in reasons behind why they may be adopting particular ways of doing and learning their mathematics. Whilst Section 6.3 does present some additional findings, it is primarily an attempt to pull together and make sense of some of the findings presented in Sections 6.1 and 6.2. Thus, Section 6.3 is somewhat more discursive than the previous two sections of this chapter. That said, each of the four sections of this chapter do become increasingly discursive as they progress. Section 6.3 specifically addresses RA(b) and RQ3 and begins to address RA(c) and RQ2, i.e. those having to do with (inter)relations between students' mathematics views and approaches.

6.1 STUDENT VIEWS

A useful starting point for addressing the RA and RQ was to establish what views students had about mathematics. This would set the stage for understanding students' thinking in relation to mathematics and offers the possibility for an orientation to the students' perspective (emic view, ref: Chapter 3). Also and importantly, this starting point allows for addressing RA(a) and RQ1(a) outlined in Section 3.1. Much of the sub-sections that follow (and the rest of the chapter) sets out findings in relation to students' views of mathematics and also their views on 'other things' in the environment of their mathematics. In this regard, much of what follows attempts to present findings using the students' voices, what the students actually said, as I think that in many of the cases the students make the point much better than anyone else could. As such it is believed that:

> young people are observant, are often capable of analytic and constructive comment, and usually respond well to the responsibility, seriously entrusted to them, of helping to identify aspects of schooling that get in the way of their learning. (Ruddock, Chaplain & Wallace, cited in Boaler, 2000, p4)

Research on student voice is an area that has been gaining increasing attention in the education literature of countries such as the UK and USA (e.g. Fielding, 2001, p100), though this seems to be much less the case in the educational literature of the Caribbean (re: Section 1.3). This student perspective in matters related to education has long been marginalised (Cruddas, 2001, p63) and/or seen as unimportant in part, it has been posited, due to the otherwise social organising role of education (Cruddas, 2001, p62). When such views have been researched, they have tended to focus on more general aspects of schooling such as extra-curricula activities, and much less so on teaching and learning processes (Fielding, 2001, p101). According to Whitehead & Clough (2004), in the scarce literature which has looked into students' views of the teaching-learning processes, (potential) benefits of the process have been 'signalled' such as greater understanding of the students' views of themselves as learners which could then yield a more informed approach to strategies that could promote students' efforts and achievement, which in turn could lead to improved student motivation. Additionally, asking students questions that require them to think about their own learning has the advantage of helping them to develop their own ideas about how they learn. Also, such research has also signalled the (potential) benefit of getting students to take more responsibility for their learning as, 'education …is no longer something being done to them but something they do' (Cook-Sather, cited in Whitehead & Clough, 2004, p217).

Despite the seeming advantages of including student voice in research on education (e.g. and as also noted by Ruddock et al in Boaler, 2000, given earlier), there are some caveats that should also be considered in such. In this study for example, it is questionable the extent to which students could realistically be expected to respond to some (questionnaire) items due to their limited experience of a variety of teaching and learning methods/ways in mathematics. As an example, the questionnaire item enquiring about what style of teaching allows you to learn mathematics better (see Appendix AI, Section IV item 14) may not have been an entirely 'fair' question for the students as arguably many of them would not know nor could not be expected to know what such teaching or learning styles were. In this vein, Cruddas (2001, p63) warns against an uncritical 'essentialising' of the student experience by 'assuming that they are free to represent their own interests transparently'. Thus, in giving voice to their views, the sample students may have been constrained in the context of this study by such factors as limited experience, loyalty to teachers and/or school, and, during group interviews to the presence of others of their classmates, amongst other factors. These considerations should be kept in mind when reading the findings to be presented.

The subsections that follow present findings from the study, but as they also include interpretations of these findings (etic considerations), the presentation does get progressively discursive. There are seven of these subsections looking at students' views of mathematics which also necessarily interrelates themselves and significant others (e.g. teachers, peers, parents) in their mathematics. The first of these subsections presents an overview of student views from closed questionnaire items. The remaining subsections present students views about mathematics on issues as illustrated by the subsection title. These subsections (except Subsection 6.1-7) begin by looking at student responses to closed and/or open questionnaire items, which is then supported as appropriate with data from student interviews and classroom observations. Subsection 6.1-7 makes use of student interview data.

6.1-1 An Overview

This initial overview presents the statistical results from a number of closed items on the student questionnaire. In this presentation, in addition to an analysis which looks at the student sub-groups of gender and school-type, the analysis will include results of those that looked at the occupational level of the students' parents. Though each individual view might not be given an in-depth analysis in later discussions, this overview is nonetheless relevant as it provides the beginning of a global sense of the students' views. Table 6.11-1 starts with a look at how students responded to dichotomous Yes/No questions.

Table 6.11-1: Student Responses to Yes/No Questions – Proportions responding *Yes*

Question	Male (117)	Female (169)	Mixed (177)	Single-sex (109)	All (286)
Do you like maths? (283)	77% (89)	55% (92)	61% (106)	69% (75)	64% (181)
	χ^2= 15.166, df=1, p<0.001, phi=0.231		ns		
Do you think maths should be compulsory to CXC level? (277)	82% (91)	69% (114)	71% (123)	78% (82)	74% (205)
	χ^2=6.124, df=1, p=0.013, phi=0.149		ns		
If mathematics was NOT compulsory, would you still choose to do it to CXC level? (271)	80% (87)	68% (110)	69% (116)	79% (81)	73% (197)
	χ^2=4.660, df=1, p=0.031, phi=0.131		χ^2=3.719, df=1, p=0.054, phi=0.117		
Do you think every secondary school child can do mathematics to CXC level? (265)	51% (54)	44% (70)	51% (84)	40% (40)	47% (124)
	ns		ns		

Number of respondents in brackets; Proportions are based on number of group responding

Chi-square tests were also carried out to compare the way students of a particular sex responded between the two school-types. Within boys there was not a significant difference in the way boys of either school-type responded to these questions. Within girls, there was only a significant difference to the last of these questions shown here on the way girls of either school-type responded, with 54% of girls in mixed schools responding *Yes* whereas 23% of girls in single-sex schools did so ($\chi^2=13.760$, df=1, $p<0.001$, phi=0.294). More will be said on this point in Section 6.3 to follow. Similar tests on these four items using parental occupational level as the investigating variable did produce a significant difference for the second of these items ($\chi^2=7.682$, df=2, $p=0.021$, Cramer's V=0.188), i.e. whether mathematics should be compulsory to CXC level. Students of MC parents were most inclined to respond *Yes* (31/34, 91%), followed by students of IC parents (61/84, 73%) and then students of WC parents (66/99, 67%).

The first and third of the questions shown in Table 6.11-1 related directly to students' own experience and/or perception of themselves in relation to mathematics, whilst the last question asked students about their perception of other students. This table shows that students' responses to questions which related directly to themselves tended to be positive, with more than 50% of each group responding *Yes*. Despite this tendency to be positive about their perceptions of themselves in relation to mathematics, there is a statistically significant gender difference for three questions (and also for the second question shown here), and whilst students in single-sex schools tended to be more positive about these self-related questions, only the third question in Table 6.11-1 produced a difference which was close to a statistically significant result between school-types. In relation to the last question in Table 6.11-1, it is noteworthy that students' perceptions of the mathematics 'ability' of other students was less positive than the responses they gave for themselves, and also that the 'trend' is reversed between school-types, that is, a higher proportion of students in mixed schools gave a positive response that mathematics was do-able to CXC level.

Table 6.11-2 presents the proportion results of student responses to the Likert-scale items using the subgroups of sex and school-type. Chi-square tests were conducted on each item, and where there was a global significant difference these are given below the respective item. Where no such results are given, there was not a significant difference at the 5% level. Figure 6.11-1 presents a pictorial overview of the collapsed results for these same items (i.e. Strongly Agree and Agree combined, Disagree and Strongly Disagree combined), taking the number of respondents to an item as 100%.

Table 6.11-2: Student Responses to the Likert-scale Items, Gender and School-type

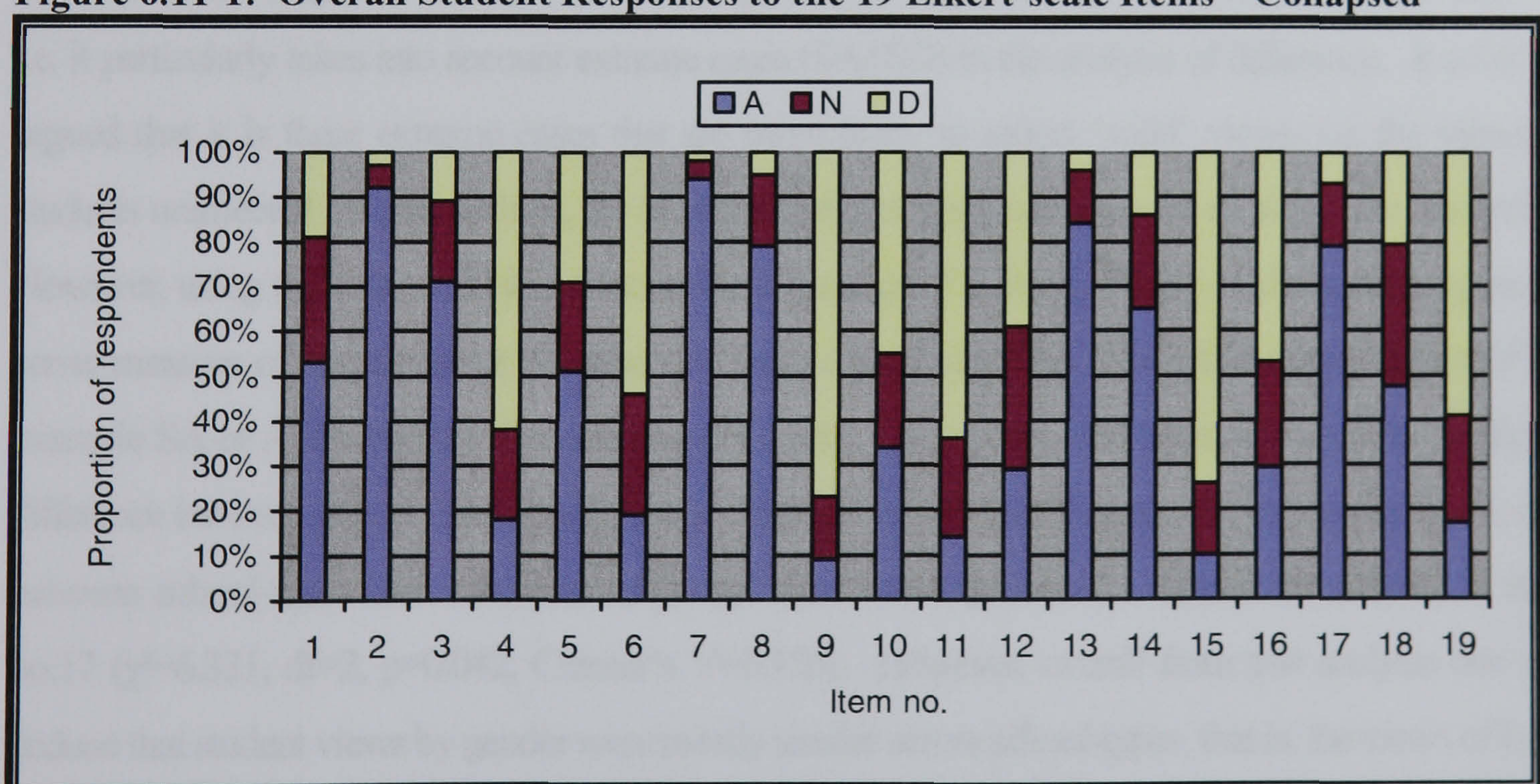
Question		Male (117)	Female (169)	Mixed (177)	Single-sex (109)	All (286)
1. I like maths. (268)	SA	28%	17%	22%	20%	21%
	A	38%	29%	33%	30%	32%
	N	23%	31%	25%	32%	38%
	D	6%	15%	12%	10%	12%
	SD	6%	8%	7%	7%	7%
	Tot	**(104)**	**(164)**	**(169)**	**(99)**	**(268)**
		χ^2=11.868, df=4, p=0.018, Cramer's V=0.210				
2. Maths is useful in everyday life. (269)	SA	69%	69%	68%	70%	69%
	A	22%	24%	24%	22%	23%
	N	6%	4%	4%	6%	5%
	D	1%	2%	2%	1%	2%
	SD	2%	1%	2%	1%	2%
	Tot	**(103)**	**(166)**	**(169)**	**(100)**	**(269)**
3. I use maths I learn in school to solve problems outside of school. (265)	SA	28%	29%	27%	32%	29%
	A	41%	43%	46%	36%	43%
	N	19%	17%	17%	19%	18%
	D	7%	8%	6%	10%	8%
	SD	6%	2%	4%	3%	3%
	Tot	**(102)**	**(163)**	**(167)**	**(98)**	**(265)**
4. It is okay in my country to say 'I don't know maths'. (261)	SA	7%	7%	6%	9%	7%
	A	11%	11%	13%	7%	11%
	N	16%	22%	21%	19%	20%
	D	34%	26%	30%	28%	29%
	SD	31%	33%	30%	37%	32%
	Tot	**(99)**	**(162)**	**(164)**	**(97)**	**(261)**
5. Maths is a difficult subject. (262)	SA	17%	24%	22%	20%	21%
	A	25%	33%	27%	34%	30%
	N	18%	22%	19%	22%	20%
	D	24%	12%	18%	13%	16%
	SD	17%	9%	13%	10%	12%
	Tot	**(101)**	**(161)**	**(164)**	**(98)**	**(262)**
		χ^2=11.728, df=4, p=0.019, Cramer's V=0.212				
6. Being good at maths is passed down from parents. (266)	SA	7%	7%	8%	6%	7%
	A	17%	9%	10%	14%	12%
	N	38%	21%	29%	25%	27%
	D	25%	37%	32%	32%	32%
	SD	13%	27%	21%	22%	21%
	Tot	**(101**	**165)**	**(167)**	**(99)**	**(266)**
		χ^2=19.615, df=4, p=0.001, Cramer's V=0.272				
7. I can do well in maths if I work at it. (265)	SA	66%	71%	71%	66%	69%
	A	28%	22%	21%	29%	24%
	N	3%	6%	5%	4%	5%
	D	1%	1%	1%	0%	1%
	SD	2%	1%	1%	1%	1%
	Tot	**(101)**	**(164)**	**(167)**	**(98)**	**(265)**
8. I usually do maths homework. (266)	SA	33%	47%	44%	37%	41%
	A	41%	36%	35%	42%	38%

	N D SD	23% 3% 1%	12% 3% 2%	17% 2% 2%	15% 4% 1%	16% 3% 2%
	Tot	**(101)**	**(165)**	**(167)**	**(99)**	**(266)**
9. It doesn't really matter if I understand a math problem if I get the right answer. (264)	SA A N D SD	3% 12% 16% 34% 35%	3% 2% 12% 38% 45%	4% 7% 14% 38% 37%	1% 5% 12% 34% 47%	3% 6% 14% 36% 41%
	Tot	**(100)**	**(164)**	**(167)**	**(97)**	**(264)**
		χ^2=11.651, df=4, p=0.020, Cramer's V=0.210				
10. It is impossible for me to do well in maths at CXC without extra out-of-school lessons. (267)	SA A N D SD	13% 20% 21% 30% 17%	20% 15% 22% 25% 19%	20% 17% 19% 26% 18%	12% 16% 25% 27% 19%	17% 17% 21% 27% 18%
	Tot	**(101)**	**(166)**	**(168)**	**(99)**	**(267)**
11. I will still get the job I want even if I don't pass maths at CXC. (264)	SA A N D SD	6% 9% 27% 32% 27%	4% 10% 20% 28% 39%	5% 10% 24% 26% 35%	4% 7% 20% 35% 34%	5% 10% 22% 29% 35%
	Tot	**(101)**	**(163)**	**(166)**	**(98)**	**(264)**
12. I do not need to think about the work when doing maths, I just have to remember the rules. (263)	SA A N D SD	5% 30% 31% 23% 10%	12% 13% 33% 27% 16%	13% 23% 26% 24% 15%	3% 13% 43% 28% 12%	9% 19% 32% 26% 14%
	Tot	**(99)**	**(164)**	**(164)**	**(99)**	**(263)**
		χ^2=14.492, df=4, p=0.006, Cramer's V=0.235		χ^2=16.517, df=4, p=0.002, Cramer's V=0.251		
13. Discussion is an important part of learning maths. (264)	SA A N D SD	44% 37% 14% 4% 1%	49% 37% 10% 3% 1%	50% 33% 12% 4% 1%	41% 44% 11% 3% 1%	47% 37% 12% 3% 1%
	Tot	**(100)**	**(164)**	**(166)**	**(98)**	**(264)**
14. It is important in maths to be able to work quickly. (262)	SA A N D SD	23% 40% 18% 14% 4%	31% 34% 22% 11% 1%	31% 36% 18% 12% 3%	24% 38% 26% 12% 1%	28% 37% 21% 12% 2%
	Tot	**(99)**	**(163)**	**(164)**	**(98)**	**(262)**
15. Word problems are out of place in maths because maths is about numbers. (264)	SA A N D SD	4% 8% 23% 43% 23%	4% 4% 12% 38% 42%	4% 6% 18% 35% 37%	4% 5% 13% 48% 30%	4% 5% 16% 40% 35%
	Tot	**(101)**	**(163)**	**(165)**	**(99)**	**(264)**
		χ^2=13.170, df=4, p=0.010, Cramer's V=0.223				
16. In maths, knowing <u>how</u> to multiply is	SA A	12% 21%	10% 15%	13% 18%	7% 15%	11% 17%

more important than knowing when to multiply. (265)	N	26%	23%	22%	27%	24%
	D	29%	32%	31%	30%	31%
	SD	13%	20%	16%	20%	17%
	Tot	**(101)**	**(164)**	**(166)**	**(99)**	**(265)**
17. Making mistakes in maths helps me to learn. (261)	SA	35%	44%	39%	43%	41%
	A	39%	37%	36%	41%	38%
	N	18%	12%	15%	13%	14%
	D	5%	4%	6%	2%	5%
	SD	2%	3%	4%	0%	2%
	Tot	**(99)**	**(162)**	**(162)**	**(99)**	**(261)**
18. I understand maths better if I work with my friends. (264)	SA	17%	15%	18%	12%	16%
	A	40%	26%	29%	35%	31%
	N	28%	35%	30%	37%	32%
	D	13%	17%	18%	11%	15%
	SD	2%	7%	6%	5%	6%
	Tot	**(100)**	**(264)**	**(166)**	**(98)**	**(264)**
		χ^2=9.475, df=4, p=0.050, Cramer's V=0.189				
19. Boys are better at maths than girls. (264)	SA	26	2	14	7	11
	A	10	3	6	5	6
	N	40	14	20	30	24
	D	11	19	15	18	16
	SD	13	62	46	39	43
	Tot	**(100)**	**(164)**	**(165)**	**(99)**	**(264)**
		χ^2=89.591, df=4, p<0.001, Cramer's V=0.583				

Key: SA=Strongly Agree, A=Agree, N=Neutral, D=Disagree, SD=Strongly Disagree. Proportions are given of number of group responding. Shaded areas represent a significant difference in proportions between student groups for that item.

Figure 6.11-1: Overall Student Responses to the 19 Likert-scale Items – Collapsed



Of the 19 Likert-scale items, eight (nos. 1, 5, 6, 9, 12, 15, 18, 19) produced a statistically significant difference between genders, but only one item (no.12) did so between the school-types. The strength of association or effect size measures here for the statistically significant differences are mainly of similar order with Cramer's V indicating small to moderate effects (as is also the case for the results of Table 6.11-1), with item 19, between genders, a notable exception as it produced a large effect. One, however, needs also to consider the potential for bias in this question; although boys were more moderate in their response, as a group their responses tended towards agreement to neutrality, whereas the group response of girls was more towards disagreement with the statement. It is also notable that the effect size measures here (for significant results where they existed) having to do with group differences in student views are generally smaller than those of Table 5.1-1(a) in Subsection 5.1-1 which had to do with group differences for factors which could be considered outside students' direct control. Within girls, chi-square tests across school-types showed there to be a significance difference on item no.12 (proportionately more girls in mixed schools agreeing, $\chi^2 = 15.055$, df =4, p = 0.005. Cramer's V=0.303), but no significant difference on any other item. That is, girls responded to 18 of these 19 items in the same way, regardless of school-type. Similar tests within boys brought back statistically significant difference results on three items with acceptable cell counts, namely items no.14, 16, and 19 (proportionately more boys in mixed schools agreeing in all cases, $\chi^2 = 10.454$, df = 4, p = 0.033, Cramer's V=0.325; $\chi^2 = 11.254$, df = 4, p =0.024, Cramer's V=0.334; $\chi^2 = 10.438$, df = 4, p =0.034, Cramer's V=0.323, respectively). These statistically significant differences within genders between school-types all produced effect sizes in the moderate range. Chi-square tests were also conducted on the collapsed table, i.e. SA+A collapsed and D+SD collapsed. Using the un-collapsed table for conducting these tests has the advantage of capturing all of the data as given by the students, i.e. it particularly takes into account extreme cases (SA+SD) in the analysis of difference. It could be argued that it is these extreme cases that are more likely to reflect 'valid' views, i.e. the views of students unaffected by bias such as, for example giving a response designed to please the researcher. However, using the collapsed table presents the advantage of looking at those students who registered some measure of agreement or disagreement with a particular item, given that the judgment of for example SA or A is subjective from person to person. On the collapsed table, there was a significant difference between genders for all of the same items as for the un-collapsed table except for no.12, and between school-types there was one additional item which produced a significant difference, item no.17 (χ^2=6.331, df=2, p=0.042, Cramer's V=0.156). However, overall from this analysis one can deduce that student views by gender were mostly similar across school-types, that is, the views of boys were similar regardless of school-type and the views of girls were similar regardless of school-type, but that the views of boys and girls were more dissimilar. This result potentially strengthens the case for there being no real/appreciable *qualitative* difference between what (the process that) happens at school in these school-types in terms of the teaching of mathematics, and/or how students might be experiencing it, and that the 'answer' for the student difference in outcomes lies somewhere else. It also seems to flag up the case that boys and girls, even in the same classroom, were in some respects experiencing mathematics differently.

As noted at the beginning of this subsection, chi-square tests were also conducted on these Likert-scale items using the occupational level of students' parents as variable. These tests produced no significance difference on any of the 19 items for the un-collapsed table, but two items, specifically nos. 11 and 12 did do so on the collapsed table (i.e. *I will still get the job I want even if I don't pass maths at CXC*, and *I do not need to think about the work when doing maths, I just have to remember the rules*, respectively). The results of these are given in Table 6.11-3.

Table 6.11-3: Student Responses to the Likert-scale items, Parental Occupational Level

Item	Response	WC	IC	MC	Chi-square tests
No.11 (209)	SA+A (31) N (46) D+SD (132)	13% (13) 21% (20) 66% (64)	21% (17) 28% (22) 51% (41)	3% (1) 13% (4) 84% (27)	χ^2=12.007, df=4, p=0.017
No.12 (209)	SA+A (59) N (68) D+SD (82)	36% (35) 24% (23) 40% (38)	25% (20) 36% (29) 39% (31)	12% (4) 49% (16) 39% (13)	χ^2=10.730, df=4, p=0.030

Proportions based on the number of students responding in that category; number of students in brackets

It could be argued that, based on the notion of 'chance' behind significance testing, then it could be expected that in an analysis of 19 items and using an alpha level of 5%, at least one such item would produce a statistically significant difference between group responses simply 'by chance'. There is merit to the argument, and it could be the case that some of the statistically significant findings just discussed are spurious. Although this is unlikely to be the case for the gender comparisons here, it could be so for comparisons here between school-type, and also across parent occupational level. For example, the analysis which compared student responses between school-type on the whole student sample only produced a statistically significant difference on the un-collapsed table for item no.12. However, this item also produced such a difference between school-types on the collapsed table, and did do so on the collapsed table across parent occupational level. That it was item no. 12 which was the only item to produce such a finding between school-types may not be a chance occurrence as might otherwise be interpreted based on findings to be reported later in Subsection 6.4-1. These findings (which looked at factors associated with which students of the sample did succeed in their CXC/CSEC mathematics) showed that this item (no. 12) was one of two of these 19 items which was statistically significantly associated with students passing mathematics.

From Table 6.11-2 (also Figure 6.11-1) the statements with which most students agreed were nos.2 and 7, *Maths is useful in everyday life* (92%) and *I can do well in maths if I work at it* (93%) respectively. There is a disjuncture here though between this result for statement no.2 and that for the immediate next statement, no.3 *I use maths I learn in school to solve problems outside of school*, where, although most students indicated some measure of agreement with statement no.3, only 69% of them did so, compared to 92% of students who had agreed with the previous statement. There was a sense here that for some students mathematics was important and/or useful in everyday life because they had been told so and not necessarily because they had had experience of it, or, amongst others, that they did mathematics out of school in ways different to how they learnt it in school. The statements with which most students indicated some measure of disagreement were nos.9 and 15 *It doesn't really matter if I understand a math problem if I get the right answer* (77%) and *Word problems are out of place in maths because maths is about numbers* (75%) respectively. Both these questions could be seen as related to students' views of how one comes to know mathematics or what is important in doing mathematical problems and also the nature of mathematics. However in relation to this student response to statement no.9 there seems a contrast to students' holding this view, i.e. valuing understanding mathematics problems over getting the right answer, and the way in which they responded to statement no.12 where comparatively 40% of students valued thinking over remembering the rules in working mathematics problems. These patterns of responses bring into question what it may mean to students to understand in mathematics, and to think in mathematics.

There were a number of statements for which a non-trivial proportion of students gave a neutral response. Neutrality could denote several things amongst which are an ambivalence to the statement – no opinion either way, or that students were unsure about what the expected 'right answer' to that statement was. Of the 19 statements, the one which gave the highest proportion of neutral respondents was no.1 *I like maths* (38%). This result is discussed in more detail in the Subsection 6.1-2. Other statements with a proportionately large number of neutral responses were nos.6, 12, and 18, *Being good at maths is passed down from parents* (27%), *I do not need to think about the work when doing maths, I just have to remember the rules* (32%), and *I understand maths better if I work with my friends* (32%) respectively. For the first of these, no.6, the greatest proportion of students disagreed with the statement, but yet this represented just over one-half of those responding. If one considers this in conjunction with how students responded to the immediately following question, no.7 *I can do well in maths if I work at it*, which, as indicated earlier was the statement with which the highest proportion of students agreed (93%) there is the suggestion that students may be of the view that whilst their personal success in mathematics was amenable to their efforts, this success in mathematics may well be more easily obtained by some students than others as they might have inherited it. The value of thinking over remembering rules has been briefly discussed, and possible implications of how students responded to this item and how different student groups responded will be a point to come back to in the sections to follow. Also a point to come back to will be the implications of how students responded to item 18, the significant gender difference in this, and what it means for classroom processes and how students come to learn/know mathematics. Even though more students agreed (47%) than disagreed (21%) with item 18, the high proportion of students who gave a neutral response could be due in part to structuring practices in most classrooms that allowed very little of this sort of interaction, and so that the way students' responded could have been from a position of limited experience of working with friends.

The preceding also suggests that in some respects, it appears that students did hold at the same time two or more seemingly disparate views related to mathematics. Another instance of this is in relation to items 13 and 18, *Discussion is an important part of learning mathematics* (84% of sample agreed), and *I understand mathematics better if I work with my friends* (47% of sample agreeing). Thus, whilst students are of the view that talking is an important tool in learning mathematics, it seems that this talking, is, for a sizable proportion of the students, not with their friends.

6.1-2 Liking/Disliking Mathematics, and Reasons

This subsection sets out findings having to do with students' affect for mathematics, and the reasons they gave for why they had those feelings. In doing so, the subsection addresses RA(a) and RQ1(a) relating to students' views of mathematics. The findings come mainly from questionnaire data which directly addressed this issue via both closed and open items. These findings are supported by interview data, which are also presented.

From Tables 6.11-1 and 6.11-2 in Subsection 6.1-1 there was what appeared to be a relatively high proportion of students who reported liking mathematics. The finding was unexpected based on my own work experience in this context, and also going on the achievement results of previous student cohorts. It seemed to reasonably follow that since the mathematics results of previous student cohorts had been 'poor' relative to other subjects, that more students of this cohort would have negative views of mathematics. However, the finding and its direction was relatively consistent throughout the questionnaire, for example a higher proportion of boys than girls reported enjoying their mathematics classes, and were currently doing so, i.e. reported that Forms 3&4 was the point at which they've enjoyed mathematics most. In fact, 68% of boys reported enjoying mathematics most at some point in secondary school, whilst only 49% of girls reported to doing so. Comparatively, 58% of students in single-sex schools and 57% of students in mixed schools reported enjoying mathematics most at some point in secondary school. As a measure of the internal consistency of the questionnaire, correlation statistics for the item *Do you like maths?* with that of the collapsed Likert-scale item *I like maths* (Neutral category filtered) gave a result which was statistically significant at the 0.01 level with Spearman's rho equal to 0.872 (results using the unfiltered data set gives Spearman's rho as 0.734 which is also significant at the 0.01 level). Cronbach's alpha on these two items was 0.838 (265 cases). Table 6.12-1 below juxtaposes the student proportions who responded to the items *Do you like maths?* and *I like maths* in terms of the former. This table shows that whilst 79% of students who had responded *Yes* to *Do you like maths?* also responded with some measure of agreement to the statement *I like maths*, only 48% of those who had responded *No* then responded with some measure of disagreement to the later statement, and it is this 'shift' of those replying *No*, now to the Neutral category (i.e. 42 students or 40% of those who had replied *No*) which accounted for most of the variation between these two items. Additionally, a comparison of the gender proportions of students who shifted showed that there was not a marked difference in these proportions, with 31 girls (43% of girls who replied *No*), and 9 boys (39% of boys who replied *No*) now moving to the Neutral category.

Table 6.12-1: Students' Affect for Mathematics

I like maths/ Do you like maths	Yes (169)	No (96)	Total (265)
SA+A	79 % (133)	8 % (8)	53 % (141)
Neutral	20 % (34)	42 % (40)	28 % (74)
D+SD	1 % (2)	50 % (48)	19 % (50)

Proportions as a percentage of those responding *Yes* and *No* within *Do you like maths?* Number of students in brackets.

An overarching view students expressed of mathematics was that it was difficult (hard), and this view was relatively consistent within and across data collection methods. The first point at which students' perception of mathematics as difficult came through was in their response to the first questionnaire item which directly addressed mathematics, i.e. *Do you like maths?* statistical results for the closed part of which have been given in Table 6.11-1. The question had an open adjunct asking students to give a reason for their answer, and although 63% of the student sample had replied *Yes*, it was the 37% of students who had replied *No* who gave what turned out to be the most frequent reason for their response to this question, that being that mathematics was difficult or hard. Coding of responses as difficult/hard was separated from coding responses as not understanding mathematics or that mathematics was confusing, responses which could also be interpreted and coded as difficult/hard.

Thus, mathematics as difficult/hard was a view students expressed spontaneously (i.e. in response to open questions) as well as in response to more direct items addressing this issue, e.g. item 5 of the Likert-type questions (see Table 6.11-2, Section 6.1-1). Whilst both males and females thought that mathematics was difficult, there was a statistically significant difference in the number of students of either sex who expressed this view in response to the Likert-scale item, but not so by school-type. Additionally, and in support of the gender related differences of this view, proportionately more boys than girls thought that mathematics was 'easy', this response usually given to open questions. There were implications in students' responses that their perception of the relative difficulty/hardness of mathematics was teacher-dependent as well as topic dependent.

Other views students expressed in relation to their like/dislike of mathematics, these given in response to the open question inviting students to give a reason for their reported like or dislike, related to their perceptions of its being fun/enjoyable, its importance/usefulness, that it made them think/use their brains, its being challenging, that it was confusing, that they did not understand it, etc. Even though students thought mathematics was hard, they did in some ways seem to be (pre)disposed to liking mathematics, e.g. as in the reason given by a student who had responded *Yes* to *Do you like maths?* as *'[mathematics] works my brains and sometimes it tortures me'* (10M, Mi2[8]). In the main though, this pre-disposition to liking mathematics appeared to come from a view that mathematics was important. There was some indication that there were interrelations between some students reporting that they liked mathematics, and a sense that they felt that they had to like it due to its perceived importance or usefulness in other subject areas and also particularly in the job market, and not for any aesthetic value of a like for mathematics itself. Table 6.12-2(a) outlines the frequency of the 10 most common student views in relation to the questionnaire item on reason for their like/dislike of mathematics, which is followed by Table 6.12-2(b) which gives an example of a student response which had been coded in that category of reason (given in order of decreasing frequency, top 10 reasons shown here, some students gave responses coded in more than one reason. Definition of codes for this item was given in Table 3.5-1, Section 3.5 of Chapter 3):

[8] In excerpts of student responses from questionnaire data, the following convention has been used: the first label refers to an assigned sequence number for the student followed by whether the student was male or female; the second label refers to the student's school. As example, in the excerpt just given, 10M refers to the 10th student who in this case was male; this student was in mixed school 2.

Table 6.12-2(a): Top 10 Reasons for Like/Dislike of Mathematics

Reason	Male 117	Female 169	Mixed 177	Single-sex 109	Total 286
hard/difficult	15 (13%)	47 (28%)	46 (26%)	16 (15%)	62 (22%)
fav/enjoy/fun	26 (22%)	25 (15%)	31 (18%)	20 (18%)	51 (18%)
imp/useful	20 (17%)	23 (14%)	29 (13%)	14 (13%)	43 (15%)
don't understand	5 (4%)	23 (14%)	20 (11%)	8 (7%)	28 (10%)
use brain/think	11 (9%)	13 (8%)	13 (7%)	11 (10%)	24 (8%)
challenging	10 (9%)	12 (7%)	12 (7%)	10 (10%)	22 (8%)
easy	16 (14%)	4 (2%)	7 (4%)	13 (12%)	20 (7%)
understand	8 (7%)	9 (5%)	10 (6%)	7 (6%)	17 (6%)
teacher (+&-)	5 (4%)	12 (7%)	11 (6%)	6 (6%)	17 (6%)
confusing/mix up	3 (3%)	10 (6%)	9 (5%)	4 (4%)	13 (5%)

Table 6.12-2(b): Reason with Associated Example for *Do you like maths?*

Reason	Example of student response
hard/difficult	I think it's hard, and am usually behind in it (18F, Mi1)
favourite/enjoy/fun	I enjoy doing maths (13M, Si2)
important/useful	because it can help me in life (3F, Mi6)
don't understand	I just don't understand it unless it is brought down to a level of understanding (19F, Mi1)
use brain/think (positive and negative)	it exercises my brains and when doing it blocks out everything else (14F, Si3) because you have to think to (sic) much and the problems are confusing (9F, Mi2)
challenging	because it is challenging and I enjoy taking on a challenge (18F, Si1)
easy	because it is easy (9M, Si4)
understand	I like maths when I understand what I'm doing because when I don't know what to do and I can't get it out I'm upset (10F, Si1)
teacher (positive and negative)	because the teacher put it in a easier and meaningful way so we can understand it (9M, Mi5); …the teacher don't take time to teach us. They always saying that we're behind. (5M, Mi7)
confusing/mix up	hard not interesting at all too mix up to handle (5M, Mi3)

Most reasons students gave for their like or dislike of mathematics on their own could be and were associated with whether the student said he/she liked/disliked mathematics, e.g. the reason 'hard/difficult' was given by students who disliked mathematics. However, reasons associated with the teacher and the reason 'use brain/think' were given both by students who liked and those who disliked mathematics. For reasons associated with the teacher, 10 students had responded that they liked and seven that they disliked mathematics. For the reason 'use brain/think' 16 students had responded that they liked and eight that they disliked mathematics. Additional to this last finding, 9/16 students who reported to liking mathematics because it made them think were students of single-sex schools, whilst 2/8 students who disliked mathematics because it made them think were students of single-sex schools. Although these numbers might be regarded as small, they do appear to have some import for findings to be presented later, a habitus in terms of ways of thinking that may be different between non-trivial proportions of students in the two school-types.

Table 6.12-2(a) shows other notable differences in the proportion of students who gave particular reasons according to gender and school-type. Proportionately more boys than girls gave a reason which could be considered positive, whereas for reasons which could be considered negative, proportionately more girls gave a reason coded in that category. Additionally, whilst the top four reasons given by girls follow the order given in this table, for boys, their four most frequent reasons follow a different order, and the reason hard/difficult is fourth in rank order compared to first for the girls. Between school-types, the top reason given is different, with mathematics as hard/difficult being the most frequent given by students in mixed schools, whilst mathematics as a favourite, enjoyable and fun was the most frequent given by students in single-sex schools. As was the case between genders, there is a marked difference between the proportion and number of students in the two school-types who spontaneously gave mathematics as difficult as reason for their response to the closed question.

A finding coming out of this analysis is the range of the spectrum mathematics occupies amongst students, its potential for generating emotionally extreme views. This perspective is further supported in more 'objective' questions where students were asked to list their two favourite and two least liked subjects, and their two best performing and two worst performing subjects. Mathematics and English Language featured prominently in all these (see Appendix D1, Section III, Tables for Q7-Q10 for a more expanded presentation of these subject listings), but there were some variations in where mathematics ranked according to gender and school-type. This perhaps is not unexpected, as both mathematics and English Language are compulsory for students, and so would be done by all these students. This would not be the case for other subject areas. Table 6.12-3 gives the three most frequent subjects named by subgroups of students.

Table 6.12-3: Students' Subject Rankings

Subject	Male/117	Female/169	Mixed/177	Single-sex/109
Favourite	Mathematics 47 IT 23 English 17	POA 36 English 33 Mathematics 32	Mathematics 42 POA 41 English 26	Mathematics 37 IT 25 English 24
Best performing	Mathematics 47 English 33 BT/TD 13	English 45 POA 31 Craft 21	English 42 POA 32 Mathematics 31	English 36 Mathematics 35 IT 16
Least favourite	Mathematics 27 History 18 English 16	Mathematics 80 English 28 IS 22	Mathematics 72 English 37 IS 26	Mathematics 35 History 20 Geography 16
Worst performing	Mathematics 20 History 16 English/Literature 15	Mathematics 89 English 28 Spanish/IS 16	Mathematics 75 English 35 Biology/IS 17	Mathematics 34 History 19 Spanish 17

Key: IT = Information Technology, BT = Building Technology, TD = Technical Drawing, IS = Integrated Science.

The only list for which mathematics does not feature in Table 6.12-3 is for females and their perceptions of their two best performing subjects. In this list though mathematics (along with English Literature) was fourth in the frequency count for best performing subject. Mathematics topped the frequency count for 12/16 possible lists in the table, and topped all four lists for the male sub-group. Mathematics also was the most frequently named subject for all subgroups of students in reference to their least favourite and worst performing subject. The finding of the affect spectrum for mathematics does compare in kind to that reported in Hoyles (1982). In that study 14-year old pupils were asked to give examples of good and bad learning experiences. Although not specifically a mathematics-based study, the pupils gave proportionately more mathematics-related examples of both good and more so bad experiences than any other subject area.

The range of the spectrum mathematics occupied for students also came through in interview data, although arguably, it would be expected that this would be the case given the basis on which students where selected for interview (Subsection 3.3-3). The interview of students began by asking the student group about their feelings when they realised that mathematics was timetabled for a given day. The excerpts provided below are some student responses to this question. (In interview and observation excerpts, the following convention has been used: ... indicates a pause in response; [...] indicates that something has been left out of the excerpt; words in double parentheses (( )) indicate a 'translation' of the dialect/local meaning; Int refers to the interviewer, which in all cases was me; B, G indicates a response from a boy or girl, and a number following indicates where more than one boy or girl was present, the order in which they initially responded in the interview; the number of boys and girls participating in the interview are given along with the school in brackets after the excerpt):

Interview Excerpt 6.12-1

B: The same as any other subject.

Int: [...] So you don't see maths as being, or you don't treat it as being different to any other subject? [...]

B: Just... well, it's not like I have a choice to not do it, just, since I can't, I have to do it.

[...]

G1: I don't really like maths, so... [...] ... when I see it I just... Sometimes and so I don't go to the class.

Int: Oh, you scud ((absenting oneself from classes))?

G1: Yes. [...] After the period is finished... [...] ... you just ask the rest students what was going on.

Int: Well, the fact that you're interested in what went on but you don't want to go to the class, is it maths...?

G1: No, not maths itself... [...] ... the teacher.

Int: Oh, okay. You have liked maths in the past?

G1: Yeah.

G2: I don't really like maths right now I'm in secondary school because it get harder, so... and some of the teachers, but, I don't scud – I don't like it but I still do it.

Int: Because you have to?

G2: Yeah.

(1 boy + 2 girls, Mi1)

Interview Excerpt 6.12-2

G1: Upset.

[...]

G2: Excited

Int: [...] Why are you upset?

G1: Because, it's boring.

Int: It's boring. And, has it always been boring?

G1: Not all the time. The teacher makes it like that. Other than that, me myself sitting down trying to make it, it's boring.

(2 girls, Mi2)

Interview Excerpt 6.12-3

B1: Well, me feel good when me hear a maths because...

Int: Why?

B1: Me like maths.

[...]

B1: Me lub ((love)) to count. When me go a bank or shopping or like that

Int: How about the girls – when you look at the timetable and see it's time for maths, what you feel?

G1: Step in a hell.

[...]

G2: Me feel weary.

Int: Weary? Why?

G2: Feel lak-a ((like)), you know, e' drawn out. Maths pull you down, you don't feel...

Int: Okay. The other fellas – you don't have any feelings – at least not about maths?

B2: Well, me no have no feelings, laka sobben wha'you have fu' do ((like something you have to do)).

[...]

B2: It's for your benefit. If you no wan' do it, you jus' 'tap outta class ((If you don't want to do it, you just stay (stop) out of class)).
(6 boys + 4 girls, Mi3)

Interview Excerpt 6.12-4
B2: I feel saved, 'cause that's my subject, I like it, yeah.
[...]
B1: Well, to me, I feel very confident that this is coming up 'cause we get to learn something new, different for this time, and I know it's very exciting to move on to something else new, that way it's challenging for me to accomplish.
[...]
B3: Feel good to learn something more and more every day.
(3 boys, Si4)

Interview Excerpt 6.12-5
G1: I probably will 'Ahhhh' [Laughs]
G3: I don't have a problem, I just, you know...
G1: But then I realise now that there's nothing I can do about it...
G2: It's just a next subject.
(3 girls, Si3)

The way students responded in interviews to their feelings about mathematics was consistent with the questionnaire data with regard to gender and school-type analysis. Specifically, responses were relatively similar between the school-types, but less so between gender. In interviews, boys tended to express feelings about mathematics along the lines of neutrality/ambivalence (it was something they had to do), or positive feelings (they liked it). Girls occupied a wider range in their responses, but in general they tended to be more negative than boys, and a few girls were relatively extreme in their expressions of these negative mathematics feelings. These findings from questionnaires and interviews were also by and large supported by classroom observations data in the main observation schools, where some boys did express that they liked mathematics (*'Me jus' lub ((love)) maths'* – said by two boys in different schools, Si2 and Mi5), and girls expressing negative feelings about mathematics (*'That was forever boring'* said by one girl in Si3 at the end of a mathematics class). The matter of the tedium that some students associated with mathematics was also a feature which did come out in some classroom observation sessions (see Observation Excerpt 6.22-3 in Section 6.2-2). Additionally, girls more so than boys did seem to be more affected by the *circumstances* of the mathematics, that is, the teacher, the topic, the classroom environment, etc. and took more account of these in coming to a decision in response to the questionnaire item *Do you like maths?* On the other hand boys did seem to give more consideration to the subject itself when deciding on their response to this question – more so than did the girls, and seemed to place less consideration on the circumstances of the mathematics. It ought though to be borne in mind that these findings were general trends, and were not 'true' throughout the data. Even amongst students who reported to disliking mathematics, responses to other (more open) questionnaire items did suggest that there had been a time or occasions when they liked mathematics. Disliking mathematics was something they had grown into, acquired along the way in the process of schooling. Disliking mathematics was a (learned) 'response' to certain features of their mathematics experience.

6.1-3 Rating Mathematics Performance

The findings presented in this subsection follow on from those of the previous subsection. In particular, this subsection (6.1-3) represents an attempt to address RA(b) and RQ2, which essentially have to do with how students may have come to have the views of mathematics that they reported. It was thought that students' views of mathematics may in ways be associated with what they perceived their performance in mathematics to be, i.e. how they rated this performance. The findings presented here come mainly from both closed and open questionnaire data which addressed this issue.

The results given in Table 6.12-3 in Subsection 6.1-2 suggested that there was a link between students giving mathematics as a favourite or least liked subject and their perception of their performance in it. Chi-square tests confirmed there to be a highly significant association between how students rated their mathematics performance and their response to *Do you like maths?* The results of this test are shown in Table 6.13-1:

Table 6.13-1: Association between Students' Affect for Mathematics and their Perception of their Performance

Rating Mathematics Performance	Do you like maths?	
	Yes/181	No/101
VG+G	124 (69%)	16 (16%)
Sat	40 (22%)	39 (39%)
UnSat+Poor	17 (9%)	46 (45%)
Chi-square tests	χ^2=80.456, df=2, p<0.001	

Key: VG = Very Good; G = Good; Sat = Satisfactory; UnSat = Unsatisfactory

Correlation statistics on the 5-point Likert-scale item *I like maths* and students rating of their mathematics performance (coded on a 5-point scale with 1=Very Good, through to 5=Poor), gave Spearman's rho as 0.585, which is statistically significant at the 0.01 level (267 cases). That is, students who said that they liked mathematics tended to give themselves a performance rating coded 1 or 2 (Very Good or Good), and those who disliked mathematics a performance rating coded as 4 or 5 (Unsatisfactory or Poor). A pictorial representation of this for the whole student sample is given in Figure 6.13-1. Table 6.13-2 shows how students were distributed over *I like maths*.

Figure 6.13-1: Association between Students' Degree of liking Mathematics and their Perception of their Performance

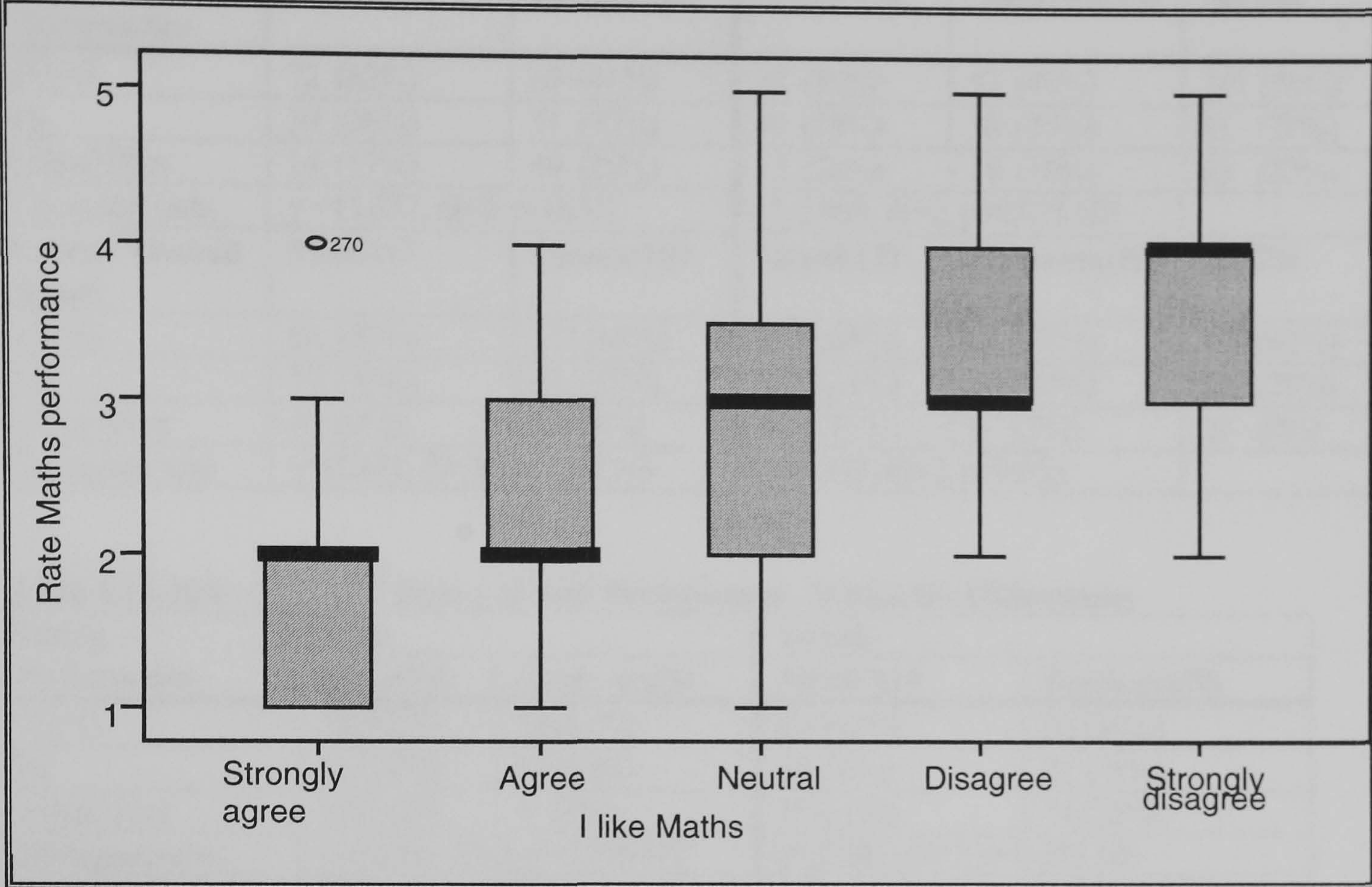


Table 6.13-2: Student Distribution, *I like maths*

I like Maths	SA	A	N	D	SD
No. of students	57	86	75	31	19
% Male (within sex)	28%	38%	23%	6%	6%
% Female	17%	29%	31%	15%	8%
%Mi (within school)	22%	33%	25%	12%	7%
%Si	20%	30%	32%	10%	7%

On the matter of students' self-reported rating of their mathematics performance, the tables which follow outline group statistics for their responses to this item, along with responses to their rating of their overall school performance. Table 6.13-3(a) looks separately at the dichotomies of gender and school-type, whilst Table 6.13-3(b) looks within each of the dichotomies to see what is happening in terms of the other factor.

Table 6.13-3(a): Students' Rating of their Performance - Mathematics and Overall School

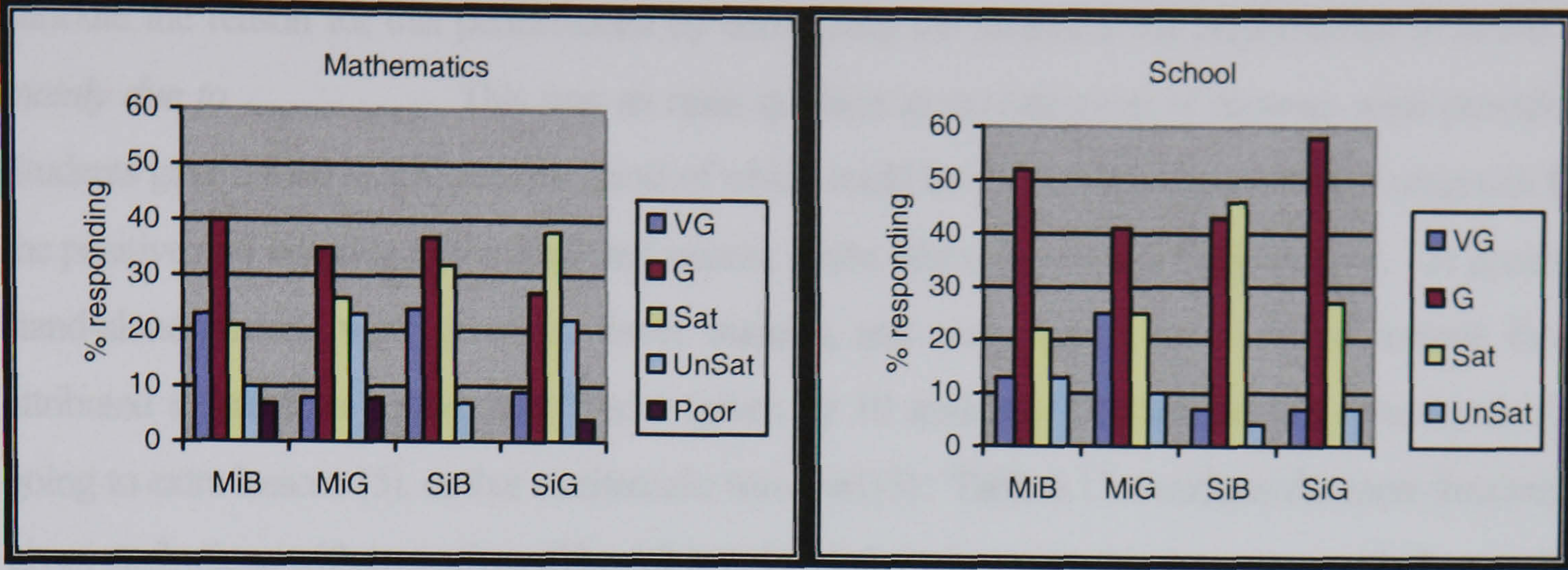
Rating – Mathematics	Male/116	Female/169	Mixed/176	Single-sex/109	All/285
VG+G	72 (62%)	69 (41%)	88 (50%)	53 (49%)	141 (50%)
Sat	30 (26%)	51 (30%)	43 (24%)	38 (35%)	81 (28%)
UnSat+Poor	14 (12%)	49 (29%)	45 (26%)	18 (16%)	63 (22%)
Chi-square tests	χ^2=15.637, df=2, p<0.001		χ^2=5.099, df=2, p=0.078 NS		
Rating – Overall School	**Male/117**	**Female/169**	**Mixed/177**	**Single-sex/109**	**All/286**
VG+G	68 (58%)	111 (66%)	116 (65%)	63 (58%)	179 (62%)
Sat	39 (33%)	43 (25%)	42 (24%)	40 (37%)	82 (29%)
UnSat+Poor	10 (9%)	15 (9%)	19 (11%)	6 (5%)	25 (9%)
Chi-square tests	χ^2=2.141, df=2, p=0.343 NS		χ^2=6.713, df=2, p=0.035		

Table 6.13-3(b): Students' Rating of their Performance - Within the Dichotomies

Rating Mathematics	Male		Female	
	Mixed/62	Single-sex/54	Mixed/114	Single-sex/55
VG+G	39 (63%)	33 (61%)	49 (43%)	20 (36%)
Sat	13 (21%)	17 (32%)	30 (26%)	21 (38%)
UnSat+Poor	10 (16%)	4 (7%)	35 (31%)	14 (26%)
Chi-square tests	χ^2=3.068, df=2, p=0.216 NS		χ^2=2.481, df=2, p=0.289 NS	
Rating – Overall School	**Mixed/63**	**Single-sex/54**	**Mixed/114**	**Single-sex/55**
VG+G	41 (65%)	27 (50%)	75 (66%)	36 (66%)
Sat	14 (22%)	25 (46%)	28 (24%)	15 (25%)
UnSat+Poor	8 (13%)	2 (4%)	11 (10%)	4 (9%)
Chi-square tests	χ^2=8.946, df=2, p=0.011		χ^2=0.344, df=2, p=0.842 NS	

For the data of Table 6.13-3(a), the only statistically significant between group difference for these self-reported ratings comes from the grouping by sex for mathematics performance, with proportionately more boys' rating their mathematics performance on the higher end of the scale than did girls. This result for the sex differences in how these students rated their mathematics performance compares in kind to that reported in Bartholomew (2000) for how top set students in a UK study had rated their mathematics 'ability'. In Table 6.13-3(a) the statistics from the overall sample show that students on average rated their school performance as being better than their mathematics performance, although a look at the group break-down of the statistics in Table 6.13-3(b) shows this not to be the case for boys in single-sex schools, i.e. more of these boys rated their mathematics performance on the high end of the scale than did for their school performance. Figure 6.13-2 shows these self-reported student performance ratings for mathematics and overall school in terms of the proportions of students for each of the given categories. These results are given from the perspective of the interrelations of school-type and gender.

Figure 6.13-2: Students' Rating of their Mathematics and School Performance by School-type and Gender



Except for girls in single-sex schools, the most frequent rating students gave of their mathematics performance was *Good*. The rating chosen most often by girls in single-sex schools for their mathematics performance was *Satisfactory* (also given as *Fair/Passable* on questionnaire). This 'result' seems somewhat contradictory if one considers it in light of the mathematics outcomes of previous student groups in these school-types (e.g. Figure 4.2-4(a) in Section 4.2). One factor that may be underlying this result, i.e. that proportionately more girls in single-sex schools gave their mathematics performance a lower rating than might be otherwise expected from previous student results and compared to the other student groups shown here, is the re-grouping for mathematics teaching at the beginning of the fourth form year based on the two-tier structure (General or Basic proficiency) of the CXC/CSEC examinations which occurred in both girls' single-sex schools. This re-grouping for mathematics teaching was a long established tradition in these two schools, passing relatively unquestioned into the yearly routine of going from third to fourth form, and did not occur at this (early) stage in any other school except one mixed school which had just started the practice in the school year of data collection. Also of note is the increased proportion of girls in single-sex schools who rated their overall school performance as *Good* (58%) compared to those who had done so for mathematics (27%) – a difference of 31% points or 17 students. This result serves to discount the possible explanation that it may just be that these girls were generally conservative in rating their own performance, as they were prepared to rate their overall school performance more favourably. For boys, as can be seen from the graphs, compared to how they rated their overall school performance, considerably more of them, regardless of school-type rated their mathematics performance as *Very Good*. No boy in single-sex schools rated their mathematics performance as *Poor*. Additionally, no student rated their overall school performance as *Poor*, although 15 students did so (nine females and four males in mixed schools, and two females in single-sex schools) for mathematics.

In addition to being asked to rate their school mathematics performance, students were also asked to attribute the reason for this performance by completing the sentence: *My performance in maths is mainly due to ________.* This was an open question as no categories of answers were provided. Students gave a total of 270 reasons, most of which could be divided into dichotomous categories for the positive and negative of the attributed reason, whilst others were stand-alone reasons. In general, stand-alone reasons were given by fewer students, and examples of these reasons include those attributed to previous performance/grades (given by 10 students), God/parents (9), career/goals (8), going to extra lessons (5), or that mathematic was hard (5). Table 6.13-4 outlines the most frequently given attributions with examples. (The full list of coded responses for this item along with the number of student respondents in the sub-groups can be found in Appendix D1, Section IV Table Q4(b)).

Table 6.13-4: Attributing their Mathematics Performance

Reason	**No. of students**		**Example of reason**
	+	-	
Practice/effort	53	19	Good; constant practice and hardwork (23M, Si4) Unsatisfactory; because I do not put in enough effort' (37F, Si1)
Teacher	26	21	Very Good; [...] and having a teacher that take time to go through it with the class (26F, Mi2) Poor; that I don't understand my teacher well [...] (15F, Mi7)
Understand	13	30	Very Good; my understanding to the math (12M, Si4) Unsatisfactory; not asking questions when I don't understand (7F, Mi3)
Like/interest	12	15	Good; my love and interest for it (9F, Mi1) Poor; focus level has drop maths makes me tired (5M, Mi3)
Paying attention	10	7	Good; [...] listening when the teacher teach (5F, Mi6) Unsatisfactory; lack of paying attention in class I tend to daydream (24F, Mi5)
Ability/ intelligence	10	5	Good; my own smartness (15M, Si2) Unsatisfactory; the best of my ability but still never pass (28F, Mi2)

From these, students attributed their 'success' in mathematics to two main factors, namely their own efforts, and factors related to the teacher; 'failure' was attributed more widely over four main reasons, to a lack of understanding, factors related to the teacher, a lack of effort/not practising enough and a dislike or disinterest in the subject. There were some other points of note in this analysis. In the main responses were distributed over gender and school-type. There were though a few cases, specifically those citing ability/intelligence and not understanding where there were notable differences in the distribution over the sub-groups considered. Although only five students cited as reason a lack of ability/intelligence, these responses all came from girls in mixed schools, whereas of the 10 students who gave their own ability/intelligence as reason, eight were boys, and five of these boys were in single-sex schools. Of the 30 students who gave 'don't understand' as reason, 25 were girls. Although not given in Table 6.13-4, mathematics as difficult/hard was given as reason for their (less than good) performance by only five students, four of whom were in mixed schools, which suggested that although students did generally think that mathematics was hard, they did not see this difficulty as the main reason for their performance in the subject. As one student said, '*... All what they need to do is to teach it much better and you would see a difference...*' (19M, Mi2, Likes maths, Rates performance *Satisfactory/Fair/Passable*).

Students had also been asked a similar question in relation to attributing their overall school performance. As few students rated their overall school performance as *Unsatisfactory* (recall, no student rated their overall school performance as *Poor*), then the attributions given here were more positive than those given for mathematics. Students gave 303 reasons here, the main ones of which in order of decreasing frequency were their own efforts (88 students), their classroom behaviour/attitude (47), parents (29), a lack of effort (23), goals/career (21), teacher positive (19), and their own ability/intelligence (19). (The full list of coded responses for this item along with the number of student respondents in the sub-groups can be found in Appendix D1, Section III Table Q12(b)). One notable outcome of this analysis is the number of attributions given to parents/home life for their general school performance, 29 such, whereas only eight students attributed parents/home life as a reason for their mathematics performance. Conversely, more students attributed success in mathematics to the teacher than did so for their overall school performance (26 students to 19 respectively); but so also did more students attribute failure in mathematics to the teacher than did so for their overall school performance (21 students to one student respectively). This result could suggest that students might be more predisposed to seeing mathematics performance as school/teacher dependent than other subject areas done in school.

6.1-4 Mathematics as Hard

This subsection takes a closer look at the prominent student view which emerged from Subsection 6.1-2, that of mathematics as difficult. In coming back to looking at this view, the subsection addresses those aspects of RA(b) and RQ1&3 having to do with how students may have come to have this view. The circumstances of learning/doing mathematics come into play here, and much of these are associated with the mathematics teacher. Findings to be presented in this relation come from questionnaire (both closed and open items), interviews and also observation data.

Table 6.14-1 looks at questionnaire data on the cross-tabulation of students' view of mathematics as difficult (from collapsed Likert-responses) and whether they had reported to liking it or not (responses to the dichotomous question). Percentages are given in terms of the number of students who responded in that way to mathematics as difficult. The table shows that whilst the number of students who agreed that mathematics was difficult was relatively evenly divided between liking and disliking mathematics, a higher proportion of students who gave a neutral response or disagreed that mathematics was difficult did report liking the subject. Chi-square tests on these results do show a significant difference (χ^2=27.075, df=2, p<0.001).

Table 6.14-1: Mathematics Affect and its Difficulty

Maths is difficult	**Do you like maths?**	
	Yes (162)	**No (97)**
SA+A (131)	48% (63)	52% (68)
N (53)	68% (36)	32% (17)
D+SD (75)	84% (63)	16% (12)

Number of students in brackets

Despite the reported statistical findings on students who thought of mathematics as difficult, and those who gave this as reason for their not liking the subject, there were students who did not appear to be convinced that mathematics was difficult, e.g. the student who gave as reason for responding *No* to *Do you like maths?*: *'Because it just seems hard to me although it is easy'* (F16, Mi6). Also, as some students did mention in several questionnaire items about mathematics being made simpler or of its being brought down to a level of understanding (e.g. in Table 6.12-2(b), Section 6.1-2), it seemed that some students had the view that mathematics as done in (secondary) school need not be as difficult as sometimes presented. Even at this stage of schooling, some students did seem to be variable in their views of mathematics, and although responding *No* to *Do you like maths?* also reported periods where they did enjoy mathematics usually based on whether they could understand it and on the methods teachers used. The following is an extended student questionnaire response which makes this point:

Questionnaire Excerpt 6.14-1

Q: Do you like maths?

R: No, it is hard to understand: keep in memory even though you revise.

Q: Describe what usually happens in your school mathematics classes.

R: In math class I get bored instantly probably because I don't understand or teacher does not explain properly what we are supposed to do.

Q: What do you like most about your school mathematics classes?

R: Doing a[n] equation or problem I understand.

Q: What do you like least about your school mathematics classes?

R: Doing something I don't understand.

Q: Describe what happened in your favourite mathematics lesson ever.

R: In my favorite (sic) math class ever I understood everything she taught and the teacher actually made the class interesting and making me actually enjoying the math class.

Q: What could be done to make maths more interesting to you?

R: Teacher actually taking time to explain and making class lively. (2M, Mi7)
(Key: Q denotes the question asked, R denotes the response.)

Thus, with regard to students' perceptions of mathematics as easy, fun/enjoyable, as well as their perceptions of it as difficult (hard), some students did imply in their responses to open questionnaire items that these factors were very much teacher-dependent. Teachers 'made maths easy' or they 'made maths fun' were responses given over several questionnaire items. For example, in stating what her favourite thing was about her school mathematics classes, a student wrote: *'the teacher is fun and simplifies things that are difficult'* (F3, Si1). Some students though did also imply in questionnaire responses that mathematics was difficult *because* of the teacher or teaching-methods, e.g. two students gave as reason for saying that they did not like mathematics the following: *'because every teacher has a different method of teaching so it is complicated and when you say you don't understand the teacher has an attitude towards you'* (F27, Mi7); and *'it is to (sic) complicated when more than 1 teacher teaches differently on the same topic'* (F26, Mi1). The view of teachers 'making mathematics difficult' was brought out more explicitly in interview data, as illustrated in the following excerpts:

Interview Excerpt 6.14-1

Int: [...] Do you find that the change in teacher, a change in teacher let's say from 1st form to 2nd form in maths, do you find that that confuses you any, or... it makes things better, or...

G1: 'Tall ((Not at all)), it makes things better. From 1st to 2nd was good, then the 3rd form teacher I had, it was a bit of problem because he made maths kind of difficult.

Int: You think he made it difficult, more difficult than it was?

G1: Yes, but moving on to 4th form and meeting the teacher that is there now, she, I think she is bringing it back down to where I work in the 1st and 2nd form.

Int: Okay, so bringing it back down meaning the 3rd form teacher was...

G1: He was making it difficult, and he should... 'am, the teacher that I have now she bringing it showing us the easier way.

Int: Okay, making it difficult in terms of you must do it this way, or...

G1: Yeah, do it this way, different from the way we learn from back then and so on, so he was making it difficult.

(2 girls, Mi2)

Interview Excerpt 6.14-2

Int: [...] is there any particular comment about maths that you hear people make often, maths is so and so...

B: Boring [drawn out]

Int: Maths is boring?

B: Yeah, all maths boring... to me, everybody, maths hard, how they teach it. When some people teach it, it's hard.

(1 boy, Si2)

That some students thought mathematics was easy, fun, as well as others thinking of it as difficult, etc. are not unusual views. Additionally, that students thought of mathematics as easy or fun *because* of the teacher is not unusual – one of the essential roles of the teacher in teaching mathematics is to make that bridge, *facilitate* the learning of mathematics and make the subject appear accessible and do-able, even easy for the student (as suggested by F3 of Si1 in the questionnaire excerpt previous), although it might be arguable whether they are also to make it 'fun'. However, the student expressed view of mathematics as difficult *because* of the teacher, or of teachers making mathematics difficult is unusual and was unexpected. The academic literature in this respect does bring out these dichotomous views students have about mathematics, that some think it is easy, but also that a marked majority of students think of mathematics as difficult. However, the view of mathematics being 'made' difficult *because* of the teacher, though it might be somewhat implied, is less widely directly brought out in studies in the academic literature. This does not discount the view that some students thought that mathematics was difficult in and of itself. There was a small group of students whose responses did suggest that mathematics for them was a subject that was inescapably difficult/hard, that is, there was no getting away from this difficulty/hardness (further compounded by mathematics being compulsory), and this difficulty/hardness was almost tangible so much so as to be insolvable, and hence hardly worth their effort. The following questionnaire excerpt makes this point:

Questionnaire Excerpt 6.14-2

Q: Do you like maths?

R: No. It is difficult I try to understand it but is still hard for me.

Q: Complete this sentence: My performance in maths is mainly due to

R: the difficulty of the subject.

Q: Give 2 words/phrases that best describe you in mathematics classes.

R: Lost and unhappy.

Q: Describe what usually happens in your school mathematics classes.

R: The teacher teaches, but most of the time I do not understand, and I do not say anything because I am afraid she might get upset with me.

Q: Describe what YOU (personally) usually do in your school mathematics classes.

R: I sit quietly and listen and watch the teacher, then try to help myself but I can't'

Q: What do you like most about your school mathematics classes?

R: The teacher tries to keep it interesting'

Q: What do you like least about your school mathematics classes?

R: I never understand what has been taught.

Q: How would you sum up your school maths experience so far?

R: Horrible (21F, Mi2)

The student in this excerpt does not implicate the teacher in any way about the difficulty of mathematics – for her, the difficulty lay with the subject, and in some ways, also perhaps with her. However, it was also the case that some students were of that view that they could do better, if not well at mathematics if they had the 'right' teacher, or if their present teacher would change their teaching method(s), e.g. the following student's response to what mathematics is to him personally: '*Maths is hard and complicated but if you have a good teacher you can pull through.*' (20M. Si2)

There are indications in Interview Excerpts 6.14-1 and 6.14-2 of the ways in which these students thought teachers were 'making maths difficult'. In Interview Excerpt 6.14-1, G1 suggests that the level of the teaching of mathematics by her third form teacher was not meeting her where she was, it was a level that was too 'high' for her to reach. She does not explicitly state language issues, but inarguably language is implicated. What G1 says in this interview excerpt is in tune with one reason given in Table 6.12-2(b) previously on students' reasons for liking or disliking mathematics; although coded under 'don't understand', the student in that instance also implies that the reason for her dislike of mathematics was wrapped up in the (for her) high level at which mathematics was being taught. What these girls, 19F of Mi1 in Table 6.12-2(b) and G1 of Mi2 in Interview Excerpt 6.14-1, are both saying is that mathematics was being made hard via the teaching, but also implied in their responses is the assuredness that it does not have to be that way, and that it could be made simpler by being *brought down to a level of understanding*. These girls' responses are supported by other student responses to open questionnaire items, where level of teaching and a variety of teacher language issues were implicated, for example:

Questionnaire Excerpts 6.14-3
Q: What style of teaching do you think allows you to learn maths better?
Simply explaining it properly and bring it down to our level (32M, Mi2)
English type teaching (20F, Mi2)
I think English language does (6F, Mi6)
Q: What could be done to make maths more interesting to you?
Involve it with young people style or otherwords (sic) young people talking. (2F, Si3)
Q: What do you like least about your school mathematics classes?
The way the teacher speaks. She has an accent so sometimes I don't understand her (1F, Si3)
Q: What would you personally) say maths is?
Good is everything but sometimes its hard to understand especially if English is not your first language and the teacher is too fast (2F, Mi2)

Classroom observations do support some of these 'problems' outlined by students. For example, it was sometimes the case that the teacher would be well into a lesson on a particular topic before a student would appear to realise the change and ask about it. In one observation session of a 70 minute lesson in Si3 (Session 2), the lesson started with a review of the corrections for a test they had done in the previous observation session The test had consisted of five questions, one each on finding LCM, finding HCF, finding the next term in number sequences, changing number bases and addition of binary numbers operations. Having completed the review the teacher then moved on to operations with Fractions, talking with students about BOMDAS and what each letter stands for and that the same rules apply for fractions as does for whole numbers. He then writes on the board: $2\frac{1}{3} - (1\frac{1}{3} - \frac{3}{4})$, but it is only at this point that a girl asks if they were finished with Binary and onto Fractions now. These transitions which may be relatively seamless to teachers do cause problems for some students, and add to the confusion and misunderstandings which students experience, as some students appear to still be stuck in the mode of the previous topic without realising that things have moved on, or needing to re-orient themselves to different topics.

6.1-5 What is Mathematics?

The findings of the foregoing may bring into question what it is students see mathematics as. The questionnaire addressed this via the open item *What would you (personally) say maths is?* This question was designed to elicit students' own thoughts of what mathematics was from their experience of learning and doing it, that is, to bring out their views of mathematics. The question was designed to address RA(a) and RQ1(a). It was also thought that students' responses to this item may give insights to their (observed) approaches to doing/learning mathematics, i.e. RQ1(b).

Students gave 340 responses ranging over a number of areas which were eventually coded into 17 categories (definition of codes for this item were given in Table 3.5-2 of Section 3.5, Chapter 3). Table 6.15-1 shows the responses with frequencies greater than 10 from this question for the whole student sample. (A complete list of responses along with gender and school-type break-down is given in Appendix D1, Section IV, Table Q6.)

Table 6.15-1: Coded Responses and Examples to *What would you (personally) say maths is?*

Response code	No. (%) of students	Example of a response
Important/useful	62 (22%)	an important tool in life (2M, Si2)
Numbers/counting & basic operations	55 (19%)	knowing addition subtraction multiplication and division is all I need (24F, Mi7)
Hard/hard to understand	42 (15%)	a complicated subject which should be simplified or not taught at all (23F, Mi5)
Way to use brains/think	34 (12%)	well... I think it is about using your brain, mind and logic (1F, Si1)
Way of life	30 (10%)	everything, it's life without it you know nothing, everything you do involves maths (3F, Mi5)
Problem solving	21 (7%)	a helpful method which is used to solve not only educational problems but everyday problems (12M, Mi4)
Don't know	14 (5%)	
Rules/formulas	13 (5%)	a bunch of... formulas, signs and sometimes letters... (1F, Si3)
Frustrating	12 (4%)	a sin (2M, Si4)

Percentages are given as proportion of the number of students.

Here again, mathematics as difficult came through as one of the most frequently expressed views of the subject. Of the most frequent responses given, this view of mathematics had the most marked difference in the proportions of male and female students who gave it, with 12/117 or 10% of boys giving it here, whilst 30/169 or 18% of girls gave this view of mathematics. Between school-types, the most marked difference in proportions came from responses coded as way to use brains/think, with 26/177 or 15% of students in mixed schools giving it here, whilst 8/109 or 7% of students in single-sex school giving a reason coded in this category. The most frequently expressed view of mathematics here though had to do with its importance or usefulness. As noted in the definition of codes for this item in Table 3.5-2, students who gave this response were mainly giving a perception of its need/usefulness in the job market and/or its usefulness in *getting* a (good) job and not necessarily its usefulness *in* doing that job, followed by its usefulness in everyday life. That is, students do seem to be aware of the 'critical filter' mathematics can play in the post-school world (e.g. on p15 of Section 1.4). Also, the sense of some students tolerating mathematics due to its perceived importance/usefulness is a feature of some responses to this question e.g. *'Maths is a very difficult subject if you don't catch on quickly. But I am determined to learn it whatever it takes because I want to be a nurse one way or the other'* (22F, Mi2). The importance or usefulness of mathematics was directly addressed in two Likert scale items, nos. 2 & 3 given in Table 6.11-2 in Section 6.1-1, namely *Maths is useful in everyday life* and *I use maths I learn in school to solve problems outside of school.* Both items generated agreement from most students (92% and 71% of students respectively), and neither statement yielded a statistically significant difference between students in any of the student groupings considered for analysis (i.e. by gender or school-type).

As well as mathematics as important/useful, one of the most frequently coded responses to what students saw mathematics as was that in terms of number/counting and/or the four basic operations of adding, subtracting, multiplying and dividing. This view was relatively evenly distributed over gender and school-types. Although there were students who had more sophisticated views of mathematics, there seemed a non-trivial proportion of students whose perception of mathematics had not moved on from what one might have otherwise expected of a primary school student.

6.1-6 In the Mathematics Classroom

The findings to be presented in this subsection have to do with how students described themselves and what it is they do in their school mathematics classes, along with other aspects of these classes. In doing so this subsection attends to aspects of the RA and RQ having to do with students' approaches to learning mathematics, e.g. RA(c) and RQ1(b). As the teacher is a major player in what happens in these classes, this necessarily brings the focus once again back unto the teacher. One of the findings coming out of the analysis in this subsection has to do with the 'activity' of listening and from this the role of language (both the teacher's and the students') in the classroom teaching-learning process. The role of 'listening' and the language implications for students are discussed. Findings from questionnaire data are first presented, and these are supported in the discussion by data from classroom observations and student interviews. In presenting the data, the subsection does get progressively discursive.

Two related open questions were asked in the questionnaire, the first of which required students to give two words or phrases that best described themselves in mathematics classes and the second asked students to describe what they (personally) did in these classes. As might be expected, there was similarity in student responses to these two questions. To the first of these questions, students gave 410 descriptions coded into 13 categories. Table 6.16-1 presents the complete results on the responses for this item (the 13th category, 'Other' is not shown).

Table 6.16-1: **How Students Described Themselves in Mathematics Classes**

Code	Male/117	Female/169	Mixed/177	Single-sex/109	Total/286
Trying/willing/participating	27 (23%)	53 (31%)	44 (25%)	36 (33%)	80 (28%)
Listening/paying attention	25 (21%)	49 (29%)	46 (26%)	28 (26%)	74 (26%)
Understanding	25 (21%)	16 (9%)	26 (15%)	15 (14%)	41 (14%)
Quiet/well behaved	15 (13%)	17 (10%)	23 (13%)	9 (8%)	32 (11%)
Enjoying/liking/interested	15 (13%)	18 (11%)	15 (8%)	13 (12%)	28 (10%)
Confused/mixed up/lost	5 (4%)	22 (13%)	13 (7%)	14 (13%)	27 (9%)
Talkative/not listening	10 (9%)	16 (9%)	17 (10%)	9 (8%)	26 (9%)
Not understanding	9 (8%)	16 (9%)	21 (18%)	4 (4%)	25 (9%)
Bored/not interested	5 (4%)	17 (10%)	16 (9%)	6 (6%)	22 (8%)
Sleepy/tired/daydreaming	5 (4%)	15 (9%)	15 (8%)	5 (5%)	20 (7%)
Not trying	7 (6%)	11 (7%)	8 (5%)	10 (9%)	18 (6%)
Frustrated/stressed	2 (2%)	8 (5%)	7 (4%)	3 (3%)	10 (3%)

Percentages are given as a proportion of the number of students in that subgroup of the sample.

For the second question (what individual students do in mathematics classes), coding of responses for this item produced a list of eight codes. These codes with frequencies are given in Table 6.16-2(a) (complete list), and an example of students' responses for each code is provided in Table 6.16-2(b):

Table 6.16-2(a): Students' Description of what they (personally) do in Mathematics Classes

Code	Male/117	Female/169	Mixed/177	Single-sex/109	Total/286
Listen/pay attention	53 (45%)	82 (49%)	78 (44%)	57 (52%)	135 (47%)
Work problems/do work	29 (25%)	41 (24%)	45 (25%)	25 (23%)	70 (24%)
Try/try to understand	9 (8%)	49 (29%)	41 (23%)	17 (16%)	58 (20%)
Participate/ask-answer questions	11 (9%)	25 (15%)	22 (12%)	14 (13%)	36 (13%)
Talk/play/inattentive	19 (16%)	14 (8%)	19 (11%)	14 (13%)	33 (12%)
Bored/frustrated/do nothing	4 (3%)	16 (9%)	13 (7%)	7 (6%)	20 (7%)
Sleep/head down/dream	8 (7%)	12 (7%)	16 (9%)	4 (4%)	20 (7%)
Take notes/write	9 (8%)	7 (4%)	7 (4%)	9 (8%)	19 (7%)

Table 6.16-2(b): Students' Reports of what they (personally) do in Mathematics Classes

Code	Example of student response
Listen/pay attention	I normally listen to what the teacher is saying and do it (7M, Mi7)
Work problems/ do work	Listen to what the teacher says. Do all the sums given. (17F, Mi4)
Try/ try to understand	I usually sit in the class and try to understand it or gaze outside the window (16F, Mi6)
Participate/ask-answer questions	To be honest I always like paying attention and try participating the most I can (9F, Mi1)
Talk/play/ inattentive	Talk when bored, listen when necessary (25M, Si2)
Bored/frustrated/ do nothing	I sit down in front and stare at the board and honestly I have no idea what is going on (37F, Si1)
Sleep/head down/dream	If the topic is boring I sleep otherwise I pay attention. (28F, Mi2)
Take notes/write	In maths class I usually write all the time and try to figure out something I don't understand (6F, Mi5)

Note: Some examples given here were coded in more than one category.

There are some notable similarities and differences in how subgroups of students responded to these items, which will have some bearing for classroom behaviour and associated inclinations/dispositions to be discussed. Between gender from both Tables 6.16-1 and 6.16-2(a), proportionately more girls gave a response along the lines of 'trying' in mathematics classes, which could suggest that mathematics classes for them were places (fields) of struggle. A valid question though is with what were students, specifically girls, struggling. Perhaps in support of this, from Table 6.16-1, proportionately more girls described themselves during mathematics as confused, bored, and sleepy or tired (cf. with the perspective of G2 in Interview Excerpt 6.12-3, Subsection 6.1-3), and proportionately fewer girls described themselves as understanding. The gender proportions of Table 6.16-2(a) lend support to the direction of the response of being bored, but not necessarily to that of sleeping. Girls though more so than boys were more likely to describe the classroom activity of other classmates during mathematics as sleeping (see Appendix D1, Section IV, Table Q7 for this). The comments of one teacher given in Questionnaire Excerpts 5.22-1, Subsection 5.2-2 also support the perspective that it was girls who were more likely to be engaged in a behaviour that could be seen as sleeping during mathematics classes (putting heads down on desks). 'Sleeping' and other such behaviours (e.g. head down, slouching) has in the Caribbean literature been more associated with the classroom behaviour of boys than of girls (e.g. Parry, 1996; Evans, 1999). The difference in the present study might be the *mathematics* context of the study. The other notable gender difference is given in Table 6.16-2(a) where proportionately more boys than girls described their classroom activity in terms of talking, playing, or generally being inattentive. It could be argued that the student numbers in both these last cases, i.e. having to do with sleeping and talking/playing etc., are small and that a much larger proportion of students described themselves and their mathematics classroom activities more favourably. However these small numbers are not without meaning; these were students' responses to open questionnaire items, and in that respect the responses were not coerced from students. That these students were prepared to describe themselves and what they did in mathematics in these ways perhaps deserves the added attention.

Between school-types there is a relative sameness in the proportions of students who gave the listed responses for both tables. In Table 6.16-1 there is some difference in the proportions of students who described themselves as confused/mixed up/lost during mathematics classes, with more students in single-sex schools saying so, but this is perhaps balanced by proportionately more students in mixed schools describing themselves as not understanding.

For the student sample, their responses to these questions indicated generally what was one of their foremost impressions about learning and/or doing mathematics, which was that it was a subject to be listened to, and a subject to be practised. No student specifically mentioned here the need, in mathematics classes, to think, that is, no student specifically mentioned the need to think as something they *actively* did in mathematics classes, although some students did give it as a reason why they liked mathematics (Section 6.1-2), and some also gave it in response to what they would say mathematics is (Section 6.1-5). It may well be that the need to think is wrapped up in student responses of paying attention, trying/asking-answering questions, working/doing problems. That said, there does however seem to be some disjuncture here between what some students thought of mathematics – what it is, what one needs to do to be *doing* it – and what *they* were reporting as *their* actual experience of doing in mathematics classrooms.

Students were asked a related question in the questionnaire in which they were to describe what usually happened in their mathematics classes. This was a more general question in that unlike the two questions just discussed, it did not individualize by asking students what they themselves did, although some students did use it to say what they did. The aim of this question was to ascertain whether there were particular patterns across school-types in what students described as happening in their classes. The full list of coded responses for this item is given in Appendix D1, Section IV, Table Q7. The two main activities students' outlined as usually happening in their classrooms were the teacher teaching/explaining work (given by 92 students), whether this be a new topic, correcting previous work/homework, and the students doing work or being given work to do (given by 75 students). Students also used this item to give their impressions of what other students were doing during mathematics classes, and the issue of 'other' students being noisy or disruptive in class (given by 43 students) was given here, although some students responses suggested that it was the school environment (and not specifically other classmates that was noisy. This was the third most frequent activity coded for overall responses to this question, but in particular it was given by more than one-half of the student sample in one of the single-sex schools (Si2). Following on, the next most frequent activity given (by 36 students) was students' listening/learning.

Students frequently described their mathematics classroom activity as listening or paying attention. But, just what does this activity entail? Davis (1996, p38) described listening as a participatory activity, so that the listener, although he/she may not speak, is not *held* silent, as whilst listening, the listener questions, challenges, etc., i.e. he/she thinks (cf. also to Voloshinov's (cited in Wertsch, 1991) notion of laying down answering words (see p130 for quote) in the process of coming to understand a person's talk). Davis goes on to point out that hearing and listening are not the same thing, with hearing being the sensory capacity upon which the ability to listen lies. In particular, hearing is undifferentiated, that is, whilst we can (are physically able to) hear, we hear everything, whereas listening is orientating, in that we listen *to* someone/thing or listen *for* someone/thing – listening narrows the focus of what it is we hear, allowing for the start of the process of making sense of the hearing. If one takes these conceptions of hearing and listening into the mathematics classroom that some of these students described, it would seem to the case that what some students labelled as the activity of 'listening', was actually, for them 'hearing', as although they were attempting to listen to the teacher, they were only really hearing him/her. What was coming through for some students from the teacher's talk/explanations were undifferentiated sounds; as discussed in Section 6.1-4 earlier, students had written in questionnaire responses about the need on the part of the teacher to make things simpler, to break things down, to explain better, that 'English-type teaching' would allow them to learn better. This reference to using English or English language when talking is used locally in A&B to mean using language that they (the listener/hearer) can understand. Again, from the responses of some students, in such cases it seems that their attempts at listening to the teacher had invariably become laboured (Davis, 1996, p50), e.g. for the student who responded *'I usually listen and take in what I can and get bored doing so'* (5M, Si2) in answer to what it was that he did in mathematics classes.

A notable general finding from observational data in mathematics classrooms (and also observed in some schools whilst administering questionnaires) was the difference in language used by teachers and students. For the observation schools, more so in two schools (Si2, Mi5) than in the other (Si3), students used the local dialect (usually called dialect in A&B, but also called Creole (ref. Chapter 2) in other parts of the Caribbean) when talking to each other and also sometimes to the teacher, whereas the teachers tended to use a more 'standard' (although at times informal) form of English when speaking to students. At times it appeared to the researcher, listening in the role of an 'outsider', that two quite distinct languages were being spoken. Whilst it may be the case that some students were specifically choosing to speak in the local dialect rather than 'standard' English, for example, as believed to be the case for the boys in Si2 (see examples from observation excerpts below), it was also the case that some of the language heard being used by some students during these sessions was from students who could not, rather than would not, do so, as there were instances where students unsuccessfully attempted to address the teacher in 'standard' English (this observation made in school Mi5). The observed disjuncture between the language being used by teachers and students has possible implications then for what students were 'hearing' when they were 'listening'. The following examples are taken from classroom observation field-notes.

Observation Excerpt 6.16-1

The teacher asks the class for factors of $12x^2$. This is followed by students' responses, which the teacher writes on the board.

From the board:

$12x^2$ – x^2, 6, 3, 2, 4, 1, x, 12, $12x^2$, $6x$, $3x$, $2x$, $4x$, $4x^2$, $3x^2$, $2x^2$, $6x^2$, $12x$ [represents order in which given by students]

The teacher then says to the class; 'Plenty of factors', to which a girl at the front of the class responds: 'Fu dat likkle subben dey?' ((For that little thing there?))

[... Later in the same class]

The teacher writes on the board:

$2x^2 + 9x + 4$ [This is the first example given where the co-efficient of x^2 was not 1]

and says to students 'I dare somebody to try this one using trial and error.' A boy at the back says 'Dat dey hard nuh' ((That (one) is hard, you know))

(Excerpts from Observation Session 2, Mi5)

Observation Excerpt 6.16-2

On arrival at the class, the teacher tells students that they are to get a short test. There is some dissention to this with various students saying – 'Me nar do no test' ((I am not doing any test)) [...]

Whilst the teacher is writing the test on the board a boy says to him, 'Sir, my pen stop work. Can I use a pencil?' The teacher replies 'Yes'. The same student comments loudly (to no one in particular) 'Since last year dis man gi' arwe dem subben nuh.' ((Since last year this man gave us these things you know (referring to what has been written on the board))) [...]

One boy after submitting his test paper, comments – 'If me fail dat test, me wan' blow - serious talking' ((If I failed that test, I deserve to be caned, seriously)). Another (different) boy says: 'There is a possibility that I might fail the test 'cause me see that me do something wrong.'

(Excerpts from Observation Session 1, Si2)

Rather than two distinct language forms though, some writers have described the dialect situation (in the Caribbean) as more of a continuum, with speakers 'located not at points on the continuum but in zones, the range of the zones corresponding to the range of their ability to manipulate linguistic forms.' (Alleyne, cited in Thompson, 1984, p161). Some forms of the English dialect spoken in A&B (and the Caribbean) are closer to the 'standard' English than are others, as is illustrated in Observation Excerpt 6.16-2 where the talk of some of the boys is closer to the recognisable 'standard' English than the talk of other students given in both excerpts. For example, in Observation Excerpt 6.16-2 the boy who addressed his request to use a pencil to the teacher in that request used a form of English closer to the recognisable 'standard' than he – the same boy – then later used in commenting in general on the nature of the work the teacher was writing on the board. The boys of Si2 displayed a greater versatility in which form of the English language they chose to use, depending (but not always) it seemed on whom they were addressing, i.e. they appeared to occupy a greater zonal range of the language continuum, than did some students in Mi5. In these classroom observations carried out in Si2, but especially in Mi5, most often there appeared to be little overlap on the continuum of the language being used by the teacher and that being used by the students. One possible consequence of this disjuncture of languages being used in the mathematics classroom is that students find themselves having to listen more intently to what the teacher says not just as a matter of hearing and trying to understand the mathematics, but also as a means of hearing, and perhaps trying to understand the spoken words, and indeed perhaps even translating those words to that of their more comfortable vernacular.

Student interviews further supported the idea that language and students' ability to understand or de-code it, or their level of access to the language of the teaching did play some role in how they could 'know' the mathematics. The following are three excerpts from student interviews which support this view:

Interview Excerpt 6.16-1

Int: […] is maths different from the other subjects?

G1: Yeah.

G2: Not really.

G1: Yeah, maths deal wid ((with)) too much a numbers.

G2: English too, 'cause English…

[…]

G1: And you have word problems.

G4: Maths more complicated because the teachers and them the way they explain it they nah ((not)) really go through certain steps, step to step…

G1: They nar ((do not)) explain properly.

G4: They jump from one place to the other.

[…]

G3: It entails English too 'cause the worded problems.

Int: Uh huh, that means you need to be able to do what?

G3: Read, understand, read and interpret.

[…]

G4: Yeah, yes, it's true nuh ((you know)) because some of the words in maths, right, in order for you to work out the maths and so you have to know the meaning of the word or so, so it's basically English or…

[…]

G5: No, like, nuh, it's like, that 'okay' dere ((there)) mean like that's what he's trying to say, is like, wha' he a say? Me no know one ting he a say nuh ((I do not know one thing he is saying you know)), all me a hear a jus' words a come out a he mouth.

(4+2 girls, Mi4)

Interview Excerpt 6.16-2

Int: Do you find that if you talk maths with your friends in maths class and you talk maths with your friends you understand better than…

G's: Yes, yes.

G2: I can say yes, definitely yes with that.

G1: Some of them have an easier way to break it down than the teacher.

G2: Or explain. Yah, and when we find out we say 'Why he couldn't just say that?'

G1: Yeah

G2: Instead of having all this long, long list of things and we not getting to the point.

(3 girls, Mi5)

Interview Excerpt 6.16-3

Int: Is that [needing to use 'brain power' in maths] different from your other subjects?

G1: Yes.

G2: No.

G1: Some

G2: It's different from some, not all.

G1: Some, because like, 'am Principles of Business, you just write notes, memorise,…

[…]

G3: And subjects like English B [literature] I find it similar because you have to think and analyse.

Int: So, in English B you have to think and analyse, and in maths you have to do the same?

G1: Yeah.

(3 girls, Si3)

In Interview Excerpt 6.16-1 the group of students brought up that their level of command of the English language did at times affect how they understood the mathematics teacher, or some words used by the teacher. As the students had brought the matter of English (language) up, I had in this interview continued by asking the group about the meaning of the fairly commonly used phrase in mathematics problems 'at least', for example as in 'How many students scored at least 10 marks'. Half of the students present thought the phrase meant 10 or more, and the others thought it meant 10 or less.

In its 1992 report on the mathematics examinations, CXC had in its general comments noted that terms such as ''least', and 'at least' posed difficulties for *most* candidates', prefacing this by saying that 'proper use and interpretation of words and phrases need to be stressed at both proficiencies.' (CXC, 1992, my emphasis) However, outside of mathematics classes, this way of expressing for example, 10 marks or more, is uncommon in the students' everyday language, in the dialect spoken. The comment of G3 later in this interview excerpt, that in order to do word problems in mathematics one needed to be able to *'read, understand, read and interpret'* is instructive. Her comment is supported by G4 in the same interview, who suggested that one needed to know the meaning of some words in maths before being able to attend to the mathematics itself. For mathematics, there is another layer added to what students need to be able to do to be successful. The students in making these comments seemed to be more concerned with the language of mathematics questions rather than with the mathematics content itself, making the point that reading was a necessary but insufficient condition in beginning the process of solving these problems. G3 in Interview Excerpt 6.16-3 does make some similar references when she likened mathematics to English literature in that both required a student to be able to not only read, but also to think and analyse, i.e. make sense of the content given.

Related literature on language in the Caribbean supports what it is these students may be implying. Craig (cited in Thompson, 1984, p167) for example has noted some possible consequences for the otherwise Creole speaking young child being taught from the beginning to read 'standard' English, one such being that these children would have difficulties relating the written words with the meanings they represent, to the end that whilst some children may learn and be able to say what the word is, they may be doing no more than 'barking at the print' as some children may be unable to make sense of their reading. This is further complicated by the fact that Creole/dialect remains largely a spoken and not a written language within the Caribbean. Whilst this situation of reading without meaning may be expected to have been reduced with increasing years of schooling, the comments of the students in the Interview Excerpt 6.16-1, and in particular that of G4 towards the end of the excerpt given here do suggest that there may be times in mathematics where this (reading without meaning) is in effect what happens.

The student G5 towards the end of Interview Excerpt 6.16-1 provided the means for beginning to deconstruct what may be involved when some students refer to being attentive or listening in mathematics classes, and her comments also provide support for some of the discussion earlier. For her, although she tried to listen, what she was doing was hearing, so that she was at times unable to make sense of what had been said, as much, it appears, from trying to understand the mathematics as from trying to understand the words being used by the teacher. There is a suggestion here that the words in use that she was hearing are sometimes unfamiliar to her, and so she has little means of forming connections with her existing language and mathematics structures. Forming connections for some students in mathematics classes may well be at a premium as earlier in Interview Excerpt 6.16-1 the interviewee G4 criticised the approach of teaching mathematics on offer because of the disjointedness of the approach. The teaching, perhaps because of a concentration on what words the teacher was using, and the mathematics content itself were lost to her. In listening to the teacher, and hearing his words, she was also having to *consciously* try and understand the teacher and the words or language in use.

But what recourse did students have when they did not understand what the teacher was saying? Students could, and did from classroom observations, say so when they did not understand. But there is evidence that they did not always do this, and that some students did not do this. When they did do so however, it was noted that a frequent strategy used by teachers was to repeat or re-explain what they had just said. It, for want of a better term, seemed to be the default strategy for this situation. There were students who welcomed this strategy (e.g. see Questionnaire Excerpts 6.16-2 later this subsection). The strategy though brought across the impression that teachers' interpretation of students' not understanding was that they had not listened, or perhaps that they (the teachers) had gone through too quickly and so needed to repeat what was said, slowing it down as necessary. This impression from classroom observations was also supported by a student in interviews who noted that: *'And if you have a problem with the maths subject right, and you explain the teacher, he ga' ((he is going to)) jus' say, you weren't listening – that's the first thing'* (G4, Mi4).

The process of coming to understand another person's talk has been described as follows:

> To understand another person's utterance means to orient oneself with respect to it, and to find the proper place for it in the corresponding context. For each word of the utterance that we are in process of understanding, we, as it were, lay down a set of our own answering words. The greater their number and weight, the deeper and more substantial our understanding will be... Any true understanding is dialogic in nature. (Voloshinov, given in Wertsch, 1991, p54)

From this, an interpretation of what G5 says at the end of Interview Excerpt 6.16-1 is that at times she had found that she had limited 'answering words' to lay down to those being used by the teacher in mathematics classes, and hence little scope for orienting herself to what was being said (cf. also with the sense in which 'orient' was used by Davis (1996) given earlier on p125). A similar situation appears to also be the case in the students' comment in Interview Excerpt 6.16-2, where the language of a mathematics content had at times been made more understandable when explained by a friend than when been done by the teacher. In that interview excerpt, the problem as described by the student G1 when referring to breaking it down could be interpreted as one of a level of language use, and could be seen as a problem of disjuncture of what zones along the language continuum the teacher and students were operating in. Where this disjuncture means there is little overlap of these zones, then students' access to 'answering words' in their attempts to understand the mathematics is restricted. As outlined earlier in Subsection 6.1-4, in student questionnaire data various students did also refer to 'breaking things down' as a means for them to understand the mathematics better, or something they liked about their teacher. Implicit in these comments is a reference to language, perhaps both the technical language of mathematics, and also the otherwise communicative language being used to get ideas and concepts across.

So, it may be that this overt focus on 'listening' or 'paying attention' in mathematics does 'get in the way' of actually learning mathematics for some students (e.g. quote given at the beginning of Section 6.1 from Ruddock et al cited in Boaler, 2000, p4). It may also be that this is more so the case for a greater proportion of students in mixed rather than single-sex schools. It could be argued that students in mixed schools have been able to pass English Language based on the data of Section 4.2, and on that basis the strength of language as a factor that gets in the way of learning mathematics is somewhat reduced. The data of Section 4.2 show that for students in mixed schools between 50-60% of them have been successful in English Language for the years given (e.g. Figure 4.2-4(c) and Table 4.2-2(b)). However, a look at the proportion of students who have been successful at the two higher grades (Grades I and II) in English Language shows this proportion for students in mixed schools to be on average approximately 25% of the successes, whereas that for students in single-sex schools is on average approximately 70% of the successes. In other words, more than one-half of students in mixed schools who have over these years been successful in English Language have been so at the lowest of the grades possible for success, Grade III, whilst for students in single-sex schools the Grade III has consistently been the grade at which the least proportion of students have been successful. Whilst students in both these school-types did describe what they did in mathematics classes as listening (Tables 6.16-1 and 6.16-2(a)), there may be a greater 'distance' to be made or more to be done by some students in orienting themselves so that they can come to understand in the sense given by Voloshinov (cited in Wertsch, 1991, p54), based on what their *initial* starting point in *subconscious* language use is (i.e. the form of the language they are predisposed to use).

It might also be argued that students would have access to a simpler form of talk via each other, as has been suggested by the girls in Interview Excerpt 6.16-2, thus reducing the distance or the work which needs to be done in orienting themselves to understanding the mathematics. Whilst not discounting that this does happen, it had been noted from classroom observations that students, but more so girls, tended to work individually on questions when given class-work, and only appeared to communicate to each other about the mathematics when they encountered a problem, or as a means of checking their work. (For a gender comparison on students' perspectives on doing mathematics with others, see item no. 18 in Table 6.11-2, Subsection 6.1-1; compare also this finding on students' classroom behaviour during mathematics to what teachers had to say in Questionnaire Excerpts 5.22-1, Section 5.2-2). The following excerpt provides the perspective of a group of students on the matter of working in groups, when asked why they tended to work by themselves when given work to do. The behaviour had been noted during observations in their mathematics classes:

Interview Excerpt 6.16-4
G3: No, we try and work it out ourselves.
G1: First ourselves and wherever we're going wrong, we ask around for help.
G2: That's the right way.
Int: That's the right way?
G3: I think that's the right way, because...
G2: They will never know your real ability.
G1: Exactly, because when CXC comes, we're not going to have... you understand?
G2: If we're all here, and we're all working together all the time, we'll never know our real ability.
G1: Exactly.
(3 girls, Si3)

Thus, students had restricted access to the use of the 'talk' aspect of language as a resource for their own use whilst in mathematics classes, which meant that they had few extended opportunities to publicly express and/or display their mathematical mis-/non/-understandings not only to the teacher and the class as a whole, but more informally to their classmates and friends. This could also therefore mean that they were generally unable to aid their thought processes via this means of talk (Pimm, 1987, p23). There is almost some sense in which link(s) is/are missing in the learning process.

Student responses to these classroom related questions, and others, also brought to the fore the importance of the teacher in students' school experience of mathematics. The issue of the mathematics teacher and things attached to him/her were brought out over several questionnaire items, including questions that did not directly address 'the teacher', and also directly and indirectly in interviews. Asking students specifically about their views of their mathematics teacher had attached ethical implications, so such a question was not directly put to students. However, and as might be seen from the preceding, students did speak both positively and negatively about mathematics teachers and mathematics teaching. Most of the extended questionnaire responses students gave were usually concerned with the mathematics teacher or mathematics teaching, for example the following responses from students in a question inviting any other comments:

Questionnaire Excerpts 6.16-1

It is not really that people do not like maths but instead take long to understand. Take me for an example. Some work I did not understand in primary school I still don't understand it. It is not because I am dunce is because I am not quick in learning things so I would really have to sit down and take time to understand it and sometimes the teacher would say I am not spending all year on one topic so I would not understand the topic fully as they say all horse don't run alike so is not everyone is meant to learn something quick so is just time and patient (sic) you need to teach maths and you should have put in the questionnaire if your teacher takes time with you to show you a sum. My answer is no. (18F, Mi2, Dislikes mathematics, Rates performance as Satisfactory/Fair/ Passable).

Maths should be made more fun and exciting for the students instead teachers just going on the board and telling us to do something. Maths teachers should be extremely patient with their students because all of us don't run at the same pace. (23F, Si1, Dislikes mathematics, Rates performance as Satisfactory/Fair/ Passable)

I love the subject maths sometimes, I am really trying my best to pass the subject but I just don't seem to have the right maths teach (sic) yet. (25M, Mi7, Dislikes mathematics, Rates performance as Unsatisfactory).

This is not to say that all student responses concerning the mathematics teacher were negative. As some findings in the preceding subsections do illustrate, students did also have positive things to say about their mathematics teacher (e.g. Subsections 6.1-2, 6.1-4). Further to those results, in other questionnaire data to an open item, 73 students gave the teacher or things related to him/her as what they liked best about their school mathematics classes, and this response was the most frequent response given to this question. Comparatively 29 students gave the teacher as what they liked least about those classes. (For a complete list of coded students' responses to these items along with frequencies, see Appendix D1, Section IV, Tables Q8 and Q9). Examples of student responses which gave the teacher as what they liked best are:

Questionnaire Excerpts 6.16-2

I like the teacher mostly because she explains and makes sure the students understand. (6F, Si1)
Teacher is informative (25M, Si2)
The teacher is very patient with us and tries to go over as much as he can. (6F, Si3)
The teacher explains the work very well (18M, Si4)
My teacher has patients (sic) with me (9F, Mi1)
When you don't understand the teacher usually explain it over again. (32M, Mi2)
When she [the teacher] give (sic) realistic examples. (7F, Mi3)
I like when the teacher is answering my question when I don't understand. (18F, Mi4)
It is fun and the teacher make (sic) it that way (9M, Mi5)

The teacher is funny and kind. (14F, Mi6)
The teacher goes slow (16F, Mi7)

These examples provided are also used to illustrate that there was at least one student in each school who gave the teacher and/or things related to him/her as what they liked best about their mathematics classes. The examples also serve to illustrate what it is that students value about their mathematics teacher and mathematics teaching. The teacher breaking things down, explaining the work well, re-explaining and taking note of students' concerns when they don't understand, having patience, going slow, being knowledgeable, using examples in teaching that students could relate to were features of responses students gave to various items throughout the questionnaire. Wrapped up in some of these student questionnaire responses were also issues that could be related to the language being used by the teacher, whether it be the technical language of the mathematics itself, or the form of English that was in use, as was suggested by students' responses provided in Questionnaire Excerpts 6.14-3 in Subsection 6.1-4.

6.1-7 Students' Views of their Parents' Expectations and Mathematics

As noted previously, along with teachers, parents are a part of the environment of students' schooling and hence also of their mathematics. Parents, and their expectations of their children's mathematics have significant import for the dispositions that students bring with them to the classroom, how students perceive it is that they can be, what they can do, whilst learning mathematics. In other words, parental expectations are an important aspect of how it is students may view the *need* to be successful in mathematics in school (e.g. in Section 1.3 and the idea posited that a reason Caribbean/Jamaican students do not perform well in mathematics was due to low parental expectations). As such, the findings to be presented address in some ways RA (c) and RQ1(b)&2, that is, those having to do with students' approaches to learning/doing mathematics, how they may have come to have those approaches, and inter-relations of these approaches with their mathematics performance. Student questionnaire data did not directly address any parental issue about students' and mathematics, but interview data did. Thus, the findings to be presented here come from students' responses during interviews.

During interviews students were asked if their parents had any particular expectation of them with regard to mathematics, and how this expectation may be different from (or the same as) that in other subject areas. Thirty-four out of 40 students directly responded to these questions. For students in single-sex schools, 8/11 (72%) thought that their parents would 'make a fuss' if they failed mathematics, with two students saying that their parent(s) would do so 'sometimes'; the remaining student did not think that his parent would be too hard on him, as he (the student) did not want to do mathematics. For students in mixed schools, 13/23 (56%) thought that their parent(s) would make a fuss if they failed their mathematics, whilst the other students did not think that this situation would particularly matter to their parent(s), and in some cases that their parent(s) would be fairly accepting/understanding of such a situation. The following are six interview excerpts which illustrate the view of some of these students regarding this issue, with examples chosen to reflect the school-types:

Interview Excerpt 6.17-1

Int: [...] do you find that your parents have any particular expectations of you in terms of maths, meaning...

[...]

Collective: Yes

G3: They say that's one of the most important subjects.

[...]

Int: Yes? So they expect you to pass?

Collective: Yes.

G2: 'Cause my Mom's a teacher so... and she teaches maths..

[...]

Int: [...] and is that maths in particular, or is that any other subject, let's say you're doing 8 subjects and you failed Home Ec., [...] would she be, he or she be the same way about that as if you had failed maths?

Collective: No.

Int: No, they'd be...

G1: Because I got 63 for mid-term maths and 54 for OP, they still ignored the OP and just told me about the maths.

Int: Oh, okay, so they'd be harder on you about the maths?

G1: Yes.

(4 girls, Si1)

Interview Excerpt 6.17-2

B1: [...] my father would normally drill me into getting my multiplication and everything but sometimes I didn't understand what he was doing this to me for so that he could make me challenge more and more other problems coming up [...]

Int: [...] do you find that your parents have any particular expectations of you with regard to maths? That is, let's say, [...] you're doing 8, 9 subjects and you take home your report and you've failed maths, but you passed everything else, would they really get down on you?

B1: Sometimes.

B3: Sometimes.

Int: Sometimes?

B2: They're expecting hundreds always. [...] If I get like 95...

Int: That's bad?

B2: Yeah

(3 boys, Si4)

Interview Excerpt 6.17-3

Int: [...] Do you find that your parents have any particular expectations of you with regards to maths? Like, let's say you passed all your other subjects and you failed maths, would they make a fuss?

G2: Yes.

G1: Yes.

Int: Yes?

G1: They would make a fuss because they say maths and English make you go to college, and they want you to go to college.

Int: So they would make a fuss.

G2: Yes.

Int: Same reason?

G2: Yeah

B: Same thing.

[...]

Int: ... Let's say you had failed Accounting but passed everything else, would they make the same sort of fuss about that?

G's: No.

(1 boy + 2 girls, Mi1)

Interview Excerpt 6.17-4

Int: Okay. You find that your parents have any particular thing they expect about you in maths?

G1: Nuh

Int: Like if you take home, let's say you doing 8, 9 subjects, and you failed maths would they make a fuss?

G1: No

Int: ... And you passed everything else?

G4: No.

[...]

G3: If I failed maths, they'd make a fuss.

Me: They'd make a fuss? If you passed everything else but you failed maths...You don't know?

G2: I don't know.

[...]

G1: Fu me Mummy nar mek no fuss 'cause she know me no lub maths. ((My Mother will not make a fuss because she knows I don't love maths.))

[...]

G3: Well, she knows I love maths.

Int: Let's say you passed everything else but failed hmmm Agri Science say, I don't know if you do it, would she make a fuss?

G3: No.

G4: Yes man.

G1: Yes.

G2: Because Agriculture takes a lot of money, you see, you have to buy a lot of things.

[...]

G2: Okay, in school, it takes a lot of money.

Int: So if you failed it she would fuss?

G2&4: Yeah

G1: All the money

G2: 'Cause she's spending her money and we're failing the subject, but I always pass Agri.

(4+2 girls, Mi4)

Interview Excerpt 6.17-5

Int: [...] your parents, do you find that your parents have any particular expectations of you with regard to maths?

G3: Um hum.

G1: Well, yes.

Int: Yes?

G2: [Laughs] I don't even know.

Int: You don't know. Yes. Let's go... let's take you first.

G3: 'Am, like if today I did a test and get it back, and, I fail, my Dad and my Mom would say, 'How you fail maths, how you fail maths? You supposed to pass. These are easy, why you fail it?'

[...]

Int: Okay, if it were Social Studies, and you failed Social Studies, would they have reacted the same way?

G3: Yes, sim... similar.

[...]

G2: My parents, all they would tell me is work harder, work harder.

[...]

G1: All of them would be mad. They would tell me I need to do better, and how I could fail it because I go to extra classes...

Int: Um hum. For maths?

G1: ... they would expect me to pass it because I go to these extra classes.

(3 girls, Mi5)

Interview Excerpt 6.17-6

Int: [...] Do you find that your parents have any particular expectations of you with regard to maths? [...] Let's say you passed everything else and you failed maths, would they have made a fuss about that?

B: Well, yeah, because for maths, you have to... it's a compulsory subject for CXC and right now we're 4th form students, we're supposed to be like, grasping, getting it to go on to CXC level..

Int: So, she'd make a fuss about that?

B: Yeah.

Int: Or he.

G: Not my mother.

Int: She wouldn't make a fuss if you failed maths? Why?

G: Because I always fail it.

Int: You always fail...

G: She's glad because I pass it now.

Int: She would be glad if you passed it – but she wouldn't say anything if you failed it?

G: She says she had the same problems before.

(1 boy + 1 girl, Mi7)

These data from students of their parental expectations with regard to their mathematics performance are second-hand data since they were not directly obtained from the students' parent(s). However, the import of these students' responses is just that – they are from the students and thus represent students' perceptions; it is what students' think are their parents' expectations. One could argue that students may then be influenced in some ways to act out in schools to reflect this perception of parental expectations, particularly in cases where the learning/circumstances may well to them seem difficult (e.g. see references to sleeping during mathematics classes (Tables 6.16-1, 6.16-2), and also absenting oneself from such classes (e.g. Interview Excerpt 6.12-1), this last given particularly by students in mixed schools as something they did do or could do).

Although limited, one of the other findings that concerned parental expectations and mathematics concerned the sex of the parent. When students did specifically identify a parent as not being upset if they failed mathematics, this parent was always the mother; this is not to say that all mothers would not be upset – some students did highlight that their mother would be upset if they failed mathematics – but, the point being made is that no student in identifying who it is that would not be upset, specifically identified a father. This, amongst other things, may also be a product of with whom the child lived, and more students in mixed schools lived with their mother only than did students in single-sex schools (Tables 5.1-1 and 5.1-2, Section 5.1). During fieldwork in A&B there were only two instances in which specific mention was made of a father in connection to mathematics; both these instances occurred in each of the boys' single-sex school, and had to do with the boys doing mathematics with their father. The first instance occurred in the Interview Excerpt 6.17-2 given by B1, where he spoke of his father's drilling him with his multiplication when he was at primary school. The second instance had occurred in an observation session in Si2, where one of the boys had shown me some work on Binomial expansions, work which he said he was doing with his father.

Additional to this finding of students' perception of parental expectation of their school mathematics performance, there is present in the responses of some students in the mixed schools (G's 1,2, &4 in Interview Excerpt 6.16-5 and G1 in Interview Excerpt 6.16-6) their perception of the value their parents would associate with the *need* for their success in mathematics and other subjects in school if the parent had to in any way pay/provide extra help outside of what was normally required, e.g. paying/providing for extra mathematics lessons outside of school, or paying for materials needed in school. Whilst this perception might well also be present for some students in single-sex schools, such considerations did not feature in the responses of any of the 11 students interviewed from the single-sex schools. It may well be that the interview sample of students from the single-sex schools is limited, and so that this finding is an artefact of the sample used. On the other hand, one could consider this finding in relation to the number of schools used; this extra provision/money aspect was not mentioned by any student in the four single-sex schools, whilst it was mentioned by student(s) in two of the seven mixed schools. This finding potentially points to a disposition – a habitus – some students perceived their parents hold, that anything that is paid for is of greater value than anything that is free, and some of these students may well, subconsciously, bring this disposition with them to school and schooling processes.

6.2 Students Doing and Learning Mathematics

Section 6.1 addressed mainly (but not only) students' views of mathematics. However, it seemed pertinent to include some perspective on these students doing and learning mathematics, in order to be able to address RQ1(b), RA(c) and those aspects of RQ2&3 about students' approach to doing and/or learning mathematics. To this end, this section contains two further subsections, the first of which presents findings and interpretations from students' attempts at an algebra task given during interviews, which is followed by findings and interpretations from data obtained in classroom observations. As the subsections include interpretations of the findings, they are discursive in nature. The interview data revealed some student approaches to doing mathematics, possibly indicating how they were learning mathematics. The observation data in particular provided snapshots of students in mathematics classes doing and learning mathematics. These snapshots allow for a look at the more micro-level processes that may have influenced some of these students' views reported earlier in this chapter concerning what these students do in mathematics classes and how they approach doing and/or learning mathematics in these classes. It also brings out some of the 'micro-interactional processes' whereby students' use of what they know and how they are disposed to use it and also to be in mathematics classes may represent a good fit or not to that expected, i.e. the 'institutionalized standards of evaluation' (Lareau & Weininger's qualitative conceptualisation of cultural capital – see Section 2.2 p28). Since classroom observations involved observations of things as they were, the topics covered in the classrooms observed were not the same, so a cross analysis of how students' responded to the same mathematics question is impossible from observation data. Observation data though do provide information on how students may have been predisposed to think and be in mathematics classes, and to doing mathematics. The algebra task given during interviews represents the only mathematics question to which a cross-school analysis is possible of the same task/question.

6.2-1 From Interviews – The Algebra Task

As mentioned in Subsection 3.3-1, the interview schedule had been revised *in situ* to include (amongst other revisions) an algebra task. This decision had been made as it had been noted from questionnaire data that a number of students had specifically referred to algebra, usually to say that they did not like or did not understand it, although a few students did give it as a topic area in mathematics that they liked. Additionally, during the course of the first interview conducted, a student had specifically mentioned that *'Sometimes algebra no mek no sense ((does not make any sense))'* (B1, Mi3). The algebra task was not given in this first school, but was given in all the other participating schools. Amongst other things, as mentioned in Subsection 3.3-3, there were time constraints on the interview in Mi3, and also it was the interview which involved all members of the participating class.

The following was the task given during interviews. It was generally asked as indicated, sometimes pointing to the terms on the paper on which they were written:

How would you do this? If you saw this on a mathematics paper, what would you do? 3a + 4b – 7a + 2b.

The question was asked in 10 of the 11 participating schools. The task came to a mathematically correct end in 3/4 single-sex schools and 2/6 mixed schools, a result which compares to the proportion of students who are successful in mathematics in the CXC/CSEC examinations of students in these school-types from the documentary data of Section 4.2. The interview excerpts presented here are firstly for 4/6 mixed schools, three which had given a 'wrong' answer and one which gave a 'right' answer, and secondly for all four of the single-sex schools, with the school which had given a 'wrong' answer given last. These results for 8/10 schools are presented in order to show similarities and differences in students' approaches to doing the task. Findings from the task mainly relate to students' use of rules, and *inclinations* in use based on students' gender and school-type (read social class). In the excerpts presented, wherever students appear to be invoking the use of a (new) rule, these passages have been highlighted.

Interview Excerpt 6.21-1

G1: You simplify it.

[…]

G2: You like group all the like terms.

G1: All the a's…

B: You group the like terms.

Int: Okay. And what you mean by 'like terms'?

G2: 'Am…

B: The a's.

Int: The a's? […] And?

G1: The b's.

B: You can't add 3a and 4b and get an answer.

Int: Okay. Why?

G1: Because it not going to be right.

B: You can get an answer if you 'am multiplying it.

Int: Oh, okay, but not if you adding it?

B&G's: No. […]

B: Because you can't add letters.

[…]

G1: You could a do it nuh ((you know)), but it going to not, if you going to do it, it going to be wrong.

Int: Okay. Okay, just tell me how you would group the a's together…

G1: You put…

[…]

B: You have 3a and you have…

G1: You put…

B: … minus 7a, so you have 3a minus …

G1: No, you put the 7 first, you put…you don't bring… you don't… you carry the smaller number, you don't carry the larger number.

Int: Okay, that's, that's what you said. Do you agree with her?

B: Yeah, that's what the teacher said.

Int: Carry the…?

B: Smaller number

G1: Smaller number, you don't carry the larger number.

Int: Okay, so what does that mean? I don't understand what that means.

G1: You see like you have 7, you carry the 3a over on that side, so you have 7a minus 3a.

[…]

Int: Do you agree with what she said?

G2: Yes.

B: Or 7a plus 3a.

Int: You going to…

G1: No…

B: Because it's a number without a sign is basically as positive.

Int: Okay… so…

G1: You carry… this is positive, so when you carry it on the opposite side you always like, if it going to be negative or positive, you always change the number.

Int: Okay. Do you agree with what she said?

B: What? Could you repeat that?

G1: You always… if you have a positive and you going to move it on the opposite side, you always carry… you always change the signs, because it not going to be right…

[…]

B: <u>Sometimes</u> you change the signs.

G2: Yes.

Int: So, you agree with what she says?

G2: Yes.

Int: Sometimes you change the signs?

G1: No…

Int: I just want to know, when you put the a's, there's a, there's a 3a, which you've said is positive, and there's a 7a, I just want to know, when you put them together, what do you write, how do you write the 3a and the 7a?

G1: It goin' be negative 7a minus 3a.

Int: Do you agree with her?

B: Yes.

G2: Yes.

[…]

Int: Okay, what will happen with the b's now?

G1: It going to be the …

B: You do the same thing …

G1: It's the same thing, but it going to be positive 4a…

B: 4b

G1: … positive 4b minus…

B: Because of the signs.

G1: … minus, minus, minus negative.. minus 2b

Int: Okay. Do you agree with her?

B: Or you can, sometimes, sometimes, I would put, you have positive 4b because you already have the signs and them and you have a plus sign between the 7a and the 2b, so the 2b already has a sign, so it's gonna be positive, you don't really put the sign in front of the number because a number without a sign…

G1: You already know it's that.

B: … in front of it is positive, so you have 4b plus 2b.

(1 boy + 2 girls, Mi1)

Interview Excerpt 6.21-2

G1: Well, you group…

G3: You group…

G1: …. you group them…

G3: … int…

Int: Them what?

G2: Group the 'am…

G3: The like terms…

G2: The like terms.

G3: … together.

Int: The like terms are like which ones?

G3: 3a

3G's: 3a and 7a

G1: You put them together.

Int: Uh huh.

3G's: And 4b and 2b.

G1: You put them together.

Int: Okay. And how would you put the a's and the b's together?

G3: You say 3a…

Int: Uh huh.

G1: You transmit it over here…

G3: Trans 'am… no…

G2: You could do any… both ways, you could bring over, or you could…

[…]

G3: Well, the 7a have a minus sign in front of it so you carry over the negative… minus 7a over to the 3a…

G2: And put… and then it becomes …

G3: 3a… positive 3a minus 7a and, you say, plus 4b…

G1: It's…

G3: … negative 4b plus…

G1: 2b.

Int: Do you agree with what she said?

G1: Well, I would carry the 3 over here and the 2 over here, so the 3 would become negative by the 7, and the 2 would go over here and become negative from the 4.

[…]

Int: Do you agree with what she said? I think she said something different to what you said.

[…]

G3: Well, it can do both ways…

G1: It can work both ways.

G3: … 'cause you gonna get the same answer. You supposed to get the same answer.

(3 girls, Mi5, 3 girls)

Interview Excerpt 6.21-3

G: Put all the a's together…

Int: All the a's…

G: And then put all the b's together. You say 3a 'am plus 7a, and just write the answer, 10, then 4b minus 2b…

[…]

Int: Okay. You heard, you heard what [Name] said? You agree with her? […]

B1: You put all the a's together. […] The negative sign supposed to become a positive sign.

Int: The negative sign supposed to become a positive sign. Okay. You agree with what he said?

[…]

B2: 'Am, I don't know, no.

Int: No, you don't agree with that part. Okay. Well, what, what do you think is supposed to happen next? After you put the a's together, what happens?

B2: You add 7 and 3 […] and you add 4 and 2, and subtract what you get from…

Int: Oh, okay, so you add 7 and 3 and get 10a? [Nods head] And 4 and 2 and get 6b but you write 10a minus 6b you mean?

B2: You add 3 and 7, you get 10a, and 4 and 2 you get 6b, and then minus6b from 10a.

(1 girl + 2 boys, Mi6)

Interview Excerpt 6.21-4

G2&3: You group the like terms… [Pause]

G3: And then, if you say…

G1: And then you go try everything.

G4: If you moving them, when you moving them to the other side of the 'am…the signs dem goin' change

G2: Okay, you go say 3a plus 7a

G3: 3a take away 7a, and then you say…

G3&2: … plus 4b plus 2b

(4+2 girls, Mi4)

Interview Excerpt 6.21-5

G1: Group like terms together…

Int: Group like terms together. Like terms means?

G1: Like what's common

G3: 3a and 7a and 4b and 2b.

G1: Then you see what's common between the first and open brackets and…

G3: Yeah.

G1: … a's outside and then say 3 minus 7, and then you say b and 4 plus 2.

G2: No…[drawn out]. You sure? You just put the like terms together and find out the answer.

Int: Okay.

G2: You just do them together and you just find out the answer. This minus this and that plus that. [Points as she says to the 3a, 7a, 4b, 2b, in turn.]

Int: You agree with what she said?

G1: Yeah, you can do it that way.

G4: You can work it out.

Int: I don't necessarily want to know the answer, I'm just asking how you would have done it.

G2: Is it 6b minus negative 4a, minus 4a, and then that's the answer, bam.

(4 girls, Si1)

Interview Excerpt 6.21-6

B: Well, I can tell you the answer from this, but… I would just put that with that, and that with that, that would, take away that from that and add that to that. [Boy indicates by pointing, putting the 3a with the minus 7a, and the 4b with the 2b, and that he would take away 7a from 3a and add 4b to 2b.]

(1 boy, Si2)

Interview Excerpt 6.21-7

B2: So 3a minus 7a… […] …Plus 4b plus 2b.

Int: Do you agree with what he said?

B1: Yes I do.

[…]

B3: Yes.

Int: And?

B2: Like when you add 3a plus, no minus 7a, that's minus 4a, plus 6b.

[…]

Int: So it's a case of doing what to the 'am… to the variables?

B1: Grouping… grouping like terms together.

(3 boys, Si4)

Interview Excerpt 6.21-8

G3: Group like terms.

Int: Group like terms?

G2: Yeah, group the like terms.

[…]

G3: The b's and the a's.

G2: 7a's plus

G1: 7a's and

G3: You group them together.

G2: Yeah, you group all the a's and all the b's and then you work the sum.

Int: I don't want to know the answer, but, how would you put the b's together?

G3: 4b minus 2b?

[…]

G1: Ah, yeah…

Int: … and how would you put the a's?

G1: And 3a plus 7a.

G2: Plus 7a.

Int: And everybody agrees with that?

G2: Um hum.

G3: Yah.

(3 girls, Si3)

A total of eight rules were identified in overall student responses from the 10 schools, to include: group like terms; can't add (different) letters; carry the smaller number (let the smaller follow the larger); a number without a sign is positive; when carry (transmit, move) to the opposite side, change signs; sometimes you change signs; find what's common, and put in brackets; try everything. With respect to the 'rule' of moving the smaller rather than the larger term made explicit by G1 of Mi1 in Interview Excerpt 6.21-1, but also apparently guiding the response of G1 of Mi5 in Interview Excerpt 6.21-2, an example of a teacher giving this rule did appear in classroom observation sessions in Mi5:

Observation Excerpt 6.21-1 (from a session about two months prior to interview)

The lesson is a review of algebra, and the teacher has asked the class to solve:

$3x - 1 = 5x + 6$

The teacher says to the class that the equation has four terms, and asks the class what to do next. Some students say that like terms should be moved to the same side. The teacher asks the class if there is a choice of what to move. Some students (notably fewer than before) say 'Yes'. The teacher says that usually, you would let the smaller follow the bigger, like if you go out with your younger brother, he usually would follow you. A girl says 'We're dealing with maths now nuh'. The teacher says 'Maths is about life.' The teacher goes on to say that any of the terms can move, but it is usually easier to let the smaller follow the larger, that is, taking 3x over to the side with 5x. (Excerpt from Observation Session 6, Mi5)

In giving the task, the rule of grouping like terms together was expected, but the 'other rules' students invoked were not. Within this rule-use there was some difference in how students in some schools made use of rules in giving their response: for some students, rules were things to work with, select amongst, ease in and out of, as needed; for other students, any rule, once given by the teacher, was to be used. Some students in explaining how they would work this task used rules with an at-home-ness, ease or sense of ownership (feel for the game) not apparent in the responses of other students, to an extent which made the use of rules virtually invisible; other students used any and all rules that seemed even vaguely relevant to the context to an extent which made the use of rules starkly visible. Students' orientation to using rules was different, and this difference tended to run along the lines of school-type and gender.

More specifically, some students in mixed schools showed an inclination to rule-use which drew their attempt to work through the algebra task to be more about the rules than the mathematics. With regard to the gendered nature of rule-use, it appeared that girls were more inclined than boys to use rules. The situation though is arguably somewhat unclear particularly within mixed schools as it was mainly girls who participated in interviews. That said, in Interview Excerpt 6.21-1, although the boy did use rules, he did seem to invoke their use mainly as a means of defending his response, and not specifically as a disposition to their use. In one case he appears to distance himself from a rule (when moving carry the larger) by saying *'that's what the teacher said.'* However, it is a boy in Interview Excerpt 6.12-3 who invokes the rule of changing signs. There was also some inclination to rule-use in the girls' single-sex schools. In Interview Excerpt 6.21-5 (Si1), G1 used brackets and picked out common terms, whilst in Interview Excerpt 6.21-8 (Si3), in addition to grouping like terms, the girls appear to be using a rule of changing the signs of whatever is being moved, although they do not explicitly say so. Whilst G1 of Si1 in Interview Excerpt 6.21-5 might be deemed to 'overuse' rules in working through the task, her rule-use does result in a choice which is not inappropriate to the task. Overall there seemed to be less of a tendency for girls in single-sex schools to use rules compared to girls in mixed schools. For example, in Interview Excerpt 6.21-2 for Mi4, even though the girls do come to a mathematically correct answer (largely based on the efforts of G3), others of the girls gave responses that indicated an intent/inclination to use some of these 'other' rules. The boys of the two single-sex schools if anything, showed a disinclination to use rules (Interview Excerpts 6.21-6, 6.21-7, schools Si2 and Si4 respectively). In neither school does a boy explicitly invoke the use of a rule, and in Interview Excerpt 6.21-7 one boy, B1, only does so when asked at the end of the solution.

Thus, in their attempts at this task some students in single-sex schools seemed more able to see the mathematics beyond the rules e.g. Interview Excerpts 6.21-6 and 6.21-7, whereas those in mixed schools seemed to lose sight of the mathematics *because of* the rules (e.g. Interview Excerpts 6.21-1 and 6.21-2). Rules given to mediate the working of algebra questions had for some students, more so those in mixed schools, constrained, rather than facilitated the process. For some students rules given in algebra were literally taken at face-value as things to be used whenever they encountered algebra questions, whatever the context. In employing the use of rules these students were in some ways taking a mathematical hammer to the question with the hope that some *thing* would eventually be right, this interpretation supported by the comment of G1 of Mi4 in Interview Excerpt 6.21-4 when she says *'...try everything'* giving this as a strategy for solving such tasks. There was a general tendency for students in mixed schools to make more use of rules and to use otherwise irrelevant and/or incorrect rules for this context. These particular students' responses also tended to be more hesitant and halting than those of students in single-sex schools. It would be difficult to say that students in mixed schools had not learnt anything in their mathematics classes, but the mathematics they had learnt at least from this example, was clouded in rules which they had not made sense of. Even in explaining how they would work the task, these students' choice of words or language-use still arguably had more of a ring of a teacher's voice than that used by the students in the single-sex schools, e.g. in addition to the language of the rules used, use of 'transmit' by G1 of Mi5 in Interview Excerpt 6.21-2, which G3 appears to try to correct in the next line, but gives up on having also apparently forgotten the 'correct' teacher-word. It was as if these rules were not their own; they were someone else's tools which students were having to carry about and 'try out' in algebra contexts. These students had an orientation to using rules as being inherently 'good', that their use would make the mathematics 'right' as it was the teacher who had given the rules. This orientation to rule-use by students in the two school-types provides a perspective of Bourdieu's description of the relation of habitus or embodied cultural capital and field. Students in single-sex schools, in particular the two boys' single-sex schools did appear to have a certain taking for granted-ness about rule-use in their approach to working this task; having encountered a playing field of which they felt themselves a part, they were like 'fish in water' (Bourdieu & Wacquant, 1992, given earlier in Section 2.2, p26). However, it seems the case that some students in the mixed schools were feeling the 'weight of the water' (ibid), had no sense of a feel for the game in relation to the fact that the task was algebraic, and so were prepared as a coping strategy to *'try everything'*.

It may be assumed that these teacher-given rules for student use were given with the best of intentions, that of facilitating the manipulation of algebraic terms, and perhaps even to relate mathematics to students' everyday lives as Observation Excerpt 6.21-1 suggests. However, the language and intentions of the teachers are at times in conflict with students' predispositions in ways of thinking and making sense of situations. For example, 'moving to the opposite side' is often said by teachers in relation to the manipulation of algebraic terms in solving (linear) equations, but from the evidence of this example some students in mixed schools seemed to have not recognised the speciality of that algebra context for the use of that rule, nor what teachers mean by 'opposite side' as it seems any movement of an algebraic term constitutes moving to an *other*, i.e. 'opposite' side. The language use and teaching norms of teachers in mathematics, e.g. giving rules, formulas, and the teachers' expectations of how students will make use of these rules have come into contact with a disjuncture or misfit of how some students may be predisposed to interpret these rules, that is, not as a *selection* of tools to aid the working of mathematical (algebraic) tasks, but as a *set* of tools to (always) be used. In Interview Excerpt 6.21-4, G1 of Mi4's referral to *'And then you go try everything'* suggests that trying everything was not a strategy or approach peculiar to the context of this task, but was an ongoing and continual 'resource' some students drew on in algebra and arguably other mathematics contexts perhaps when unsure or not recognising what was required. These micro-level processes (e.g. trying everything, using any teacher-given seemingly relevant rule) having to do with the ways in which some students may be predisposed to think and be and so mediating how they make use of what they 'know' (from what they have been taught) are the resource or embodied cultural capital available for them to draw on, and are what some students are otherwise coordinating with but this in ways not consonant with that expected by the teacher (e.g. Lareau & Weininger's conception of cultural capital given in Section 2.2 p28).

Bernstein's recognition and realisation rules (2000, p17) also provide a micro-level perspective via which this difference in orientation to using rules based on these students' school-type (read social class) can be viewed. In the schools where this task was given, all students recognised the algebra context and were able to determine what rules 'might' apply, but as discussed previously some students seemed unable to take the further step of distinguishing amongst these rules to determine which one(s) may be appropriate for the particular context. In Bernstein's terms, these students appeared to have limited access to an answering 'legitimate text' (Bernstein, 2000, p17). Specifically, recognition rules allow persons to 'recognise the speciality of the context they are in' (ibid, p17) whilst realisation rules present the means via which persons are able (or not) to respond appropriately (to answer) to the speciality of the context. Bernstein goes on to say that:

> Many children of the marginal classes may indeed have a recognition rule, that is, they can recognise the power relations in which they are involved, and their position in them, but they may not possess the

realisation rule. If they do not possess the *realisation rule*, they cannot then speak the expected legitimate text. (2000, p17)

With respect to this algebra task some students seemed aware of a somewhat powerless position in being able to 'answer' or produce the 'expected legitimate text', and so overcompensated by trying to mathematically subdue such questions *('try everything')*. Alternatively, students' recognition of a powerlessness in such contexts could also lead to some surrendering and doing nothing, as suggested and concluded by G5 in Mi4, despite the efforts of one girl, G3, to convince the other interviewees of the worth of algebra. Interview Excerpt 6.16-9 illustrates the dispositions of some students in this interview to algebra:

Interview Excerpt 6.21-9

G2: [...] it depends on the topic they teaching 'cause I like fractions and so, but something just wrong with me and Algebra.

Int: You don't like Algebra?

G1: Neither me.

G2: It's not that I don't like it nuh...

Int: It makes sense to you?

G1: No. E no mek no sense ((It does not make any sense)).

[...]

G3: It make sense, 'cause suppose you don't know something in the world you can use it. [Laughter] - Find out what it means.

G1: When you go work you ga ((are you going to)) have anything to do with b and a and x?

G3: So, if you're at the workplace and you don't know what something is...

G1: Ask somebody dat ((that)) know.

[...]

G3: Say you have an unknown, you don't know something, and you have a variety of things linking chains you can...

G2: You go say x something.

G3: ... work out the problem and find out what the answer be.

G1: Me no see why no body need fu' know how fu do dat, all a dem a counting ((I do not see why anyone needs to know how to do that, all of that is counting))

[...]

G5: Sometimes you like see all dem things in algebra right... sometimes e no mek no sense say me a go do it [algebra] because me nar go understand. ((Sometimes you see all those things in algebra, right, ... sometimes it does not make sense that I try to do it because I will not understand.))

(4+2 girls, Mi4)

Surrendering for some students thus appears as a legitimate coping strategy in mathematics classes when the mathematics just does not make sense, or is beyond the scope of where they are in terms of making sense of the level of mathematics (example, see the actions of the girl in Observation Excerpt 6.2-2 in Subsection 6.2-2 to follow). Surrendering or doing nothing was another disposition some of these students brought with them towards algebra and mathematics. It is noteworthy that when given the algebra task later in the interview from which Interview Excerpt 6.21-9 was taken G5 of Mi4 did not participate in giving a response (see Interview Excerpt 6.21-4), although she had been quite vocal in giving her views of mathematics during the interview. Specifically, Bourdieu (1984) suggested that doing nothing was a characteristic of the working class, 'a resignation to the inevitable' (p372), when their habitus (embodied cultural capital) encountered a field in which there is a sense of powerlessness.

The findings presented here do bear similarities to those reported in Cooper & Dunne (1998, 2000) and Cooper (2001) specifically in terms of what becomes obvious (or not) to students based on their social class backgrounds. Their work with primary age children in the UK was based on the use of realistic (i.e. questions set in an everyday context) versus esoteric (ones set in more abstract contexts) mathematics items in assessment. They noted that working class students become distinctly disadvantaged by the use of realistic items in mathematics assessment, suggesting that when faced with such items these students did not always recognise the speciality of the *mathematics* context, and so tended, as an *initial* strategy, to draw on their everyday knowledge of such contexts in approaching a solution (e.g. Cooper & Dunne, 1998, p119). The findings presented here are limited in that only an esoteric item was used. However, this item did appear to discriminate between students in the two school-types in a way similar to that reported in Cooper & Dunne (1998; also as that in Lubienski (1997) for an American context) for realistic mathematics items. It may be that although it is an esoteric item type and so would normally be expected to reduce the extent to which students are likely to draw upon their everyday 'common sense' knowledge and so increase the 'obviousness' of the mathematical context, the arguably 'foreign-ness' of the algebra context produced alternate approaches amongst some students. These approaches could be termed of an all-or-nothing nature; rather than attending to the specific *speciality* of *this* algebra context (e.g. there was not an 'other side'), some students, more notably those in mixed schools, seemed to fail to make a further recognition step and saw only the algebra context. Thus, they used rules without any finesse or appreciation for what might be appropriate for this context. With an awareness amongst interview students in mixed schools of a relative powerless position with respect to algebra (they did not understand it, did not like it) and that their everyday knowledge would not do, there seems sufficient evidence to suggest that there was then a disposition to draw on what mathematics they did know. But, in doing so, some students drew on *all* the mathematics they knew that might apply in the context. There seems a case to be made that there was more at play here with the way some students approached the task than simply the mathematics; and that some students were using the mathematics they knew in ways that had little to do with the mathematics, perhaps drawing on how they knew to be in everyday contexts and this in an otherwise 'foreign' situation. The foreign-ness of the algebra context appeared to have decreased the obviousness of the mathematical task for some students. According to Cooper (2001, p248) 'this sense of the 'obvious' or the 'appropriate' has to be learned, either in the home or the school… opportunities for learning what is appropriate in school mathematics may not be equally distributed across social class cultures' (p248). This sense of the obvious in mathematics questions, this 'feel for the (mathematics) game' seems a form of embodied cultural capital less available to students in the mixed schools, given their propensity to take things at face-value. Further, if one incorporates the assessment of the function of schools given by Bourdieu (1973, p84, given in Section 2.2, p29), the opportunity for acquiring this form of cultural capital whilst in school is made more difficult for some children as schools have tended to implicitly demand such competencies of all students rather than transmit them.

But, in some sense, the behaviours described in students' approaches to the algebra task was how some students, more notably a greater proportion of those in mixed schools (and girls), knew how to *be* in mathematics contexts. It therefore does not seem improbable to conceive of this *way of being* as mediating how some students approached doing mathematics in general. That is, in doing mathematics, where realisation failed, some students then appeared to be reaching beyond the confines of the mathematics content to find some way of organising their approach to the mathematics. In doing so these students were finding coordination with how they knew to be (a part of their embodied cultural capital), and this way of being was mediating how they used (or not) available mathematical tools and so how they did mathematics. That students were using rules to mediate working through the task is evident (more explicitly so in some cases than others), and that some students were using them in ways further mediated by something else outside the evaluative standards expected also seems evident. It is posited that the way in which all students may be predisposed to using rules in working mathematics questions is mediated by what resources they are able to trade *on*, i.e. their embodied cultural capital. In the case presented here, this embodied cultural capital, that is, dispositions to trying everything without paying due attention to the question itself or looking beyond surface features, dispositions to using any and all rules in the expectation that some *thing* would eventually be right, dispositions to surrendering to the inevitable when faced with a context to which they are not attuned (e.g. algebra), dispositions to questioning why they would need to know this in the real world as someone else will know, these dispositions do not serve students well as they are not (always) a good fit to that expected, even implicitly demanded in schooling and mathematical processes. This is not to suggest that students in single-sex schools embodied 'more' cultural capital than those in mixed schools, but the cultural capital embodied and brought to school by some students in mixed schools might be less valued in educational and mathematics teaching and learning processes.

6.2-2 From Observations

This subsection will start with an overall description of each of the three schools/classrooms in which observations were carried out. This will then be followed by an extended synopsis of one session from each of these classrooms. For this synopsis the third session of observation in each school was chosen in order to reduce possible subjectivity in choosing an 'interesting' lesson, and also to illustrate the typicality of these classes. Additionally, the third session in each case occurred more than one month into fieldwork activities, and it was thought that students would have become more accustomed to my presence in the school and classroom. The third session also reflects a point before any video-recordings of classroom sessions had taken place, and so potentially reduced chances for students and teachers to 'play up' for the camera. The extended synopses are then followed by shorter excerpts of some classroom exchanges. These episodes serve to support some of the findings given earlier and also to illustrate the degree of 'typicality' of the preceding extended synopsis for each school/classroom. It was thought that a look inside students' mathematics classrooms would put the mathematics views of students into perspective, and whilst providing 'answers' to students' mathematics approaches, may also address aspects of the RA and RQ having to do with the interrelations of views and approaches and ultimately performance, i.e. RQ2&3 and RA(c). Outlining data from classroom observations necessarily brings some focus specifically on the teachers of the classes that were observed.

The Schools and Mathematics Classes

All three schools (Si3, Si2 and Mi5) were located in or on the borders of the capital city. Si3 was the school in which a class set rather than a mathematics teaching set had been given for questionnaire administration (Subsection 3.3-3). The students of Si3 had been re-grouped for mathematics teaching based on the CXC/CSEC two-tiered General/Basic syllabus, and the classroom reality of this for the participating students of this school had just started in the school year (when fieldwork began) beginning September 2004. Most of the students would have been taught in the same class groupings for the prior three years of secondary school. This re-grouping for mathematics teaching may be considered an established tradition in this school. The group being observed was the lower ability group of their class; there were two fourth form classes each divided into two groups of General and Basic, so that there were two parallel General groups and two parallel Basic groups for mathematics. It had been noted that the class's timetable, which was permanently on the back blackboard in the classroom, had mathematics qualified in this way, i.e. Basic maths, General maths, which were taught at different times. Additionally, in questionnaire data from this school 10/18 students had also so qualified the mathematics they were doing (nine students had written General maths and one student had written Basic maths), something that occurred with only one other student of the entire sample outside this school. The school followed a Day rather than a weekday timetable so that the actual weekday on which the class had mathematics was variable. The class size of the group being observed had 10 girls, which meant that there were a lot of empty desks/chairs in the classroom. Students tended to sit in the same seats however. In almost every case, I arrived to meet the teacher in the class or I arrived at the class at the same time as the teacher. The teacher of this class made the most visual use of textbooks of teachers in the three classrooms observed, doing so both to assign students work (usually from the assigned student textbook) or to use in teaching (both from the assigned student textbook and other texts). The students had very little in the way of 'down time'. The school itself was always very quiet, and only on rare occasions was a child seen outside a classroom, usually appearing to be on the way to somewhere rather than loitering. This group of students (girls) although they did talk to me outside of usual class time, did not do so at all during mathematics class times, and never asked me for help with any assigned work. Students of the other two classrooms had done so.

The class set in Si2 was one class set of three for the fourth form level. Most of the students had been kept in the same grouping since first form (Year 7), and the camaraderie amongst the boys was apparent. The class size for this group as on the class list was 30 boys, and each boy had his own desk and chair. Unlike the two other classrooms in which observations were carried out, the teacher of this class was not always present during observation sessions – on one occasion he was particularly late for the class and on two other occasions he was present for some time but left (once for a significant period of time and the other permanently) during some point in the session. He did usually, but not always leave work for the students to do though, either assigning work from the text book, or giving work for one boy (the monitor) to put on the board. On this latter occasion this boy, the monitor, then took on the role of teacher when writing the work on the board, explaining the work as he wrote it on the board, checking the work of other of his classmates – a role which the other students seemed to accept. This teacher was the only one of those observed who did actively put boys into groups to do assigned work, and when he did not do so, he appeared to be the most tolerant of those teachers observed when the boys did work in groups or consulted with each other about assigned work. In reference to textbook use, this teacher used the textbook on some occasions to assign students work; otherwise, he did not make any visible use of textbooks in his teaching. Of the three classrooms observed, this set of boys as a group was the most rowdy – this perspective also supported by what the boys themselves reported in questionnaire data, where more than one-half of them described their mathematics classes as noisy (see in Subsection 6.1-6). However, the students of this class were amongst the highest proportion of students by individual school who responded *Yes* to *Do you like maths?* (ranking 2nd behind the other boys single-sex school), with the most frequent reason given for their response being that they enjoyed mathematics, that it was fun – a reason seemingly more connected to the mathematics itself. When asked after one lesson about the behaviour of the boys during lessons, the mathematics teacher had replied that 'boys will be boys'. This set of students (boys) more than any of the other class sets observed did ask me about work when they did not understand, or tried to draw me in in some way to helping them with assigned work or to check their work.

The class in Mi5 was the second grouping of four sets, grouped for overall 'ability' and not specifically for mathematics. In each subsequent year level from the first form these students would have undergone such a re-grouping each year, so that the group mix each year could potentially be quite different from that of previous years. Thus, the mathematics experience of students to this point would have been different from that of students in the other two schools. Indeed, during interviews two of the students reported to not having had a mathematics teacher during one term of the previous year in the third form. Checks of the students' reports for this class from the previous year do appear to support this, as mathematics grades were missing for a number of the students (10/35), which usually is an indication that students had been without a teacher. The class size for this group as on the class list was 35, but there were not ever 35 students present in any of the sessions observed. Despite this, the class was slightly short on desks and chairs and so in some observed lessons in the classroom there would be one or two students with either a chair but no desk, or no chair so that they sat on a desk. The mathematics teacher of the class observed in this school made the least use of any textbook. Assigned work for students was usually written out on the board, and on only one occasion did the teacher visibly have a textbook in the class which he used to get examples of work in the topic being done. However, this teacher's non-use of the student assigned textbook seemed to be a way of trying to 'protect' students from the mathematics. In doing so he perhaps unwittingly took on a role that made him almost the sole mediator/facilitator of what mathematics the students came to see and know. Additionally, as this teacher did not use the textbook he may have given the impression that the textbook was not 'good enough' as students modelled this behaviour and also did not use the textbook. This school too was the noisiest of the three schools in which observations were conducted. Usually, upon arrival at the school, there seemed an inordinate number of students who appeared to be simply 'hanging out' outside classrooms.

Extended synopses and shorter excerpts from observation sessions in each of the classrooms (Si3, Si2 and Mi5) now follow. In presenting these synopses there are issues related to the type of talk students engage in, to whom the talk is directed, the language of the talk (form of English used by both teachers and students), the distribution/locus of mathematical authority in the classrooms. There are also issues to do with how students (mis)interpret the language (instructions, notes, questions) from teachers, and also how teachers interpret questions etc from students. The excerpts also reflect things having to do with how mathematics is presented to students, and how students come to know their mathematics. These issues will be discussed following the presentation of the excerpts.

Extended Synopses

Observation Excerpt 6.22-1

These are periods 5 and 6 of an 8-period day (allotted time 80 minutes). There are nine girls in the class. It is the start of the lesson, and the teacher tells the class that they are going to be starting Consumer Arithmetic, and will begin by looking at profit and loss. He asks students who can tell him what a profit is. In unison, some of the girls say that it is a gain. One girl extends by saying when you sell something for more than you bought it for.

The teacher then dictates (from a book) to the class: *'A profit occurs when your revenues exceed your expenses.'* One girl says *'Okay...'* [drawn out, as if to say, If you say so... - possibly not understanding the words?] [...] After dictating the teacher writes on the board: **Profit = S.P. – C.P.** [...]

The teacher asks students who can tell him what a percentage is. After some mumblings, some students say to him that it is a number over 100 times some other number. The teacher then says 'Well, a percentage is a number over 100.' He then asks, if looking for a percent profit, you are looking *'in terms of what?'* There is no real response from students – they just look at each other, and then back at him [I am not sure myself what it is he is asking/looking for].

The teacher gives an example by giving a cost price and selling price, and asks what the profit is. Students say that it is $10 (which it is). The teacher then asks if someone wanted the percentage profit, would that be *'in terms of the cost price or the selling price?'* The students, in unison reply the selling price, and one girl then says you look at both. The teacher then says that it is in terms of the cost price since for percentage profit *'you want to determine it in terms of what it cost you to get it'.* There is an 'uncomfortable' silence from the students. The teacher asks if there are any questions – there is no response from students.

The teacher then goes through a similar explanation for finding percentage loss. During this explanation, one of the girls interrupts by saying *'But...'*, however the teacher does not stop, and the girl did not continue. At the end, the teacher asks again if there are any questions. Again, there is no response from the students, though there are some giggles.

The teacher now asks the class for an expression for percentage loss. One of the girls says that it is loss over selling price multiplied by 100 over one. The teacher asks her why selling price. She replies that it's because that's what you sold it for. The teacher repeats the same explanation he gave before (see above) of why it is over cost price, says *'Okay, good'* and tells students to take this example [Of note, he did not give them any chance to ask questions, nor did he ask this time if they had any]. The teacher dictates the following example:

A shopkeeper buys 25 cricket balls at a total cost of $150. (a) He sells them for $8 each. What was his percent profit? (b) He sells them for $5 each. What was his percent loss?

He asks the class how to proceed. One of the girls says that you have to find how much he bought one ball for. The teacher replies *'Okay, if you want to go that route'.* He then writes on board (repeating each line as he writes it on the board).

25 cricket balls @ $150

sells them @ $8 each

C.P. = $150

S.P. = $8 x 25 = $200

The profit = S.P. – C.P.

= $200 - $150 = $50

The percent profit = $\dfrac{\textbf{profit}}{\textbf{C.P.}}$ **x 100%**

= **$50/$150 x 100%** (and after canceling…)
= **33.33%**
= **33%** […]

Towards the end of the lesson the teacher announced to the class that he was going to be dictating homework. to which one girl says *'If we don't get the class work, how we going do the home work?'* (Observation Session 3, Si3)

Observation Excerpt 6.22-2

These are the first two periods of an 8-period day (allotted time, 70 minutes). There are the usual number of boys in the class (~30), and every boy sits at his own desk with a chair. On my arrival several of the boys shout that they are not doing any test today (on the two previous observation sessions the boys had gotten a test). The teacher arrives about 5 minutes later, and gives two boys two sets of test papers to return to the class. One boy says to the boys distributing the papers *'When you see my paper, just gi' ((give)) Miss George, just gi' Miss George.'* The boys do, and the boy has received 21/23 for one test and 16/19 for the other. […]

The lesson for the day is on straight-line graphs. The teacher says to the class that they should have graph sheets, and one boy asks *'Today?'* The teacher then asks the class how many of them have graph sheets. Five boys raise their hands. The teacher re-phrases and asks how many of them have graph sheets here. Now two boys raise their hands. The teacher says to the class that it seems that they have forgotten that they were supposed to bring graph sheets to class. Some boys tell him that he did not say today. The teacher writes on the board:

Straight Line Graphs, and writes an example on the board. […]

Some students are copying from board. Others are overtly looking in their Science textbooks (Integrated Science and Biology), which they have open on their desks. (I had earlier asked a boy if they were getting a test and he said yes). From the board:

Examples **Draw the graph of y = 6x. Use values of x from –3 to 2.**

Steps

Prepare table values

Write coordinates

Plot points

Draw straight line through points

A boy asks if they should write that – the teacher replies *'yes, write everything'*.

The teacher calls a boy forward to the blackboard, saying that he was talking. The boy says that he was just asking a question – the teacher says to him that that is still talking. The teacher tells the boy to complete the table he has drawn up for y-values. The boy does so quickly and correctly, with some input from the boys at the front of the class, although it did not appear that he really needed the help. When he is done a few boys applaud. […]

The teacher says to class that *'we'* will look at another example, then will give a chance to generate points. He tells students to copy what the boys have written. […]

(Other example) From the board:

2) Draw the graph of y=2x – 4. Use the values of x from –5 to 5.

The teacher calls a boy forward to the board [so far, the teacher has called boys to the board who at the time just prior had been doing something that might be deemed out of order (e.g. talking, standing, etc.)]

From the board:

x	-5	-4	-3	-2	-1	0	1	2	3	4	5
2x											
-4											
y											

The teacher says to boy that he will let him finish first columns and that he (the teacher) will start him off. He continues by saying, *'We are looking for 2x – 4. We will do in pieces.'* He does the first one, saying *'2 times – 5 = ….'* A boy (not the one at the board) says *'–10'*; the teacher says, *'and now –4 is….'* A different boy, (this boy is and has been standing at the classroom door for most of the class, invariably fanning himself, and is not the one at the board), says *'6'*. The teacher says *'Hold on, wait…'* The boy corrects and says *'–14'*.

The teacher now leaves the boy called to the board to complete the whole table. The boy who is standing at the classroom door says to the boy at the board, *'See the sequence?'* The boy at the board correctly completes the table. When he is finished, the boy at the door says *'That's my boy!'*

The teacher now calls a different boy to write the coordinates. The boy, looking at the table, writes at first (-5, -4). The boy at the door says to him *'Boy, you retarded'*. Some other boys tell him it is –10, other boys that it is –14. The boy is unsure, erases the –4, leaves the –5. The boy at the door takes the chalk from him and writes on the board (-10, -14) as the 1st coordinate. The class laughs. One boy from the class says to the boy called forward to the board *'It's x and y, x and y.'*

The teacher calls another boy to the board to write the coordinates. The boy does so correctly. Before leaving the board, however, the teacher tells him that he has missed something. The boys of the class tell him that it is the commas between the brackets [of each pair of coordinates] e.g. (5, -14), (-4, -12), etc. One boy says to this boy (the one at the board) *'Even dunce me know that.'* (Observation Session 3, Si2)

Observation Excerpt 6.22-3

It is the last two periods of the school day (periods 7&8, allotted time, 70 minutes). I am sitting in the second row from the back, between a boy (on my right) and a girl (on my left). There are also 2 boys sitting in the back row directly behind the boy and girl between whom I am sitting. At the start of the class there are seven boys and 22 girls, but during the lesson two other girls and later one other boy arrive. The 29 students present at the start are all sitting at a desk and chair; the two girls who arrive late sit on two chairs (no desks) and the one boy who arrives late sits on a desk in the front. The lesson for the session is on Binary Operations. From the board:

If x* y = 2x + 4y, what is 3 * 1 and 1 * (2 * 5)

The teacher asks the class how is the 1st different from the 2nd. Students say that the 2nd has brackets, and you must do the brackets first. The teacher says that he will give them two questions to work out to see if they understand. From the board:

1) If x = 3, y = -4, find the value of x^2 - 2y.

2) If a * b means 4ab, find the value of 2 * 3.

Some students say to the teacher that they did not get any with x^2 the last time. The teacher asks the class what is x^2 equal to – some students say x times x.

The girl sitting beside me asks the boy behind her *'How much you get?'* The boy says *'negative 17'*, then questions (as if to himself) whether it is positive or negative. He appears to re-work the question then tells the girl *'positive 17'*. The girl asks him *'positive 17 a' de one wid de sign?'* ((Is positive 17 the one with the sign?)) She then says that she doesn't understand the 2nd question. In talking to her, she thinks that the * means to multiply, has focused on the end of the question, so that it is 2 x 3 = 6. I say to her that the * can mean anything, its meaning is not fixed, and that you need to look at what the question says the * means, each question on its own, and in this question it says that * means 4 times a times b. After looking at the question for a while longer the girl puts aside her mathematics exercise book, and takes out her POB text book, appearing to read it.[…]

The teacher writes five more questions on the board and tells students to work on them quickly. From the board:

If a = 3, b = 2, c = -1

1) a + b 2) a^2 + b 3) a^2 - c^3 4) a – c 5) $\frac{3c + 5a}{b}$

In working on no.3, the boy beside me turns to the boy behind him and asks him if you have 5^3, what do you do. The boy tells him by writing it out that it is 5x5x5, and then the boy who has provided the answer asks me if that is right. I say *'yes'*. However, the boy beside me still writes -1^3 as 3. I ask him about it, and he tells me that it is –1 x –1 x –1, which is 3. I ask him what is –1 x –1, he tells me, 1, and I then ask him what is 1 x –1, and he tells me –1, then hits his head with his hand.(as if dawning realisation). The teacher goes through solutions with whole class. [...]

The teacher writes on the board for the class **If x * y means √xy, find the value of 9 * 16.**

Some students say that they've never seen the √ sign before (they indicate this by pointing to the sign on the board). One student shouts out that it means square root.

The boy at the back and left of me asks me if his answer is right to this question. It is, but he has written: 9 x 16 = 144 = 12 I tell him that his answer is right, but that he needs to put in the square root signs in all the processes just before he actually takes the square root.

The teacher gives another question for the class to do: **If a * b means 2ab² + 1, find the value of 3 * 5.**

The boy behind me on my right in working this question leaves off the first '2'. I ask him why he has done so. From his response, it seems that he does not know what to do with it. [...]

Some students tell the teacher that they do not understand. The teacher goes through again, saying, for example that they need to substitute numbers for variables, substitute means replace, or take out and put in. The teacher asks students, *'What expression will we be replacing in?'* A girl says in 3 * 5. The teacher continues asking this question to different students around the class, with each giving him the same answer.

The teacher returns to the board, saying that he will *'spread out the expression'*. He asks the boy sitting on the desk in the front to do so. The boy says: *'2 times a times b times b plus 1'*. The teacher then asks another boy what the value of the 'a' is in this. The boy does not respond. The teacher asks the boy sitting beside me and he says *'3'*.

The teacher then works through on the board: **2 x 3 x 5 x 5 + 1 = 151** [...]

The teacher now gives the class the following question to do:

If x * y means 3x – y, find the value of (a) 1 * 2

He tells the class that he will give one minute for them to do that, and that there are some tortoises in the class. Shortly after, the boy in the back and right of me loudly announces that he is finished. The teacher asks him for his answer, and he says *'2'*. The teacher asks the class if anyone else got 2. Some students shout that the answer is *'1'*. The same boy says that the answer is 2, then looks back at his work, corrects and says no, it is 1. After this, the same boy says *'Me can't do no more, jack, me head a hat me.'* ((I cannot do anymore, my head hurts))'

The teacher writes part (b) on the board: **(1 * 2) * 4** saying that this is the last one.

The boy in back and left of me says aloud (almost immediately) that the answer is –3. The teacher asks him if he did it in his head. He replies *'yes'*.

The two boys behind me keep asking (not directed to anyone in particular) if it is not 1:30 yet (the scheduled end of the school day).

The teacher asks a particular student how is (b) different from (a). The student does not respond. He asks another girl, and she says *'It has a 4 in it'*. Another student says that it has brackets, whilst another says that it has three constants.

The teacher himself works part (b) on the board. [...]

At the end of the class, before packing up his books, the boy on my right asks me what does this (points to the * symbol in his book) mean. I say that it means whatever you've been told that it means in the question, it doesn't have a fixed meaning, it changes from situation to situation, and that he needs to read each question where it comes up to see what meaning has been given to it. It seems that he expects it to mean the same thing all the time, for example, to multiply or to add, and is the source of his confusion. He says *'thanks'* and goes. (Observation Session 3, Mi5)

Shorter Episodes

Observation Excerpt 6.22-4

The lesson is on simple interest, and the teacher has written the simple interest formula on the board along with what each letter stands for. After working on an example from the textbook with some input from the class, the teacher says that they will now look at how to find other parts of the simple interest formula, if given interest. Various girls say *'I don't understand', 'I don't remember', 'I don't know'* etc. The teacher says to them *'I will give them to you.'*, and he writes on the board:

$$I = \frac{PRT}{100}$$

T =

He has left the part after the equal sign blank and says to the class that they need to bring over 100, and since dividing by 100, they would take it across and ... He leaves for students to 'fill in'. A girl says multiply by 100. The teacher says to the class that they don't need to learn this formula for Time, as there is a way to find it mathematically. He writes on the board: $I \times 100 = \frac{PRT}{100} \times 100$

Some girls respond to this *'Wha....? Do it the other way.'*

The teacher writes again on the board saying as he does so:

$$I = \frac{PRT}{100}$$

$100 \times I = PRT$ *'take over 100 and multiply'*

$\frac{100 \times I}{PR} = T$ *'so, for T, bring over PR and...'*; some students complete, *'divide'*

The teacher says to students that he is giving it to them so that in case in an exam, under pressure, they forget, then they would be able to work it out. One girl (G1 in interviews from this school – e.g. see Interview Excerpt 6.3-3 in Section 6.3) says to him *'I prefer to just memorise it. That way you are giving us is confusing me. I don't understand what you have there, and I look in the book and I understand.'* There follows some discussion amongst students and teacher on this. The textbook has just given the formulas. There is active resistance amongst some students to learning, seeing, or trying to understand what the teacher is doing. Finally the teacher says to the class *'The book has made you lazy. All it has done is given you the formulas.'* G1 says *'Exactly, just learn them.'* (Observation Session 7, Si3)

Observation Excerpt 6.22-5

The students are working on addition and subtraction of Matrices, to which the students have just been introduced in this lesson. One boy says to another after having checked his answers against that of the boy: *'Wha' 2 plus -2 be? How you get –4? Is not 0? Wha' 1 plus –1 be?'* Later in the class a boy says to another who has been using a calculator: *'Those numbers are easy. The numbers aren't even past 10, and all you using calculator.'* The boy with the calculator replies to him *'The negatives are killing.'* (Observation Session 12, Si2)

Observation Excerpt 6.22-6

The teacher has given the class five minutes to solve the following simultaneous equations:

$$-2x + y = -8$$
$$3x + y = 17$$

Students work individually for about 10 minutes. The teacher then asks a student (boy) for the first step. The boy says *'Put in brackets'*. The teacher says *'No'*, and asks another student (boy) for the first step. This second boy starts to say *'Look for one of the variables...'*, and the teacher takes over and says *'Look for one of the variables to eliminate.'* The teacher then continues, asking the class who chose to eliminate x, and why they chose x. One student says *'Because x comes before y'*. (Observation Session 9, Mi5)

Aspects of these observation excerpts support some of the points made in the Subsection 6.2-1 on students' attempts at the algebra question. These include, for example, in Observation Excerpt 6.22-4 a female student's insistence on rules/formulas for working out the answer to other terms in the simple interest formula; the inclination to clutch at anything, any rule or procedure that may seem even vaguely relevant, e.g. *'put in brackets'* in Observation Excerpt 5.32-6, and a sort of reverting to everyday thinking when the rule has not been accepted, e.g. *'because x comes before y'* in this same last excerpt.

During observations in Si3 it was noted in field notes that the teacher of this class did tend to introduce a topic by talking with the students about what they knew about the topic. However, in giving notes on words/terms associated with the topic, this teacher also tended to use a more formal version of language, usually taking definitions from a textbook rather than using the ideas just discussed with students. This teacher made much more use of the assigned student textbook than did teachers of the other two classrooms observed. With regard to the extended Observation Excerpt 6.22-1, throughout this lesson it seemed evident to me that students were not understanding the mathematics, this from the long pauses and nervous giggles when the teacher asked if there were any questions. Students had problems with the form of language in use, as might be interpreted in the excerpt given, and this even though they consistently throughout the observation period in this classroom spoke a form of English closer to the 'standard' than any of the other two student groups observed. The way the teacher chose at the start of the lesson to define 'profit' set the tone for the rest of the lesson of the excerpt given here. Throughout this lesson (and other lessons that followed in this topic area) students appeared to be unfamiliar with the meaning of words and terms used, e.g. words/terms such as 'incurred', per annum, the varying uses of marked price/cost price, selling price/sale price, down payment/deposit to refer essentially to the same thing, and this, as well as having some problems with the mathematics, e.g. not understanding why some things/sums of money/percentages obtained en route to an answer were subtracted, others added, etc. The teacher's response to this last was usually to go through again what was written on the board, or what he had said before, saying for example that percentages found were added or subtracted because 'it' was a profit or loss. During the lesson of Observation Excerpt 6.22-1 the teacher appeared intent on getting through a volume of work quickly saying at one point that this work was easy, disregarding, it seemed, that students were not understanding. His aim appeared to be to teach – he seemed to have had a set agenda in mind, with little allowance for contingencies that may have been associated with where the students were. At several instances in this lesson he did ask students for their input on particular concepts/notions he wished to introduce, but then he seemed to disregard students' offerings to give as notes conceptions of his own or a textbook's. This perspective is supported by his approach to working the question with the cricket balls. He had asked students for a method to start, and despite a student offering a legitimate way of starting the question he proceeded by a way different from that offered, and no further consideration of the student's offering is made.

It had been observed too that in this classroom (as also to an extent in the others observed) during teaching the mathematics was very much tied to formulas. Students were usually given a formula for a particular concept, (e.g. in Observation Excerpt 6.22-1 that for profit) this formula was written on the board, and the solution of examples that followed usually centred around use of the given formulas. What tended to then happen in other classes is that if a question asked for a word or term that students could not find in a formula, some of them appeared to be at a loss as to what to do. But, the teaching was very much centred about solving mathematics questions in this way by using these formulas, so, in some way the student's (G1) resistance to actually having to think about how to re-arrange the variables of the simple interest formula was a learned behaviour, as she was then, in this class, being asked to think in a way she did not *normally* have to when doing mathematics.

It had been noted during observations in Mi5 that the mathematics teacher of this class did seem aware of a disjuncture in language, in particular with the language of mathematics, as he did take care to give students notes on the meaning of words/terms that he wished to use in whatever topic area he was teaching, and invariably during the lesson questioned students on what those words/terms meant as he used them. He used such expressions as 'spread out' for 'factorise' and also for 'expand' as in Observation Excerpt 6.22-3, 'take out and put in' for 'substitute', 'the number in front of' for 'coefficient', amongst others. In this classroom too, more than the other two classrooms observed, the teacher tended to give students notes on the steps of a procedure, writing these on the board. However, I was left with the sense that this concentration on correct mathematical language in *this* classroom was being directed at an inappropriate audience. This is not to say that such practices ought not to be attempted. But, it may be the case that this overt focus by the teacher on language may in some ways have distracted these students from the mathematics. There is some support for this, I think, in the attempt at the algebra task by three girls from this classroom (Interview Excerpt 6.21-2 in Subsection 6.2-1) and the exchange between G1 and G3 where one has used 'transmit' seemingly for 'transpose' and the other tries to correct her but seemingly cannot recall the 'correct' word. Other support for this comes in another lesson where students were working on factorising quadratic expressions. The teacher in giving notes to the class had given a list of steps, the first step being that students were to multiply the coefficient of x^2 by the constant. However, in looking at the work of individual students near where I sat and talking to them, there was evidence that students knew the meanings the teacher had associated with the terms as they could repeat them to me, but had no sense of their practical use in the work given, nor could transfer their learned meanings to the questions before them. These students in this particular lesson were taking the coefficient of x^2 to be the constant in questions where the coefficient of x^2 was 1, even though they could repeat what the teacher had given to them as the meaning of 'the coefficient of x^2'. It seems that in the earlier whole class exercises these students had completely missed any contextualisation of 'the coefficient of x^2', and now given work on the same, could recall the meaning of the term, but could not fit this meaning into its use in the given context. This phenomenon has been likened to learning words in a foreign language, where the dictionary meaning of words is known, but there is no feel for them in contextualised speech (Luria, 1981, p176). Here again, I think, there is a mis-match between the ways in which students have used their acquired knowledge and the ways expected by the teacher.

In the lesson given here in Observation Excerpt 6.22-3 for Mi5 the teacher seemed to miss the point of what some students were not understanding. The teacher had treated as similar two levels of substitution, one, a direct substitution of numbers for letters – variables as he would have called them – into mathematical expressions, and the second, substitution into binary operations, arguably a higher order level of substitution as the student has to make sense of more abstract ideas. In this latter substitution the student needs to be able to make links amongst three rather than two things; he/she has to make sense of the meaning given to whatever symbol has been used for the binary operation, and also realise how that meaning connects to the letters and numbers given/intended for substitution. Using the four students near where I sat as a sub-sample of students in the class, there were two students, the girl and boy between whom I sat who both thought that the '*' symbol used in the binary operations was an indication to multiply. These two students were not making the necessary connections of the meaning of the '*' to the expression given, treating the '*' as an operation having a fixed meaning of its own. However, in addressing the claims of a lack of understanding by other students, the teacher does not make the link of the meaning of the '*' itself – he moves seamlessly amongst the three ideas given in the question without referring specifically to the '*'. The girl beside me soon abandoned her participation in the lesson seemingly on this account, and whilst the boy persisted in participating in the lesson, it is clear from the question that he asked me at the end of the lesson that he still had not grasped what it is that the '*' symbol represents. It was not that the boy could not substitute; he had been able to work through the questions given that involved a direct substitution. However, he had not been able in the class to make sense of the more abstract ideas connected with the '*'.

Also in Observation Excerpt 6.22-3 in Mi5, the behaviour of the girl beside whom I sat is illustrative of some of the micro-level processes that occur in mathematics classes that get lost in statistical data. This girl was not unwilling to learn mathematics; via her initial participation she showed an inclination to 'play the game'. She did participate in the class, but to the point that she may well have deemed that she could. Her question to the neighbouring boy about whether the answer of negative 17 referred to *'de one wid de sign'* indicated a more fundamental level of not understanding mathematics. It suggested not only that she did not understand directed numbers, but that she had no concept of the real mathematical meaning of such an answer; for her, –17 was just a symbol for something – a number presumably, and had little meaning in relation to anything else. In a Bourdieuian sense, despite her inclination to 'play the game', she had no real 'feel for the game' (Bourdieu & Wacquant, 1992, p128; see also Section 2.2, p25-26), and what she had as resource to trade *on* in this game based on the 'rules' in operation of that classroom was not of the sort that allowed for her to acquire any better feel for the game and so perform well in it. Her misunderstandings here went beyond the level of the topic being taught. So, she did what for her would perhaps in the circumstances be the next logical thing to do – abandoning the mathematics (cf. 'approach' of doing nothing). The fact that she abandoned the mathematics for another subject supports the interpretation of her having an inclination to learn, but that in this case it was the (level of) mathematics that got 'in her way'.

The excerpts from Si3 and Mi5 contrast somewhat with those of Si2 (Observation Excerpt 6.22-2, 6.22-5). The boys of Si2 were more often left alone with the mathematics by the teacher, both when the teacher was present, but also at times when he sent work to the class for the boys to do. These boys were more active in learning mathematics – both physically, getting out of their seats, moving around the classroom, certainly talking with each other, and perhaps also cognitively in that since the teacher took what may be considered as a more sub-ordinate role in directing activities in class, the boys then were given and took on more responsibility for their mathematics learning. However, the excerpts also highlight an inclination on the part of students to take teacher's instructions literally, at face value, for example in the exchange about whether the boys had graph paper. There seems evidence too of a reduced 'struggle' on the part of these boys with having to overtly attend to language – as for example in an exchange near the end of Observation Excerpt 6.22-2 where the boy says *'It's x and y'*, rather than 'co-ordinates', even though co-ordinates had been in the language of what the teacher had written on the board. However, there is no doubt that most of these boys knew what to do, even if they might not have used the formal correct mathematical language in the process.

One of the observations about the conduct of classes in Si3 and Mi5 in particular was the bit by bit nature in which students were 'dispensed' mathematics, and the regularity of this occurrence. That is, in most of the classes observed, unless a test was being given, students were given a (closed) mathematics question to work on, invariably told to work on it 'quickly', and then corrections of that piece of work were done before another 'piece' would be dispensed. Teachers were in a way 'possessive' of the mathematics, giving out a little and then 'quickly' taking it back to have a look before giving it (or others) out again. It seemed essentially to be a case of rationing the mathematics. It could just be that this is the way in which these teachers taught, and may be a strategy used to have all students at the same place in terms of where they may have reached in the mathematics. However, it inarguably led to actions or behaviours which were less agentive on the part of students, that is, a reduced capacity to be creative in mathematics classes, and allowed for a close adherence to the rules, formulas, and methods of the teacher and textbook – i.e. less room for students to think creatively and reduced control over how far in mathematics classes students could govern their own learning. In these two classrooms, the teachers did give an impression that mathematics was to be done quickly; the teacher in Si3 sometimes used the word in a string, saying on one occasion *'Quickly, quickly, quickly, quickly'*; the teacher in Mi5 in addition to using the word when he gave students work, also at times gave a specified number of minutes in which students were to do assigned work. There was not a recorded instance in field notes where the teacher of Si2 used 'quickly' to students.

One other commonality in the teaching-learning process in all of the classrooms observed was that in whole class oral question-and-answer sessions, students' answers, whether right or wrong were hardly ever examined. 'Wrong' answers were usually ignored, given no account of, and questioning usually stopped when the 'right' answer had been given. Therefore, at least from these sessions, there was limited opportunity for students to learn from their mistakes, other than to learn that a mistake had been made. What the nature of the mistake was, why students thought that the answer was the one given (whether right or wrong), where in the process to an answer a student had gone wrong, etc. were not dismantled, so the scope for students to hold on to particular misconceptions was fertile, as they had few opportunities to confront the reason for their work being wrong. The teacher's response of '*No*' in Observation Excerpt 6.22-6 serves as an example. Whilst it is possible to solve simultaneous equations in which the use of brackets would facilitate the process, e.g. as in using a substitution method, the class to that point had only been exposed to the elimination method, and the teacher's response of *'No'* suggested that the use of brackets was wrong rather than that that was not the answer he was looking for.

In all three of these classrooms, and as illustrated in the excerpts here, the students seemed to be in a constant battle with language use in addition to their struggles with the mathematics. However, the level of this struggle with language seems of a lower order in Si2 than perhaps it was in Si3 and Mi5, even though the students of Si2 did speak a form of English closer to that of the students of Mi5 than those of Si3. The teachers of Si2 and Mi5 did seem to be more aware of these language struggles than did the teacher of Si3. It may be that because the students of Si2 spoke amongst themselves more, they then had more immediate access to 'a more appropriate level of language... made possible through dialogue amongst the students' (Zevenbergen, 2000, p201) and hence alternate means (resources) of coming to understand/learn the mathematics, a means that was less accessible in the other classrooms observed. The excerpts also point to dispositions in thinking of students towards learning and doing mathematics. For example, some students of Si3 had seemingly dispensed with the notion that mathematics did or needed to make sense; for them the sense was in learning the rules and formulas for working particular topic areas, and this was their survival mechanism for learning mathematics. In Observation Excerpt 6.62-4 which comes from this school, whilst it is the case that only one student (G1 of interviews from this school) objected to the teacher's efforts to show how the simple interest formula may be manipulated to make other variables the subject, none of the other girls objected to what this girl had said about understanding by learning the formulas, and indeed as a group they were resistant to the teacher's efforts in this respect. But, in some ways, this was a learned behaviour; it was in this way that most of their observed mathematics classes were conducted.

6.3 MATHEMATICS, STUDENT IDENTITY, CULTURE AND SCHOOL

How some students felt about themselves in relation to mathematics has been a theme running throughout the interpretations presented of students' expressed views. This section presents findings that deal mainly with student behavioural patterns in mathematics classes, how these patterns may reflect conformity or not to expected positions, and the relationship to mathematics students may then have formed. It is an attempt to interpret and explain in part some of the gendered differences in the mathematical experience of boys and girls that has appeared evident in the views they have expressed in the findings presented thus far. The section then later turns the focus onto cultural traditions that become entrenched in how 'school' is enacted, in particular the practice of ability grouping and the implications of the practice in/for mathematics. There are two subsections to follow. The first of these looks at the notion of 'learning by the rules', which refers to both cognitive and social aspects of how some students seemed to be learning mathematics. The second subsection looks at the messages which students take away from ability grouping practices, both in mathematics and also in the more generalised ability grouping which occurs at the point of entry to secondary school. It is posited that both these types of ability grouping influence the identities students develop, and the dispositions they enact in their mathematics learning. The two subsections address the issues outlined through the notion of identity, and the influence of culture and school. The subsections are aimed at addressing specifically RA(b)&(c) and RQ3&2. The subsections that follow are particularly discursive in nature.

6.3-1 Learning by the Rules

One of the findings of this study in relation to students' identity and mathematics learning has to do with observations carried out of classroom processes in mathematics, and how very much 'gendered' these processes were. The work of gender/gendering here is of the type described by Connell (1987), where its function as played out in the classroom was as a verb. According to Connell (1987, p140), gender's functions in society would be more visible if it was seen as a verb – *to* gender, so that gendering was a doing word, and the sexes could be gendered into positions expected by society, and not one(s) that they necessarily would naturally hold. Using Connell's idea of the function of gender yielded for me an interpretation that the observed student behaviours and identities in these mathematics classes were positional, that is, they were identities students were taking on as they might have subconsciously perceived to be befitting wider societal and teachers' expectations, and for girls in particular was not necessarily how they would otherwise be; i.e. they were learned behaviours, learned identities. This finding was one for the group of students observed, and so denotes the pattern of things, although there were deviations from this pattern.

There were distinctions between the ways in which boys and girls behaved and were allowed to be (positioned themselves and were positioned) in classroom interactions whilst learning mathematics. This distinction for the most part went beyond school-type although boys and girls in single-sex schools tended to represent the extreme of cases. Girls in the main were very much of the mould of the 'ideal student'. In general they took notes, writing whatever the teacher wrote on the board. When given work to do in class, they tended not to interact with other classmates whilst doing this work, doing the work on their own (as generally expected), with frequent referrals to their notes, tending to use each other at most as a check on their answer. In this relation, they were generally quiet whilst the lesson was in progress and usually did not overtly talk to other classmates. Boys, on the other hand, whilst they did take notes, did not always do so, tending to either talk to each other or nearby classmates whilst the teacher wrote on the board, or alternatively appeared to be listening to the teacher whilst he wrote on the board (e.g. see comment of boy in Table 6.16-2(b) who gave what he did in mathematics classes as *'talk when bored, listen when necessary'*). Sometimes they were caught out on taking or having the notes as the teacher would erase the board before they had written them. In relation to this too, they would at times specifically ask the teacher if they had to take notes of what he wrote on the board. When given work to do, boys would almost immediately work along with a neighbour (in the mixed school this was often, but not always another boy), talking about how to do the work, less often observed referring to notes, and tended to use each other (or other students) more than as just a check on the answer. In the mixed school in which observations were carried out the boys were more likely to 'get away' with this behaviour as they were few in number (ratio of boys to girls being about 1:2). and they tended to sit in the middle or back of the classroom, which was also the observed pattern in most of the mixed schools whilst administering the student questionnaire. (In fact, a similar choice of seating by boys has been noted in other literature in the Caribbean (Parry, 1996). In my study, whilst I believe it to be the seating choice of students in the mixed classroom in which observations were conducted, that was perhaps not always the case. In Mi3 for example, I noted that all six boys sat in one row at the back of the classroom whilst the four girls sat in one row at the front of the classroom. On enquiry, the students said that that had been how they were seated by their form teacher.)

These observed behaviour patterns are supported by the students themselves in data gathered from other methods. In questionnaire data for example and students' response to Likert-scale item no.18, there was a significant difference between the way boys and girls responded to *I understand maths better if I work with my friends*, where proportionately more boys than girls indicated some measure of agreement with the statement (57% and 41% respectively, Table 6.11-2, Subsection 6.1-1). The work pattern of boys tending to work in groups and girls on their own is also supported in data given by the teachers (Questionnaire Excerpts 5.22-1, Subsection 5.2-2). Also in questionnaire data proportionately more boys than girls (16% to 8%, see in Table 6.16-2(a), Subsection 6.1-6) gave responses coded as 'talk/play/inattentive' in describing what it was that they did in mathematics classes. In interview data girls of Mi4 gave the following as reason why at times they kept quiet in class:

Interview Excerpt 6.31-1

G2: They say they understand right, but they don't understand.

Int: But why would you say you understand if you don't understand?

G2: Because the teacher go fly inna passion.

G1: They 'fraid they goin' kip back the class

[...]

G2: 'Cause when the teacher buss up students, you wouldn't want to ask nothing 'cause you 'fraid the teacher might buss you up too, so it's better not asking the teacher, it's better not knowing

(4+2 girls, Mi4)

One boy of Si4 also gave as reason a fear of keeping back the class for why he did not ask the teacher to go over something he did not understand; however his fear did not appear to extend to the teacher himself, as he and another interviewee noted that:

Interview Excerpt 6.31-2

B1: I'd go quietly to the teacher. I don't want to be interrupt (sic) the other persons who are trying to learn too, 'cause you know if I do that I'm holding back the class.

[...]

B3: I just try work it out in different ways but if I still can't get it, go to the teacher, or go to a friend.
(3 boys, Si4)

These patterns of classroom behaviours were not without implications for the ways in which students were learning mathematics. For girls, they tended to be more reliant on the notes they had taken, trying to 'match' a problem to one done before. Also they were more inclined to try to use all rules/guidelines given by teacher in their approach to working a problem (Section 6.2). These patterns of behaviour could be seen as in effect keeping girls just that much further away from the subject matter of the mathematics, allowing for them to think less, engage with the mathematics content less. For girls, the good fit of their profile to that of the 'ideal student' appeared to be working against them. Being quiet, appearing to listen, taking notes, working individually were for girls covering a 'multitude of sins' as these allowed for them to appear 'busy' in mathematics classes as a 'cover' for engaging less with the mathematics content. They approached doing mathematics mechanically, aiming to just get through it, sort of like walking in shoes that did not fit. As some girls alluded, being quiet in mathematics classes did not necessarily mean that they were listening or understanding what was being said (e.g. in Table 6.16-2(b), Subsection 6.1-6 responses of 16F of Mi6 and 37F of Si1). In effect, they could be seen as 'paying the price for sugar and spice' (Boaler, 2002) in their school mathematics classes. Alternatively, boys more often than girls appeared to be visibly 'off-task'. Because they appeared to be less reliant on notes, and more likely to talk, they were then more likely to talk to other classmates about how to do the work (including making their answers public). Their approach to the mathematics, at least in whole class interactions was less rule-bound or mechanical than girls (e.g. compare Observation Excerpts 6.22-1 and 6.22-2 given in Subsection 6.2-2; see also comments of teachers in Questionnaire Excerpts 5.22-1 and 5.22-2, Subsection 5.2-2). Thus, given work to do in class, this approach more often positioned them to think through the problem in its own terms, rather than trying to 'match' it to one they had done before. The approach brought them that much closer to (involved them more with) the content of the mathematics than perhaps was the case for a larger proportion of girls, and so allowed for boys to think more, engage with the mathematics more. For boys, these behaviour patterns were working for them in the sense of allowing them to make (more) sense of the mathematics, entering the 'space' of mathematicians. They were comparatively more 'comfortable' with the mathematics – shoes fit. For boys, their (less than ideal) classroom behaviours appeared to be working for them. There was more of a sense of 'entitlement' (Holland et al, 1998) or ownership amongst boys that mathematics was something *for* them. But, it may be that both boys and girls were engaging with the form of mathematics that they have come to know from their classroom experiences of it, and that the nature of this mathematics was for girls more rule-bound than the nature of the mathematics boys have come to know (see Subsection 6.1-3 for more specifically on the views of boys and girls on the nature of the mathematics). These observations perhaps explain somewhat the direction of the affect responses of boys and girls, regardless of school-type/social class (Subsection 6.1).

An interpretation of the findings concerning gender patterns of classroom interactions is that in mathematics classes, girls were positioning themselves and being positioned more in relation to expected gender socialisation norms – i.e. behaving by the rules of what was expected of them more in terms of gender behaviour, and this carried over into their ways of learning in the classroom – i.e. learning by the rules on two counts, social norms, carried over into classroom behaviour and so into using what (i.e. rules, guidelines) was given to them by the authority figure of the teacher. As boys tended to be less rule-bound or mechanical in their approach to doing mathematics, they were also fulfilling societal expectations/rules of expected male behaviour – acting with authority. Boys in mathematics classes, were positioning themselves (taking up subject positions) that showed a sense of entitlement – their behaviour signified an 'at ease-ness' or 'comfort' not seen as much amongst girls. Proportionately more of them were flexible in their approach to the mathematics, were able to 'move about in the (space of) mathematics'.

This pattern of classroom behaviour though is consistent with that reported in other Caribbean literature of student classroom behaviour (e.g. Evans, 1999), and has been traced back to how boys and girls are socialised in the home, where the prevailing maxim is to 'tie the heifer and loose the bull' (given in Figueroa, 2004, p147). This maxim means, in essence, that girls are expected to conform, behave, stay in-doors, etc., whilst boys are expected – even encouraged to misbehave, be outdoors, etc. Boys occupied a wider and larger social space than is usually allowed girls. These behaviour patterns were arguably being played out in the mathematics classrooms, both literally and figuratively (e.g. the comment of the teacher of the boys of Si2 to the behaviour of the boys as *'boys will be boys'* (given in Subsection 6.2-2). In the girls' single-sex school, it was observed that some girls did on several occasions attempt to work with other girls when given work to, but they were invariably sent back to their seats by the teacher. It was girls of this classroom who in Interview Excerpt 6.16-4 of Subsection 6.16 noted that working on their own was *'the right way'* of doing mathematics problems. In the mixed school, the teacher had one day become rather upset with the students exactly for the tendency of looking at the work of others for checking answers, saying to them:

> It's because you're looking at somebody's book. And if you remember what happened at mid-term, only about two people passed, so what is the advantage of looking at somebody else's book? You don't know if he's right and you're wrong. That's why you all are failing. You're cheating by looking at other people's book, and they're failing. (Observation Session, Mi5)

However, because of where boys physically positioned themselves in this classroom, they were more likely to 'get away' with just such behaviours.

But, there are also some seeming paradoxes here. Whilst the demonstrated and observed approaches to doing and learning mathematics did appear to be more overtly rule-bound for girls (e.g. Subsections 6.2-1 and 6.2-2 respectively), it was boys who in direct questions were more likely to describe their mathematics approaches in this way. In the overview of Subsection 6.1-1 and the results presented in Table 6.11-2 for example, proportionately fewer boys than girls recorded some measure of disagreement with statement nos.9&12. By disagreeing with statement no.9, students would essentially be saying that they valued understanding a problem over getting the right answer; however proportionately fewer boys than girls had this view (disagreed) about their work in mathematics (69% to 83% respectively), which could denote a valuing of product over processes which inarguably is provided by a concentration on rules/formulas. By disagreeing with statement no.12 students would be saying that they valued thinking over remembering rules; again here, proportionately fewer boys than girls had this view about their work in mathematics (33% to 43%). It could be that in addition to having these views about learning in mathematics, the more social nature of their mathematics learning for boys served as a form of cultural capital, that is, an added resource which is more accessible to them in mathematics from social expectations. These social expectations are a better fit to their habitus, and so they are able, in mathematics to use these expectations as a means of mediating what they do whilst learning/doing mathematics, e.g. talking to each other and so having access to 'a more appropriate level of language' (Zevenbergen, 2000, p201, see also in Subsection 6.2-2, p165), and are thus able to trade *on* these in classes for a 'good' performance. Their access to this form of cultural capital is further aided by their smaller numbers. Girls on the other hand had less access to this form of cultural capital, and indeed, the form of this cultural capital (societal expectations) was different for girls. Thus for girls, a concentration on rules or formulas in their learning/doing of mathematics was not 'balanced' with access to a more appropriate level of language during classes, inarguably leaving mathematics for them as a mystifying subject.

6.3-2 Ability Grouping Messages – Who is Mathematics for?

There was another aspect in which the structuring practices of some schools, specifically re-grouping students for mathematics classes, appeared to have a direct and immediate impact on the students' developing mathematics identity (e.g. see also Zevenbergen, 2003; Boaler, Wiliam, & Brown, 2000). In the two girls' single-sex schools, students had just been re-grouped for mathematics teaching at the start of the fourth form year in line with the two-tier structure of the CXC/CSEC mathematics syllabus, i.e. General and Basic – and this coincided with the start of data collection for this study. As mentioned in relation to Si3 (Subsection 6.2-2), this practice was a long established 'tradition' – it was the way things were done in *both* girls' single-sex schools, but this re-grouping was not done in either of the two boys' single-sex schools. Boys at the school-leaving stage in the two boys' single-sex schools were entered by their schools for the General proficiency level of the examination. In one of the boys' single-sex school, the CXC/CSEC mathematics Basic examination was done by boys at the end of the fourth form before moving on to doing the General proficiency of the examination at the end of the fifth form (see footnote 4, bottom of p74). In the other boys' single-sex school, the principal revealed that during the late 1990s the school had tried out the Basic proficiency of the mathematics examinations, entering some boys for that tier. This trial however was deemed to be unsuccessful as examination results were then worse than they had been prior to the trial, in that the boys were getting the lowest possible grades at this Basic proficiency level whereas before few boys had been getting the lowest grade possible at the General proficiency level. According to the principal, it was as if being entered for this (lower) tier of the examination had conveyed to the boys the message that they were only at that level and so condemned them to fail. Thus, they behaved in that way, giving up on mathematics, and thereafter did not bother to try. The Principal did go on to say too that generally a child was placed at a disadvantage in being entered for the Basic proficiency of the examinations, as they could not get anywhere with it, including further studies and/or employment as the society does not value this proficiency of the examination; even if a child got five subjects at the highest grade for the Basic proficiency (Grade I) they still could not get anywhere as someone looking at a results slip would value more the fact that a child had written the subjects at the General proficiency of the examinations even if they had not obtained a passing grade, as the impression would be given that he/she had at least reached that level of proficiency as he/she had been selected for it.

Having been a part of this education system, I had been pre-disposed to taking for granted this re-grouping for mathematics teaching 'tradition' in the girls' single-sex schools, seeing it as a matter of co-incidence without any cultural meaning attached. However, as I have become more deeply involved in the data, and having read more on the history of education in the Caribbean, I no longer hold that opinion as tightly. Given the traditional outlook of the single-sex schools in particular, it may well be that there is more significance to what does and does not happen with regard to the structuring of the mathematics curriculum in these schools than might immediately met the eye, especially for someone who is/has been a part of that structure, and also for the present participants/stakeholders in that structure. There is something about this way of doing things that has been allowed to pass unquestioned into a 'tradition' in these schools. There may be an underlying gendered outlook operating perhaps at a subconscious level which directs the accessibility of the mathematics curriculum in these schools, with which, i.e. sex, of students can and cannot do mathematics, and that some girls just cannot do it.

One possible effect of this re-grouping practice seemed connected to how students in these schools saw themselves in relation to (being able to do) mathematics, and the relationship they developed with mathematics. Table 6.32-1 provides a more de-segregated analysis of the statistics for the numbers and proportions of students responding *No* (as proportionately more of the sample gave this response) to the questionnaire item *Do you think every school child can do maths to CXC level?* Group statistics for this question in terms of those responding *Yes* were given in Table 6.21-1.

Table 6.32-1: Responding *No* to '*Do you think every school child can do maths to CXC level?*'

School -type	Male/106	Female/159	Total/265
Single-sex	20/48 (42%)	40/52 (77%)	60/100 60%
Mixed	32/58 (55%)	49/107 (46%)	81/165 49%
Whole sample	52/106 (49%)	89/159 (56%)	141/265 53%

Girls in single-sex schools responded *No* to this question in significant proportions. In rank order of the 11 participating schools, they were first and second for the number of students who responded *No*. Chi-square tests show there to be a significant difference between boys and girls in single-sex schools (χ^2 = 12.927, df = 1, p<0.001), but not so for boys and girls in mixed schools. There was also a significant difference between girls in the two school-types (χ^2 = 13.760, df = 1, p<0.001), but not so between boys in the two school-types. The finding of a significant difference for this question between girls in the two school-types is particularly notable, given the finding outlined in Section 6.2-1 on the Likert-scale items, where of the 19 items only one item produced a significant difference between the responses of girls in the two school-types. That is, girls, regardless of school-type, tended to respond to closed questions in the same way more so than boys of the two school-types. Students were also asked in an adjunct open question to give a reason for their response. Of the 226 reasons coded (94 for those saying *Yes*, 132 for those saying *No*), by far the most frequent reason given came from those who said *No*, and this reason had to do with students' perceptions of the nature of mathematics ability and how one might 'have/get' it, so that some students/people just did not have the ability to do mathematics or to do well in it. (For a complete list of coded responses to this item, see Appendix D1, Section IV, Table Q23.) Eighty-eight students gave this as a reason for their saying *No*, reasons coded in this category given by 67% of the total number of students saying *No*, and 39% of the overall 226 reasons given. Further, this reason for saying *No* was given by 34 of the 40 girls (85%) in single-sex schools who had said *No*, disproportionately high to their representation in the overall student sample and of the number of students who gave this reason. The following excerpts represent some of the 'typical' reasons coded in this category, given for replying *No* from girls in single-sex schools (highest proportion replying *No* – 77%):

Questionnaire Excerpts 6.32-1
because not everybody has the aptitude (1F, Si1)
because everyone is not mathematically inclined (6F, Si1)
some people just can't (9F, Si1)
everyone is not one smart in that subject area. For e.g. me (36F, Si1)
some students were not made for maths (33F, Si1)
because maths uses a lot of common sense and some of us just lack it. Most students seem to fail maths most of the times (1F, Si3)
not everyone has the brains for it (13F, Si3)

These responses from these girls are similar to those given by some teachers who had also replied *No* to this question on their questionnaire (Questionnaire Excerpts 5.22-3, Subsection 5.2-2). An interpretation of these girls' responses is that they communicated a sense of dis-entitlement, dis-inheritance – of something being available, but then being taken away. This feeling is akin to that given in Holland et al (1998, p125), that is, the sense of being 'disqualified or inappropriate'. That these girls had this perspective, and also given that proportionately more of them than other girls or any other subgroup in the sample felt that a person had to be 'made for maths' in order to do well in it might have come about from the practice in their school of re-grouping for ability for mathematics teaching (setting). The re-grouping practice which took place in mathematics appears to have propelled these girls to this view of others, and themselves, and the possible relationships to mathematics available. That is, that being good at mathematics, and further, having the capacity to succeed in it to external examination level was not equally distributed throughout the population. That it may be the re-grouping practice that fostered this view of having to be 'made for maths' in order to do well in it is buttressed by the further finding that in ranking schools according to the number of their students who gave this as reason for responding *No* to this question, the school which was third after the two girls' single-sex schools was the mixed school (Mi7) which had also just returned to re-grouping its students for mathematics teaching. In that school, 10/16 students (63% of those who said *No*, 34% of students in the class; four males and six females gave this response) who had replied *No* gave a reason coded in this category. There seems some warrant to the perspective that some, i.e. this 'critical incident', contributed to these girls having this view of others (and themselves) in relation to mathematics. It is likely that their responses are based on their own relative experience of learning mathematics, their possible selves (Kao, 2000), where the thesis goes that students will respond to questions e.g. about rating themselves in relation to what they know of the group that they are in (other students with whom they are learning – influence of ability grouping).

Interview Excerpt 6.32-1 following provides the perspective of girls from the single-sex school which led the way in giving this type of response to the open question. At the start of the fourth form these girls had been put into three tiered groups for mathematics. Two of the groups were being taught the General proficiency of the CXC/CSEC syllabus whilst the third group was being taught the Basic proficiency. These girls were from the second (or lower) of the two General mathematics groups. Prior to this re-grouping in the fourth form the girls would have been kept and taught in the same class groupings for the first three forms.

Interview Excerpt 6.32-1

Int: [...] How about the other students in your maths class? Are there any people you'd call a math-person in that math class... in your math class, somebody who seems just naturally good at maths or something?

G1: Not in our group.

Int: Not in your group?

G3: It depends on the topic.

[...]

G1: Somebody who's good at one topic, somebody is good at something else

Int: Okay, outside your group then, is there anybody who you think is just naturally good at maths?

All: Yes

G1: Yeah, lots of people.

[...]

Int: Do you consider yourself a math-person?

G2: Not really.

G1: No.

G4: No

Int: Why not?

G2: Because, it's just not me.

Int: It's not you?

G2: It's not me.

G3: Too many numbers.

Int: Okay, what's you?

G2: Me is English

G1: English Literature. [Some laughter]

G4: English Lit

Int: English Lit is you, maths isn't you? What about the maths, it's too – what?

G3: Too many numbers.

[...]

Int: [...] How about you? [...] Would you call yourself a math-person?

G4: No.

Int: Because?

G4: I don't know. I've been good at maths in primary school.
Int: [...] even when you were good at it you didn't think you were a maths-person?
G4: No. It was just easy.
G1: It was just easy.
G3: It was easy.
G2: It was easy to you, but...
G4: Yeah.
Int: But you still didn't think you were a math-person?
All: No
Int: You just more thought of yourself as a...
G2: English
Int: ... English person?
G2: Even though I don't usually speak it, I speak dialect, but, English is me.
(4 girls, Si1)

Earlier in the interview the girls had suggested some reasons for why they did not feel themselves aligned to mathematics, and having identified two business subjects (POA – Principles of Accounts and POB – Principles of Business) as subjects they looked forward to, had this to say about why they preferred these subjects:

Interview Excerpt 6.32-2
Int: You look forward to that subject – why?
G2: Because it's just how she talks about the subject and we discuss, and its fun.
Int: And you don't discuss in maths?
G1: Not really.
G4: Not really.
G3: It's all numbers.
G1: Not just...
Int: Not just?
G3: It's all numbers, so..
Int: All numbers? And there's nothing to discuss in numbers?
G1: Well, we don't do a lot of discussion with them.

In Interview Excerpt 6.32-1 in identifying that there were not any 'math-people' in *their* group, it might well be interpreted that these girls were implicitly bringing the issue of the re-grouping for mathematics into focus, although they do not ever in the interview explicitly do so. Additionally, they also pointed to what yardstick they were using to assess whom it was that they considered math-people – responding positively to the question of whether there were such people/students outside their (mathematics) group. These extracts suggest that in identifying themselves as not being mathematics persons, these students were also connecting to how the subject was being taught and hence the ways in which they were allowed to learn or come to know the subject matter, and not only to their perceptions of their ability in the subject. This might explain the repeated reference by G3 (and this continued throughout the interview) to mathematics being *'all numbers'* or *'too many numbers'*, with the suggestion that mathematics for her was stark, impersonal, distant, leaving little room for inputs of herself, whilst English provided such scope. English and the business subjects gave some room for manoeuvre, for expressions of self, whilst mathematics constrained them to be a certain way which was outside their developing understandings of themselves. It was as if being in mathematics involved a pretence on their part, in that it required their reaching outside themselves to something they were not, a persona that did not 'fit' how they would otherwise comfortably be, whilst English and the business subjects allowed them to be. Being in mathematics required a fit to a pre-determined mould (i.e. references to mathematics students being 'made'), whilst English and the business subjects allowed freer access, a more flexible mould. This perspective enhances the idea of these students' mathematics identity as being positional, in that the ways in which they were learning mathematics, being in mathematics classes, was forcing them to be (behave, think, etc.) in ways which they would not otherwise be (unnatural). The way these students expressed themselves in relation to mathematics points to their having taken up or 'sutured' (Holland et al, 1998, p33) themselves to the position afforded them, by not attempting to claim positions to which they felt they were not (or no longer) entitled (ibid, p126), or not to enter worlds of which they were not (or no longer) a part.

Having introduced the idea of 'suturing' of a person to a subject position, Holland et al (1998) then reject it as, for them, it carries the image of person and position arriving 'preformed at the moment of suturing' (ibid, p33), preferring instead the term co-development. However, ideas of suturing from its everyday meanings do work in my interpretations of this context, that is, suturing as a joining of things together, and also suturing in its medical sense, that of closing wounds to initiate the healing process. The analogy of suturing works for these girls in the sense of a closing of wounds caused by the message of the re-grouping practice, as it provides a means whereby the healing process could start; it also works in the sense that they then could be said to be suturing or joining themselves to the position afforded/allowed them, entering the mathematics spaces to which they were being assigned. For these students, their almost daily 'lived world' of learning mathematics in school classrooms had taken on a different genre. This world had excluded them to the extent that they were no longer allowed to enter the space of learning with the 'more able' of their colleagues, persons with whom they had generally shared learning experiences for most other subjects over the last three years – they were not 'smart' enough. Thus, having been 'told' so, and that relatively publicly in the high stakes arena of their school, they accepted and had already taken on the personae of the position 'thrust' upon them – they were already 'talking the talk' of the average mathematics student. This may or may not be the identity these students would have developed in relation to mathematics if things had continued as they had done before, but there is a sense that they have been propelled into *this* view of themselves by the regulating effect (Lerman, 2001, p98) of the re-grouping procedures.

Arguably a feature of how this group of students responded in Interview Excerpt 6.32-1, is that, in their efforts to not go beyond their entitlement in mathematics, even when they did find mathematics easy, they felt that it was not anything of their doing, i.e. it was not because they belonged to the world of 'able maths students', but because the mathematics was easy. For example, in that excerpt the girls all replied *No* to seeing themselves as 'maths-people' even at times when they thought they had been good at it. Success, when it was had, was attributed to things/circumstances outside themselves rather than seeing it as any 'goodness' of their own. Thus, having been indirectly 'told' they were not the most able mathematics students, then being able at mathematics was a 'no go' area for them, and any signs of just such characteristics were a chance occurrence, or otherwise a matter of common sense, something anybody would be able to do, so that evidence of their being able at maths were discounted. The students appeared reluctant to enter the space of the 'able maths student', and distanced themselves from any such identity. They perhaps did not want to be viewed as 'passing' (Fordham, cited in Holland et al, 1998, p132) in such privileged worlds, especially as they had been 'told' that they did not belong there. They had accepted the identity then of the average mathematics student, and in doing so distanced themselves somewhat from mathematics, as if any closer alliance would involve an 'impersonation, acting as if one is someone…one is not' (ibid, p132), and they might once again be found out and identified therein as 'foreigners', not belonging. Mathematics classes, perhaps hastened by the re-grouping procedures connected to the subject, brought these students almost en masse to ideas of what they were not, and hence to what they were. They had learned more than the subject matter of mathematics, they had also learned that they were not 'maths-people'. These students' experience is consistent with the conception of learning as a process of becoming via participation in practices (Wenger, 1998) and that this participation 'positions' persons to 'perform their own trajectories through them' (Lerman, 2001, p88).

The girls who participated in the interview from the other girls' single-sex school presented a more vivid and powerful picture of the influence of ability grouping practices in mathematics on what identities have now become available for them and their reduced agency in 'perform[ing] their own trajectories through' their participation in these practices. This group of students interviewed were a part of the class (Si3) in which observations had been conducted of Si3, and their classroom has been described in Subsection 6.2-2. As mentioned there, this group of girls was one of two parallel Basic mathematics groups (there were also two parallel General mathematics groups):

Interview Excerpt 6.32-3

Int: How do you feel about maths being compulsory? If you had a choice, would you have chosen it?..

G1: Nope [...]

G2&3: No, no.

G3: Well, it's okay, 'am, well, I think they should let you do what level of maths you need for what you plan to become.

G1: Exactly. [...]

Int: Would you call yourself a math-person? [...]

G2: No.

G1: No.

[...]

Int: You think of yourself as a Basic maths person?

G2: Yeah

G1: Yeah, me too.

G3: I don't really like, okay, like, 'am, General maths has a lot of like functions, like, f bracket x bracket and all those stuff...

G1: Yeah, and I'm not that kind of...

G3: ...I like business maths, Consumer Arithmetic and all that.

G1: Yeah.

Int: Okay. Is there anybody in your... not necessarily in your maths class, but in your form class that you think is a math-person?

G1: Oh yeah, the Chinese girl. [...] She's brilliant. She can work any maths subject...

G3: Any subject at all at a time.

[...]

G1: Anybody who has a good brain in maths, it's like, they know they're gonna get a good job and, you know...

Int: So the disadvantage to doing...

G1: Basic maths, you're not sure about the future.

G3: Exactly.

G2: I do not believe that.

G1: That is my fear. I am not sure about the future because I'm... bare.

G3: And I want to be an accountant and I see Basic maths in my way.

G1: Exactly.

Int: Basic maths in your...?

G3: Way.

G1: I want, like, if I'm going to university I don't want to tell them I doing Basic maths 'cause like, you know...

G2: I'm not afraid to say I'm doing Basic maths, because I'm doing it.

G3: I'm not afraid of saying it nuh ((you know)), but what I'm saying I shouldn't have to do it if I don't want to do it.

G2: I don't see that it's getting in my way any how because I am doing my work, it's not like I'm not doing it. I'm doing it maybe at just a lower level. Because you just have... Okay, I'm doing the same amount of work, I know General is doing a little bit more than me, but I'm still doing something that General is doing, so, I don't look down on myself because I'm doing Basic maths.

G3: 'Am, also, the students that do General maths, they look down on us.

G2: Not all.

G3: Not all of them, but some of them. Some of them was with us, and just went over.

G1: I find that the Antiguan society is like, if you're a maid, it's like people don't care nothing, if you're a doctor, people will more see, respect you, you understand. I find that society is very... I guess that's why we fear our future, you know.

(3 girls, Si3)

It is the girls themselves in the interview who bring up, more explicitly than the girls of Si1, the issue of levels of mathematics and via this the re-grouping for mathematics that had occurred. An interpretation of this reference to levels of mathematics is that brought through by ideas of privilege and power and the constraints these hold for these girls, the mathematics spaces into which these girls felt they could comfortably enter. These ideas are more poignant in this interview than with the girls of Si1 (Interview Excerpt 6.32-1). Privilege, power, status are all notions intertwined with positional (relational) identity (Holland et al, 1998, p125), and the girls' responses in Interview Excerpt 6.32-3 does bring these notions across, especially with G1's reference to maid and doctor, professions which she seems to be contrasting as what may be allowed (the possible self) by access to Basic and General tiers respectively of mathematics. Two of the girls in this interview, G1 and G3 do seem to be acutely aware of a 'class-ness' about mathematics, a social ordering that had come about because of the way that mathematics learning and teaching had been structured in their school. The structures associated with learning mathematics in their school, and the experience of mathematics these students then had, had for these students become 'a critical process' in unveiling 'their conditions within a system of class division' (Valero, 2004, p14). In a similar vein, Bourdieu provided the following perspective of the function of mathematics in schools:

> Often with a psychological brutality which nothing can attenuate, the school institution lays down its final judgments and its verdicts, from which there is no appeal, ranking all students in a unique hierarchy of forms of excellence, nowadays dominated by a single discipline, mathematics (1998, p28).

It appeared to be the case that G1 and G3 of Si3 had a perspective that if mathematics could be used in that way in their school, it potentially would also occur in the world outside school. As mentioned in Subsection 6.2-2, in listing the subjects that they were doing, nine of the 18 students who completed the questionnaire in this school identified themselves as doing 'General' mathematics. One other student identified as doing Basic mathematics, and another student who had written 'Basic maths' then 'whited out' the word 'Basic'. The other students had just written mathematics. (Data from the 2006 CXC/CSEC mathematics results for this school show that of the 18 students who completed the questionnaire, nine students had indeed done the General proficiency of the examination, and six students had done the Basic proficiency; three other students could not be matched.) This qualifier of mathematics on the part of the students might have had much to do with the practice of the school of now describing mathematics in this way (see in Subsection 6.2-2). However, there seemed more here than might otherwise meet the eye as being a part of school practices. In stating that they were doing *General* mathematics, the students in this school who had done so in completing the questionnaire were separating themselves from others of their peers who were doing *Basic* mathematics, and claiming 'rights' and privileges as members of a particular group of people. They were in effect laying claim to spaces, saying that they 'belonged' to the group of 'able maths students.' What had for years been 'mathematics' (primary through to the first three years of secondary school) had within a few weeks of being enacted been qualified by *type* of mathematics, and hence signified, as intimated by the students' responses to the open item, that mathematics was for smart people (from Subsection 3.3-1 the questionnaire was administered during the first month of the new school year). Being selected for *General* mathematics was a status symbol within this school, a view somewhat confirmed by one of the mathematics teachers within the school who noted that being selected for the General mathematics class was not necessarily good for some of students, as it resulted in some of them thinking that they had arrived, that the selection process was the examination, and they therefore tended to relax their efforts (Field-notes). Outside this school, there was only one other student who had qualified mathematics (or any other subject) in this way, and that was in the other girls' single-sex school (Si1).

The practice of ability grouping practices in (for) mathematics was changing who these girls could become, altering trajectories, altering identities. Being put into Basic mathematics for two of these girls went beyond merely a re-grouping of students for easier teaching (Sukhnandan & Lee, 1998). The implications were more far reaching socially and academically. Limitations were now placed on their possible academic and career trajectories on leaving school. The sifting effects of the discipline of mathematics had reduced their agency not just in the mathematics classroom, but also in their academic and career goals. G1 in Interview Excerpt 6.32-3 refers to being bare – perhaps a reference to a feeling of a loss of control, reduced agency, over her planned goals. She was being pigeon-holed into something she did not see herself as, being denied access to a social world she could imagine herself a part. Mathematics had power and status, and a qualification, i.e. a pass in it assured one of a good job. This then accorded persons respect. Without mathematics, which was equivalent to doing Basic mathematics, she was open and vulnerable i.e. *'bare'*, unprotected from the wiles of those in more powerful positions. According to G3, this was already occurring in the 'lived world' of their school. Some class/form mates, specifically those who had gained entitlement to General mathematics and hence the position of privilege (Holland et al, 1998, p127) that goes with it, were already *'looking* *down'* on them, and the loss of respect was already occurring. For both these girls, G1 and G3, their position was vulnerable and the situation would become even more dire after they left the relative protection of their school for that of the Antigua State College, where departments were differentiated by what uniform you wore. There, their braininess or not would be more visible to a wider society. Both G1 and G3 share similar perspectives on how they saw these sorts of relations in 'Antiguan' society, and the perspective they present is a rather class-ist, elitist one.

For G3, Basic mathematics was a hindrance to what she wanted to be, her future image of herself. She had intentions of becoming an accountant, and perhaps with some justification, Basic mathematics was not a means to that goal, but was blocking her path, standing in her way. She was the first of the group to bring up the issue of level of mathematics (near beginning of Interview Excerpt 6.32-3). The rationale she offered for who should be allowed to do what (level) mathematics is the rationale outlined in the CXC/CSEC syllabus (see in Section 1.4). Rather than being an opportunity, Basic maths was for her an obstacle. She revealed later in the interview that she was going to out-of-school classes for General mathematics. In this way she was trying to regain some control over her desired trajectory. The two girls G1 and G3 were unwilling to accept from their perspective what seemed the position and positional identity being afforded them by the practices of their school based on different levels of mathematics proficiency, and one of these girls had already devised a strategy to re-position herself. Thus, whilst these two girls did appear to view the re-grouping practices of their school as exclusionary as might also be interpreted to be the view of the students of Si1, their perspective appeared to be one of wanting to belong, to enter that world of the 'able maths student', unlike the students of Si1.

G2 presented a less class-ist view of the implications for her of the mathematics re-grouping, and her perspective was one more based on her perception of her ability in mathematics. She was more accepting of Basic mathematics as a level more suited to her ability. She was willing to accept, and did take on the identity of a Basic mathematics student. She had effectly already 'sutured' herself to the position chosen for her, but this suturing was one of a different genre, not one of attempts to heal a wound, but of one of finding, accepting, and joining herself to her assigned 'position/place'. In this way, her acceptance of the position afforded her was dissimilar to that of the students of Si1 in that she did not seem to see her position as exclusionary. She appeared to be more content with this position. She was more willing to adjust her career goals in light of the new direction she might therefore be required to take. She had said earlier in the interview that she once wanted to be an accountant, but that she no longer wanted to be one as according to her *'now it's kind of being challenging'*. She did seem to have become aware that this career choice might not be as feasible but denied that it was because of the mathematics. She later identified herself as an Office Procedure (business) type person. She had simply re-routed her career goals into something which she deemed a less demanding aspect of the same area, making the best of the hand dealt to her. For her, although some doors might have been closed because she was doing Basic mathematics, she saw some others as still being widely open.

As previously mentioned, the practice of ability grouping for mathematics, at least at this stage of schooling, was largely confined to the two girls' single-sex schools, although one mixed school (Mi7) had just started the practice. The responses of students in other schools particularly to the question of whether there were maths-people' in their classes will now be considered. Boys in the two other single-sex schools did appear to have much more positive views of themselves in relation to mathematics (e.g. the affect and performance rating responses outlined in Sections 6.2-1, 6.2-2, 6.2-3). They were also more inclined than any of the other subgroup of students to think that all secondary school students could do mathematics to CXC level (Table 6.32-1). Despite this however, there were some of them who, like the girls in the single-sex school, also thought that a person had to be 'made for maths'. From Table 6.32-1, although more of this group of students replied *Yes*, their most frequent reason for their response came from those responding *No*, and again had to do with this 'made for maths' view, with 10/20 (50%) of the boys who said *No* giving this as reason.

In response to the question of whether there were 'maths-people' in his class, the lone boy interviewed from Si2 had this to say:

> Interview Excerpt 6.32-4
> Int: Are there any math-people in this class?
> [...]
> B: One, two, three, four, yeah.
> [...]
> Int: Are you a math-person?
> B: Nuh ((No)) I am not a work person.
> Int: You are not a work person?
> B: I don't do any kind of work. For the first term you just cruise.
> Int: The last two terms is work?
> B: Harder work.
> (1 boy, Si2)

Although this boy did not identify himself as a 'math-person', he did qualify this by noting that he was not a 'work-person'. He did however appear to have a sense of his 'position' in mathematics relative to that of other boys in his class. This was the boy, who towards the end of the extended Observation Excerpt 6.22-2 given for his school in Subsection 6.2-2 had said *'Even dunce me know that'*. His relationship with mathematics appeared relatively ambivalent, and it was arguably wrapped up in his overall 'attitude' towards school and doing work in school. He had not developed any particular relationship, positive or negative it seemed, with mathematics. His school mathematics experience did not appear to be marked into a process of becoming (Wenger, 1998) identifiably distinct from his overall school experience. Holland et al (1998) do note that there were cases where some people never really form any particular relationship, any particular identity in a group, although they are members of that group. Despite this however, although the boy in this interview did not consider himself a 'maths-person' he appeared to have no doubt that he could be, if needed, successful in mathematics, and that being successful in mathematics (i.e. passing the subject) was entirely within his control, which was not necessarily the case for the interviewed girls of the single-sex schools. He expressed a greater sense of agency – that is, a capacity to act on his mathematics world, than did the girls in the two single-sex schools discussed previously. The following provides more of his view in this respect:

Interview Excerpt 6.32-5

Int: Which of those you think affects your performance most? Effort, [...] or your natural ability, or whether or not you're interested in the topic, or [...]

B: I would choose that one. (Boy has chosen interest)

Int: If you're interested in the topic?

B: I not interested.

Int: So, if you're interested you work better?

B: Um hum.

Int: Okay.

B: If I don't *have* to do the work, I don't do it.

[...]

Int: And what makes you decide if you have to do the work or not?

B: Once I fail I not goin' fail again.

The three interviewed boys of the other single-sex school (Si4) considered themselves 'math-persons' although one of the boys did qualify this by saying that it depended on the topic. This perspective of themselves in relation to mathematics should also be read in conjunction with that given in Interview Excerpt 6.12-4 in Subsection 6.1-2), which represented the responses of these same boys to the prospect of mathematics being timetabled for a particular day. In that excerpt B2 in fact claimed 'ownership' of mathematics – *'that's my subject'*, which could be inferred as pointing to a sense of entitlement. B2's response also conveys a sense of belonging, of being rescued; rather than approaching mathematics with a sense of trepidation as does come through from some other students' (girls') responses (see examples of these in the interview excerpts in Subsection 6.1-2), his response conveys a sense of being rescued – *'I feel saved'* – of belonging, of a sort of 'coming home' as it were when it was time for mathematics (cf. with Bourdieu's notion of habitus finding a field of which it is a part – 'fish in water', see Section 2.2, p26). These boys too do support some of the points made by the girls of Si3 with regard to being seen as able to do well in mathematics – that such 'ability' accorded a person respect, e.g. a response given by B2 in relation to mathematics and the job market: *'When they [employers] look at your report or look at maths they see it's good, respect, they respect you.'* There is power and privilege to be had in being able to do well in mathematics, and these boys brought this out, but in ways opposite to that brought out by the girls in single-sex schools. For these boys, there was, as it were, a sense of expectation of being a part of such a community, of having access to the privileges that come with success in mathematics. For these boys, rather than a constraint, i.e. *'maths in my way'* as given by G3 of Si3 in Interview Excerpt 6.32-3, mathematics was for them an affordance, a possession, i.e. *'my subject'*, a tool to be used to get to where they wanted to be, a gateway which would allow them to be whom it was they could see themselves as becoming. In comparing the responses of these boys to those of the girls in the single-sex schools it becomes easy to see how the identities in mathematics that the girls formed were hard-*earned* standpoints (cf. Holland et al.'s 'hard-won standpoints', Section 2.1, p20) the girls had formed 'for themselves' from their lived experiences of mathematics in school.

Interviewed students in mixed schools all identified students in their classes, both boys and girls, whom they saw as 'maths-people'. In two cases other students in the interview identified one student also being interviewed as a 'maths-person' – and in both cases these identified students were girls. The relationships these students had developed, and were developing with mathematics seemed to be much more in a state of flux compared especially to that of the girls in the single-sex schools. However, in some cases the mixed school students also brought across notions of power, privilege and respect that become attached to other students they saw as being good in mathematics. In several of the interviews the students also brought across the idea that some of these students in their classes whom they considered as 'maths-people' tended to be unwilling to share what they knew, to help other students in their classes who asked for or needed help with their mathematics (a point also made by the girls of Si3 concerning students they considered 'math-people'). The following three excerpts provide a sense of these ideas in the views of students in mixed schools.

Interview Excerpt 6.32-6

Int: [...] Are there any math-people in your class, people who are, just seem to be naturally good at maths?

All: Yes.

[…]

Int: Are they different from the other people in the class?

G1: Not really, because if you don't understand they will help you.

[...]

B: But you have to ask them.

G1: But not all of them, some of them will help you, but not all.

[...]

G1: Say they like, okay, like, they can do it better than you, so sometimes and so when you have to ask them to like help you, or, some of them like, if they know they're better, and you don't understand, and they ask if you don't understand, and sometimes and so they help you do it, like, and some of them they don't like, if you ask them, you have to ask them like three and four times before they can help you.

(1 boy + 2 girls, Mi1)

Interview Excerpt 6.32-7

Int: [...] are there any math-people in your class, people you would consider math-people?

G1: [Identifies the other girl being interviewed, G2, in addition to two boys in her class].

Int: Are they similar to the other people in the class, or different?

G1: Different. [...] 'Cause when we're doing maths others will ask around ask around ask around, but they will never ask. [...] They will give, but they'll never ask because they know how to do it.

Int: ... so they work by themselves?

G1: They work by themselves.

[...]

Int: [...] let's say you get back a test, and [G2] has gotten 90, and you've gotten, let's just say 20, [...] is there any particular way that [G2] might be, the other students might react to [G2] and how they would react to you in the class? [...]

G1: I'm going to feel left out because every minute they're going to be asking [G2] for answers, and I'm going to be like, why nobody wants to ask me.

Int: Oh, so okay, they sort of respect [G2]....

G1: ...More than they respect me. [...] They just ignore me and don't ask me nothing, they keep asking [G2], [G2].

(2 girls, Mi2)

Interview Excerpt 6.32-8

Int: 'Am, are there any math-people in your class, people you would call a math...

G's: Yeah [... Girls identify one boy and three girls from their class]

[...]

Int: [...] do you find that you can go to these people and ask them to help you if you don't understand?

G's: No...

Int: You can't?

G1: Sometimes.

Int: No, sometimes?

G3: [Identifies the boy named earlier as the only person she/they can ask for help]

Int: Why?

G2: He all, no... one day we can't find them...

G1: Yeah.

G2: ... the other, they ignore us...

G1: Yeah.

Int: Do you think they look down on you because you don't understand...

G2&3: Yes.

G1: Well, something like that.

G3: Yes, yes, a straightforward yes.

[...]

G3: ... the last time I asked [teacher's name] for my, my, my marks, before school close, and [two of the girls named earlier] were asking, and because they pass, and he told me I fail, so I want to know why I fail and how much I got, and they say 'Don't you hear the man say you already fail, wha' you a boder he fa'? ...Whá' you a boder he fa?' ((Why are you bothering him?))

(3 girls, Mi5)

As mentioned, there was more of a sense of fluidity about the mathematical relationships the students in mixed schools have formed. There was a sense that even at this penultimate year of schooling, some mixed school students were still relatively unaware of their position with respect to mathematics. They rated their mathematics performance in relative terms similarly to that of students in single-sex schools, and boys in particular had on average rated their mathematics performance similarly to their overall school performance (Table 6.13-3(b), Subsection 6.1-3), although previous CXC/CSEC results suggested otherwise. This though might, amongst other things, be a function of what is essentially the 'ability grouping' carried out prior to their entry to secondary school (see Subsection 3.3-2 and also Sections 3.5 and 4.1).

The practice of 'ability grouping' students for secondary school entry may have contributed in mixed school students having what might be seen as a false sense of security about their relative position in relation to mathematics, essentially allowing them to view their mathematics performance in better terms than might otherwise be the case. This could result in more relaxed approaches, more relaxed efforts in their doing and learning of mathematics, an approach with no real sense of 'urgency' concerning the state of their mathematics performance. 'It's all the same', i.e. they have no choice in having to learn it, and so they just have to make do (e.g. boy in Interview Excerpt 6.12-1, Subsection 6.1-2) was one of the perceptions of an approach some students adopted to mathematics, the identity they developed with mathematics. Whilst it is 'true' that this was a perception gained from *both* students in mixed and single-sex schools (e.g. Interview Excerpt 6.12-5, Subsection 6.1-2), one could argue based on the evidence of the history of past performances in the CXC/CSEC (mathematics) examinations that 'the same' of mixed schools is at a different level from the 'the same' of the single-sex schools. 'It will all turn out right in the end' is another of the approaches interpreted from interview responses of particularly mixed school students, this in part from the way in which they responded to the algebra task. Whilst some of these students expressed what could be interpreted as unease about the ways in which mathematics was being taught or a realisation that they did not necessarily understand what they were learning and doing (e.g. Questionnaire Excerpts 6.14-1, 6.14-3; Interview Excerpt 6.16-2), there was a sense in which as it was coming from the teacher, and as they had managed to pass tests sometimes, it would all 'come out in the wash' eventually. Further, even where students expressed unease, they seemed to be generally unsure of what it is *they* could do to turn this about in their favour (e.g. G5 in Interview Excerpt 6.21-9, Subsection 6.2-1). Students can (and do) develop a 'mathematics habitus' (Zevenbergen, 2003, p6) or a form of mathematical identity based in part on what and *who* is available in the environment in which they are learning. Extending from Zevenbergen, this habitus or embodied cultural capital thus becomes a resource some student use to trade on in mathematics. These interpretations of the positional i.e. relational, (Holland et al, 1998, p127, see also in Section 2.1, p20) identity that as a group students in mixed schools develop would inarguably have implications for the availability to them of success in mathematics at the CXC CSEC.

Students were not unaware of these expectations implicit though they might be that were placed on them by society in general because of what school uniform they wore. In response to the open questionnaire item of the advantage of going to their particular school (Appendix A1, Section III, Q3), of the 29 reasons coded as 'top/good school', only one student in a mixed school gave such a reason (see Appendix D1, Section III, Table Q3). As example, one girl in a single-sex school had given as response to this question, *'when you go to [name of school] people look at you in a whole different light'* (17F, Si1). These were/are the everyday social implications of the 'cultural practice' (Boaler & Wiliam, 2001, p78 in reference to this practice in the UK for mathematics teaching) of a generalised ability grouping that students live with in A&B. Faced with these expectations, students in the various school-types 'know' that there are certain standards of performance that they must (or not) live up to, and this in practice includes performances in mathematics. Whilst this is 'true' for school and school subjects as a whole, the documentary data of Section 4.2 suggests that the implications of the ability grouping practices are most stark for performances in mathematics.

Smith (2003, p466) has made the point that 'If learning is constructed as participation in a community of practice... then the nature of that community is a crucial factor in the quality of learning.' According to Wiliam & Bartholomew (2004) writing from a UK context, in learning mathematics a student's school is not as crucial a factor as which set they are in. However, in this Caribbean context, the documentary data of Section 4.2, and the findings to be presented in Subsection 6.4-1 to follow show that school can indeed be a crucial factor in students' mathematics learning; but the schools in this context have been 'setted' from the outset. All learning does not result from intentional teaching, and some students learn more from the (social) practices of schools than the subject matter of classrooms.

Further, as schools embody the social order and logic of the education system and wider society in which they exist (Smith, 2003), students come to learn implicitly about what is valued in these areas. In an elitist educational system, and with mathematics the most elite subject of them all the students of the two girls' single-sex school had learnt much more (through the ability grouping practiced for mathematics) about mathematics and its regulating/gate-keeping role in wider society than anything the subject matter alone of mathematics could convey. They also learned about themselves, and what they could, and could not be. But, much earlier, from 'lessons' learnt at the point of entry to secondary school, *all* students had come to develop a sense of identity that perhaps in ways mediated how they thought they could be when learning/doing mathematics.

6.4 CXC/CSEC Results for the Student Sample

This section attempts to address the RA and RQ that deal with student performance in mathematics e.g. RA(c), RQ1(c). There are two further subsections to come. The first of these addresses which students of the sample were successful in the CXC/CSEC mathematics examinations of May/June 2006. In doing so, a number of factors are looked at in order to determine the association, if any, of variables within these factors and student success. These factors include student background data (e.g. those provided in Section 5.1) and also student views (e.g. of those given in Subsection 6.1-1). Student CXC/CSEC results in English Language are also provided both for comparison and also to ascertain the possible association of language as a factor in the mathematics successes. The second subsection provides a profile of four students in the mixed schools who were successful in mathematics. The students were chosen as some of their views of mathematics via questionnaire and/or interview excerpts have been provided in the previous subsections of this chapter. The profiles suggest that in order to be successful in mathematics, these students may have taken on a more agentive role than that allowed in their classrooms in their learning of mathematics.

From the 286 participating students in the study, CXC/CSEC mathematics results from the May/June 2006 examinations were found and matched for 222 students. Two hundred and nine students of the sample had been entered for the General proficiency of the mathematics examinations, although one student did not sit the examination. Thirteen students of the sample had been entered for the Basic proficiency of the examinations, but three of these also did not sit the examination. In terms of those entered, this distribution for the sample students represented a 16:1 ratio in favour of students being entered for the General proficiency of the mathematics examinations. The corresponding statistic for the school student population from which the sample was drawn is 15:1 (797 school students for the

General proficiency and 52 for the Basic proficiency). Unmatched data were missing for a variety of reasons, including not having enough details from some students from the original sample in order to do the match (e.g. students who choose not to give background details, e.g. their names, date of birth in questionnaire data. Additionally, there were a number of students (52) whose names and/or dates of birth obtained from questionnaire data could not be found in the statistical results for their school; it was inferred that the most likely reason for this had to do with these students not reaching the fifth form to write the examinations in May/June 2006. For persons whose names could be matched, there were a few students who were absent from the examination. It will be mentioned here that 7/10 of the students of the sample who sat the Basic proficiency of the mathematics examinations successfully completed this examination as defined by CXC/CSEC, four students obtaining a Grade II and three students a Grade III. Of the ten students who sat this level of the mathematics examination, six were from Si3, and did include the three girls who participated in the interview from this school (Interview Excerpt 6.32-3). However, the focus of this section, as has been that of the study, will be on those students who sat the General proficiency of the examinations. There was though one notable finding concerning the Basic proficiency of the examinations that will be mentioned here. This concerns the mixed school, Mi7, which at the start of data collection for this study (September 2004) had just returned to re-grouping students for mathematics based on the proficiency levels of the syllabus, having abandoned the practice around the beginning of the 2000's and entering all students for the General proficiency of the mathematics examinations. The school ought to then have entered its first cohort of students for the mathematics Basic examinations from that scheme in the May/June 2006 examinations. However, whilst 15 students from the school had been entered for the Basic proficiency of the mathematics examinations, no student actually sat the examination.

6.4-1 Who Succeeds in Mathematics?

Table 6.41-1(a) provides statistics on the CXC/CSEC mathematics pass rate results for the student sample compared to that of the school student population from which the sample was drawn. Similar results for English Language are also given in Table 5.51-1(b) (all students of the sample who could be matched had been entered for the General proficiency of the English examinations).

Table 6.41-1(a) Sample to Population Comparison CXC/CSEC Pass Rates for Mathematics

Pass Rates	Sex		School-Type		
	Male (S:P = 83:311)	Female (125:486)	Mixed (124:562)	Single-sex (84:235)	Overall (208:797)
Sample (208)	48% (40)	48% (60)	23% (28)	86% (72)	48% (100)
Population (797)	39% (122)	34% (165)	19% (104)	78% (183)	36% (287)

S=No. students in sample; P=No. students in population; Number of students in brackets

Table 6.41-1(b) Sample to Population Comparison CXC/CSEC Pass Rates for English Language

Pass Rates	Sex		School-Type		
	Male (S:P = 85:334)	Female (135:517)	Mixed (129:594)	Single-sex (91:257)	Overall (220:851)
Sample (220)	64% (54)	79% (107)	61% (79)	90% (82)	73% (161)
Population (851)	60% (201)	74% (385)	59% (352)	91% (234)	69% (586)

Table 6.41-1(a) shows that although the student sample writing the General proficiency of the mathematics examinations represented 26% (208/797) of the overall school student population writing the examinations, those of the sample who passed mathematics represented 35% (100/287) of the students who did pass. Similar statistics for Table (b) show that students of the sample who passed English Language represented 27% (161/586) of all students who did pass, much closer to their 26% (220/851) representation in the overall student population. For 8/11 of the schools used in the sample (all four single-sex schools and four of the seven mixed schools), the sample pass rate in mathematics was higher than that of the school (for one mixed school the pass rates were the same as all students of the school had failed mathematics); whilst for 5/11 of the schools used in the sample, the sample pass rate in English was higher than that of the school (for one single-sex school pass rates were the same, as all students of the school had passed English).

From the proportion success rates of the student sample compared to the population from which it was drawn, there appears to be a marked difference in these proportions for mathematics, less so for English Language. Binomial one-sample tests of proportions were conducted in order to ascertain the 'significance' of these differences between sample and population success rates. According to Siegel & Castellan (1988, p37), the one-sample binomial test can provide answers to the question of whether a significant difference exists between observed and expected proportions for a series of dichotomous data. A one-sample test is appropriate in this case as the sample is being compared to the population from which it was drawn, and the sample is a relatively large proportion of this population (~26%). For mathematics, these tests gave $p<0.001$ for the 2-tailed test, whilst for English Language, $p=0.202$ for the 2-tailed test.

There is a need here to say something further about the typicality or not of the student sample used in the study. With respect to the population of students who did write the CXC/CSEC examinations in May/June of 2006, the student sample used represents about one-quarter of that population, which, in most cases is a relatively large sample. However, whilst appearing to be fairly representative in terms of the proportion which was successful in English Language, the sample used was significantly more successful in mathematics, the focus of this study. This is a confounding and unexpected finding of the study, as it was hoped that the student sample class who participated in the study would be representative of the population from which it was drawn. Of course, it may be that the fourth form class chosen by the principal or mathematics teacher/HOD for participation in the study was in some way more mathematically 'able' than others of their colleagues in the fourth form year. Whilst not disregarding this as a possibility, the strength of it as the only explanation is weakened by the non-significant difference between the proportions successful in English Language. It should be noted that based on Table 6.41-1(a) the participating study student sample which could be matched for CXC/CSEC results contained a higher proportion of students of the population of students in single-sex schools than it does for the mixed schools (84/235 or 36% and 124//562 or 22% respectively), and from Section 4.2 it is this group of students who have 'traditionally' been markedly more successful in mathematics. However, these proportions (36%:22%) are similar for English Language (Table 6.41-1(b)), and the same 'fact' of 'traditional' success rates applies and therefore would arguably invalidate the basis of this last as explanation. An alternative explanation for the significantly different mathematics outcome for the student sample compared to the population could be that participation in the study may in some ways have acted as an intervention in these students mathematics learning. The comments of some students, noted in the questionnaire section on 'other comments' implied a possible positive effect of participation in the study, e.g.:

Questionnaire Excerpts 6.41-1

I think maths is not that hard, but you have to put your head there and go to after school lesson. To be honest with you I want to go but I don't have the money at the moment so I would have to wait until next year when I reach in fifth form, at this moment my sister is going to do her exam so she is going lesson that's why I can not go now. But in the mean while I will go home an (sic) practise some maths on my own, and I thing [think] they should make maths more fun. (24F, Mi2)

[...] I feel confident about mathematics now that I have answered these questions (2F, Si1)

The results of Table 6.41-1(a) were further broken down in order to gain a sense of which of the sub-groups had produced marked differences in mathematics outcomes compared to the population. Table 6.41-2 provides the statistics on this break-down.

Table 6.41-2: Sample to Population Comparison of Pass Rates for Mathematics – the Subgroups

Cf. Sex / School-type	Sample		School population	
	Male	**Female**	**Male**	**Female**
Single-sex	33/41 81%	39/43 91%	83/109 76%	100/126 79%
Mixed	7/42 17%	21/82 26%	39/202 19%	65/360 18%

Chi-square tests on these numbers for the student sample again show there to be highly significant differences within sex between the school-types, i.e. between girls of the two school-types (χ^2=47.877, df=1, p<0.001, phi=0.619) and between boys of the two school-types (χ^2=33.846, df=1, p<0.001, phi=0.639). The differences within a particular school-type between sexes though are not significant, i.e. there is not a statistically significant difference in the pass rates of boys and girls in mixed schools, nor between boys and girls in single-sex schools. The table also shows that three of the four sub-groups of the student sample had higher pass rates in mathematics than the population from which they were drawn, but that males in mixed schools of the student sample had a slightly lower pass rate than that of the population.

Further chi-square tests were carried out on the sample to compare the proportions of students who passed mathematics against a number of factors and their variables used in the student sample. The results of these are given in Table 6.41-3:

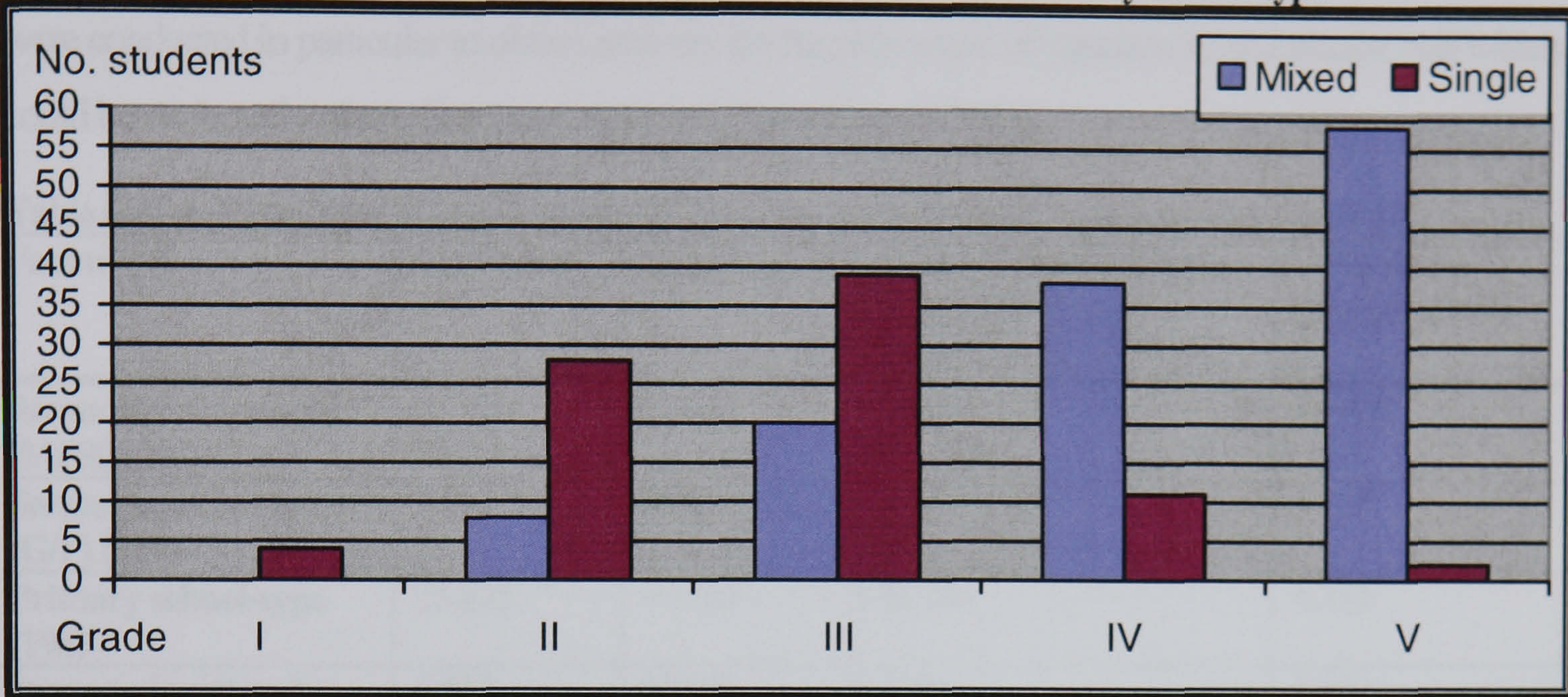
Table 6.41-3 Sample Student Passes for Mathematics against a number of Factors

Factor	Variables	Student Passes	Chi-square Tests
Sex (208)	Male (83) Female (125)	48% (40) 48% (60)	χ^2=0.001, df=1, p=0.978, phi=0.002
Secondary school-type (Mi/Si) (208)	Mixed (124) Single-sex (84)	23% (28) 86% (72)	χ^2=79.958, df=1, p<0.001, phi=0.620
Secondary school-type (G/P) (208)	Government (180) Private (28)	44% (80) 71% (20)	χ^2=7.068, df=1, p=0.008, phi=0.184
Primary school-type (198)	Government (117) Private (81)	34% (40) 69% (56)	χ^2=23.405, df=1 p<0.001, phi=0.244
Parent educational level (110)	≤primary (21) ≤secondary (44) Tertiary (45)	38% (8) 36% (16) 69% (31)	χ^2=10.885, df=2, p=0.004, Cramer's V=0.315
Parent occupational level (165)	MC (29) IC (64) WC (72)	76% (22) 53% (34) 38% (27)	χ^2=12.503, df=2, p=0.002, Cramer's V=0.275
Adult at home (206)	2-parent (104) Mother only (88) Other (14)	58% (60) 39% (34) 43% (6)	χ^2=7.124, df=2, p=0.028, Cramer's V=0.186
Rate maths performance (207)	VG+G (103) Sat (60) UnSat+P (44)	48% (49) 53% (32) 43% (19)	χ^2=1.092, df=2, p=0.579, Cramer's V=0.073
CXC English (P/F) (208)	Pass (151) Fail (57)	56% (85) 26% (15)	χ^2=14.895, df=1, p<0.001, phi=0.268
Do you like maths? (206)	Yes (133) No (73)	49% (65) 47% (34)	χ^2=0.100, df=1, p=0.752, phi=0.022
Maths is difficult (190)	SA+A (96) N (38) D+SD (56)	49% (47) 61% (23) 39% (22)	χ^2=4.112, df=2, p=0.128, Cramer's V=0.147
Would you choose maths (197)	Yes (148) No (49)	53% (78) 37% (18)	χ^2=3.757, df=1, p=0.053, phi=0.138
Don't think, just remember rules (190)	SA+A (54) N (66) D+SD (70)	33% (18) 53% (35) 57% (40)	χ^2=7.590, df=2, p=0.022, Cramer's V=0.200
Boys better at maths than girls (192)	SA+A (32) N (51) D+SD (109)	28% (9) 51% (26) 52% (57)	χ^2=6.051, df=2, p=0.049, Cramer's V=0.178

Percentages are given as of the total of number of students within that category variable. For example, for secondary school-type (Mi/Si), 28/124 or 23% of students in mixed schools had passed the mathematics examinations. Number of students in brackets. Effect size measures given on all factors for comparison.

From the estimates of strength of association, Table 6.41-3 shows that the factor most strongly associated with students' success in mathematics was type of secondary school as mixed or single-sex. The strength of this factor is of the order of Cohen's (1988, p81) 'as high as they come' for educational research. Other background factors looked at in Section 5.1 (Table 5.1-1(a)) show relatively moderate associations on student success in mathematics, although the order of their magnitude is somewhat less than the associations with school-type reported earlier. Figure 6.41-1 shows the actual distribution of the CXC/CSEC mathematics grades for the student sample comparing the school-types mixed and single-sex. (Passing Grades are I-III; although the grading system is on a 6-point scale, no student of the sample who could be matched obtained the lowest grade, a Grade VI.)

Figure 6.41-1: Distribution of the CXC/CSEC Grades for Mathematics by School-type



From the results presented in Table 6.41-3, of note is that there was not a statistically significant difference in the pass rates of male or female students. Additionally, two main student views discussed previously, i.e. whether or not students liked mathematics (Subsection 6.1-2) and their views on the difficulty of the subject (Subsection 6.1-4) did not yield statistically significant differences in the proportions of students who actually succeeded in it. That is, whether or not a student was later successful in their CXC/CSEC mathematics was not significantly related to whether they liked the subject, or thought that it was difficult. Nor was later success in any way related to how students had rated their mathematics performance, with sample proportions of those who passed relatively evenly distributed over whether they had rated this performance as *Very Good/Good*, *Satisfactory*, or *Unsatisfactory/Poor*. Further, of the overview of students' responses to closed questionnaire items presented in Subsection 6.1-1 in Tables 6.11-1 and 6.11-2, students' views were only significantly related to eventual success in mathematics on two of these items, namely numbers 12 and 19 of the Likert-scale (collapsed) items (last two factors shown in Table 6.41-3). (For the dichotomous item on whether students would choose mathematics if it was not compulsory (see Table 6.11-1) there was a difference which was approaching significance – shown in Table 6.41-3). For both Likert-scale items, no. 12 *I do not need to think about the work when doing maths, I just have to remember the rules*, and also no. 19 *Boys are better at maths than girls* there was a higher proportionate pass rate amongst students who had given a neutral response and/or disagreed with the statements than for those students who had responded with some measure of agreement.

Simple logistic regression analyses were conducted using passing or failing the CXC CSEC mathematics as dependent variable against those factors from Table 6.41-3 which were significantly associated with pass rates (and that one approaching significance). The simple regression analyses were conducted in particular to obtain answers for the proportion of variation in success (or not) which could be attributed to these factors as separate independent variables.

Table 6.41-4: Results for Simple Logistic Regression on CXC/CSEC Mathematics Pass/Fail

Factor	Chi-square	Significance	Proportion of Variation explained (from Nagelkkerke R^2)	Odds Ratio (from Exp(B))
Secondary school-type (Mi/Si) (208)	86.670	<0.001	45.5%	20.408
Secondary school-type (G/P) (208)	7.232	0.007	4.6%	3.125
Primary school-type (198)	23.895	<0.001	15.2%	4.312
Parent educational level (110)	8.156	0.004	9.5%	2.137
Parent occupational level (165)	12.642	<0.001	9.8%	2.182
Adult at home (206)	5.479	0.019	3.5%	1.712
CXC English (P/F) (208)	15.406	<0.001	9.5%	3.606
Would you choose maths (197)	3.796	0.051	2.5%	1.919
Don't think, just remember rules (190)	6.613	0.010	4.6%	2.564
Boys better at maths than girls (192)	4.542	0.033	3.1%	2.288

Note: df=1 in each case

The results of the simple logistic regression provide further support for the findings of Table 6.41-3 on the strength of the school-type factor as mixed or single-sex on student success in mathematics. When the factors are considered separately, it accounts for 45.5% of variation in the pass/fail rates, by far the greatest proportion of the factors. The odds ratio results also indicate that based on this factor, all other things being equal, a student is approximately 20 times more likely to be successful in mathematics if he/she was in a single-sex school.

A series of multiple logistic regression analyses were also conducted in order to determine a combination of factors which together *each* made significant contributions in explaining the proportion of variation in the pass/fail rates for the combined model. All factors from Table 6.41-4 were entered via a simultaneous entry method except parental educational level as its use would mean that approximately one-half of the student sample for whom grades were had would be excluded. The model showed that in the combination of factors, only the three factors of school-type made significant contributions to the proportion of variation in pass/fail rates. The model was re-run with those three factors only, and the results of the multiple logistic regression are given in Table 6.41-5.

Table 6.41-5: Results of Multiple Logistic Regression on Student Background Factors with CXC/CSEC Mathematics Pass/Fail as Dependent Variable

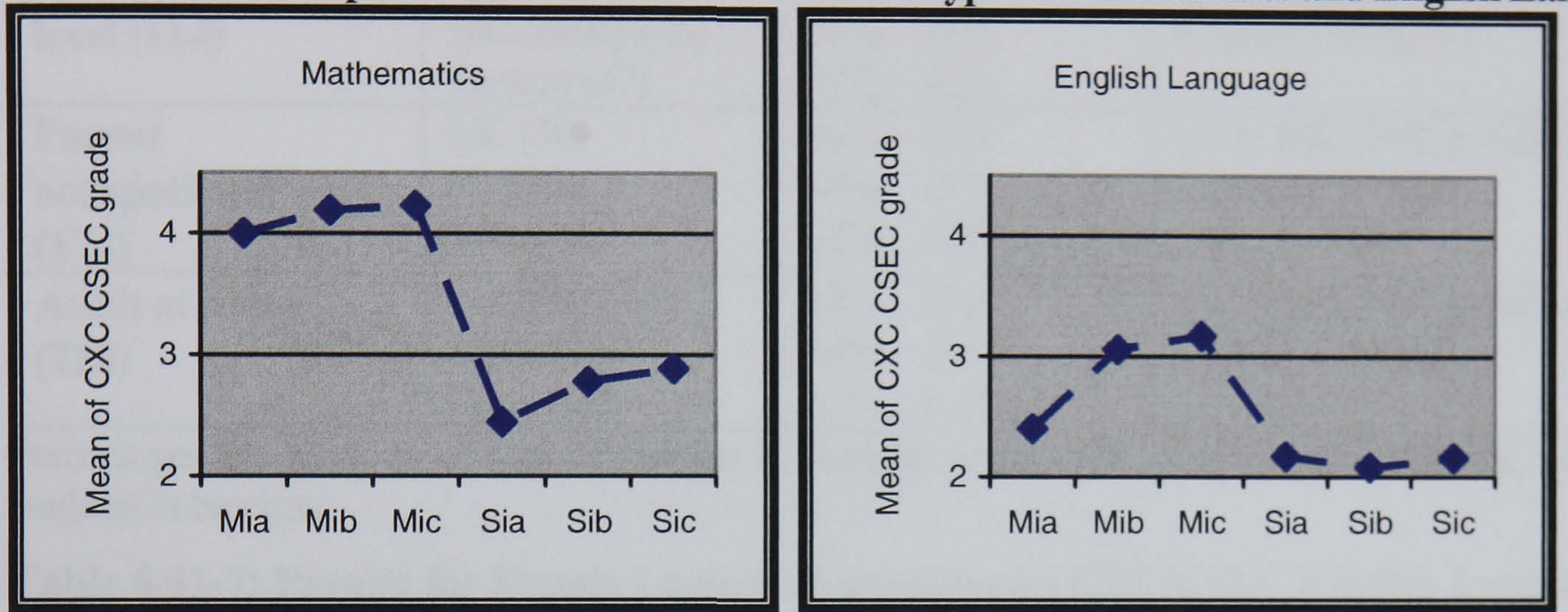
Factor	Wald	df	Significance	Odds Ratio (Exp(B))	Regression Results on model
Secondary school-type (Mi/Si)	39.158	1	<0.001	58.824	χ^2=104.067, df=3, p<0.001, N=198; **Nagelkkerke** R^2=0.545
Secondary school-type (G/P)	10.447	1	0.001	13.541	
Primary school-type (G/P)	10.407	1	0.001	3.941	

The results of the multiple logistic regression analyses show the strength of the school-type factor of whatever typing and stage of education, and in combination with home and student view factors effectively overrides the statistical significance of these other factors. In tandem this three school-types account for 54.5% of the variation in which students pass or fail the CXC/CSEC mathematics examinations. Of particular note though is the odds ratio column which once again re-enforces the strength of the school-type (at secondary level) as mixed or single-sex. Even in combination with these other factors which make significant contributions to the combined model, this typing of secondary schools means that students in single-sex schools were approximately 59 times more likely to be successful in the CXC/CSEC mathematics examinations than students in mixed schools. That said, one ought though to bear in mind that this school-type, and indeed all the school-types looked at are confounding factors as they also 'contain' i.e. are associated with these other home background factors (see Table 5.1-1(a), Section 5.1).

Student home factors were then combined with the (same) mathematics views factors in another series of multiple logistic regression analyses. Although this produced a model with a significant p-value (χ^2=21.974, df=6, p=0.001; proportion variation explained = 18.3%), the only significant factor in this model was parental occupation. The simple logistic regression results for this factor were given in Table 6.41-4. Finally, the analysis was re-run using the three student mathematics views factors. Once again, although a significant model was produced (χ^2=12.058, df=3, p=0.007; proportion of variation explained 8.6%), only one of the factors was found to be significant, that having to do with thinking versus remembering rules. The simple logistic regression results for this factor were given in Table 6.41-4. Through these series of analyses, the most important factors accounting for student success in mathematics were those to do with school-type at both primary and secondary level. It is instructive that through the process of re-running the tests the only student view which was in any way significantly associated with students' eventual success or failure in mathematics is that relating to thinking versus remembering rules when doing mathematics, and this only when run in combination with other student views. From Table 6.11-2 in Subsection 6.1-1, this view had been one of the few student mathematics views which produced a significant difference between the school-types. And, it is this school-type factor which is being seen here as being extremely influential in predicting student success or failure in mathematics.

Chi-square tests were also carried out to determine how some of these student background factors were operating *within* the particular school-types, single-sex or mixed. Specifically, these tests were done on the four factors, namely, primary school-type, parent educational level, parent occupational level and adult at home. Only for the first of these factors, i.e. primary school-type, was there found to be a significant difference in the numbers of students who were successful in the CXC/CSEC mathematics, and this only for students in mixed schools. Twelve of the thirty-two (12/32) or 38% of students in mixed schools who had attended a private primary school had been successful whereas 15/87 or 17% of students in mixed schools who had attended a government primary school had been successful; χ^2=5.474, df=1, p=0.019, phi=0.214. Within school-type on all other of these four background factors there was not a statistically significant difference in the proportions of students who were successful in the examinations. This result suggests that what is being seen on the whole student sample as a significant difference in mathematics success rates based on parent educational level, parental occupational level and adult at home is a sort of 'rub-off' effect of the type of school a student is in. However, one needs to bear in mind that the way in which students are allocated to or get to be in particular secondary school-types is not random. There is at the outset highly significant differences and moderate to high associations in the proportions of students in these secondary school-types based on these four background factors (refer to Tables 5.1-1(a) and 5.1-1(b) in Section 5.1). Specifically, a child is more likely to be in a mixed school if he/she attended a government primary school, lives with his/her mother only, has parents who are working class and whose (parents') educational level is secondary or less. Alternatively, a child is more likely to be in a single-sex school if s/he attended a private primary school, lives with both parents, has parents who are middle and/or intermediate class and whose educational level is secondary or tertiary. Having segregated the student population thusly, then it seems that at least for mathematics, the type of secondary school does take over in influencing student success in mathematics. Thus within a school-type, the school-type factor appears to level the playing field for students of these varying home backgrounds in terms of success in mathematics, awarding success (or failure) evenly to students regardless of home background; but between school-types it awards this success at different levels (see Figure 6.41-2 following for an illustration of this, recalling that a grade of I, II or III is deemed as 'successful'). In other words, once in a particular school-type, a child's home background largely does not appear to matter in terms of gaining success in mathematics, but from the outset, this home background is *highly influential* in doing what needs to be done in order for the child to gain access to the secondary school-type that increases his/her chances of such success.

Figure 6.41-2: Means Plot of CXC/CSEC Grades, Comparing School-type and Parental Occupational Levels within that School-type for Mathematics and English Language



Key: a,b,c refers respectively to middle, intermediate and working class parents; Mi and Si refer to the school-types mixed and single-sex as used previously.

Similar tests as those carried out and presented in Tables 6.41-3 and 6.41-4 for success in mathematics were also carried out for English Language, and the results of these are shown in Tables 6.41-6 and 6.41-7 for comparison:

Table 6.41-6: Sample Student Passes for English Language against a number of Factors

Factor	Variables	Student Passes	Chi-square Tests
Sex (220)	Male (85) Female (135)	64% (54) 79% (107)	χ^2=6.576, df=1, p=0.010, phi=0.173
Secondary school-type (Mi/Si) (220)	Mixed (129) Single-sex (91)	61% (79) 90% (82)	χ^2=22.660, df=1, p<0.001, phi=0.321
Secondary school-type (G/P) (220)	Government (185) Private (35)	72% (133) 80% (28)	χ^2=0.986, df=1, p=0.321, phi=0.067
Primary school-type (207)	Government (121) Private (86)	66% (80) 84% (72)	χ^2=7.986, df=1 p=0.005, phi=0.196
Parent educational level (114)	≤primary (21) ≤secondary (46) Tertiary (47)	57% (12) 80% (37) 89% (42)	χ^2=9.373, df=2, p=0.009, Cramer's V=0.287
Parent occupational level (174)	MC (30) IC (69) WC (75)	89% (27) 84% (57) 62% (48)	χ^2=11.899, df=2, p=0.003, Cramer's V=0.262
Adult at home (218)	2-parent (109) Mother only Other (15)	84% (91) 64% (60 67% (10)	χ^2=10.530, df=2, p=0.005, Cramer's V=0.220

Percentages are given as of total of number of students within that category/factor variable; Number of students in brackets

Table 6.41-7: Results for Simple Logistic Regression on CXC/CSEC English Language Pass/Fail

Factor	Chi-square	Significance	Proportion of Variation explained (from Nagelkkerke R^2)	Odds Ratio (from Exp(B))
Sex (208)	6.775	0.009	4.6%	2.270
Secondary school-type (Mi/Si) (220)	24.845	<0.001	15.5%	5.780
Primary school-type (207)	8.321	0.004	5.7%	2.636
Parent educational level (114)	8.454	0.004	11.3%	2.532
Parent occupational level (174)	12.023	0.001	9.9%	2.511
Adult at home (218)	8.131	0.004	5.4%	2.017

From Table 6.41-6, here again, student success (i.e. passing) in English Language was more strongly associated to school typed as mixed or single-sex than to any other factor. However for English Language, secondary school-type is more weakly associated than it had been for mathematics. Two other findings from this table are notable. The first of these has to do with the other way of typing secondary schools, that is, as government or privately owned; this factor was not significantly related to students' success in English Language but it had been for mathematics. Secondly, the student's sex was statistically significantly associated with success in English Language, with proportionately more girls being successful; it had not been so for mathematics. The results of the simple logistic regression with CXC/CSEC English pass/fail as dependent variable (Table 6.41-7) confirms school-type (mixed or single-sex) as the factor accounting for most of the variation in pass/fail rates, all other things being equal. However, these results also show that school-type as mixed or single-sex accounts for markedly less of the variation in pass/fail than it did do for mathematics. The same is also the case for all the other background factors looked at here. These findings for English Language, combined with the related findings for mathematics where all ways of typing school yielded significant differences may add credence to the view that mathematics is largely learnt at school; this notion will be considered further in Chapter 7.

As had been done for the mathematics results, a multiple regression analysis was conducted entering (via simultaneous entry) all the factors from Table 6.41-7. From that analysis, three factors emerged (school-type, gender and parent at home) as making significant contributions to variations in pass/fail rates for the model, and another multiple regression analysis entering these three factors was conducted. The results of this last are shown in Table 6.41-8. This combination of factors for English language which together made significant contributions to the 'best' model accounted for 24.7% of the variation in English Language pass/fail rates.

Table 6.41-8: Results of Multiple Logistic Regression on Student Background Factors with CXC/CSEC English Language Pass/Fail as Dependent Variable

Factor	Wald	df	Significance	Odds Ratio (Exp(B))	Regression Results on model
Secondary school-type (Mi/Si)	17.057	1	<0.001	5.988	χ^2=38.207, df=3, p<0.001, N=206; **Nagelkkerke** R^2=0.247
Gender	12.484	1	<0.001	3.670	
Parent at home	5.697	1	0.017	1.952	

Analyses had been conducted which looked at how the success or failure of students in mathematics was distributed over the grade they obtained for English Language and vice versa. These analyses were done in order to ascertain whether there was some link between students passing mathematics and a 'measure' of their facility in the English Language. Tables 6.41-7(a) and (b) show the results of these:

Table 6.41-9(a): Sample Students' Success in Mathematics distributed over English Language Grade

CXC English grade	CXC Mathematics Pass	Fail	Chi-square Tests
1	27	7	χ^2 = 27.935, df=4, p<0.001 Cramer's V = 0.366
2	34	25	
3	24	34	
4	11	35	
5	4	7	
	100	108	

Table 6.41-9(b): Sample Students' Success in English Language distributed over Mathematics Grade

CXC Mathematics grade	CXC English Language		Chi-square Tests
	Pass	Fail	$\chi^2 = 16.033$, df=4, p=0.003 Cramer's V = 0.278
1	4	0	
2	32	4	
3	48	11	
4	32	17	
5	35	25	
	151	57	

Shaded areas correspond to the areas of concentration of students.

Both analyses yielded statistically significant results. However, the analysis which looked at student success in mathematics and how that distributed over a measure of a facility in English (Table 6.41-9(a)) was more highly significant than that which looked at student success in English and how that distributed over a measure of a facility in mathematics. That is, it seemed to be the case that students who were successful in mathematics were aided in this by a facility in the English Language – of the 100 students who passed mathematics, 85 of these had also passed English Language, but that a facility in English Language did not guarantee success in mathematics – of the 151 students who had passed English Language, 67 of these had failed mathematics, 59 of whom were students in mixed schools.

6.4-2 Against the Odds?

As given in Table 6.41-1(a) from the study's student sample there were 28 students (seven boys and 21 girls) out of 124 in mixed schools who had been successful in mathematics. This result was particularly notable for the sample of girls from mixed schools as there was a marked proportion of them who were successful compared to others of their group in the overall school population (Table 6.41-2). On these bases there seemed some warrant to investigating further those students within mixed schools, and a seeming 'culture', that is, a way of being and habitus, i.e. (subconscious) disposition to failing mathematics, who nevertheless succeed. Five of the seven boys (83%) had responded *Yes* to *Do you like maths?* (75% of all boys in mixed schools had done so), whereas only 7/21 (33%) girls had done so, this proportion for girls being much lower than the way girls in mixed schools had responded to this question (53% of all girls in mixed schools had done so). Outside of this finding, there did not appear to be any other remarkable finding from this sample of students other than that previously mentioned as pertained to type of primary school attended, as other background data and student views were much in line with how sample students had responded to questionnaire items.

A sub-sample of these students were selected in order to be able to profile what it is, the some*thing* that these students may have had that enabled them to be successful in mathematics, seemingly against the odds. The criterion for selection was based mainly on finding such students who had also participated in interviews as it was felt that the interview data would provide the means for making better sense of these students' questionnaire responses and their ways of thinking in relation to mathematics. From the sub-sample of students in mixed schools who participated in interviews (29 students made up of 10 boys and 19 girls; however seven students could not be matched, two boys and five girls) there were three girls who had been successful in the mathematics examinations. None of the interviewed boys from mixed schools who could be matched had been successful, and therefore questionnaire responses from one of the seven boys from the main student sub-sample will be profiled. The profile data presented for the three girls comes from questionnaire and interview data.

From the students in mixed schools who participated in interviews the girls who were successful in mathematics were G1 of Mi1, G1 of Mi2 and G3 of Mi4 in interview excerpts used earlier in this chapter. Two of these girls (of Mi1 and Mi2) had in questionnaire data responded *No* to *Do you like maths?*, both giving a reason coded as mathematics as difficult. These girls though had apparently found 'ways to be' that better suited their learning of mathematics than that on offer in their mathematics classrooms. A more in-depth profile of each of these girls will be given following. A common finding about all three of these girls and their ways of thinking was in the responses they gave regarding their views of their parents' expectations of their school mathematics. All three girls had responded in interviews that their parent(s) would fuss or be upset if they failed mathematics. Again, this is not to say that all students in mixed schools who thought that their parents would fuss or be upset if they failed mathematics eventually passed the CXC/CSEC mathematics examinations. However, also of note is that of all the students who participated in interviews, including those in single-sex schools, it was only one student from a single-sex school who had responded that their parent(s) would not make a fuss or was unsure of their parents' reaction who was eventually successful in mathematics, and this was the boy of Si2.

G1 of Mi1 at the time of interviews had just turned 17 years old. She had obtained a Grade III for mathematics and a Grade IV for English Language, meaning that she had failed English Language. She had passed a total of seven subjects. She had attended a government primary school. She gave her entry year to secondary school as 2000, which would mean that she had repeated a prior form during her years at secondary school. She gave the adult at home as her mother, giving her mother's occupation as a maid, an occupational level later categorised as working class. She did not indicate her mother's educational level. In addition to responding *No* to *Do you like maths?*, this girl had listed mathematics as one of her two least liked subjects and also as one of her two worst performing subjects. She had rated her mathematics performance as *Poor*, being one of only 15 students in the whole study student sample to do so. She attributed this performance to a lack of enjoyment. In relation to some of the other questionnaire items discussed so far, this girl did not think mathematics should be compulsory *'because student (sic) do not pass mathematics like the other subjects'*. She had also responded *No* to all three items on whether she thought mathematics was compulsory, whether she would choose mathematics if it was not compulsory, and whether she thought all secondary school children could do mathematics to CXC level (see Table 6.11-1 Subsection 6.1-1 for overall student sample statistics on these items). From questionnaire data she was selected for interviews as one of the 'waverers' as despite responding *No* to *Do you like maths?* she had chosen the neutral category for the Likert-item *I like maths*. She described what she did in mathematics classes as mainly taking notes. In response to the questionnaire item about what she saw mathematics as, she had said *'maths is a subject that you have to do to got into a collage (sic) or to get a job in the near future'*. She later gave a similar response during interviews when asked of parental expectations with regard to mathematics (Interview Excerpt 6.17-3, Subsection 6.1-7). In Interview Excerpt 6.12-1 Subsection 6.1-2, this girl had expressed that she did sometimes absent herself from mathematics classes not because of the mathematics but because of the teacher. However, she also noted that she compensated for this by getting notes on the lesson from other students. It may be the strength of the motivation of *getting into* college and/or *getting* a job which may have in some way predisposed her to making the effort to do mathematics. This girl was also somewhat critical of others of her classmates whom she found to be less willing to help when other classmates did not understand the mathematics (Interview Excerpt 6.32-6, Subsection 6.3-2). During the interview this girl also said that outside of school she did sometimes watch a local television programme called *Mastering Mathematics*, saying that she liked how the instructor presented the mathematics as he went through *'step by step'*. According to her if the programme was on and she did not particularly want to watch it she still did as *'sometimes your parents telling you, watch that please, and, you don't want to really watch but because you want them to stop hegging ((harassing)) on you, you just watch it'*. Despite her claims of not liking mathematics, this student did not seem to be unwilling to try to do some mathematics, as in the algebra task, along with mainly the boy of the interview group from this school, she gave one of the more persistent attempts at delineating how she would work the task, an attempt that was heavily reliant on rules (Interview Excerpt 6.21-1, Subsection 6.2-1). Her attempt at the algebra task also highlighted that although she claimed to absent herself from mathematics classes, she had learned some mathematics, although it was shrouded in rules.

G1 of Mi2 was at the time of interviews 16 years 10 months old. She had obtained a Grade III for both mathematics and English Language, and had passed a total of six subjects. She had attended a government primary school, and gave the entry year to secondary school as 1999, which would suggest that she had twice repeated some earlier form(s) during her years at secondary school. She lived with both parents. One of her parents worked at a local airline company and the other as a maid supervisor, so that her parental occupational level had been categorised as intermediate class. She had indicated that her mother had attended college, and this was the highest educational level of the adults at home. She had rated her mathematics performance as *Unsatisfactory*. She attributed her mathematics performance to *'the best of my ability but still never pass'* which had been coded as lack of ability. As had G1 of Mi1, this girl had listed mathematics as one of her two least liked subjects and also as one of her two worst performing subjects. She also did not think that mathematics should be compulsory, and had responded *No* to the three questionnaire items on whether mathematics should be compulsory, whether she would choose mathematics if it was not compulsory, and whether she thought all secondary school children could do mathematics to CXC level. From questionnaire data she was also selected for interviews for her school as one of the 'waverers' as she had responded *No* to *Do you like maths?* but had then chosen the neutral category for the Likert-item *I like maths*. She described herself in mathematics classes as being attentive though talkative but also noted that *'if the topic is boring I sleep otherwise I pay attention'*. She had described mathematics as *'basically addition, subtraction, multiplication and division'*. This was the girl who first made explicit during interviews the view of a teacher making mathematics difficult (Interview Excerpt 6.14-1 Subsection 6.1-4), and also of a teacher making mathematics boring. During the interview she expressed a discontent with the individualistic way in which teachers tended to expect students to learn and do mathematics (Interview Excerpt 6.12-2 Subsection 6.1-2), alluding later in the interview that she did not study (or learn) in that way, but rather did all of her homework or class assignments, as much as possible, by working with her friends. Although she did not like mathematics, she seemed in some way *consciously* disposed to being successful in it because of her preferred career choice which she listed as 'sole trader' and what she perhaps thus saw as a *need* to be successful in mathematics if she was to be successful in her career choice. In questionnaire data she had initially responded *Yes* to *Do you like maths?*, giving as reason that *'my addition, subtraction, multiplication, division so that when I grow to control my money no one can rob me'* – but she had then erased this (though it was still visible) in favour of *'No because to me it is hard'*. However, it was a point that she returned to in interview data about the usefulness of mathematics, saying:

> G1: The disadvantage is [to doing poorly in mathematics], there are disadvantages because [...] me having my own business, I won't be able to count and knowing how to do this and that to get, so people

can rip me from my money and so on, so I would make, instead of making a profit, I would make a loss [...] And it's good to know maths so that you would make a profit. (Mi2)

Thus, she gave a view of mathematics as a sort of protection or guarantee against the wiles of society (cf. this view of mathematics with that of G1 of Si3 in Interview Excerpt 6.32-3 Subsection 6.3-2 and the view that without mathematics she was *'bare'*).

Both girls, G1 of Mi1 and G1 of Mi2, had found other ways to be in mathematics classes that may have aided their quest at success in mathematics. These girls seemed more distinctly aware than some others of their classmates of a mismatch between how they would otherwise be, and the ways demanded of them in mathematics classes in order to gain some access to the mathematics. Rather than continuously adjusting their habitus/dispositions to that demanded of the mathematics classroom, they had found ways to adjust the learning of mathematics to a context that better suited them, either by taking notes and asking other classmates for help when needed, or by working whenever possible with friends on class or home assignments. In this way, they displayed some degree of agency, some capacity to re-make the mathematics world of their classes to a context that better suited their habitus. Perhaps this was possible for these girls too based on what was an underlying awareness of an expectation from home of success in mathematics, that is, despite flaunting the rules, their behaviour with regard to success in mathematics was nonetheless in some ways mediated by their perception of parental expectations. They had found ways to work within the evaluative standards required of school and mathematics classes which were arguably at the edges of the expected 'rules', but which were better suited to accord them some modicum of success.

G3 of Mi4 however presented somewhat of a different profile to the previous two girls. G3 of Mi4 was 14 years 11 months old at the time of the interview. She had obtained a Grade II for both mathematics and English Language, and had passed a total of eight subjects. She had also attended a government primary school, and gave her year of entry to secondary school as 2001, which would indicate that she had not repeated any prior form during her years at secondary school. She lived with both parents; one of her parents was a bartender, and the other a shopkeeper, which meant that her parents' occupational level had been categorised as working class. The highest educational level of either parent was secondary education. Unlike the previous two girls profiled, this girl had responded *Yes* to *Do you like maths?*, and also had listed mathematics as one of her two favourite subjects and as one of the subjects in which she performed best. As her reason for liking mathematics she had written *'I don't know I just love it'*. She had rated her mathematics performance as *Very Good*, being only one of 14 females in the entire student sample to do so. She attributed her performance in mathematics to her efforts, also including here *'what I sow I will surely reap'*, a statement which has some ring of a parental tone to it. She had responded *Yes* to all three questionnaire items on whether she thought mathematics should be compulsory, whether she would choose mathematics if it was not compulsory and whether she thought all secondary school children could do mathematics to CXC level. From questionnaire data she had been selected for interviews for her school as one of the students who responded consistently throughout the questionnaire that she liked mathematics, indeed choosing the strongly agree category for the Likert-scale item *I like maths*. Although she also expressed views of mathematics as useful, her questionnaire responses did suggest that she liked and enjoyed mathematics on its own merits. She described what she did in mathematics classes as *'look, listen and learn'*, and implied in other places that if one paid attention to the teacher, then one would learn mathematics. This was the girl who during the interview in her school essentially guided the direction of the algebra task towards a 'correct' end (Interview Excerpt 6.21-4, Subsection 6.2-1). Again during the interview, she was the student who had identified that in order for students to do well in mathematics they needed to be able to *'read, understand, read and interpret'* (Interview Excerpt 6.16-1, subsection 6.1-6), supporting the views of other girls in the interview that a facility in English language did help in doing mathematics. This girl was the one who tried to persuade her classmates of the value of algebra outside of school (Interview Excerpt 6.21-9, Subsection 6.2-1). The transcript of the entire interview from this school suggests that she may have eventually been pushed out of the discussion as the interview went on, as the other interviewees continued to express discontent with mathematics and its learning.

G3 of Mi4 had in ways bought into the demands of school, bought into the ways that school and mathematics classes required of her in order to be successful. Alternatively, it may also be that she did not 'buy in' so much as that what was being required of her, the way she found she needed to be in mathematics classes was not too far removed from how she would otherwise be, that is, not far removed from her habitus, and the dispositions and resources – cultural capital – she brought with her to school from familial investment – as may be evidenced in the statement about reaping what you sow. During the interview in her school, the other interview students had identified her as the 'math-person' in their class, saying that she was not different from others of their classmates other than that she was quiet. She was the only student from her school to be successful in the CXC/CSEC mathematics examinations. Her disposition to being quiet, and also how she described what she did in mathematics classes seemed to be a good fit for what is ordinarily demanded of students in mathematics classes, and together with the embodied cultural capital in the form of these dispositions she brought to school may have positioned her to make better use of the ways of learning mathematics on offer than others of her classmates. She, in a Boudieuian sense, had a 'feel for the game', an awareness of what she needed to do and how she needed to be in order to be successful in school mathematics.

The boy (2M, Mi7) whose extended questionnaire excerpt was given in Subsection 6.1-4 (see Questionnaire Excerpt 6.14-1) had been successful in mathematics. He had obtained a Grade II for mathematics, but had not passed English Language, getting a Grade V. He had passed a total of five subjects. The boy had not given his date of birth on the questionnaire. He had attended a private primary school, and gave his entry year to secondary school as 2001, which would mean that he had not repeated any prior form during his years at secondary school. He lived with his mother, had given his mother's occupation as a supervisor, which had been categorised as intermediate class. He indicated that he did not know the educational level of his parent(s). He had given mathematics as one of his least liked subjects and one of his worst performing subjects. He rated his mathematics performance as *Unsatisfactory*, being one of only 10 boys in mixed schools (out of 62 boys who responded to this item) to rate their mathematics performance as *Unsatisfactory* or *Poor* (Table 6.31-3(b), Subsection 6.1-3). He attributed this performance to a *'lack in interest'*. In some ways 2M of Mi7 was unusual amongst boys of the sample (responding *No* to do you like maths) and also amongst the seven boys of the sample who did pass mathematics. As previously mentioned, five of the seven boys had claimed to like mathematics, and as such had rated their mathematics performance as *Good*.

This boy, 2M of Mi7's questionnaire excerpt had been given to serve as an example of a student who did not seem convinced of the difficulty of mathematics, and who, though responding *No* to *Do you like maths?*, responsed to other items in a way which could be interpreted as suggesting that he could like mathematics, if he could understand it. As if in confirmation of this interpretation, he had responded with *Agree* to the Likert-scale item *I like maths*. His questionnaire responses to open items did imply that he was in a 'quest for understanding' (Boaler, 1997, p292) in mathematics classes. The reason he gave for disliking mathematics – *'keep in memory'*, suggested that his approach to mathematics (or the one he found himself having to do) was very much based on memorising, some awareness that this rote memorisation was not serving him well, and that what he really wanted to be able to do was understand mathematics. Additional to the information given in Questionnaire Excerpt 6.14-1, the two words he used to describe himself in mathematics classes were *'bored, confused'*. He had responded *No* on the two items concerning whether mathematics should be compulsory, and whether he would choose it if it was not, but *Yes* to that concerning whether he thought every secondary school child could do mathematics to CXC level, citing as reason *'if they want to have a successful job'*. It is believed that this boy may be an example of a student for whom participation in the study did have some positive effect, and perhaps an 'awakening of consciousness' (Bourdieu, 1990, p116; see also in Section 2.1, p27) as his responses concerning mathematics did seem to become progressively positive through the questionnaire. For example as reason for his response on the last open item on the questionnaire on preferred profile on leaving school whether with or without mathematics (see Appendix A1 Section IV, Q29) he had responded *'although I don't like it my dream profession may include a little knowledge in math'*. He earlier in the questionnaire indicated his career choice as doctor.

Bourdieu's theory of cultural reproduction offers an explanatory model for differences in the general patterns of educational success between students from different social/cultural backgrounds. However, Moore (2004) has noted that the theory offers much less for differences in such success for students from otherwise similar social/cultural backgrounds, i.e. cases that are exceptions to this model. According to Moore, Bourdieu is not entirely silent on this issue, although what he has offered (in conjunction with Passeron) is characteristically vague. The notion important for Moore (ibid) is that of 'degree of selection' (p453, which he cited from Bourdieu & Passeron), saying that exceptions to the rule have tended to go through a process of more rigourous selection than other members of their group, relying on an interaction of their available cultural capital and this rigour. He quotes the following from Bourdieu & Passeron:

> ... it is clear why ... the working class students come top in the sub-group of Latinists because they doubtless owe the fact of having done Latin to a *particularity of their family background* and because, coming from a class for which this route is more improbable, they have had to *manifest exceptional qualities* in order to be channelled in this direction and persist in it (cited in Moore, 2004, p453; his emphases)

Moore then pointed out that Bourdieu & Passeron had little else to say of nature of the 'particularities' and 'exceptional qualities'. They did offer though in a footnote a comment which suggested answers to what these particularities and exceptional qualities are might be found in social/cultural intra-group differences. It is there, in combination with the notion of 'degree of selection' that I look for possible explanations for the success of these students profiled.

The students profiled here are exceptions to the explanatory model. But what 'degree of selection' or particularity of family background might there be that may have contributed to their success in mathematics? All four of the students did seem to have an 'awareness' about their mathematics performance and/or the possible implications of the process of learning mathematics they were finding themselves in and how that fitted or not how they would otherwise be. This 'awareness' of themselves in relation to mathematics was arguably not widespread amongst others of their classmates based on the tenor of their responses and particularly their perceptions of their mathematics performance (see Table 6.13-3(b)). All three of the girls during interviews had thought that their parent(s) would be upset if they failed mathematics. From Subsection 6.1-7, although limited, this 'result' for students interviewed from mixed schools was less widespread compared to students in single-sex schools, and so could be seen as a particularity of these students' family background. The girls of Mi1 and Mi2 had both had extra year(s) of mathematics, having repeated previous forms; this may speak to a more rigourous selection. Both G1 of Mi2 and G3 of Mi4 lived at home with both parents, which, for the overall student sample was significantly associated with success in mathematics (Table 6.41-3). This home situation was less common amongst students in mixed schools than was living with Mother only (Table 5.1-1(a)). The boy, 2M of Mi7 had attended a private primary school, which for the whole student sample and notably within mixed schools was also significantly associated with eventual success in mathematics; it was also less likely to be a feature of the primary school-type of students in mixed schools. Both the boy and G1 of Mi2 had parent(s) whose occupational level had been coded as intermediate class. Parent occupational level had also been significantly associated with mathematics success for the whole student sample, with 34/64 or 52% of students whose parent(s) had been coded at the intermediate class level being successful (Table 6.41-3). However, parent(s) at the intermediate class level was a feature associated with 33% of students in mixed schools (Table 5.1-1, Section 5.1). But, these particularities seemed relevant to the students profiled here on an *individual* basis; other than for the already noted exception of primary school-type, there was not a pattern to these amongst the other students in mixed schools who had been successful in mathematics. But, perhaps that is the nature of particularities. Thus these particularities, whilst they may serve as necessary conditions for success in mathematics of students at an individual level, are for other students neither necessary nor more importantly sufficient conditions for such success.

Chapter 7

Discussion

7. DISCUSSION

This chapter sets out a more general, macro-level discussion of the findings of the study. It is an attempt to draw the findings together and to present interpretations that stand more 'outside' the context of study. Thus, the focus of the discussion is not specifically to address individual RA or RQ but to address them from a more integrated and holistic perspective.

There is a point that ought to be kept in mind concerning the main student sample in considerations of the findings of the study. The student sample who participated in this study represented a sample from an already select group of students, having been successful in negotiating the CEE (and to a lesser extent the post-primary examinations) to gain access to secondary school, and further to have survived at least the first three forms of secondary schooling to still be there at fourth form (in particular, refer to the discussion for the school year 2003-2004 at the beginning of Section 4.2). As mentioned in Chapter 1, attrition rates in secondary schooling in the Caribbean are high, and this is no less 'true' in A&B. In light of this consideration, some otherwise surprising findings, e.g. the proportion of students reporting to liking mathematics, might not be as surprising, as there would arguably be some intrinsic want, disposition even, in these students both for education (almost 100% of the sample saw education as important for future success), and also for mathematics, to be successful in mathematics (as they saw this as being needed in order to get a good job).

This chapter contains three main sections in which the study's findings are discussed. The first of these sections also contains three subsections. The first main section looks at some findings of the study from the perspective of a disjuncture where expectations fall somewhat short of realities. The second main section looks once again at the notion of interplay from the study's title. A conception of interplay had been offered in Section 2.1. Looking at interplay once again serves as a basis for discussing what could be considered the more abstract aspects of the RA and RQ, those having to do with inter-relations, i.e. RA(c) and RQ2. The third section marks a more direct discussion from theoretical perspectives of the notion of agency, with also efforts to see what it might look like from the findings of the study.

7.1 DISJUNCTURE

There seemed running through the findings of the study the idea of a disjuncture. The term 'disjuncture' has been chosen to describe a difference between things which are *expected* to be similar (Oxford Paperback Dictionary, 2001). The expectation of similarity is, for me, crucial to the idea of disjuncture being proposed in relation to the study's findings. It is because things are expected to be similar that they are often missed, glossed over, misrecognised even in the Bourdieuian sense (see in Section 2.1 p31), in being taken for something other than what they are. The disjuncture comes in various forms, some of which are as follows: firstly, in some students' expectations of what mathematics is and what they find themselves doing in mathematics classes; secondly, disjuncture in language, and expected student proficiency in use (to include making sense of, use of, written and oral interpretations of); thirdly, of some students' expectations falling short of the observed realities, e.g. in the area of perception of their performance and actual outcomes on external examinations, in particular for boys in mixed schools, amongst others. From all this, one does get the sense that the mathematical underachievement (underperformance) of students 'is more apparent than it is real' (Gates & Vistro-Yu, 2004, p53-54), that is, that there is some evidence that the 'apparent' low performance of students in the CXC/CSEC examinations for mathematics is not necessarily a 'real' reflection of an inability in the subject. It may however be more of a reflection of other social and cultural student background factors, some of which students bring with them to school as habitus, embodied in the form of what cultural capital they have to offer to trade on in school for success. Further, of the subjects that students study in school it is the outcomes in mathematics that seem to best contain the mixture of these social/cultural factors (from documentary data presented in Section 4.2, also the findings and discussion of Subsection 6.4-2). That is, whilst a greater proportion of students in mixed schools seem to have been able to overcome disadvantage that may be associated with home background and other cultural factors both in English Language and across other subject areas, fewer of them seem to have been able to do so in mathematics. According to Gates & Vistro-Yu, (ibid, p54) the apparent versus real notion of the underachievement of working class students in mathematics has been so contrived – that is, education systems and the position of mathematics in such systems are so set up that they allow for and are complicit in this underachievement occurring. It seems in A&B, the context of this research, the mathematical underperformance is something that, amongst other reasons, has happened, or been allowed to happen in some sense unwittingly, by default, due to the set up of the educational system, the associated history of the system and the way society works/what society values. This default position arises because it seems that alternative positions have not been duly considered and given opportunity to happen.

7.1-1 Difficult Mathematics

Asking students directly *Do you like maths?* might be considered a potentially biased and simplistic way of getting at or addressing the issue of students' views of mathematics. There is the problem of what it is students mean when they say that they like or dislike mathematics. Attaching the adjunct open question asking for a reason for their response in some way dealt with the issue of what it is students may mean by liking or disliking mathematics. The advantage of asking the question in this way though is that it is direct, and is pitched at a level with which students could engage. Further, it served as an opening 'ice breaker' towards getting at students' views of mathematics, and it in the present study did serve adequately to open the conversation on student views of mathematics and how it is they may have come to have those views. As seen from the findings outlined in Subsection 6.1-2 the question did serve to bring out what has come to be a prominent student view of mathematics in this study, that it is difficult, and further that some teachers make it so.

The student perception of mathematics as hard/difficult deserves more consideration. In giving the reasons for their answers to *Do you like maths?*, although only reasons which included the words hard or difficult were coded as such, students did use other words or terms that could be interpreted as hard/difficult, for example, saying that mathematics was confusing, that they did not understand it, that it was a *'brain buster'*, that it was challenging (this usually from students who said they like mathematics), etc. Perhaps there has been an inadequate *appreciation* of this 'fact' by some teachers as well as policy makers in this Caribbean context. That is, apart from an acknowledgement that mathematics is cognitively demanding and considered difficult by many, there seems to be little else done in order to facilitate its learning or teaching in schools. For example, mathematics learning may be impeded by the practice of placing its teaching, in particular at the primary level, in the hands of persons whose personal experience of the subject has not been one of success, *and* not seeing this as an inherent problem in the way mathematics teaching is structured in the education system. This situation is further compounded at the secondary level where, for the most part, the teaching of mathematics is placed in the hands of someone who has had some previous success with mathematics and therefore may not or cannot see the difficulty that there may be for the student (e.g. the apparent disjuncture in students identifying algebra as a topic area they did not like, whilst this area was the most frequent given by study teachers as their favourite to teach). It seems to be the case that even if a teacher sees mathematics as easy for themselves, as a part of their profession and what it is they need to do in classrooms as a significant mediator of students' mathematics, he/she ought to be able to see mathematics as difficult, what it is in particular topic areas that may be difficult for their students (e.g. Shulman, 1986, p9).

This is not to say, for example, at the primary level, that a certification or qualification in mathematics guarantees improved teaching; but, on the other hand, it is difficult to see how no such certification or qualification improves access to such guarantee, especially when there has been a tradition (culture) of provision at the primary level of teachers who have no such qualification in mathematics. In other words, it is difficult to ascertain how students may be appropriately introduced to mathematics, or for that matter what type of mathematics it is they can come to know, when the introducer him/herself does not really 'know' what he/she is introducing. In the context of the study, some students in their schooling and learning of mathematics are likely to have moved from one extreme to another, from teachers in primary schools who had no qualification *per se* in mathematics, to some teachers in secondary schools who consider themselves specialists in the subject and cannot see mathematics as difficult, how it may be difficult for students. This for me is another case of disjuncture.

In a sense, it could be said that there is a situation where mathematics teaching at one stage of schooling is placed with (some) persons who are not good enough, and at the next stage with (some) persons who are 'too good' (e.g. in an inability to see mathematics as difficult). Invariably it is the student who is largely left (and often on his/her own) to negotiate this divide between the mathematics teaching at different stages of school and in different forms in schools. There is a sense in which mathematics in schools is structured so as to let many in (mathematics is compulsory for all students at all stages of schooling), but its teaching is structured to let few out. The situation arguably appears to shore up the end almost it seems at the expense of the beginning. This is undoubtedly problematic especially so in a subject area already generally seen and structured in the curriculum as hierarchical. Greater consideration and attention needs to be paid to mathematics teacher recruitment and continuing professional development at both primary and secondary stages of schooling. The primary stage is as crucial as the secondary stage as all primary teachers are expected to teach mathematics, and so all ought to be seen as mathematics teachers. The findings of this study suggest that poor quality at the primary stage of schooling is not always (nor perhaps often) redeemable in the secondary stage.

The concern is that with mathematics and its teaching in A&B, it ought not to be business as usual. There is a general concern that students' achievement in this subject is low, but as has been found in this study, low achievement in mathematics is more markedly a 'problem' in mixed than in single-sex schools. It is arguably the case that the schools themselves are making a difference in these achievement levels; the findings of Subsection 6.4-1 are pertinent here. However, given the year on year consistency of the outcomes and with different student cohorts, there seems sufficient evidence to posit that there is also some other underlying consistency of structure that contributes to the observed achievement than that which might be *solely* attributable to schools per se. That is, whilst student achievement in mathematics could be attributable to (what happens in) schools, there appears to also be something else at work mediating student achievement that maintains the observed consistency in achievement levels within and between the school-types seemingly regardless of year-on-year differences in individual students and also (though over longer time frames) differences in teaching personnel. Mathematics, and its teaching, cannot be treated as 'any other subject' if there is a real desire for achievement levels to rise. Mathematics and its teaching also ought not to be treated as any other subject given the crucial social role it plays in the opportunities a child may reasonably *expect* to have upon completing secondary school (re: Subsection 6.3-2). As with Moses & Cobb (2001), access to mathematics and mathematical success for some students in A&B can be seen as a civil rights issue, as without it their school-leaving horizons are limited.

Teachers remain one of the more confounding influences on students' experience of school mathematics (e.g. Ruthven, 2001). The teacher is a factor which is at times easy to overlook, or perhaps intentionally avoided due to the complexities involved in dealing with this 'factor'. Wiliam & Bartholomew (2004, p279-80) noted the 'tricky business' of educational reform largely due to the inextricable link of a teacher's personality with his/her daily practice. Other studies have pointed out the crucial role of teachers in facilitating learning, both in their pedagogical approach, and also in the way they treated students (Boaler, 2000; Nardi & Steward, 2003). This teacher influence in education in general is also true in the Caribbean, where the 1999 student attitude survey in the OECS had found that

> teacher interest and support is the most important predictor of liking for school and of the level of effort that students make in the classroom. Among the variables measured, it is also the only significant predictor other than age and gender – in other words, the only modifiable determinant – of academic performance (Hinds et al, 1999, p82)

In exploring the notion of teachers *making* mathematics *hard*, there was a recognition of a need to reacquaint with possible meaning(s) of the words 'make' as well as 'hard' or 'difficult'. In the context used, these may be, but are not limited to the following:

- ✧ For 'make': to cause to exist or happen, to bring about, to create; to cause to be or become; to prepare, fix, to get ready or set in order for use; to engage in, to carry out, perform; to achieve, produce, or attain; to institute or establish, to enact. (source: YourDictionary.com, http://www.yourdictionary.com)
- ✧ For 'hard': requiring a great deal of endurance or effort. For difficult: needing much effort or skill to do or understand; causing or full of problems. (source: Oxford Paperback Dictionary, 2001).

The notion of 'make' that students used in relation to conveying the idea that teachers 'make' mathematics hard/difficult has to do with a causing to be or become, which could be related to how mathematics is prepared or readied for presentation, or perhaps how it is engaged in, carried out or performed. Thus, when some students suggested that teachers were making mathematics hard, the sense obtained was that some teachers were preparing, engaging in, carrying out, and producing a mathematics that required much effort and/or skill (perhaps out of the ordinary) to do, to learn, or to understand, so that there was almost as it were two forms of hardness/difficulty, a 'no way in' hard, i.e. the mathematics was impenetrable, as well as a 'no way out' – i.e. if in, the mathematics was insolvable; so that teachers were making be something that need not be so.

Thus, students thought that they could learn from mistakes they made in mathematics (item 17 in Table 6.11-2, Subsection 6.1-1, 79% sample agreeing); but in classrooms observed there seemed little opportunity, little allowance given for students to learn from such mistakes during actual class time. Students have come to have a view that speed was important in doing mathematics (item 14 in Table 6.11-2, 65% of sample agreeing), so it seems they were given little space to struggle, to see struggling as a legitimate way to be in learning mathematics (see Pendlington, 2005 on this). This has implications on students having time in mathematics classes to think, to think through working a problem, and may explain in some way their responses to item 12 of Table 6.1-2 where overall 40% of the sample disagreed that they needed to think other than remembering rules in mathematics. Arguably, the way mathematics is taught in some of these classrooms, the bit by bit nature in which it is invariably dispensed and taken back, lends itself to students coming to have this view. Mathematics has also been made difficult for some students due to a tendency of some teachers to disallow student-student interactions in class, such as talking to each other, working together. Learning mathematics was seen by a fair proportion of students as an individual enterprise as less than half of the sample – 47% – agreed that they could learn mathematics better if they worked with their friends (item 18 in Table 6.11-2). Rather than promoting individual thinking on the part of students as might be the intentions of the teacher, disallowing such interactions inarguably makes the child more reliant on the teacher, and may also explain the teacher view of girls being more teacher-dependent than boys (e.g. Questionnaire Excerpts 5.22-1 and 5.22-2, Subsection 5.2-2), as it is girls who were more likely to approach learning mathematics in this 'expected' way (Subsection 6.3-1).

This situation, especially at the secondary level, has the potential for opening up gaps in students' learning of mathematics – a situation which several students alluded to. These gaps were being made and further widened in students' learning of mathematics as teachers were not always meeting students where they were. The starting point of the teaching was at times too far for some students to make the connection or 'bridge' (as used by Pickering, 1995, p116) to the learning. Further, too often it appeared to be that the responsibility for making the adjustment, the need to 'bridge' was being placed fully on the shoulders of the students. Given how largely teacher-directed these mathematics classrooms are from student descriptions, then opportunities to like mathematics or not, to see mathematics as difficult/hard or not, are mediated by teachers. The teacher is the purveyor of these students' mathematics, supplying what mathematics the students get, how it is and should be known and/or understood, and ultimately how that mathematics is experienced. In fact there is a real conflict as teachers and students appear to be at cross-purposes. Some teachers appear even to students to be aiming to get through the syllabus, whereas students in the main are aiming, or trying to understand the mathematics. The result of these conflicts is that often, in the mathematics classroom there is little convergence of aims.

It is important to keep in mind, however, that the mathematics as hard is the perception of only some students. Some students who responded *Yes* to *Do you like maths?* did in fact refer to the teacher as 'making maths easy', or 'making maths fun'. However, the idea or theme that it was the teacher who was doing the *making* of mathematics still applies here. These referrals by some students to the role of the mathematics teacher in the classroom do highlight just that, that in these teacher-directed mathematics classrooms, it is quite often the teacher who is *making* the mathematics, i.e. it is he/she who is the one preparing, engaging in, talking, and bringing about the mathematics. Students get little opportunity to do much else than listen, and hope to learn. And, too often students find themselves being required to learn in the way the teacher knows, and are given little space to learn in ways more suited to them. The focus is on the teacher and the teaching; the reason for teachers entering the classroom has been to teach, and at times there seems less importance accorded to learning (cf. introduction in Burton, 2002, p158). Greater consideration ought to be given by teachers to 'be aware of sensitivity to the needs of her (sic) students or she is in danger of assuming a teaching style that satisfies her own needs instead of the motivational needs of her students' (Grouws & Lembke, quoted in Malloy & Malloy, 1998, p251-252). The implications of the caveat of this statement seem to apply for example in Observation Excerpt 6.22-1 (Subsection 6.2-2) where students at the end of the class were clearly dissatisfied. Therefore, some students find the mathematics being *made* i.e. engaged in, or enacted in such environs, hard.

Caribbean mathematics classrooms ideally should give students more opportunities to *make* mathematics for themselves. My impressions of some of the classroom observations had been that the teacher was at times reluctant to let students do the mathematics their way, reluctant to let go of the mathematics. But this presents mathematics to students then as a ready done thing. Students would well benefit from seeing the doing of mathematics as more of its reality, a messy, sometimes torturing affair, and this means that they should be given more opportunities to get their hands dirty by participating in the making of the mathematics, especially with the teacher and/or classmates. There is much room for diversification in A&B mathematics classrooms. Perhaps students have come to see mathematics as hard/difficult because they have not been given the time or the space to see it in any other way. For the most part, the sample students seemed to be in no doubt that they could do mathematics, given the right resources to do so. One of those resources was time, and included the pace at which mathematics teaching occurred. A teacher's over-emphasis on speed may be coming at the expense of students' perception of a need to think beyond remembering rules. Thus, students may not see struggling as a part of learning mathematics.

That said, teachers remain a far too easy target. An explanation that accounts for the differences in outcomes of students by school-type by laying 'blame' at the feet of teachers and teaching processes, or wider, that the processes of the education system unequally distribute (mathematics) teachers (cf. background information on teachers in the two school-types, given in Subsection 5.2-2) as it does students would be inadequate in this study given the consistency of these outcomes. From student questionnaire responses, there was not any appreciable difference in how students of the two school-types described their classes, what happened in these classes, what they (the students) did do in the classes. Additionally, whilst there did seem to be some pattern in the experience and qualifications of mathematics teachers in mixed and single-sex schools the differences were not significant. But, giving to everyone, i.e. in this case, students, *equally* when these students begin at different starting points (in terms of the fit of what resources they have to that expected or implicitly demanded of schools) seems a more covert case of 'symbolic violence' (Bourdieu, in Bourdieu & Wacquant, 1992, p167) as it serves to further uneven the playing field. Some students, due in part to features of their home background, are better positioned to make the 'expected' use of these equally distributed resources. According to Bourdieu, symbolic violence is a violence (in other words, an injustice) that is perpetuated on a person 'with his or her complicity' (ibid, p167) due in large part because it is misrecognised as a violence (injustice), as it is the way things are done, have been done, it is 'the order of things' (ibid, p168). Gates & Vistro-Yu (2003, p40) have highlighted the issue of equity versus equality in mathematics education. Equity promotes not the notion of equal instructions for all students, but rather that all students should be given the appropriate resources that will enable equal access to mathematical success.

But, classrooms are not neutral places. Both teachers and students bring with them 'baggage' of various sorts that may impinge on what is possible in the classrooms for the teaching and learning of mathematics. One such has to do with who mathematics is for, discussed in some detail in Subsection 6.3-2. From Subsection 5.2-2, some mathematics teachers in A&B are entering classrooms with an underlying view that not every student therein are 'made' for the mathematics they are teaching. From the qualitative results associated with Table 6.32-1 (Subsection 6.3-2), a non-trivial proportion of students (88/265 or 33% of those responding) shared a similar view. Providing 'equal mathematics' creates a situation where it is the student who has to be moulded (i.e. 'made') for a fit, or alternatively who has to seek ways of positioning him/herself to make sense of what is on offer. That 'equal mathematics' is inflexible. However, mathematics can be 'made' so that it fits the students for whom it is intended, and this includes mathematics at the General proficiency of the CXC/CSEC. This form of mathematics is more flexible. It could involve both teachers and students in its 'making', giving students opportunities to learn in the ways more suited to their identities. This form of mathematics, 'equity mathematics' would also mean that teachers would need to be prepared to use more variety in their teaching, as well being prepared to 'let go' of the mathematics.

7.1-2 Language

The unconsciousness of language, and that it might be a factor that could influence some students' learning of and performance in mathematics had been taken for granted in the initial proposal and design focus of this study. As with Brumfit (cited in Robertson, 1999, p75), the factor of language had been so familiar, its larger than life nature so universal as to render it virtually invisible, so that language was not a particular focus of the study, and may well have remained that way if the study design had not incorporated in particular an observational data collection method. The pre-designed questionnaire instrument did pick up on some points of language (e.g. refer to Subsection 6.1-6), and in interviews students did also allude to language issues, especially in the (choice of) language groups of students used in the interview itself. However it was in observational data that the issue of language, and how it may 'get in the way' of students' mathematics learning made more forcefully. Many times when students said that they did not understand, it was not always about the mathematics as it was about specific choice of word(s) of the teacher and/or textbook. In some cases, it was the not knowing what was meant by a word or term used in a question that prevented some students from working on/doing a question which, when given the meaning of the word/term, the student could then go on to do. This finding is not without implications for the CXC/CSEC, whose philosophy of question-setting for the mathematics examinations (which, perhaps it ought to be considering the more global context within which the examination qualifications must be set) is one of mathematics as problem solving (CXC, 2001, p1 for the 2003 version of syllabus). Thus, for these Caribbean students, proficiency in language does matter in mathematics, and it matters more than perhaps is currently accepted, as the students must be able to more precisely wade through the words of a question, making sense of these words and interpreting what is being asked of them, usually with not as much scope for error in interpretation as might be allowed in other more discursive subjects. Students in two different schools, Si3 and Mi4 did directly link the need for proficiency in language with being able to do well in mathematics, one likening mathematics to English Literature in the need for students to be able to analyze just what is 'going on' in the question. However, because language was not a particular focus of the study, a deeper exploration of this factor and examples of how it impedes or facilitates mathematics learning has proved to be somewhat of a limitation to the study.

On the matter of the disjuncture in language use, Craig (1971, p376, citing from Stewart), made the point that to the Caribbean child, 'English is neither a native language nor a foreign language.' Despite what may seem the datedness of this observation, the point made is no less valid or relevant to today's Caribbean; it remains a crucial point. If one considers the nature of the teaching process for mathematics, and the pervasiveness of language in this process, this 'state of play', that is, situation in the field in a Bourdieuian sense, has important implications for the teaching and learning process of mathematics in schools. There is a general perception in A&B, carried over into (secondary) classrooms, that everyone speaks and understands 'standard' English, and in particular that the language that an individual person speaks *is* English. The result is that a student can perhaps recognise and appear to understand 'standard' English 'far out of proportion to his (sic) ability to produce it … [thus giving] the illusion that the target Standard English is known already' (Craig, 1971, p377). There is almost as it were a failure on the part of at least one teacher observed to recognise the language of the teaching as a possible impeding factor in students' mathematics learning. Matters of students' not understanding were often seen, and perhaps even dismissed as 'because you were not listening' (e.g. comment of G4 from Mi4 given in Section 6.1-6, p130) with the impression given that careful listening will produce mathematical understanding. The possibility of language as an interfering variable in students' understanding of the mathematics was given short shrift, in some sense even by the teacher who did seem to recognise that some students may have problems with the formal form of the 'standard' language (from Subsection 6.2-2). But, and as has also been noted by Zevenbergen (2001, p39), students who may be seen as disadvantaged because of their social class background are usually not seen as being disadvantaged by their language, especially when there is a general perception that such students are native speakers of the dominant language. In some of the classes observed, and also in some of the schools visited, 'standard' English was at most an additional (or second) language (e.g. as used by Setati, Adler, Reed & Bapoo, 2002, p129) for a marked proportion of the students, in that it was a language being spoken/used in the (school) environment of the students (used by teachers and some students) but not the language some students (unconsciously) gravitated to/used when speaking to each other, sometimes also to the teacher, and in other informal contexts/situations, e.g. during break-times, etc. In effect, 'standard' English could not be said to be the linguistic habitus of a large proportion of students. Further, these observations were more prevalent in the mixed schools visited, although it was also present in (some) single-sex schools.

According to Austin & Howson (1979, p 163, commenting on that given in Strevens) a key question in any considerations of how language factors may play out in the mathematics teaching-learning process is 'Do the teacher and learner share the same (first) language?' These authors go on to elaborate this point, stating that 'the language of the learner… its 'distance' from that of the teacher [and] its 'distance' from the language in which he is asked to work mathematically…' were key issues for consideration with respect to language and mathematics. There does seem to be some legitimacy in stating that the answer to the question of whether teachers and learners share the same (first) language is not always nor as simple as 'yes' in the A&B setting, for whilst teachers may share the local dialect, they did not, in my classroom observations and school visits, instruct in it, nor generally use it when talking to students. With specificity to mathematics education though, it seems that the 'distance' between the language being used by the teacher (and where used the language being used in textbooks) and that more readily accessible to learners is further exaggerated as (some) students are having to first de-code (translate) the spoken or written words, and then assign mathematical meaning to them. Whilst it might be true that in these settings some students deliberately choose to speak dialect in classroom exchanges for a variety of reasons (e.g. Mercer & Maybin, 1981, p80) as believed to be the case especially amongst the boys of Si2 (e.g. Observation Excerpt 6.16-2, Subsection 6.1-6; Observation Excerpts 6.22-2 and 6.22-5, Subsection 6.2-2), there is a sense that this form of the language is *the only* easily accessible language for others. Thus, in having to 'pay keen attention' to what the teacher is saying, or in having to concentrate efforts on understanding every word the teacher says, another layer of imperviousness (difficulty) is being added in the process of learning mathematics, and the mathematics becomes further removed or perhaps even lost to some students.

Robertson (1999, p81) writing on issues of the 'language' of instruction in the teaching of English versus a foreign language in the Caribbean has noted that whilst Caribbean English language teachers may teach with the assumption that students' first language is not English, the teaching of a foreign language is premised on just this assumption. This latter assumption is not confined to foreign language classrooms, and in particular it extends to mathematics classrooms, arguably itself a 'foreign' language to many students. That such conflicts of language exist in classrooms other than the English language classroom in the Caribbean context, and the implications of this for the student has been noted:

> … it is in areas *other than language teaching* that the problem is more severe. The pupil in the class designated "English" is focused on language and *conscious* of the necessity to be on his guard. However, in other subject areas his attention is directed to a different content; the textbooks assume control of the official language as does the teacher, in most cases… (Carrington, cited in Pollard, 1983, p35, my emphases)

This unconsciousness of the possible interference of choice of language in use in the teaching-learning process in subject areas other than English is not only true for the student, but also for the teacher. The teacher in these other-than-English classes is perhaps 'less on guard' that his/her choice of language might not be universally understood by all students, not only for technicality of terms, but also for the choice of language, i.e. the form of English in use. In the classrooms observed during this study this awareness or not of the choice of English word-use was evident to varying degrees. In one classroom in particular, the teacher appeared to defer authority of choice of language/word-use to textbooks, etc., or to 'talk' the mathematics in a 'textbook', i.e. 'standard' English way. The area of the spectrum of dialects of English that the teacher used in classes was very much close to the end one may see as 'standard' English.

It seems then that there may be a case made that language does play a non-trivial role of getting in the way of students' learning of mathematics. Its potential interference may be lessened if perhaps students had more opportunities amongst themselves to openly use talk as a resource (Adler, 1999) in mathematics classes. However, in the classrooms observed, particularly that of Si3 and Mi5 but less so in Si2, the responsibility for 'talk' was very much in the mouths of the teachers, and any such talk from students was in a more subsidiary and often covert form. This finding from observations is also supported by students' responses to questionnaire data, for example, their description of what they did in mathematics classes (Subsection 6.1-6), which indicated for the most part a relatively passive role. Students had few legitimate opportunities to express their mathematical understandings and hence participate in any meaning-making processes, both amongst themselves or with the teacher via this medium. Also coming from this is that 'a more appropriate level of language' (Zevenbergen, 2000, p201, see also in Subsection 6.2-2, p165; Subsection 6.3-1, p170) was largely inaccessible to most students in some of these classrooms. Further, as shown in observation excerpts from Si2 (Observation Excerpts 6.22-2, 6.22-5, Subsection 6.2-2), when students did have more legitimate access to their own talk as a resource for learning, the nature of the mathematics discourse was of a different genre as it moved beyond a subconscious focus on language to a more overt focus on the mathematics. To this point, if their language in talk and more specifically a dialect form of English is *the* form of embodied cultural capital (Bourdieu, 1997/1986) or resource (Adler, 1999) some students bring to mathematics classrooms as the best of what they have to trade *on* for mathematical success, their possession of this resource is de-valued in that field, and their access to this success is restricted.

Adler (1999) elaborated on the idea promoted by Lave & Wenger that transparency of resources is a necessary condition for access to a practice. This idea, applied to the resource of language and talk in the mathematics classroom means that transparency is achieved when language (talk) as a mediating tool is both visible 'so that they can be noticed and used', yet also invisible 'so that attention is focused on the subject matter, the object of attention in the practice.' (Lave & Wenger, given in Adler, 1999). When there is an imbalance in this relation to the extent that the resource of language (talk) becomes increasingly 'visible', i.e. loses transparency (as is the case from findings from this study), then the practice (learning mathematics) is no longer accessible, and there is a sense in which the whole is lost, i.e., attention is necessarily re-directed from the subject matter, and the parts do not (always) re-constitute the whole.

In these Caribbean educational systems, there is capital imbued in the 'standard' English language. It was the language of teaching in the secondary schools and classrooms visited, and where the textbook was in use, it was also the language of the mathematics textbook. In particular, it is the language of the CXC/CSEC examinations, including the mathematics examinations at both proficiency levels. Interestingly, of the classrooms consistently observed, disjuncture in the form of language in use appeared to be more of a problem in Si3 and Mi5 than in Si2, this even though the students of Si2 spoke more consistently the local dialect form of English than did students of Si3. This finding as related to the class of Si3 is particularly important as this was a single-sex school with students from more advantaged backgrounds than those in mixed schools. Moreover, from observations in this school, the students, more so than any of the other observation schools, *consistently* spoke a form of English which was closer to the 'standard' English. Additionally, it is this school for which all students had been successful in the CXC/CSEC English Language examinations (mentioned in Subsection 6.4-1, p190). The teacher of this class, although tending to introduce a topic by way of an informal discussion with students, in giving notes on the topic tended to defer authority of what words/terms/concepts may mean to a textbook. These students nonetheless did seem to have problems with this more formal form of the English Language which was the medium in which they were having to learn their mathematics. The teacher of Mi5 was also particular about mathematical language use in his teaching, although as mentioned in Subsection 6.2-2 he did not usually have a textbook in the classroom whilst teaching. He, however, took pains to give students notes of relatively informal meanings for various mathematical terms that would come up in a topic, and to use those mathematical terms in his teaching, invariably checking by asking students what such terms meant. What may have eventually occurred is that students did learn what the terms did mean, but this in some way may have detracted from the actual learning of the mathematics. What both these teachers did in their teaching may be seen as insisting on correct mathematical ideas for words or terms, or the use of such correct mathematical words/terms which in some sense may have conveyed the image that the language of mathematics was the language of the 'standard' English. These teachers appeared to hold an implicit belief in the 'innocence of words and transparency of language' (Maclure, 2003, p12), and this, in the 'standard' form of English, as an appropriate tool or resource to get mathematics ideas across in classrooms. Implied in this is that if students listened well, they would then be on the way to learning the mathematics. Thus, the mathematics for students becomes shrouded in a layer of language that students did not always understand, and at times it is this layer of language that some students are finding impenetrably hard.

But there are power relations involved in language, and language, despite its universality and apparent invisibility, is (also) not neutral. The findings of this study have shown that there are implications for the form of English on offer in teaching mathematics, the accessibility of these forms to the learners, and consequently, which students get included in and which (unwittingly) get excluded from learning mathematics. Thus, within the teaching of mathematics in these classrooms access to and flexibility in the 'standard' English had indeed become a 'treasure' (e.g. Bourdieu & Wacquant, 1992, p146) – a form of cultural capital that is implicitly *demanded* of *all* students although there is some evidence that this 'treasure' was not equally distributed across students of all social backgrounds. As given and alluded by the girls of Mi4 in Interview Excerpt 6.16-1 (Subsection 6.1-6), in order to be able to do mathematics well, a student needed to have a level of command of the 'standard' English to be able to read *and interpret* what was being said and/or asked. That is, the student needed to be able to do more than 'bark at the print' (from Craig, cited in Thompson, 1984, see also Subsection 6.1-6, p129). That students spend much of the time in mathematics classes listening to the teacher when this teacher-language is for some students non-trivially different in form to that of their usual everyday linguistic habitus has implications for *what* learning can take place. In addition, this latter situation is further complicated by the fact that some words/terms are essentially 'foreign' as they are not a part of the language even in the 'standard' form students may hear every day. If one considers these last two points in combination, it is not difficult to see how student listening may become laboured, to the point of its not being fine-tuned beyond the realm of hearing (e.g. Davis, 1996, see also in Subsection 6.1-6, p125). Again, this point is supported amongst others by the interview students of Mi4 (Interview

Excerpt 6.16-1, Subsection 6.1-6) where one girl says that sometimes in mathematics classes all she can *hear* are words out of the teacher's mouth but that she does not understand.

Wells (1999) in commenting on Cole's interpretation of the mediating role of tools used in sociocultural activities such as education noted that in order for tools to effectively carry out their mediating function, they must fulfill two requirements, namely they 'must be capable of contributing to the achievement of desired effects in the world; and… they must be in the hands of a person who understands their meaning and mode of functioning in relation to the goals of the activity they mediate' (p138). The use of language as a mediating tool in the teaching-learning process of A&B (and Caribbean) mathematics classrooms has not always been able to successfully meet these two requirements. As noted there is some disjuncture between the language of instruction and the language with which most students are most comfortable, so that perhaps in some cases the analogy is applicable to teachers and textbooks using a 'wrong' tool for a particular purpose, or in other cases using the 'right' tool but in an inappropriate way. This last analogy can be seen in relation to the hands in which the tool rests, i.e. the second requirement for effective tool use, but it would be unfair in these circumstances to simply lay 'blame' at the feet of mathematics teachers. The problem of language and education in general in A&B, and indeed in the wider Caribbean, is more of a systemic one, in a failure of education policy makers to reconcile the language realities of the majority of the population and hence that brought to school by most students, with what actually happens in schools. With respect to language, schools have generally not been starting where the children are. Robertson (1999, p83) has argued that 'where language fails, the entire education programme is in jeopardy', and later questioned the political will of those in charge of educational change in the Caribbean to overhaul rather than tinker with the system. In his argument he called for a more *conscious* awareness of the 'intimate relationship between language and education' (p83). He incorporated a quote from Shuy in his argument of the importance of attending to language in educative processes which I think aptly describes the situation in the Caribbean and A&B with respect to language and mathematics education:

> Education is to be given credit for recognizing small glimmers, from time to time, of the fact that learning relies heavily on language. The journey toward understanding this fact, however, has been ponderously slow and difficult, not simply because of the invisibility of the subject, but also because of the false information, incomplete knowledge, and stereotypes of language which educators inherit and pass along to future generations with discouraging faithfulness. (cited in Robertson, 1999, p83)

7.1-3 Other things

There are some other things that seem from the findings of the study to be at a disjuncture. This subsection will address these. The subsection starts however with a look at language factors, but from a perspective different from that in the previous subsection which had to do with disjuncture in classroom language forms. The perspective taken here has to do with the seeming disjunctures, paradoxes even, concerning language factors and mathematics performances for subgroups of the sample as relates to the findings from Subsection 6.4-1.

The consistency of the differences in performance outcomes that exist between the two school-types used as the main area of consideration in this study suggest that these differences are more than simply an artefact of student views (attitudes, beliefs) in these school-types, of the effort or lack thereof that successive student groups within these school-types put into doing/learning mathematics. If anything, the similarity in proportions across school-types of student views about mathematics highlighted in the overview in Subsection 6.1-1 shows that it is not specifically student views that may be constraining or facilitating success in the subject. Perhaps the performance differences ought to be expected and allowed for. However, it is arguably the case that students in mixed schools have largely been able to overcome the marked-ness of those differences in other subject areas – possibly through choice, in choosing subjects they are good at – and also in English Language, but this success has been more difficult to access in mathematics. Why this might be remains an elusive and beguiling question. If mathematics is learned largely at school, then surely the effect of school ought to be to even out the advantages of one group over another in this subject area, distributing success equally across social groups within it *regardless* of type of school. Further, one would expect that for a subject such as English Language, in which some students arrive at school with an advantage over others due to the linguistic capital they have gained from the home/family (and the better fit of this to that demanded and/or expected in schools), then all other things being equal, schools would be more likely to distribute success *unevenly* across student social groupings therein as some students would have continual greater access to forms of this cultural capital outside as well as inside school. However based on the sample students in this study, whilst within a school-type success in mathematics does appear to be relatively evenly distributed across social groupings, there remains a wide disparity of this success *between* school-types – a proxy for the concentration of students of different social classes. Additionally, there is on average less of a disparity of such success in English Language between the school-types. Further, within a school-type, whilst single-sex schools have distributed English Language success relatively evenly across student social groupings, within mixed schools there is some difference of the distribution of level of success particularly between middle class students and the other social groupings, such that the English Language outcomes of the middle class students in mixed schools is more similar to that of students in single-sex schools than it is to students of other social groupings within the mixed schools (e.g. Figure 6.41-2, Subsection 6.4-1).

Thus, there is a mixture of the expected with the unexpected in the findings of this study with regard to student outcomes in mathematics, and in comparison to what happens in English Language. That within a school-type, schools have been able to award success in mathematics relatively evenly across student social groupings does support the notion of mathematics being learned largely at school; however, that such success is significantly different between school-types suggests that there is some*thing* significantly different about the school-types themselves that is mediating what the mathematics outcomes are. Whilst one cannot discount the mix of students in the school-types along with the whole notion of school ethos as one such factor, the *pattern* of student background factors in these school-types was also found to be significantly different, and highly so. That is, the situation regarding a student's success in mathematics for which secondary school-type accounts for most of the variation is largely premised on the socioeconomic situation of parents and some of the choices they make, and this *before* the child starts school. Further, the effect of socioeconomic factors and parent choice seems to be more influential in mediating student outcomes in mathematics than in English Language. If one accepts the initial premise then that an area such as language is largely learnt at home, and therefore schools would further exaggerate any differences that students bring with them in this aspect, the 'truth' of the premise seems more valid in mixed than in single-sex schools, as single-sex schools seem to have been able to evenly distribute success to students regardless of home background to a better degree than what happens on average in mixed schools. An interpretation of this finding could be that home background influences are more wrapped up in the English Language outcomes of middle class students in mixed schools, whereas single-sex schools have been more successful in negating the effect of home influences. But, the fact that middle class students in mixed schools have not been able to do any better than their colleagues of other socioeconomic backgrounds within this school-type in mathematics whereas they have been able to do so in English Language suggests that a facility in English Language does not guarantee success in mathematics. It could also suggest that with regard to the learning of mathematics, it does very much matter with whom a child is learning, that is, the learning community in which a child is positioned (e.g. Linchevski & Kutscher, 1998; Burton, 2002; Smith, 2003), perhaps more so than it does for English Language, say. That said, the findings of Subsection 6.4-1, and particularly the results of Tables 6.41-9(a) and (b) do suggest that whilst a facility in the standard English Language does not guarantee success in mathematics, success in mathematics is made less likely without it.

In addition to the apparent paradoxes of the English Language results and the relation to mathematics results between the school-types, there are also paradoxes of the findings of the results between the genders. As girls were significantly more successful in English Language than were boys, then it would be expected that if language is a factor in the learning of mathematics that girls would also have been more successful in mathematics than were boys. However, this was not the case for the student sample (Table 6.41-3), and for the overall student population, proportionately more boys had been successful in mathematics than had girls in the 2006 examinations (Figure 4.2-3(a) and Table 4.2-1, Section 4.2). It may be that in their learning and doing of mathematics, as boys during class time accessed more legitimate forms of mathematics through *their* talk, boys come to know their mathematics differently (from girls) and are less dependent on English Language per se for success in mathematics. Girls on the other hand in their learning and doing of mathematics during class time accessed less these more legitimate forms of mathematics via the language in use, and thus are more dependent on the mathematics being in a (similar) language in which it was learnt in order for them to be successful. These are highly speculative arguments, but they offer *an* explanation for the seeming paradox of girls being more successful in English than boys, but tending to be less so in mathematics, *if* language is a factor in these successes. What I am positing is that the issue of language, based on the evidence of classroom processes during mathematics found in this study, may be more of a factor for girls than it is for boys for success in mathematics.

But, Bourdieu warns against semiologism, that is, reducing matters of communication to being simply due to a difference in the power relations that exist between the persons communicating (see Bourdieu, 1997/1986, p54), arguing that other forms of capital and a person's access to these also underlie what shows up as differences, for example in educational achievement. (Bourdieu also in the same paper makes similar warnings about economism, that is, reducing group differences to being merely about matters related to differences in economic capital). Heath (1983, p343) took a similar line of argument within the whole aspect of language and linguistic capital, citing from her study that differences in educational achievement ran deeper than that which may be associated with differences in formal language structures, as these achievement differences also had to do with a whole language socialization process, how it is a child, from home, may have come to be able to interpret the questions, statements, pieces of language (e.g. interpretation of 'rule') that may be taken for granted in the dominant, though in the context of this study minority, culture. Further, there are matters of embodied cultural capital or habitus, that is, what it is students may subconsciously do, the unspoken regularities (e.g. Bourdieu, 1990, p64) they have come to live by, which impinge on what their actions are likely to be particularly when they encounter fields in which what embodied cultural capital it is they have to trade on is given little currency.

In putting forward the notion that aspects of a student's culture may in some way be mediating their mathematics learning, the concern is with those aspects that a student co-ordinates with, shaping how he/she knows how to be in the world, guiding actions/behaviour, shaping identities. These are aspects that a student acquires before starting school, but also importantly are still on-going during the schooling process, explicitly, but more often implicitly conferred. These are matters of dispositions, some of which some students bring with them, like baggage, to school, and mathematics, learning mathematics in school. Others are learnt through schooling processes. Such dispositions from the findings of the study include for example valuing what parents may have to pay for and giving less value to things that are 'free'; seeing as a viable option absenting themselves from classes if they do not wish to attend or sleeping in such classes; a disposition to finding space for failing a subject such as mathematics based on what is perceived to be parents' expectations with regard to success in the subject. This last aspect, parental expectations of their child's mathematics should not be discarded off-hand. Although reporting on students' participation in advanced mathematics, Ma (2001) had found that parental involvement (which included parental expectations) were more important determinants of students' future participation in such courses than were peer influences and teacher expectations. It seems to follow that Ma's finding in relation to advanced mathematics would have importance as to how it is that the students of that study would have approached the learning and doing of secondary level mathematics.

In the present study, other dispositions that students embody include taking rules at face value and in some cases misrecognising the speciality of mathematical contexts in questions; in some of these cases reverting to knowledge from everyday experiences as a strategy/approach to solving such questions; over-using rules and formulas given by the teacher as, since given by the teacher they were inherently 'good' and would make the problem right; or, alternatively, being overcome with a sense of helplessness and doing nothing; valuing rote memorization of rules over thinking through questions; and also, going through mathematics in a sort of haze of unawareness, e.g. as relates to their rating of how they were doing in the subject (Subsection 6.1-3). Arguably, these dispositions fall short of the evaluative criteria required for success in mathematics; but these dispositions also represent the way some students use (and know how to use) what they know, that is, they represent what are students' 'strategic use of knowledge' (from Lareau & Weininger, 2003, p569, see also in Section 2.2, p28) for learning in mathematics classes. Further, as has been shown in the study, these dispositions together constituted a pattern that was more likely to be found amongst students in mixed schools than those in single-sex schools. And so it was that it was students in mixed schools who were more likely to embody patterns of dispositions that did not fit well with expected evaluative criteria for mathematics, even though, in some case, these patterns of dispositions did fit well with how the teaching was conducted. What seems to be another matter of disjuncture is what the intentions of the teacher are in what it is students would take away from the mathematics teaching, and what it is that students become focused on, and do take in during learning (e.g. Observation Excerpt 6.21-1; the attempts at the algebra task of students from Mi1 and Mi5, Interview Excerpts 6.21-1 and 6.21-2 respectively). When teaching is constituted as a 'one size fits all' activity, the learning that results is invariably differentially acquired, and especially so when students' access to inter-actional activities amongst themselves is reduced.

But, in some ways, I also want to argue that A&B students who have survived and are still present in schools to the fourth and fifth forms of secondary by and large are not without the inclination to play the game, participate in the field of learning mathematics. The extended observation excerpts provided in Subsection 6.2-2 do lend some support to this sense, as also do the student profiles provided in Subsection 6.4-2 of the students in mixed schools who did pass mathematics 'despite the odds'. There is a sense in which students may not know how to learn mathematics, what it is that may work best for them, as the ways in which they have been allowed to learn mathematics have been limited.

7.2 INTERPLAYS

Coming back to interplay at this point might seem a strange point of departure after the discussions of disjuncture in the previous section. Interplay seems in opposition to disjuncture in that interplay suggests, as conceptualised in Section 2.1, that things are linked to each other in some way, that they relate, or inter-relate in some way. There is evidence amongst the findings presented that there are such links, such relations and inter-relations. It is an exploration of these interplays that is the focus of this section.

A point of note with regard to the findings of this study has to do with the finding of significant differences as well as no significant difference, i.e. similarities between subgroups of the sample. It is an important finding and 'significant' in its own right that within gender, students across school-types had more similar views of mathematics than differences. That is, whilst there were statistically significant differences between boys and girls on a number of closed questionnaire items, girls as a group, regardless of school-type, and boys as a group (although there were more intra-group differences) tended to agree or disagree in similar proportions to opinion statements. This finding potentially points to factors outside the boundaries of school, and suggest some socializing effects, from the home and/or what students may have subconsciously taken in from society, that may be shaping the gendered views (in that they are products of a learned social stereotyping) students eventually come to hold about mathematics.

I am aware that I have used 'gender' as the preferred notion in the study where 'sex' might be the more appropriate word (e.g. in making comparisons between males and females, boys and girls) and also that there are instances where 'sex' and 'gender' have been used interchangeably. I am also aware that the literature does highlight a difference between how these terms have come to be conceptualised (e.g. Leder, 1992). However, it seems to be the case that what may have started as sex differences for the student sample had eventually come to be played out as gendered differences. In this conceptualisation, gender is seen as a response variable (e.g. in Boaler, 2002; compare also to Connell's (1987, p14) conceptualisation of gender as a verb rather than as a noun given earlier in Subsection 6.3-1, p166), where the nature of the way a child behaves in certain contexts is as much a product of how he/she is expected to be and perceives to be expected of him/her. In this study, this gendered nature of being does seem to have formed a part of how it is boys and girls respond to mathematics. In mathematics classes, girls were less likely to talk and/or work with friends as they, amongst other things, perceived this to be what was expected of them, e.g. doing things *'the right way'* (Interview Excerpt 6.16-4, Subsection 6.1-6), for some even though it went against their habitus, that is, their natural inclinations of being. For boys, there seemed a closer meeting of habitus and (positional) identity, as the ways they were and in some cases allowed to be in mathematics were for the most part in sync with their natural inclinations. Although, to some extent, from the classroom observations in the mixed school the students as a group were not generally allowed to talk or work with each other, the boys in that class had found ways to be, via physical positioning, amongst others, that allowed them once again to be in ways they would ordinarily be. That the ways students responded in mathematics were gendered does point to the way in which learning in mathematics had for these students become tied to cultural norms (e.g. Leder, 1992), but that these ways are 'gendered' rather than 'sexed' also does allow room for hope, as, according to Leder (ibid, p607), such gendered processes are more amenable to change.

As regards the make-up of the student sample, there is some indication that the sample of boys in secondary school is of a more 'elite' status than the sample of girls (see Table 5.1-1(a), Section 5.1). Keeping in mind that there are fewer boys in secondary school than girls, proportionately more of the boys are in 2-parent households, had attended a private primary school, and had a parent whose occupational level could be categorized in a higher socioeconomic grouping. Although none of these (social/background) differences is statistically significant from girls on its own, together they do show a general pattern in the direction of boys who are still in secondary schools to the fourth form being from more 'privileged' backgrounds. Taken from another perspective, there seems to be some evidence here from the make-up of the student sample, that background factors associated with socioeconomics (and outside of schooling, although arguably the two are interrelated in this issue) may be largely accounting for the rate of survival of boys in secondary schools, seemingly working to disadvantage boys in general. That said, it also appeared to be the case that in a sense 'social class', where it did operate in schools and in relation to mathematics, worked differently for boys and for girls. That is there seemed to be some expectation of whom mathematics is 'naturally' for. In schools mathematics teaching was differentially organised, this more pertinent for single-sex schools, but arguably also the case in the mixed school observed as boys were able to position themselves to make this so. Also within schools teachers had different expectations about mathematics for boys and girls in that markedly more of them thought that boys were better than girls, and girls were in fact in rank order third following boys and both/neither/don't know. Parents as a group too had different expectations of sons and daughters, evidenced in an overall pattern of rating the performance of sons as better than that of daughters, factors which could potentially serve to disadvantage girls.

In the Interview Excerpt 6.32-3 two of the girls of the single-sex school spoke as if they had already failed mathematics, this despite not writing the CXC/CSEC for another 1½ years. The girls spoke in this way due to their being positioned to follow the Basic mathematics syllabus. Thus, they talked of *'basic maths in my way'*, that with *'basic maths, you're not sure about the future'* as one was left *'bare'*. These girls were very aware of the social role mathematics played in where it is they could go, what they could reasonably expect upon completing school. There are distinct power relations involved in being able to do mathematics and doing well in mathematics. This aspect has been alluded to by students, e.g. in the matter of mathematics according someone respect and some students do appear to be unconsciously yet acutely aware of these power relations with regard to mathematics, and their position within these. Based on the documentary evidence provided in Section 4.2 of adults coming back to (re)taking the CXC/CSEC mathematics, it is for females more so than males that mathematics appears to be getting in the way. Whilst it may well be that these out-of-school females are coming back to mathematics for their own satisfaction, it seems more likely the case that they are finding mathematics 'in the way' of allowing access to desired career paths. Bailey, writing from a Jamaican context has also suggested that this gendered positioning of girls in the school curriculum may also be getting in their way in the world beyond school:

> The focus on the quantitative gains that Jamaican women have made in education, however, masks the fact that … these same females, because of where they are positioned in the school's curriculum, actually have less of a competitive advantage outside the school than their male counterparts… the resultant explanation of male under-achievement therefore needs to be challenged … because society obviously has different expectations for males and females in terms of the social currency of certification. The under-achievement of males in the educational arena has not resulted in parallel under-achievement in the economic and political spheres. (Bailey, 2004, p67-68)

Thus in some ways, the behaviour of students in school in relation to mathematics and the gendered similarity of student views suggest that the effect of gender was 'trumping' social class in the ways students of either gender come to form self-understanding of and for themselves in mathematics.

The data and descriptions and data outlined in Subsections 6.2-1 and 6.3-1 respectively of the way girls tended to approach learning and/or doing mathematics goes against the grain of that reported more recently in the literature of girls and their mathematics (in particular the work of Boaler). But, there are senses in which the relationships the girls of this study then come to form with mathematics, their understandings of themselves in relation to mathematics are similar to that which has been given by Boaler (1997, 2002). Some girls, whatever their school-type, gave the sense that they were just trying to get through their school mathematics, at best surviving, at worst enduring the experience. Although overall more than one-half of them had chosen *Yes* to *Do you like maths?* analysis of their further responses suggested that they chose this response perhaps due to a predisposition to liking things, and that they in fact did not particularly like the mathematics they were having to learn in school – it was something they had to do, so they were just getting on with it; they perceived it to be important in improving life chances, whether for further education or in the job market, and so they *had to* like it, in effect. There does appear to be some willingness on their part to engage with the mathematics, but the form of mathematics they were having to engage with was not part of their understandings of themselves (e.g. comment of G2 in Interview Excerpt 6.32-1, Subsection 6.3-2 and mathematics being '*not me*'), not a part of their habitus. It is perhaps this realisation that they just were 'not getting it', not understanding what they were doing, and being at a seeming loss as to how to redeem this situation that girls, more so than boys, expressed more negative views about mathematics. Thus, as a coping strategy perhaps, and with an eye to its perceived importance, some girls were just trying to get through it. Some of them had dispensed with the notion of mathematics making sense, and were prepared to use strategies e.g. rote memorization, a strict adherence to rules and formulas, matching to a previous example, rather than thinking through the questions, as comes through in the Observation Excerpt 6.22-4, Subsection 6.2-2. For some girls, doing well in mathematics did not necessarily translate into a liking for the subject, an identity with the subject, as mathematics did not allow for them to be who they understood themselves to be.

To this point, there is a sense in which the responses of some groups of students to questionnaire items about mathematics were with a degree of unawareness of their 'true' position with respect to mathematics. This, I think, is particularly so for boys in mixed schools who reported in great number to liking mathematics, and the majority of whom rated their mathematics performance as *Very Good* or *Good* (e.g. in Table 6.13-3(b), Figure 6.13-2, Subsection 6.1-3). This is not to say that these boys might not like mathematics even though their performance was not good; but, as shown in Subsection 6.1-3, there was a significant link between students' liking mathematics and the way they rated their mathematics performance. Whatever their in-school grades in mathematics may have been, it is questionable what message it is that some students take away from these; that is, boys and girls may be interpreting their in-school mathematics grades differently. This may also explain why girls in single-sex school responded as they did with respect to liking mathematics and rating their mathematics performance, as, in some way, they seemed to have interpreted the re-grouping practices of their school as being 'told' that they were not good at mathematics. As cited in Ruthven (2001, p362), some students may not consider poor grades as indicative of their not doing well in a subject unless they are specifically told so. This perspective, in this study, seems to be particularly 'true' for boys in mixed schools. But, it is also boys in mixed schools who also were more inclined to think that they could get the jobs they wanted even if they failed mathematics (item 11 from Table 6.11-2, Subsection 6.1-1) – and based on Bailey's (2004) perspective outlined above, and the statistics behind who comes back to mathematics in A&B, these boys might not be wrong. Whilst these boys might have been relatively unaware of their school position and mathematics, perhaps they were more acutely aware of their societal position and (the need for) mathematics.

But, based on outcomes in the CXC/CSEC, it is students in mixed schools (and possibly more the girls) for whom mathematics has consistently been 'in the way', as proportionately more of them have been, and based on the results of this study's sample students continue to be unsuccessful in mathematics. If the system of selection to secondary schools in A&B was explicitly and openly made along the lines of social class, then there might justifiably be concerns of exclusion. However, because it has been constructed as being based on merit, in particular, academic merit, and a 'reward' of school choice to those students who have done well, the selection process is painted with the brush of legitimacy which A&B society seemingly has come to accept. Society has then also come to accept what appears to be the equal distribution of resources after the selection process, as this perhaps is seen as giving every child an equal chance. What has failed to be recognised, misrecognised even, is that from the outset the potential beneficiaries of these equal resources were not 'equal' at the start.

With respect to the interplay of gender, social class and mathematics then, the following represents an emerging picture. Girls positioned themselves in relation to expected classroom norms of behaviour, but it is this positioning which might in fact be contributing in constraining their learning of mathematics, what and how mathematics is learned. However, with respect to outcomes 'more privileged' girls in these respects had better outcomes, even though both female groups in the present study reported similar disaffection with mathematics. So, girls were more inclined to express disaffection with mathematics, and were finding it to be hard perhaps because the way in which they were learning the mathematics *was* hard. But, paradoxically, some interview data suggested that girls behaved the way they did in mathematics because that was how they thought they had to be (i.e. *'the right way'*). Thus, girls were positioning themselves, and were being positioned in mathematics classes in ways that did not provide a good fit for mathematics learning. Conversely, whilst boys positioned themselves in more deviant ways in relation to the expected norms of classroom behaviour, this positioning was providing a better fit for their learning, or at least engaging with the mathematics subject matter, and allowing for more of a sense of enjoyment of mathematics. Perhaps they were enjoying mathematics more because they were learning it more in ways that facilitated sense making, i.e. ways that were 'less hard'. But, again, paradoxically, the enhanced perception of confidence in their 'ability' to do mathematics might be getting in the way of their performance outcomes in the subject as the outcomes in the CXC/CSEC mathematics (see Sections 4.2 and also 5.5-1) suggest may be occurring. Despite whatever these gendered positions may be though, it is their school-type – a proxy for social class position – that 'trumps' gender in their CXC/CSEC mathematics achievement.

What this analysis has shown is that whilst gender and social class may represent some of the main factors to be considered in explanations of student mathematics outcomes, their contribution as sources of the explanations do not have equal weight. If one looks towards the process of learning mathematics and students' affection for the subject as indicative of outcomes, data from the present study suggests that the weighting of gender and social class in providing explanations for this is reversed. The 'best answer' for improving mathematics outcomes seems to lie in improving the social conditions of the students. There are no easy answers.

7.3 Coming back to Agency – Theoretical and Empirical Perspectives

In conceptions of agency, human agency, and how is it enacted, is presented as a dialectic process. In delineating a concept of human agency, one ought to bear in mind that this 'agency' must take place in a context, one which conforms in various ways to some 'structure'. In the literature-conceptions of agency, there is an implied sense of structure associated with the concept of agency. Examples of the literature-conceptions include: from Holland et al (1998, p3, see also in Section 2.1, p22). agency is mediated, i.e. structured, by the identities an individual forms *in situ*; in Pickering, (1995, p18) human agency as already tamed by culture, i.e. structure (e.g. Pickering, 1995, p18); also in Pickering (1995, p17, see also in Section 2.2, p26), of human agency, characterized by intentionality, having to accommodate existing contingencies and thus being susceptible to 'tuning' via a process of 'resistance and accommodation' (Pickering, 1995, p22). That is, the process of human agency always occurs in relation to or in answer to some other 'structured' process. Sewell (1992) has noted that it is difficult to define what is meant by 'structure' without re-using the word in defining it. He does give what he sees as three problems with the use of the term, which points towards how it tends to be conceptualised in the literature. The first two of these problems are related, and will be the focus here. Firstly, and in what for Sewell is the main way in which the notion is used, structure in social life tends to be associated with 'rigid causal determinism' (p2), with direct cause-effect relationships, and so is impenetrable to change. Within this conceptualisation of structure 'the efficacy of human action' (p2) – or agency, is overlooked as a viable possibility. Secondly, and related to this first formulation of structure, is how change is dealt with. Rigid causal determinisms suggest a stability of processes which then allow little room for change, so that change, when it does occur is more often placed outside the structure, or at a point of break-down of the structure. Put together, these formulations of structure do not allow for the existence of independent human action within them.

In Giddens' structuration theory (cited in Barnes, 2000), 'structure' is seen as a resource for individuals to draw on and use – a tool – rather than specifically as a constraint determining human action. This view of structure thus discounts the role of social structures in determining what individuals do. Individuals who are acting agentively *use* the social tools of structure available to them as resources to re-make their world, and in this way actively contribute to the re-making of the social system itself. In this formulation of structure, structure is juxtaposed with the idea of human agency. This agency has to do with an individual's capability to act within the social system of which he/she is a part and to transform it (e.g. see in Barnes, 2000, p26) – thus putting change very much as central to the idea of agency. For Giddens, 'It is analytical to the concept of agency that a person (i.e. an agent) "could have acted otherwise"' (Giddens, cited in Barnes, 2000, p27).

In this study, mathematics, learning mathematics in school, constitutes the cultural world or field of the lived experience of interest. In this 'world' identity has to do with students' understanding of themselves in relation to mathematics, mathematics learning, and the relationships they form with mathematics. For some students in the study, their view of mathematics, and the relationship they then form with mathematics, has for them been formed via hard-earned experiences (cf. hard-'won' standpoints) in the cultural world/field of mathematics in their schools. This I think is particularly so for the students – the girls – in single-sex schools. In a sense it seems that having been made aware – brought to a level of consciousness – of what their schools' (teachers') thoughts are of their 'ability' in mathematics, the girls thus formed understandings of themselves in relation to mathematics, which in some ways also comes to be an understanding of themselves in relation to what it is they can/may be – their life trajectories. These self-understandings, these identities, have in ways been thrust upon them; but some of the girls are less accepting of these identities, and so create a space for answering these positionings to re-make their world, to be more agentive in relation of what mathematics can do for them. For some of the girls, the position afforded them in mathematics, placed mathematics as a constraint – outside them, as exemplified by the girl's statement, *'maths in my way'*. This seems to me to be a particular example of external structure determining these students' actions, what it is they then can do to 'answer'

Within these structures, that is, the set up of the educational system and how mathematics itself is positioned and structured within this, how is it possible for an individual to exercise agency? Where does agency lie? There seems a case to be made for what it is students do with the hand that is dealt to them. The profiles presented of students in mixed schools (Subsection 6.4-2) who succeeded in mathematics suggests that some of these students (specifically G1 of Mi1 and G1 of Mi2), having been dissatisfied, discontent even with the form of mathematics, and the way in which mathematics was on offer in their schools, re-positioned themselves in ways in relation to the mathematics that gave them more control over their own learning of mathematics. This action, within the mathematics structures that exist within schools and outlined in this study, are highly agentive, and could arguably at times be seen as particularly deviant. But, some of these students were nonetheless able, and found the space to carve out a new position for themselves in relation to mathematics, and one that better suited their ways of learning. Also, the degree of agency exercised by the students profiled did come with some awareness, and 'awakening of consciousness and socioanalysis' (Bourdieu, 1990, p116, given also in

Section 2.2, p27) that the position they were in with respect to mathematics was not the one they wanted to be in. The other important point is that these students found ways to be *within their habitus* that allowed for some chance at success in mathematics. That is, they found ways in which the embodied cultural capital that they brought with them to school, e.g. talking/working with friends, getting notes from classmates, how they made strategic use of what knowledge and skills they had, would have value even within these structures, and so that they would be able to trade *on* these for the chance of mathematics success.

Chapter 8

Concluding Comments

8. CONCLUDING COMMENTS

This final chapter contains four sections. The first of these presents a summary of the main findings of the study, these primarily in relation to the RA and RQ, but also other findings that are worthwhile within the context. The second section looks at what I think are some of the limitations of the study, what I would do with the benefit of hindsight. This provides a platform for suggesting areas worthwhile for further study. The third section then turns to the strengths of the study, the possible contributions it makes to the field of education and education research. The chapter concludes with some suggestions for possible ways forward for education policy within the Caribbean.

8.1 SUMMARY OF MAIN FINDINGS

In this section I come back to the RA and RQ, summarising what I think are the main findings in relation to them, as well as the sections/subsections which addressed them in more detail.

Table 8.1-1: Summary of Study's Main Findings in Relation to RA and RQ

RA/RQ	Where (mainly) addressed	Summary of main findings
RA(a)/ RQ1(a) Student views	6.1, 6.3-2	Majority of students reported liking mathematics, boys more so; however, prevalent views were mathematics as difficult, important, challenging, confusing, easy, enjoyable, boring
RQ1(b) Approaches	6.2, 6.3-1, 6.1-6, 6.1-7	Adherence to rules/formulas and steps of a procedure, individualistic (gender-dependent), a subject learned by listening and practising; room to fail for some students due in part to perception of parental expectations/values
RQ1(c) Performance	6.4, 6.1-7	School-type at both levels crucial, these are all predicated on home-types; students' mathematics views seemingly much less associated; parental expectations more closely linked
RA(b)/RQ3&1(a) What factors involved in views; how come to have those views; issues reflected in views	6.1-6, 6.1-7, 6.3 5.2-1, 5.2-2	Teacher very much involved in students' mathematics views; parental expectations/values also involved in views, but to a seeming less degree than teachers; also some perception of societal expectations based on school-type
RA(c)/RQ2 Inter-relations	6.3, 6.4	Views and approaches inter-related via a sort of gendered expectations; these expectations in turn a product of students' (and also teachers' and parents') (subconscious) perceptions of societal positionings. Seeming disjuncture between views and performances

As outlined in Section 1.1, a starting point of this thesis had been that there would be a link between students' views of mathematics and their performance in the subject. The study did find that students' mathematics views appeared to be linked to their perception of their school performance (Subsection 6.1-3), but that this link breaks down at the point of performances in external examinations (Subsection 6.4-1). That said, given that the starting point of this study was premised on the notion that there were problems in the mathematics teaching-learning in the Caribbean and A&B in particular, it is easy to lose sight of the fact that more students than not reported to liking mathematics, and in particular, boys overwhelming so. This is a positive general finding of the study, especially given the perspective within the region of boys underachieving and under-participating in school. One other notable general finding has to with the student view of mathematics as difficult *because of* the teacher, and although giving this difficulty as the main reason why they did not like mathematics, also displaying a willingness to not see this difficulty as a reason for their performance in it (e.g. Table 6.13-4, Subsection 6.1-3). Also notable is the finding related to students' perception of the social role of mathematics. Whilst students generally perceived mathematics as important for access to places upon finishing school, the ability grouping practice in the girls' single-sex schools seems to have brought this reality closer home for these students. There have also been overarching findings. One such has to do with the factor of language. This factor as an issue has been raised, both by the students themselves and also from observation data. In this study, language as a factor is elusive, almost intangible, as it is difficult at times to specifically say 'This is a language issue'. Indeed, in the Caribbean context and the apparent seamlessness of language use along a spectrum accepted as 'English' it is easily misrecognised, and for that reason, its strength as a factor in students' mathematics learning becomes strikingly important. Another of the overarching findings has to do with the factors of gender and social class. These factors have permeated the findings of the study, which show that issues to do with students and mathematics are not just about their gender, nor are they just about their social class. There is no one simple 'catch-all' phrase that can adequately summarise the findings on these issues for all students, as the findings are different depending on which sub-group of students is being looked at, and which mathematics issue is being assessed. As had been noted in Section 7.2, the 'best answer' for improving student outcomes in mathematics seems to lie in improving their social conditions, but this does not resolve the gender and affect issues which seem to be coming in large part from classroom processes.

8.2 Limitations of the Study – If I Had It to Do All Over Again

One aspect that was limited in this study has to do with getting at students' thinking when they offered answers to mathematical questions. There was a thought that there would be some scope for addressing this in classroom observations. The limitation arose to a degree due to an aim of studying classroom processes as they were. Teachers however very rarely asked students a reason for answers offered, whether 'right' or 'wrong'. Very often there was very little which could be done in the immediately 'afterwards' of a mathematics class for asking students about such thinking, in part because students were off to other classes, or in a rush to leave school at the end of the day. This is an aspect though that in the Caribbean context is worthy of further investigations. As seen for example in Subsections 6.2-1 and 6.2-2, students very often have quite legitimate reasons why they offer the (sometimes seemingly nonsensical) answers that they do. Also in relation to this, it would have been instructive to investigate in a more meaningful way specific differences in the ways students from the two school-types approached doing a variety of the same mathematics questions/tasks. This I think may have brought out further differences or similarities in the ways some students may have been predisposed to think, what strategies they employed in working through mathematics problems.

The study presented here was a case study focused mainly on an aspect (i.e. the student view) of the mathematics educative process in A&B. Limitations of finance, time and access restricted much of the data collection to A&B. It would have been useful to have gained some wider Caribbean perspective on this issue in order to determine a feel for the transferability of findings to other Caribbean contexts. As previously mentioned, a week was spent doing data collection in the nearby country of St.Kitts-Nevis. The choice of St.Kitts-Nevis was opportunistic as in geographical terms it is the closest to A&B of other Caribbean territories, but also and importantly, it had seemed their CXC/CSEC mathematics results had consistently been better than those of A&B and Caribbean averages (e.g. see Appendix F for more on this, including a comparison of CXC/CSEC results for some selected Caribbean countries). It had been thought prior to fieldwork that there was possibly something 'more right' going on in St.Kitts-Nevis than might be the case in A&B. However fieldwork did reveal that there were a number of mediating factors in the results of this territory, to include, for example, that a greater proportion of their students wrote the CXC/CSEC mathematics examinations at the Basic proficiency level than is the case in A&B, and also that whilst all students who continue in school must do mathematics to the fifth form, not all students who do reach fifth form are required to do the mathematics CXC/CSEC examinations as is the case in A&B.

Another limitation of the study has to do with the confounding factor of findings related to the single-sex school-type. In A&B and the Caribbean, school-type is associated with parents' occupational status and educational level. In A&B single-sex schools are the preferred school-type of all parents for their children, but tend to be realised by those could be considered more 'middle class'. However, it is probable that some of the performance differences noted in mathematics between school-types of mixed or single-sex could be attributable to the factor of the gender-mix of the schools in addition to factors related to the students' home (social) backgrounds. There would have been some scope for investigating this factor if access had been gained to the two main private mixed schools in A&B (see in Subsections 3.3-2 and 3.3-3). However, the inclusion of these schools would have presented some problems of interpretation of data, as although they are 'private' (hence fee-paying) schools, they have not traditionally been the schools of choice for (middle class) parents.

That language issues may be involved in students' performance in mathematics was not a direct focus of the study, and in ways, this also presents some limitations. As has been noted by Zevenbergen (2001, p39, also given in Subsection 7.1-2, p219), students from otherwise disadvantaged backgrounds are often not perceived to be disadvantaged by their language, especially when it is felt that everyone does speak and understand the dominant language. This observation by Zevenbergen is especially true of the Caribbean and A&B context. There could be an unwillingness to perceive language as a problem in students' learning of mathematics, especially when it seems from the CXC/CSEC English Language results that students are passing English Language. Robertson (1999) has noted such unwillingness on the part of policy makers in the Caribbean in what he termed a 'refusal to recognize' (p84) in relation to the importance of language issues in education. However the findings of the present study suggest that this, i.e. issues surrounding language, is an area within Caribbean mathematics education in need of more focused research.

8.3 Strengths of the Study and Contributions to the Field

This study has paid particular attention to what students have had to say about their learning of mathematics and this within a Caribbean setting. As cited in Jenkins (2006), this is not to privilege the student voice as being in any way 'more true' than that of the other stakeholders in education, 'but it provides a crucial element still too often overlooked' (Nixon et al, given in Jenkins, 2006, p49) in educative processes. This student-voice, especially in Caribbean educational research, has been largely under-researched. As noted in the introduction (Section 1.3), studies in education in the Caribbean have tended to focus on more general education issues and within this, issues related to gender and the end product of achievement results, and also on issues related to teacher education. This study provides a unique perspective in the Caribbean in that it gives voice to students' concerns, and this in a key curriculum area which has important implications for the opportunities they can reasonably expect to access on leaving school.

Within the Caribbean, this study highlights in more detail the need at the student level for a wider locus of concerns in education. An overt focus on gender issues may have contributed to an unwitting lack of attention at other potentially more problematic issues which may be impacting educational achievement, e.g. those related to language, social class and ties to school-types. The study also highlighted the perceived social role of mathematics education and how, in the Caribbean, it may stand in the way of the educational (and career) aspirations of particular groups of students, i.e. those from less privileged backgrounds, and to a lesser extent, girls. This positions the mathematics being taught in Caribbean schools as the preserve of (more) middle class boys (as this is the group of students to *both* like *and* perform well in it) strikingly similar to how it has been characterised in Western countries.

Many of the findings of the study are not necessarily 'new' to those which have been reported in the academic literature on mathematics education in Western countries. That some of these findings 'mirror' situations that exist in Western countries perhaps ought not to be surprising. As has been noted in Section 1.2, Caribbean education systems continue to be based on a British model, and so could be expected to reflect some of the problems inherent in this system. According to Louisy (2001, p432) the Caribbean region has a 'historical *predisposition* to adapt to external influences' (my emphasis) and this is no less the case in education. That said, on a more international basis, the fact that the context of the study was in the Caribbean taps into a gap that is present in the field of education and mathematics education. Studies of educational processes in small states are limited, and studies of mathematics education more so. Louisy (2001, p435) further made the point that the Caribbean region has been 'grossly under-represented' in educational studies. She goes on to quote the following from Brock:

> … whatever the eventual answers to the problems of educational provision in small states might be, they will more likely be found if there is much more research both into particular and general issues in this field. This means more in-depth case-studies of individual systems as well as more comparative analyses across the numerous range of small states (Brock, cited in Louisy, 2001, p435).

The context and methodology of the present study has attended to aspects of how questions related to educational provision in small states may be addressed as identified by Brock. The study has attended to an educational problem within the Caribbean, i.e. the apparent underachievement of students in mathematics, via an in-depth case study of one such territory, A&B. This is a strength of the study, and represents one of its contributions to the field of educational research.

8.4 Ways Forward

In some ways the problems identified in this study as pertains to the learning and teaching of mathematics may well not be the ones that educators or persons responsible for policy decisions want them to be. The problems are complex, they are not 'nice' and addressing them would involve drastic changes in re-thinking the structure of educational systems, and what learning *looks like* both cognitively and physically, amongst others. It would involve paying greater attention to what happens in schools at both the primary level in terms of teacher recruitment and secondary level. It would seem to follow that if some teachers enter classrooms with a view that not all secondary school students can do mathematics to CXC level, then perhaps, implicitly they may teach mathematics 'accordingly' (e.g. in Gates & Vistro,-Yu, 2003, p44). This adds credence to the student view and interpretation thereof of mathematics being 'made' by some teachers inaccessibly difficult. Gates & Vistro-Yu (ibid) ask the question 'Is Mathematics for All?' It seems legitimate in the context of the findings of this study, also taking into consideration that Caribbean countries have taken on a mandate of providing secondary education for all by 2015 (UNESCO, 2000; also given in Section 1.2, p1-2) to question the position of mathematics education at the secondary level in this mandate, and *what* mathematics is meant, and for *who* 'all'. It seems almost illogical to require all students reaching a certain level of education to do the CXC/CSEC mathematics examinations as is the case in A&B when the curriculum and education system itself is set up in such a way which almost ensures the failure of a majority of students. Teacher education and in-service support are crucial here.

It is useful once again to be mindful of the sampling strategy for selection of the student participants in this study. There are key points here; they were *students* in the *fourth form* of *secondary* schools (re. see Subsection 3.5). These points did mean that in the A&B context an unknown but sizable proportion of *teenagers* would have already been excluded from the study (based on what is known from Chapter 4 of the process of reaching this stage and level of schooling). No account is taken of out-of-school teenagers, as in the main they would not have sat these CXC/CSEC examinations. Thus, the study's student sample could be seen as an 'over-selected' group of teenagers. That the findings and results reported in this study are what they are for an otherwise over-selected group of teenagers has substantive policy implications as A&B (and the Caribbean) move towards universal secondary education. Simply rolling out such education across the board without due consideration of problematic areas addresses issues of access, but not those concerned with the *quality* of such education. The indications from this study are that student success in mathematics in such a situation is an area most primed to be adversely affected by such a move if things remain as they are and some strategic planning is not employed to address the issue. Attention needs to be paid to what happens at the primary level of schooling if one accepts, as the findings of Subsection 6.4-1 suggest, that this level of schooling continues to be one of the factors more closely associated with student eventual success in mathematics at the end of secondary school. It may be that subject specialists in mathematics should be employed in primary schools for teaching throughout the years of primary school. This is not to disregard what happens in secondary schools, as again from the findings of Subsection 6.4-1 and the discussion in Subsection 7.1-1 there are indications that the secondary experience can compound primary experiences in mathematics learning. It may also be that the definition of success in the

CXC/CSEC may have to be re-considered, particularly (but not only) in how society views such success. Inarguably students need to be offered more ways to be successful in mathematics as a means of increasing their access to such success (Boaler, in press, p21-22).

But, and as has been highlighted by Jennings (2001, p108), even when teachers do receive the necessary (pre-service) training they find their efforts to implement much of what they have learned thwarted in the field of practice for reasons which included the examination orientation of schools and a predisposition of principals for 'familiar methods' of teaching. This could explain in part why mathematics education in the Caribbean has retained much of its 'traditional' character. If changes are indeed wanted in the levels of end-product mathematics achievement, there is a fundamental need to re-think the whole conception of learning, and how teaching and learning are structured in the education system and in schools. Some of this has to do with ability grouping practices. Repeatedly the education literature in developed countries show there to be little to be gained in terms of *learning* from ability grouping practices both generally (Sukhnandan & Lee, 1998) and in mathematics (e.g. Boaler et al., 2000; Gates & Vistro-Yu, 2003), and further such practices tend to provide 'slight benefits' to students in higher ability groups 'at the expense of significant losses' to students who get placed in lower ability groups (Boaler et al, 2000, p633). This is one other way in which schools '*contribute*' (Bourdieu, 1998, p19, his emphasis) to the perpetuation of social inequalities, remaining very much a social 'conservative force' (Bourdieu, 1974). And, mathematics seems within Caribbean education a preferred locus for the continued perpetuation of such social inequalities and conservatism.

Following on from the comments of Hickling-Hudson (2004; given in Section 1.3, p5), she continued to note (as did Griffith, 2005) that despite the changes in Caribbean education brought on by the introduction of the CXCs, the examinations, in tandem with stratified education systems continue to perform a 'neo-colonial, exclusionary function' (p298). This seems particularly 'true' in relation to mathematics education. There seems a need for a greater awareness of just these processes at all levels of the education system. Also, there is a need for recognition of the implications of the social role of mathematics, and that an overhaul of, rather than tinkering with, the education system is needed in order to address problems in mathematics education, and that such overhaul must also consider the social conditions of the students whom it serves.

The result that students in the main and especially boys reported to liking mathematics offers a starting point for a way forward. Despite what may seem as against the grain, there is a willingness, disposition even on the part of students to like mathematics. Further, the study shows that some students are able to succeed in mathematics despite what may seem otherwise insurmountable odds. That is, there is a will on the part of students to succeed in mathematics. What is now arguably needed is the social, cultural, and political will to make this happen.

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Appendices

APPENDICES

APPENDIX A: THE QUESTIONNAIRES

A1: The Student Questionnaire

Dear Student,

This questionnaire forms the first part of a study being undertaken by a former teacher, Patricia George, towards the attainment of a PhD degree in mathematics education at the University of Leeds, England. The study seeks to understand Caribbean/Antiguan students' views about mathematics, and factors that help in forming these views.

Your participation in this study is key to determining its success. As part of that, I would appreciate if you would complete this questionnaire – there are no right or wrong answers, just your honest opinion is being sought.

The questionnaire is divided into 4 parts. Individual responses (to all parts) will be kept confidential, and anonymity will be preserved in the actual report of the study. Your name (and contact number) is being asked for follow-up purposes only, in interviews to follow (to expand on some of your responses).

If you have any additional comments, or wish to contact me for any reason, I can be reached at patpari@hotmail.com.

Thanks in advance for your assistance.

Patricia George

.....Section I - Personal Details.....

Name: ____________________ School: ____________________

Contact number/details: ______________________________

Sex: Male ☐ Female ☐

Date of Birth: ________________(day/month/year)

Country of birth: ____________________________

Village/Community where you live: ______________________

Former Primary School attended (please also indicate in the line below the table whether this school was in Antigua & Barbuda or not; if more than one school, just give last one)

Private	Government

____

Did you attend pre-school (before primary school) Yes ☐ No ☐

Entered into secondary school as: (tick one)

primary student ☐ post-primary student ☐

Year of entry into secondary school ________________

1. What job/career do you hope to have after finishing schooling?
____

2. What subjects are you doing now in 4^{th} form?
____
____
____

3. Reason for your choice of subjects: ______________________
____

4. Which 4 of these subjects do you think will be most important to you for your chosen job/career? ______________________________
____

5. Which 1 of the subjects you named in no. 2 do you think will be least important to you for your chosen job/career? _________________________

6. Do you think that having an education is important?

Yes ☐ No ☐

Give a reason for your answer.
____
____

7. What after-school activities/lessons, etc. are you involved in?
____

8. How do you usually get to school?

Bus ☐ Car ☐ Walk ☐ Other ☐

9. After finishing this (your present) school, which one of the following to you hope to do? (Tick one)

College(if this, state which department) Department: ____________________	
ABIIT (A&B Institute of Information Technology)	
School/University outside Antigua and Barbuda	
Work in Antigua and Barbuda	
Work outside Antigua and Barbuda	
Other (please specify) _______________________	

10. Do you obtain an allowance/pocket money? Yes ☐ No ☐

11. Do you have an after-school/part-time job? Yes ☐ No ☐

12. Religion/Church: ___________________________

13. About how often do you go to church?

More than once a week ☐ Once a week ☐

Once a month ☐ Hardly ever ☐

Never ☐

14. Give 2 words/phrases that best describes you in general.

____

..... Section II - Home Details.....

1. In the table below,

- In column 2., place a tick (√) for yes or a cross (x) for no if the adult named in column 1. lives at home with you;
- Only answer the remaining columns (3 - 5) for those adults you've ticked (√) in column 2;
- *In the column 5, choose the educational level from the set {none completed, primary, secondary, college/A'level, university degree, don't know} for the adult you've ticked (√) in column 2.

1. Adult	2. At home	3. Country of birth	4. Occupation	*5. LAST educational level completed
Mother				
Father				
Grandmother				
Grandfather				
Other relative				
Guardian				
Other (please specify)				

2. Number of children in your household (18 yrs. or less; count yourself if you fit):

____

.....Section III - Views on School.....

1. Do you like school?

Always ☐ most times ☐ sometimes ☐

hardly ever ☐ never ☐

2. What is the *highest* level of education you hope/expect to complete?

Form 5 ☐ College (name department) ☐

Bachelor's/first degree ☐ Master's degree ☐

PhD. ☐ Other (specify) ☐

3. What do you see as the main advantage to YOU (personally) of going to your particular school?

____

____

4. Do you think that going to school is important? Yes ☐ No ☐

Reason for answer: ____

____

5. Give 2 words/phrases that best describe YOU in school.

____

6. Which ONE of the following statements BEST applies to your views of school? (tick ONE)

- School is for learning.	
- School is for socializing with friends.	
- School is for learning, with the added advantage of socializing with friends.	
- Socializing and learning are equally important aspects of school.	
- School is a way of passing time.	

7. Which are your 2 favourite subjects at school?

____

8. Which 2 subjects do you perform best at in school?

____

9. Which are your 2 least liked subjects in school?

____

10. Which 2 subjects do you perform worst at in school?

11. What are the 2 most important reasons why you would like a subject?

12.(a) How would you rate your overall performance in secondary school?

Very good ☐ Good ☐ Satisfactory/ Fair/Passable ☐

Unsatisfactory/ Could be better ☐ Poor ☐

12.(b) Complete this sentence: My performance in school is mainly due to

.....Section IV - You and Mathematics.....

1. Do you like maths? Yes ☐ No ☐
Reason for answer:

2. Do you enjoy your school mathematics classes?
Always ☐ Most times ☐ Sometimes ☐

Hardly ever ☐ Never ☐

3. When did you enjoy mathematics the most?
Primary school ☐ Forms 1-2 ☐ Forms 3-4 ☐ Never ☐

4.(a) How would you rate your secondary school mathematics performance so far?
Very good ☐ Good ☐ Satisfactory/ Fair/Passable ☐

Unsatisfactory/ Could be better ☐ Poor ☐

4.(b) Complete this sentence: My performance in maths is mainly due to

5. Give 2 words/phrases that best describe you in mathematics classes.

6. What would you (personally) say maths is?

7. In 1 or 2 sentences, describe what usually happens in your school mathematics classes.

8. In 1 or 2 sentences, describe what YOU (personally) usually do in your school mathematics classes.

9. What do you like most about your school mathematics classes?

10. What do you like least about your school mathematics classes?

11. Describe what happened in your favourite mathematics lesson ever:

12. In a word or phrase, how would you sum up your school maths experience so far?

13. What could be done to make maths more interesting to you?

14. What style of teaching do you think allows you to learn maths better?

15. If you do not understand or know how to do something in maths, which of these do you USUALLY do? (tick one)

Ask a friend ☐ Ask the teacher ☐

Try and figure it out yourself ☐ Nothing ☐

16. How do you prepare for a maths test?

17. Who helps you with maths homework?

____

18. What is your opinion about using a calculator in doing maths?

____

____

19. What is your opinion about the usefulness of your mathematics text book?

____

20. Do you think mathematics should be compulsory to CXC level?

Yes ☐ No ☐

Reason for answer: ______________________________

____

21. Why do you think mathematics has been made compulsory to CXC level (by Ministry of Education)?

____

22. If mathematics was NOT compulsory, would you still choose to do it to CXC level?

Yes ☐ No ☐

Reason for answer: ______________________________

____

23. Do you think that every secondary school child can do mathematics to CXC level?

Yes ☐ No ☐

Reason for answer: ______________________________

24. Do you think that generally in Antigua and Barbuda, it is important to have passed mathematics at CXC level?

Yes ☐ No ☐

Give a reason for your answer.

____

____

25. Do you expect to pass your CXC maths? Yes ☐ No ☐

Reason for answer: ______________________________

- If Yes, would you then take maths if you do further studies?

Yes ☐ No ☐

Reason for answer: ______________________________

- If No, would you re-sit maths at some later time?
Yes ☐ No ☐

Reason for answer: ______________________________

26. Do you go to extra maths lessons (outside of school)?

Yes	
Yes, but does not make a difference	
No, don't need to	
No, but need to/will start	
No, will not make a difference	

27. Which of the following *best* describes how you feel most often in school maths classes?

Happy/ Enjoying	Interested	Confident	Worried or anxious	Frustrated	Bored or Sleepy	Lost or confused	Other (please specify)

28. *Consider the following, and use it to respond to the question below:*
A writer in the Antigua Sun newspaper, commenting on what was perceived as Antigua and Barbuda's poor mathematics CXC results (2003), had this to say:-
'The nation of Antigua and Barbuda is locked in a ... "Mathematics Paralysis" ... The fact that there is a mathematics paralysis is evidenced by the fact that there is no public outrage, no public debate and no articulated or published plan to change the shocking and unacceptable results ... We have accepted our plight. It is business as usual ... we have not only accepted out plight, but have accommodated it.'
The comment was based in part on the following statistics:

Year	2000	2001	2002	2003
% persons passing maths (CXC general grades I, II, III)	34	31	36	38

What do you think of the writer's comments? ______________________________
____
____
____
____

29. Which profile below would you prefer to leave school with?

7 subject passes, but not maths ☐ OR 6 subject passes with maths ☐

Reason for answer: ____

____

[N.B. Question 30 continues on the next page. However, use the space below to tell me about anything related to mathematics (your views, feelings, etc.) that you think I have missed in this questionnaire.]

Also, thanks very much for your assistance.

30. In the table below, indicate your level of agreement or disagreement with each statement by placing a tick in the appropriate box.

#	Statement	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
1	I like maths					
2	Maths is useful in everyday life					
3	I use maths I learn in school to solve problems outside of school					
4	It is okay in my country to say 'I don't know maths'.					
5	Maths is a difficult subject					
6	Being good at maths is passed down from parents					
7	I can do well in maths if I work at it					
8	I usually do maths homework					
9	It doesn't really matter if I understand a math problem if I get the right answer					
10	It is impossible for me to do well in maths at CXC without extra out-of-school lessons					
11	I will still get the job I want even if I don't pass maths at CXC					
12	I do not need to think about the work when doing maths, I just have to remember the rules					
13	Discussion is an important part of learning maths					
14	It is important in maths to be able to work quickly					
15	Word problems are out of place in maths because maths is about					

	numbers					
16	In maths, knowing how to multiply is more important than knowing when to multiply					
17	Making mistakes in maths helps me to learn					
18	I understand maths better if I work with my friends					
19	Boys are better at maths than girls					

A2: The Parent Questionnaire

Dear Parent,

This questionnaire forms a part of a study being undertaken by Patricia George (former teacher, Mathematics and Chemistry at OCS and PMS) towards the attainment of a PhD degree in Mathematics Education at the University of Leeds, England. The study seeks to understand Caribbean (Antiguan and Barbudan) students' views about mathematics and how these relate to their mathematics performance. In addition, the study hopes to determine how such things as the students' image of themselves, views about school, or society in general, or other reasons, may influence their views about mathematics.

I would appreciate your participation in the study by your completing the questionnaire attached. Please feel free to give your full, honest opinion on each question. Individual answers will be kept confidential, and anonymity will be preserved in the actual report of the study.

If you have any additional comments, suggestions, concerns, etc., I can be reached at P.P.George@education.leeds.ac.uk or patpari@hotmail.com

Thanks in advance for your assistance.

Patricia George

About your child:

1. Is your child (for whom you are completing this questionnaire) a
   boy ☐ or girl ☐ ?
2. What is your child's date of birth? ____________________ (day/month/yr)

Mathematics Details:

1. How would you describe your child's secondary school mathematics performance? (Tick one)

Performance	
Very good	
Good	
Satisfactory/Fair/ Passable	
Unsatisfactory/Could be better	
Poor	

2. What do you think is the most important reason for your child's secondary school maths performance (as indicated in No.1 above)?

____
____
____

3. Do you expect your child to pass maths at CXC level at the end of 5th form?

Yes ☐ No ☐

Reason for your answer: ______________________________
____
____

4. Mathematics and English Language have been made compulsory to CXC level by the local Ministry of Education. Do you think that **maths** should be compulsory to this level?

Yes ☐ No ☐

Reason for your answer: ______________________________
____
____

5. If maths were not compulsory, would you require that your child take it to CXC level?

Yes ☐ No ☐

Reason for your answer: ______________________________
____
____

6. What comment about maths has your child expressed to you most often?

____
____
____

7. Do you think your child's school maths performance is better than, worse than, or similar to your own?

Better ☐ Worse ☐ Similar ☐

Why do you think this is the case? ______________________
____
____

8. Do you like maths? Yes ☐ No ☐

Reason for your answer: ______________________________
____
____

9. What would you (personally) say maths is?

____
____

10. What usually used to happen in your maths classes at school?

____
____
____
____
____

11. In a word or phrase, how would you sum up *your* school maths experience?

____

12. Which of the following BEST describes you used to *feel* in your school maths classes? (Tick one)

Happy/ Enjoying	Interested	Confident	Worried or anxious	Frustrated	Bored or Sleepy	Lost or Confused	Other (please specify)

13. What comment(s) about maths do you make to your child?

____

____

____

14. Do you find that you need to know/use maths in your everyday life or at work?

Yes ☐ If this, in what ways or when ______________________

____

____

No ☐ If this, reason for answer ______________________

____

____

15. Have you ever used a calculator to do maths?

Yes ☐ No ☐

16. What is your opinion (with reason) of school children using a calculator in doing maths?

____

____

____

17. Do you think that generally in Antigua and Barbuda, it is important to have passed mathematics at CXC level?

Yes ☐ No ☐

Reason for your answer: ______________________

____

____

18. With which profile below would you prefer for your child to leave school?

7 subject passes, but not maths ☐ OR 6 subject passes with maths ☐

Reason for your answer: ______________________

____

____

19. What Antiguan and Barbudan attitude or way of thinking do you think may influence how your child does maths?

____

____

____

____

20. A writer in the Antigua Sun newspaper, commenting on what was perceived as that nation's poor mathematics CXC results (2003), had this to say:
'The nation of Antigua and Barbuda is locked in a ... "Mathematics Paralysis" ... The fact that there is a mathematics paralysis is evidenced by the fact that there is no public outrage, no public debate and no articulated or published plan to change the shocking and unacceptable results ... We have accepted our plight. It is business as usual ... we have not only accepted our plight, but have accommodated it.'

The comment was based in part on the following statistics:

Year	2000	2001	2002	2003
% persons passing maths (CXC general grades I, II, III)	34	31	36	38

What do you think of the writer's comments? ______________________
____
____
____
____

21. In the table below, indicate your level of agreement or disagreement with each statement by placing a tick in the appropriate box.

#	Statement	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
1	Maths is useful in everyday life					
2	It is okay in Antigua and Barbuda to say 'I don't know Maths'.					
3	Maths is a difficult subject					
4	Being good at maths is hereditary					
5	My child can do well in maths if he/she works at it					
6	It doesn't really matter if my child understands a math problem if he/she gets the right answer					
7	It is impossible for my child to do well in maths at CXC without extra out-of-school lessons					
8	My child will still get the job he/she wants even if he/she does not pass maths					
9	You do not need to think about the work when doing maths, you just have to remember the rules					
10	It is important in maths to be able to work quickly					
11	In maths, knowing how to multiply is more important than knowing when to multiply					
12	Word problems are out of place in maths because maths is about numbers					

About You:

Sex: Male ☐ Female ☐

Relationship to child: Mother ☐ Father ☐ Grandmother ☐

Grandfather ☐ Other relative ☐ Guardian ☐

Age range: 20-29yrs ☐ 30-39yrs ☐ 40-49yrs ☐

50-59yrs ☐ 60 yrs. or more ☐

Last level of schooling completed (please tick one):

Primary	Secondary	College/ diploma	University degree	Other (please specify below)

Occupation: ______________________________

Country of birth: ______________________________

Religion/Church: ______________________________

Secondary school attended: ______________________________
(if outside of Antigua & Barbuda, just give name of country)

Contact information: ______________________________
(This is asked for follow up purposes only)

Thank you very much for taking part. If you have any additional comments, e.g. your views, feelings about maths itself, or anything you think I have missed, please note them overleaf, or feel free to contact me.

A3: The Teacher Questionnaire

Dear Teacher,

This questionnaire forms part of a study being undertaken by Patricia George (former teacher, Mathematics and Chemistry at OCS and PMS) towards the attainment of a PhD. Degree in Mathematics Education at the University of Leeds, England. The study seeks to understand Caribbean students' views about mathematics and how these relate to their mathematics performance, what factors determine what these views are, and how these views are related to such things as how they see themselves (personal identity), school, cultural, or other issues.

I would appreciate your participation in the study by your completing the questionnaire attached. Individual answers will be kept confidential, and anonymity will be preserved in the actual report of the study.

If you have any additional comments, suggestions, concerns, etc. I can be reached at patpari@hotmail.com or P.P.George@education.leeds.ac.uk

Thanks in advance for your assistance.

Patricia George

You, your students, Antiguan & Barbudan society, and mathematics

1. Do you like maths? Yes ☐ No ☐

Reason for answer: ___

___

___

2. How did you come to be teaching mathematics at your present school?

___

___

3. In the table below, please place a tick beside your favourite math topic to teach (choose one) and your least favourite one to teach (choose one), giving a reason for each choice in the spaces provided below the table.

Topic	Favourite to teach	Least favourite to teach
Algebra		
Business Arithmetic		
Computation and number		
Matrices and vectors		
Measurement and Constructions		
Relations, functions, and graphs		
Statistics		
Sets		
Trigonometry and geometry		
Other (please specify)		

Reasons for answers: ___

___

___

4. Do you teach other subjects, beside mathematics?

Yes ☐ No ☐

If yes, which of the subjects you teach is your favourite *to teach*, and why?

___

___

5. Which of the following would you say best describes how *you* feel most times whilst *teaching* mathematics in your school? (Tick one). Give a reason for your answer.

Enthusiastic /energized	Happy /enjoying	Confident /at ease	Depressed /sad	Angry	Worried /anxious	Frustrated	Other (please specify)

Reason for answer: ___

___

___

___

6. What usually happens in your classroom when you are *teaching* mathematics?

___

___

___

___

7. What usually used to happen in your mathematics classes when you were at school?

8. In a word or phrase, how would you sum up your school maths experience?

9. What would you (personally) say maths is?

10. Which of the following *best* describes how you used to feel in you school maths classes (your student days)?

Happy/ Enjoying	Interested	Confident	Worried or anxious	Frustrated	Bored or sleepy	Lost or confused	Other (please specify)

11. Which one of the following would you say best describes how you usually teach mathematics? (Tick one). Give a reason for your answer below.

Teach same as how taught	Teach different to how taught	Teach making use of techniques learnt in teacher-training	Other (please specify)

Reason for answer:

12. What areas/aspects, if any, related to the teaching of mathematics, do you think you would like further professional development in?

13. Do you think that every secondary school child can do mathematics to CXC level?
Yes ☐ No ☐

Reason for answer:

14. Do you think mathematics should be compulsory to CXC level?
Yes ☐ No ☐

Reason for answer:

15. If mathematics was not compulsory, and you had to 'sell' the subject to encourage students to do it, what point(s) do you think would be most important?

16. What do you think is the *main* reason why some students do like maths? (Tick one)

Necessary to their career/further study plans	Good ability/ performance in the subject	Parents, friends, siblings (or others) who have been successful in it /because of it	Teacher delivery of subject	Making best of a 'no choice' /compulsory situation	Other (please specify)

Other specified:

17. What do you think is the *main* reason why some students don't like maths? (Tick one)

Do not see 'real world' applications	Poor ability/ performance in the subject	Parents, friends, siblings (or others) who have been successful without it /unsuccessful in it	Teacher delivery of subject	Rejection of a 'no choice' /compulsory situation	Other (please specify)

Other specified:

18. What are some important factors in determining how students perform in maths?

19. In your experience, which group, boys or girls, perform better at mathematics?

20. In your experience, what characteristics or patterns of behaviour have you noticed in the ways in which boys and girls go about doing maths in the classroom?

21. What comments do students make, or what things do they do to bring out their like of (for those students in this group), and dislike of (for those in this group) mathematics?

Like maths (comments and/or actions):

Dislike maths (comments and/or actions):

22. What is your opinion of student calculator use in doing mathematics?

23. What is your opinion of the usefulness of the maths text book for you and also for the students?

For you: ____

____

For students: ____

____

24. A writer in the Antigua Sun newspaper, commenting on what was perceived as that nation's poor mathematics CXC results (2003), had this to say:
'The nation of Antigua and Barbuda is locked in a … "Mathematics Paralysis"… The fact that there is a mathematics paralysis is evidenced by the fact that there is no public outrage, no public debate and no articulated or published plan to change the shocking and unacceptable results… We have accepted our plight. It is business as usual … we have not only accepted our plight, but have accommodated it.'
The comment was based in part on the following statistics:

Year	2000	2001	2002	2003
% persons passing maths (CXC general grades I, II, III)	34	31	36	38

What do you think of the writer's comments?

____

____

____

____

____

____

25. What is your opinion of students going to extra out of school mathematics lessons?

____

____

____

____

____

26. What Antiguan and Barbudan attitude or way of thinking do you think may influence how students do maths?

____

____

27. Do you think that generally in Antigua and Barbuda it is important to have passed maths at CXC level?
Yes ☐ No ☐
Reason for answer: ____________________________________

____

____

28. With which profile do you think it is better for a child to leave school?
7 subject passes but not maths ☐ **OR** 6 subject passes with maths ☐

Reason for your answer: ________________________________

____

____

N.B. Question 29 continues overleaf. However, if you have any additional comments, suggestions, advice, etc. to give, please feel free to do so below, or contact me.

Once again, in advance, thanks for your participation.

29. In the table below, please indicate your level of agreement or disagreement with each statement by placing a tick in the appropriate box.

#	Statement	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
1	I like maths					
2	Maths is useful in everyday life					
3	I use maths I learned in school to solve everyday problems (outside teaching)					
4	It is okay in Antigua and Barbuda to say 'I don't know maths'.					
5	Maths is a difficult subject					
6	Being good at maths is hereditary					
7	Students can do well in maths if they work at it					
8	It doesn't really matter if students understand a math problem if they get the right answer					
9	It is impossible for students to do well in maths at CXC without extra out-of-school lessons					
10	Students in Antigua and Barbuda can still get the job they want even if they don't pass maths at CXC					
11	Students do not need to think about the work when doing maths, they just have to remember the rules					
12	Discussion is an important part of learning maths					
13	It is important in maths to be able to work quickly					
14	Word problems are out of place in maths because maths is about numbers					
15	In maths, knowing *how* to multiply is more important than knowing *when* to multiply					
16	Making mistakes in maths helps students to learn					
17	Students understand maths better if they work with their friends					
18	Boys are better at maths than girls					

N.B. I would appreciate if you would complete the additional section on your personal details overleaf.

GENERAL: About you

Sex: Male ☐ Female ☐

Number of years teaching:
0-2 ☐ 3-5 ☐ 5-10 ☐ 10-20 ☐ over 20 ☐

Number of years teaching mathematics:
0-2 ☐ 3-5 ☐ 5-10 ☐ 10-20 ☐ over 20 ☐

Your age range: less than 20 yrs ☐ 20-29 yrs ☐ 30-39 yrs ☐

40-49yrs ☐ 50-59 yrs ☐ 60 yrs or more ☐

Teacher trained: Yes ☐ No ☐

Present form levels teaching mathematics at: ______________________________

Present School teaching: ____

In the table below, please tick the box which indicates your last completed stage of education, and also your last completed stage of mathematics.

Stage	Overall Education	Mathematics
Secondary (GCE, CXC or equivalent)		
A levels or equivalent		
University degree		
Other (if this, please specify below)		

Other specified (from table above): ______________________________________

Within last 3 years, state nature (i.e. what it was about) of any mathematics workshop(s) attended, and your opinion on each:

____
____
____
____
____

Secondary school attended (if outside present country, just give name of country)

____
____

APPENDIX B: THE OBSERVATION SCHEDULE

Observation Schedule

Type: Chronological Descriptive Event Sampling

(Theoretically informed by Flanders (1970) Interaction Analysis System, as given in Robson, 1993, p211; Practically informed by my observations of Tom Roper's first year undergraduate mathematics classes.)

1. General:

Context: date; day; time of day; class period/session of day; classes/subjects before and after; teacher goes to students or vice-versa; arrival and departure times (how marked/signalled); topic being taught;
As relates to context, it is hoped that for the selected schools, at least one 1-hour period per week can be (formally) observed. However, it is hoped that the day of this session can be varied from week to week.

Physical setting: board; teacher's desk/space; student seating arrangement; windows/doors; classroom location in overall structure;

Students (general): sets or mixed ability; no. of girls/boys; student groups – who sits where, gender segregated or mixed; same/similar seating always?; is it the student's seat, or sit anywhere?

General description of introductions and closings of lessons

2. During the lesson:

For the teacher:

a) Note gender, age range, experience, etc.

b) Type of questions asked → closed (e.g. interest only in 'right' answer)
→ more open (e.g. what do you think about…, why…, explain…, different ways/another way to solve…)

Also, are questions directed generally, or to particular students? If this last, who/which student(s)?

c) Response/Feedback to student answers:
- How are wrong answers dealt with;
- How are right answers dealt with (e.g. just accepted, asked to explain, etc.)
- Feedback on class/homework, tests, oral responses

d) Response to student questions → verbal (e.g. what said, how said, does it encourage further questions?
→ non-verbal (e.g. evidence of delight/frustration)

e) More general:
- Examples/illustrations used in teaching topic; attempts to link to students' experience or everyday life, Antiguan life, etc.
- Statements/comments made about maths (topic being taught) in general, e.g. importance
- Linking of topic being taught to others
- Use of tools, e.g. text book, calculator (for him/herself, and use by class)
- Disciplinary procedures

For the student:

f) What are they doing whilst teacher is teaching – e.g., taking notes, listening, looking out windows, head on desk, talking/chatting to neighbours/friends, etc.

g) Type of questions asked to teacher – e.g.
- Concerned with understanding whys
- Concerned with facts/right answers
- Questions that suggest more fundamental misconceptions/dissonance
- Questions of relevance – how asked e.g. in reference to self, classmates, in Antigua, all in general; mathematics in general, topic in particular, etc., how asked – i.e. genuine search for knowing where when, or case of need to know, etc.

h) Student responses to teacher questions
- Reactions to questions – e.g. show of hands, looking at each other, silence, enthusiasm, or not, etc.
- Who responds when questions are directed generally
- Other students' reactions to right/wrong answers

i) Student-student interactions
- On- or off-task
- Reactions to group and /or individual classroom work/activities, homework, and tests
- When left to do work, do they talk to each other about work, or other

j) More general:
- Need for discipline
- Use of tools e.g. text book, calculators, etc.
- General classroom talk (about maths, about other things – if this, what other things, etc.)
- Classroom deportment, how uniform is worn, etc.

APPENDIX C: THE INTERVIEW SCHEDULE

Interview Schedule

Type: Semi-structured, open-ended questions (i.e. a pre-determined set of main and subsidiary questions, with the flexibility to follow up on particular responses; no pre-determined set of responses).

Thank you for agreeing to participate in this group interview. I want you to feel free to express your honest views about the questions I ask. Your responses will be kept confidential, i.e. will not be revealed to your teachers, parents, and anonymity will be preserved in any report.

I am going to ask your permission to audio-record this interview session.

Do you have any questions about anything I've said so far, or anything else, before we start?

The areas/questions to be probed:

1. **Personal Feelings/Views about Mathematics** (research aims/questions dealing with what students views of mathematics are; some culture – influences on students' expressed views)
   - ✧ When it is time for mathematics – either being time-tabled for a particular day, or coming up next on the time-table.
   - ✧ Is there anything you've heard about maths (people say about maths) that you think is (a) true; (b) not true?
   - ✧ Advantages/Disadvantages to doing well/poorly in mathematics.

2. **Identities/Culture** (research aims/questions dealing with identity and culture – how students may have come to form expressed views; how students see themselves (and others) in relation to mathematics)
   - ✧ Are you a maths-person? If not, what sort of person would you call yourself?
   - ✧ Are there math-people in your class?/Do you know anyone in your school/class who you would consider to be a maths-person? Do they behave different to other classmates?
   - ✧ Reaction/Expectations of peers. If you did a test, and you/classmate did very well (name a mark), what would other classmates' reaction be? If you/classmate did poorly (name a mark), what would other classmates' reaction be?
   - ✧ Do you have hobbies that involve mathematics? Would you watch a maths programme on tv?
   - ✧ Do you find that you ever have to use the maths you learn in school outside of school? Any after-school jobs that involve using maths? If yes, when/in what areas?

3. **Parental Expectations/Culture** (research aims/questions dealing with culture – how students may have come to form expressed views; some aspects of students' performance in mathematics)
   - ✧ What are parents expectations regarding school maths performance? If took home a report and passed everything else but failed maths, would parents make a fuss/be upset?

- ✧ What if it had been another subject (name one) which this had happened and not maths – would you expect the same reaction?

4. **Mathematics at school** (research aims/questions dealing with school – how students may have come to form expressed views; students' approach to learning mathematics)
   - ✧ Have you always had a mathematics teacher since starting this school?
   - ✧ Have you found the changes in mathematics teacher in going from one form class to a next confusing in anyway?
   - ✧ What would you say usually happens in your school maths class? The teacher comes in and.... what happens?
   - ✧ What would you like to happen (a) more often; (b) less often in your school mathematics class?
   - ✧ Is there any way you find you have to be in maths class that you don't have to be for other subjects?
   - ✧ How do you study for maths?
   - ✧ Effort, Ability, Interest, Something else I haven't thought of/mentioned: which of these do you think affects your mathematics performance most?

5. **The Algebra Task** (research aims/questions dealing with students' approach to doing mathematics)
   - ✧ How would you do this? If you saw this on a maths paper/test, what would you do? Question: 3a + 4b – 7a + 2b

APPENDIX D: DATA FROM THE STUDENT QUESTIONNAIRE

D1: Summary Statistics of Findings from Student Questionnaire

Section I – Personal Details

Country of Birth

Country	Mixed /173	Single-sex /106	Total/279
A&B	127 (73%)	65 (61%)	192 (69%)
Other Caribbean	39 (23%)	17 (16%)	56 (20%)
Other World	7 (4%)	24 (23%)	31 (11%)

Whole sample:
Attended pre-school: Responding *Yes*: 251/284 (88%)
Education important: Responding *Yes*: 284/286 (99%)

Q1 Career Aspirations: Number of Students. Total Frequency ≥10 shown here

Career	Male	Female	Mixed	Single-sex	Total
Accountant	15	35	40	10	50
Doctor/Vet	8	30	21	17	38
Business manager/owner	18	15	12	21	33
Lawyer	6	20	15	11	26
Engineer	16	0	5	11	16
Don't know	6	9	8	7	15
Teacher	0	12	12	0	12
Pilot	9	2	9	2	11

Q7 After-School Activities (Open question)

Activity	Male	Female	Mixed/163	Single-sex/104	Total/267
Art	8	20	14	14	28
Church	0	6	4	2	6
Club	2	18	13	7	20
Lessons	21	44	36	29	65
Sports	44	18	30	32	62
Work	4	3	7	0	7
None	29	50	59	20	79
	χ^2=40.652, df=7, p<0.001		χ^2=18.890, df=7, p=0.009		

Key: Art includes Music lessons, dancing, etc.; Lessons refers to academic lessons e.g. Mathematics, English, etc.; Club refers to membership in a youth organization, e.g. Girl Guides, Optimist, etc.

Other Chi-square tests on After-school activities:
Within gender: No significant difference between females in two school-types (though approaching significance with χ^2=13.920, df=7, p=0.053) or males in two school-types.
Within school-type: Significant difference between males and females in both school-types. Mixed schools χ^2=22.099, df=7, p=0.002; Single-sex schools χ^2=23.451, df=6, p=0.001

Q9 Immediate plans upon finishing secondary school

Plan	Male/114	Female/168	Mixed/176	Single-sex/106	Total/282
FE	101	159	158	102	260
Work	13	9	18	4	22
Chi-square tests	NS		χ^2=3.831, df=1, p=0.050		

Key: FE = further education

Q10 Receive Allowance – Numbers responding *Yes*

	Male/117	Female/169	Mixed/177	Single-sex/109	Total/286
Yes	75	125	117	83	200

Q11 Do you have a part-time job? Numbers responding *Yes*

	Male/117	Female/169	Mixed/177	Single-sex/109	Total/286
Yes	21	13	22	12	34
Chi-square tests	χ^2=7.061, df=2, p=0.029		NS		

Section II – Home Details

Q2 Number of children at home (including the respondent)

No. children	Male/110	Female/158	Mixed/164	Single-sex/104	Total/268
1	19	37	26	30	56
2-3	68	79	87	60	147
4-5	18	28	32	14	46
>5	5	14	19	0	19
Chi-square tests	NS		χ^2=18.798, df=3, p<0.001		

Section III – Views on School

Q1 Do you like school?

	Male/117	Female/169	Mixed/177	Single-sex/109	Total/286
Always + Most times	62	101	107	56	163
Sometimes	48	65	67	46	113
Hardly ever + Never	7	3	3	7	10
Chi-square tests	NS		NS		

Q3 Main advantage of going to particular school (Open question)

Code	Male/117	Female/169	Mixed/177	Single-sex/109	Total/286
Get an education/ prepares you for life	20	39	47	12	59
Top/good school	14	16	1	28	29
Close to home	5	17	20	2	22
Students of same level/kind	2	19	16	5	21
Better/good teachers; more attention	7	11	6	12	18
Discipline	7	11	4	9	13
Focus/no boys/girls	6	6	4	8	12
No advantage	6	5	7	4	11
Better facilities / environment	3	5	3	5	8
Subject choice	0	8	7	1	8
It's free	1	3	3	1	4
Other	4	8	8	4	12

Q4 Going to school important: Responding *Yes* 279/284 (98%)

Q6 Personal views of school

	Male/114	Female/ 169	Mixed/ 175	Single-sex/108	Total/283
Learning	17	23	30	10	40
Friends	3	0	1	2	3
Learning, advantage friends	55	86	82	59	141
Learning + friends	37	60	60	37	97
Passing time	2	0	2	0	2
Chi-square tests	NS		NS		

Q7 Favourite subjects; Frequency ≥20 (Open question)

Subjects	Male/117	Female/169	Mixed/177	Single-sex/109	Total/286
Mathematics	47	32	42	37	79
English Language	17	33	26	24	50
POA	9	36	41	4	45
IT	23	19	17	25	42
Biology	10	20	21	9	30
AG	14	11	25	0	25
OP	7	17	19	5	24
Social Studies	7	16	16	7	23
POB	8	13	12	9	21

Q8 Subjects perform best in; Frequency ≥20 (Open question)

Subjects	Male/117	Female/169	Mixed/177	Single-sex 109	Total 286
English Language	33	45	42	36	78
Mathematics	47	19	31	35	66
POA	6	31	32	5	37
IT	9	18	11	16	27
Biology	9	18	18	9	27
English Lit	4	19	11	12	23
Social Studies	9	14	17	6	23
Spanish	10	12	15	7	22
AG	11	11	22	0	22
Craft	0	21	20	1	21

Q9 Least liked subjects; Frequency≥20 (Open question)

Subjects	Male/117	Female/169	Mixed/177	Single-sex/109	Total/286
Mathematics	27	80	72	35	107
English Language	16	28	37	7	44
History	18	15	13	20	33
IS	11	22	26	7	33
English Literature	14	12	16	10	26
POB	11	15	18	8	26
Biology	12	11	18	5	23
Geography	13	9	6	16	22
Chemistry	4	16	8	12	20
Spanish	11	9	6	14	20

Q10 Subjects do worst in; Frequency≥20 (Open question)

Subjects	Male/117	Female/169	Mixed/177	Single-sex/109	Total/286
Mathematics	20	89	75	34	109
English Language	15	28	35	8	43
English Literature	15	13	14	14	28
History	16	11	8	19	27
Spanish	10	16	9	17	26
Biology	14	9	17	6	23
IS	5	16	17	4	21
POB	8	13	16	5	21

Q11 Reason for liking a subject (Open question)

Code	Male	Female	Mixed	Single-sex	Total
Enjoy doing/fun/interesting	46	61	51	56	107
Career/goals	26	51	52	25	77
Teacher+	21	44	41	24	65
Easy	29	29	33	25	58
Performance	23	26	32	17	49
Because understand	10	34	31	13	44
Gain knowledge/educate	6	18	15	9	24
Important/useful	6	11	15	2	17
Challenging/think	6	7	10	3	13
Other	7	7	8	6	14

Q12(b) School performance due to (Open question)

Code	Male	Female	Mixed	Single-sex	Total
Effort	36	52	52	36	88
Attitude/behaviour in class	25	22	31	16	47
God/parents/home environment	8	21	18	11	29
Lack effort/interest	7	16	13	10	23
Goals/career	5	16	15	6	21
Ability/understand	8	11	12	7	19
Teachers+	9	10	11	8	19
Friends/distractions/school environment	8	7	8	7	15
Pay attention	5	6	6	5	11
Previous performance/ grades	2	8	9	1	10
Enjoy/like/interest	1	7	6	2	8
Not understanding	2	2	2	2	4
Other	3	6	5	4	9

Section IV – You and mathematics

Q2 Do you enjoy your school maths classes?

	Male/116	Female/169	Mixed/ 176	Single-sex/109	Total/285
Always + Most times	57 (49%)	73 (43%)	81 (46%)	49 (45%)	130 (46%)
Sometimes	51 (44%)	73 (43%)	74 (42%)	50 (46%)	124 (43%)
Hardly ever + never	8 (7%)	23 (14%)	21 (12%)	10 (9%)	31 (11%)
	NS		NS		

Q3 When enjoyed maths most

	Male/117	Female/164	Mixed/175	Single-sex/106	Total/281
Primary school	33 (28%)	73 (45%)	67 (38%)	39 (37%)	106 (38%)
Forms 1&2	39 (33%)	41 (25%)	44 (25%)	36 (34%)	80 (29%)
Forms 3&4	40 (34%)	40 (24%)	55 (31%)	25 (24%)	80 (29%)
Never	5 (4%)	10 (6%)	9 (5%)	6 (6%)	15 (5%)
Chi-square tests	χ^2=9.207, df=3, p=0.027		NS		

Key: Forms 1&2 would be lower secondary, Forms 3&4 middle to upper secondary school

Q4(b) Maths performance due to (Open question)

Code	Male	Female	Mixed	Single-sex	Total
Practice/effort	23	30	33	20	53
Don't understand	5	25	14	16	30
Teacher+	11	15	15	11	26
Teacher-	9	12	14	7	21
Lack effort	6	13	8	11	19
Dislike/disinterest	6	9	11	4	15
Understand	6	7	7	6	13
Enjoy/like/interest	6	6	6	6	12
Paying attention	5	5	6	4	10
Ability/intelligence	8	2	5	5	10
Previous performance/grades	2	8	9	1	10
God/parents	2	7	6	3	9
Goals/career	4	4	6	2	8
Not paying attention	4	3	5	2	7
Maths is hard	2	3	4	1	5
Lack ability	0	5	5	0	5
Extra lessons/teacher	3	2	5	0	5
Other	2	10	9	3	12

Q6 Mathematics is (Open question)

Code	Male	Female	Mixed	Single-sex	Total
Important/useful	26	36	37	25	62
Numbers/counting/basic operations/computations	21	34	30	25	55
Hard/hard to understand	12	30	28	14	42
Way to use brains/think	14	20	26	8	34
Way of life	10	20	17	13	30
Problem solving	9	12	11	10	21
Don't know	6	8	11	3	14
Rules/formula	3	10	8	5	13
Frustrating/annoying	4	8	9	3	12
Not interesting/not fun	1	9	7	3	10
Challenging	4	6	7	3	10
Easy/easy to understand	4	4	6	2	8
Fun/enjoy/interesting	3	4	3	4	7
For bright people	1	4	3	2	5
A science	1	4	3	2	5
Confusing	1	5	3	3	6
Other	3	3	3	3	6

Q7 What usually happens in school maths classes (Open question)

Code	Male	Female	Mixed	Single-sex	Total
Teacher explains/teaches	28	64	49	43	92
Students do work/given work	29	46	41	34	75
Other students/noise	21	24	26	19	45
Students listen/learn	15	21	23	13	36
Students talk/discuss maths	9	16	12	13	25
Don't understand	3	19	13	9	22
Teacher gives hw	8	12	5	15	20
Students sleepy/tired/bored	4	15	17	2	19
Students don't listen	7	8	8	7	15
Students take notes	6	2	2	6	8
Quietness	2	3	4	1	5
Other	12	3	10	5	15

Q8 Like most about school maths classes (Open question)

Code	Male	Female	Mixed	Single-sex	Total
Teacher	27	46	50	23	73
Nothing	10	20	16	14	30
Fun/lively	12	12	14	10	24
When understand	8	14	14	8	22
(Home)work	11	9	11	9	20
Topic	4	13	13	4	17
When interesting	8	6	4	10	14
The challenge	3	10	7	5	13
Jokes	8	4	7	5	12
Learning new things	5	5	7	3	10
Easy	5	3	5	3	8
Working with friends	3	5	5	3	8
Everything	1	5	5	1	6
Other	2	5	6	1	7

Q9 Like least about school maths classes (Open question)

Code	Male	Female	Mixed	Single-sex	Total
Other students	16	26	27	15	42
Nothing	14	19	26	7	33
Topic	7	22	20	9	29
Teacher	13	16	11	18	29
(Home)work	13	15	18	10	28
Hard	12	15	22	5	27
When don't understand	8	11	13	6	19
When boring	6	8	9	5	14
Tests	1	7	3	5	8
Quick pace of lessons	1	6	3	4	7
Too long	1	5	2	4	6
Other	4	7	7	4	11

Q14 Style to learn maths better (Open question)

Code	Male	Female	Mixed	Single-sex	Total
Exciting/fun/different teacher	19	30	31	18	49
Better explanations	22	21	25	18	43
Slower pace/patience	13	19	27	5	32
Discussions/more interaction	8	16	14	10	24
Individual attention/teacher's help	3	8	6	5	11
Using examples	5	6	5	6	11
Visual aids/variety	2	7	7	2	9
Nothing	2	6	8	0	8
Other	8	9	13	4	17

Q15 Usually do if need help with mathematics

	Male/106	Female/167	Mixed/175	Single-sex/98	Total/273
Ask a friend	27	61	57	31	88
Ask teacher	49	73	81	41	122
Try figure out myself	28	32	35	25	60
Nothing	2	1	2	1	3
Chi-square tests	NS		NS		

Q17 Who helps with maths homework (Open question)

	Male/107	Female/169	Mixed/176	Single-sex/100	Total/276
Family	16	35	34	17	51
Friends	10	21	19	12	31
(Lesson) teacher	5	13	11	7	18
Parents	17	21	15	23	38
No one	59	79	97	41	138
Chi-square tests	χ^2=19.031, df=5, p=0.002		24.142, df=5, p<0.001		

Key: Family includes a sibling, aunt, uncle, cousin etc. but NOT a parent

Q23 Reasons for response: Can every secondary school child do maths to CXC level?

Code **Positives *Yes***	Male	Female	Mixed	Single-sex	Total
If make effort	7	17	14	10	24
Have potential	6	16	15	7	22
Important/useful	9	10	15	4	19
Easy	7	6	8	5	13
Compulsory	0	7	7	0	7
Other	4	5	4	5	9
Negatives *No*					
Some just can't/different	25	63	44	44	88
Don't make effort	9	6	11	4	15
Don't like	4	11	9	6	15
Hard	4	8	8	4	12
Other	1	1	2	0	2

Other Statistics associated with the CXC/CSEC Mathematics Examination Results

Mathematics Pass/Fail: Age (in years) of student at start of field-work (01/09/2004)

Age	No. students Pass/98	No. students Fail 107
13	4	1
14	46	23
15	30	36
16	17	28
17	1	15
18	0	4
Chi-square tests	χ^2=28.611, df=5, p<0.001	

Mathematics Pass/Fail: Number of subjects passed

Number of subjects passed	No. students Pass/100	No. students Fail/108
0,1	0	5
2,3,4	10	57
5,6	32	31
7,8	46	15
>8	12	0
Chi-square tests	χ^2=65.529, df=4, p<0.001	

School-type comparison: Requirements for entry to the Antigua State College

Department	Requirements	Mixed	Single-sex	Total
For A' levels	6 subjects, English + Maths	15	61	76
	7 subjects, English	21	48	69
For other departments	5 subjects, English + Maths	17	65	82

D2: Definition of Codes for Open Questionnaire Items

Section III

Q12(b) School performance due to

Code	Meaning
Effort	This word, studying, determination, etc.
Attitude/behaviour in class	These words, not listening/inattention, some positive connotations
God/parents/home environment	These words or idea conveyed
Lack effort/interest	These words, not studying enough, etc.
Goals/career	These words, references to future (out-of-school) aspirations, idea conveyed
Teachers+	Positive references to teachers
Ability/understand	These words; references to potential, intelligence, etc.
Friends/distractions/school environment	These words, some outside distractions, e.g. tv; usually negative connotations, a few positive
Enjoy/like/interest	These words, positive attitudes
Pay attention	These words, listening
Previous performance/grades	References to grade, performance
Not understanding	These words, or idea conveyed
Other	Response does not fit any of above categories

Section IV

Q4(b) Maths performance due to

Code	Meaning
Practice/effort	These words, idea conveyed
Don't understand	These words, idea of being confused, idea conveyed
Teacher+	Positive references to a mathematics teacher
Teacher-	Negative references to a mathematics teacher
Lack effort	Idea conveyed, not practicing enough, lazy
Dislike/disinterest	These words, negative attitudes, idea conveyed
Understand	This word, idea conveyed
Enjoy/like/interest	These words, positive attitudes, idea conveyed
Paying attention	References to listening or paying attention
Ability/intelligence	These words, references to smartness
Previous performance/grades	Specific reference to grades, to being good at maths
God/parents	These words, idea conveyed
Goals/career	These words, references to future (out-of-school) aspirations, idea conveyed
Not paying attention	References to not listening, not paying attention
Maths is hard	This word; include difficult
Lack ability	These words, references to not being able; idea conveyed
Extra lessons/teacher	References to going to maths classes out-of-school, getting extra tuition
Other	Response does not fit any of above categories

Q5 Two words/phrases that best describes themselves in maths class

Code	Meaning
Trying/willing/participating	These words; idea of persistence; asking questions/interacting
Listening/paying attention	These words, being alert, etc.
Understanding	This word/ idea conveyed e.g. mathematically inclined/intelligent; idea of being alright/fine/ok in maths
Quiet/well behaved	These words; idea of being good, not talking, doing what is expected
Enjoying/liking/interested	These words; having fun
Confused/mixed up/lost	These words; idea conveyed
Talkative/not listening	These words – idea conveyed; being playful; idea of being distracted, restless
Not understanding	These words; idea conveyed; idea of not getting the maths, being slow, not being good at maths
Bored/not interested	These words; idea conveyed
Sleepy/tired/daydreaming	These words, idea conveyed
Not trying	These words; being lazy, not participating
Frustrated/stressed	These words, idea conveyed; anxious; being depressed; anger
Other	Response does not fit any of above categories

Q7 What usually happens in school maths classes

Code	Meaning
Teacher explains/teaches	These words, teacher writing on board, etc.
Students do work/given work	These words
Other students/noise	References to (other) students making noise, noisy environment, off-task talking
Students listen/learn	These words about (other) students or themselves
Students talk/discuss maths	These words, talking to convey participation in lesson by students, on-task talking, asking/answering questions (related to maths)
Don't understand	These words; students (or themselves) looking lost, confused
Teacher gives hw	Explicit reference to being given hw
Students sleepy/tired/bored	These words, idea conveyed
Students don't listen	These words, response suggests students doing other things (not to include talking) besides maths and/or whilst the teacher is teaching/talking explaining
Students take notes	These words, references to students writing, copying from board
Quietness	This word, silence
Other	Response does not fit any of above categories

Q8 Like most about school maths classes

Code	Meaning
Teacher	Teacher and/or something he/she does explicitly mentioned
Nothing	This word; liking when it is not maths; idea conveyed
Fun/lively	These words
When understand	These words
(Home)work	These words; liking of the work given, liking the rules/formulas, liking the solutions
Topic	A topic identified
When interesting	This word; idea conveyed
The challenge	These words; the idea conveyed
Jokes	References to jokes, laughter
Learning new things	Idea of learning, gaining, being smarter, etc.
Easy	This word – similar words
Working with friends	The idea conveyed
Everything	This word; idea conveyed
Other	Response does not fit any of above categories

Q9 Like least about school maths classes

Code	Meaning
Other students	References to other students, noise level, environment, size of class (too big)
Nothing	This word; likes everything
Topic	A topic identified
Teacher	Teacher and/or teaching methods explicitly mentioned
(Home)work	References to (being given) work, exercises, homework, having to write, etc.
Hard	This word; also difficult, complicated, etc.
When don't understand	These words; when confusing,
When boring	These words, when not interesting
Tests	This word, quiz, etc.
Quick pace of lessons	Idea conveyed
Everything	This word, not liking anything about maths, saying that they hate/don't like it, etc.
Too long	Classes go on for too long, classes are too long
Other	Response does not fit any of above categories

Q23 Can every secondary school child do mathematics to CXC level

Code	Meaning
	Positives (Response *Yes*)
If make effort	These words, idea conveyed
Have potential	This word, response indicating students should be/are able to
Important/useful	These words; idea of need/necessity whether in other subjects, to get a job, etc.
Easy	This word; idea conveyed
Compulsory	This word; response associated with students having no choice
Other	Response does not fit any of above categories
	Negatives (Response *No*)
Some just can't/different	These words/phrases; references to students (not) being made for maths, not mathematically inclined, that not everyone is good at it/understands it, that everyone is different; ideas conveyed
Don't make effort	These words; students not trying hard enough, not wanting to do maths
Some don't like	Students not liking maths; idea conveyed
Hard	This word (include difficult, complicated); idea conveyed
Other	Response does not fit any of above categories

Appendix E: Interview Data Analysis – Categories

Views about mathematics
Affect views
- It's all the same/ambivalence
- Positive feelings – maths as easy; beguiling, fun
- Negative feelings – maths as hard; boring
- When like maths

Gendered nature of these

Other views
Maths as needed/important (tastes bad, but is good for you (medicine))
Social role of mathematics – spaces and places

Identities/Culture
Maths-people – preferred working styles
Mathematics as endowing respect
Ability grouping messages – who is mathematics for?

Parents/parental expectations
Parents helping with mathematics
Money values
Spaces – expectations of success; room to fail
Knowing how to 'be' in mathematics

Differences by school-type noted

Maths at/in school
Teacher factors
- Teachers 'make' maths hard; easy; fun; boring, etc.
- Pace of lessons
- Language factors: symbols, need for efficiency in English Language, using understandable language
- Rationing the mathematics – whose mathematics?

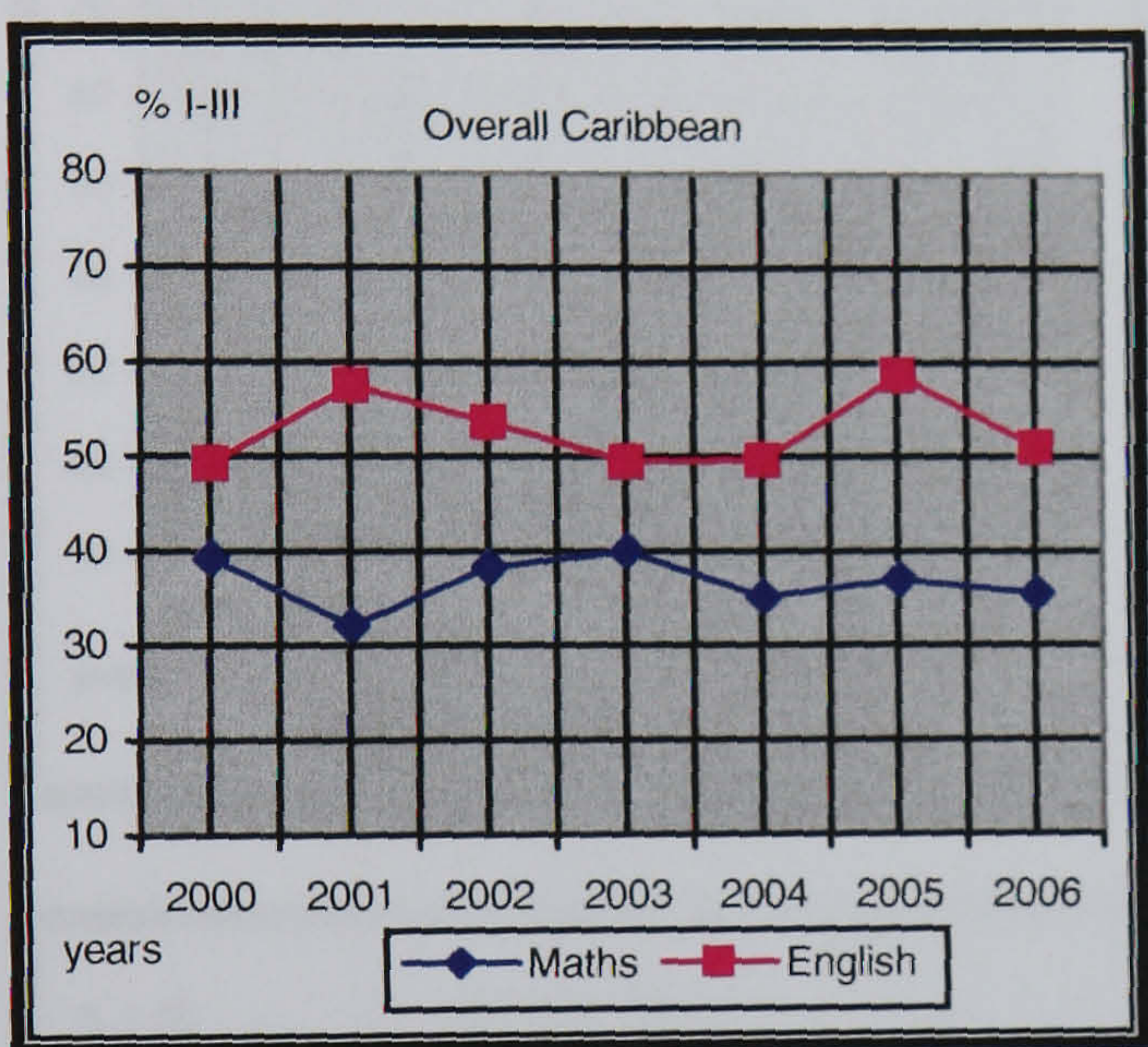
Maths approach
Listening/paying attention – what do you hear when you listen
Working with friends/individual work – doing things 'the right way'

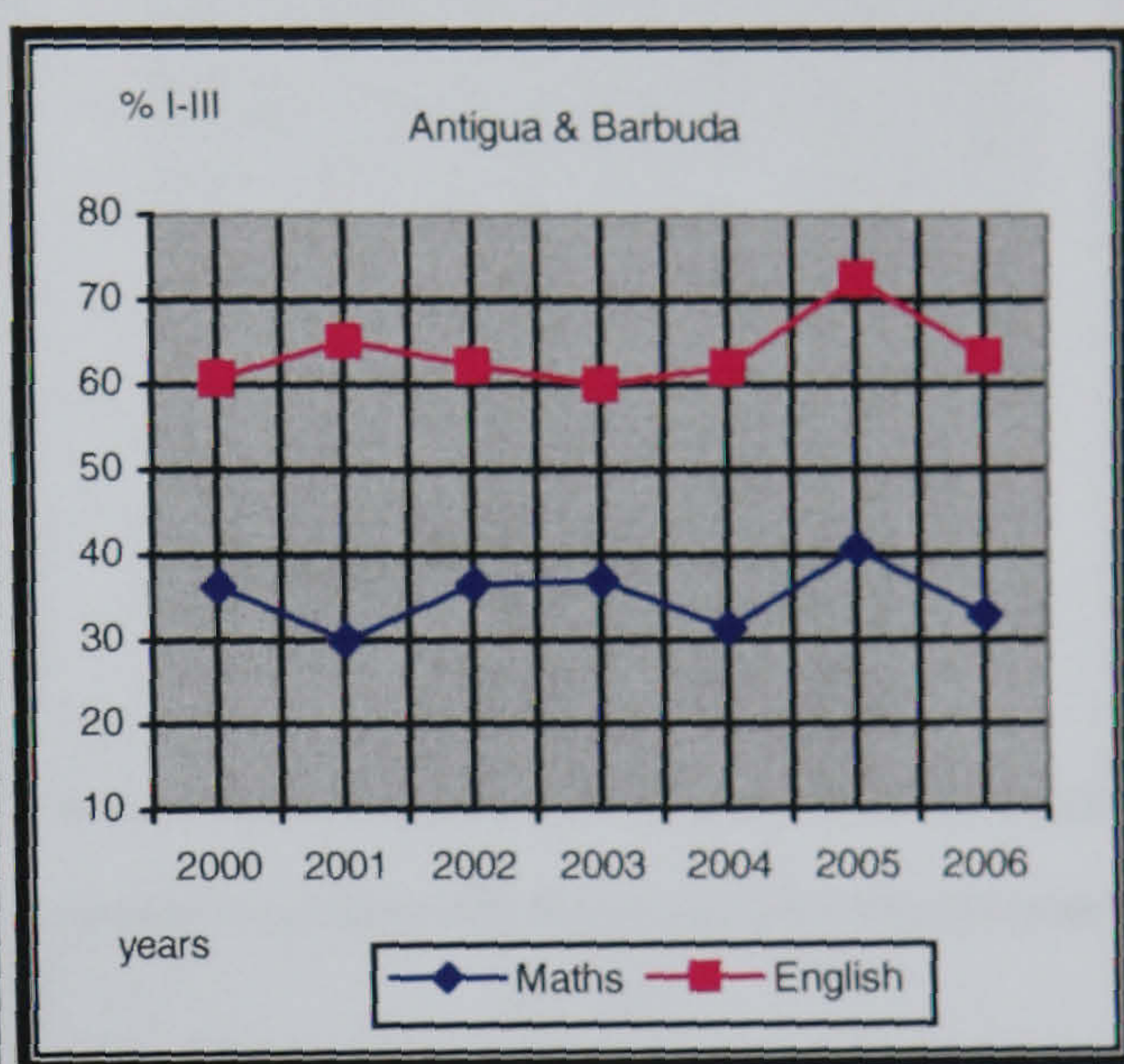
Language Issues permeate some of these

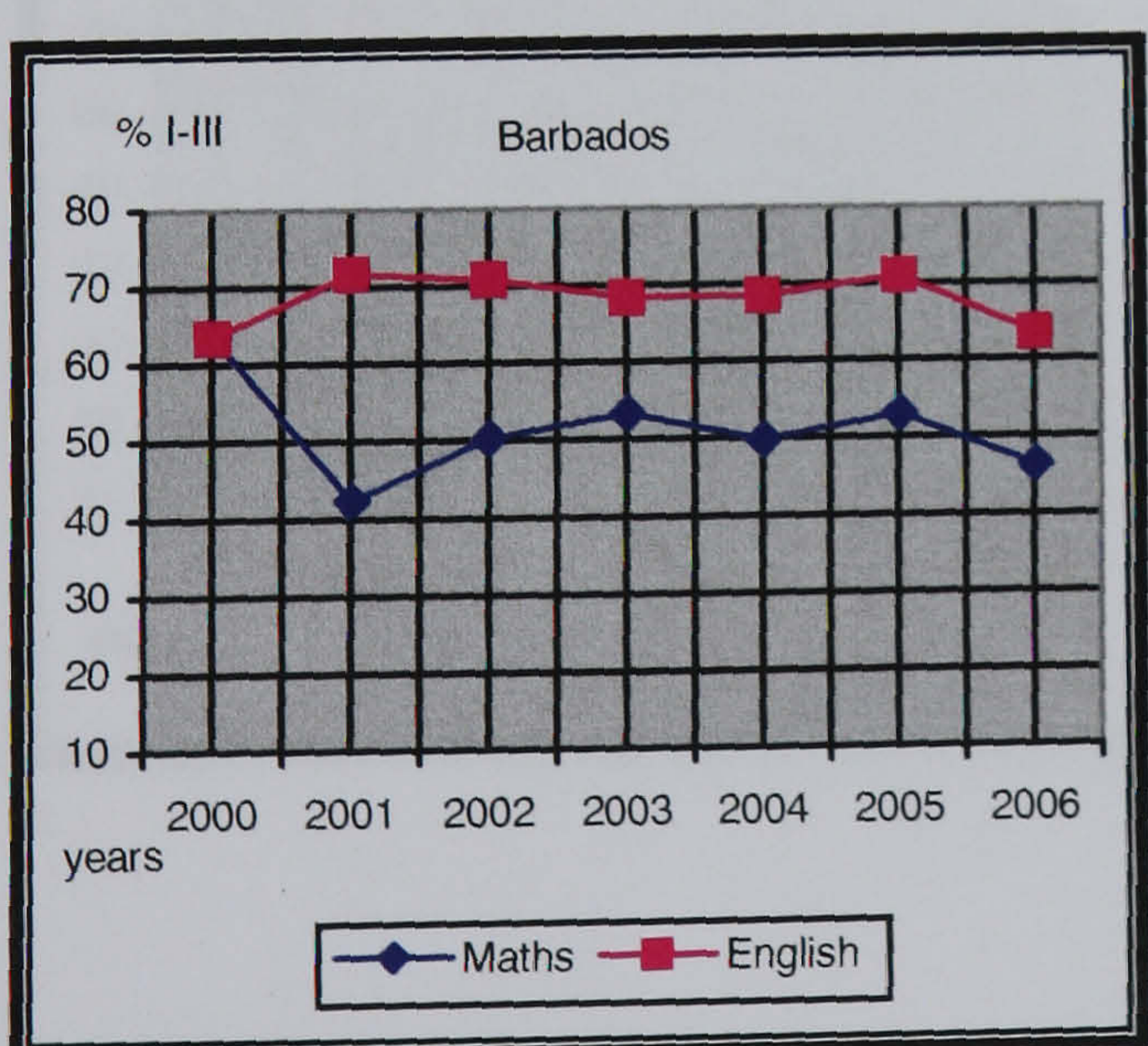
Learning by the rules/memorising
Practicing
Thinking ability
Blanking out
You don't study maths
Data from the algebra task

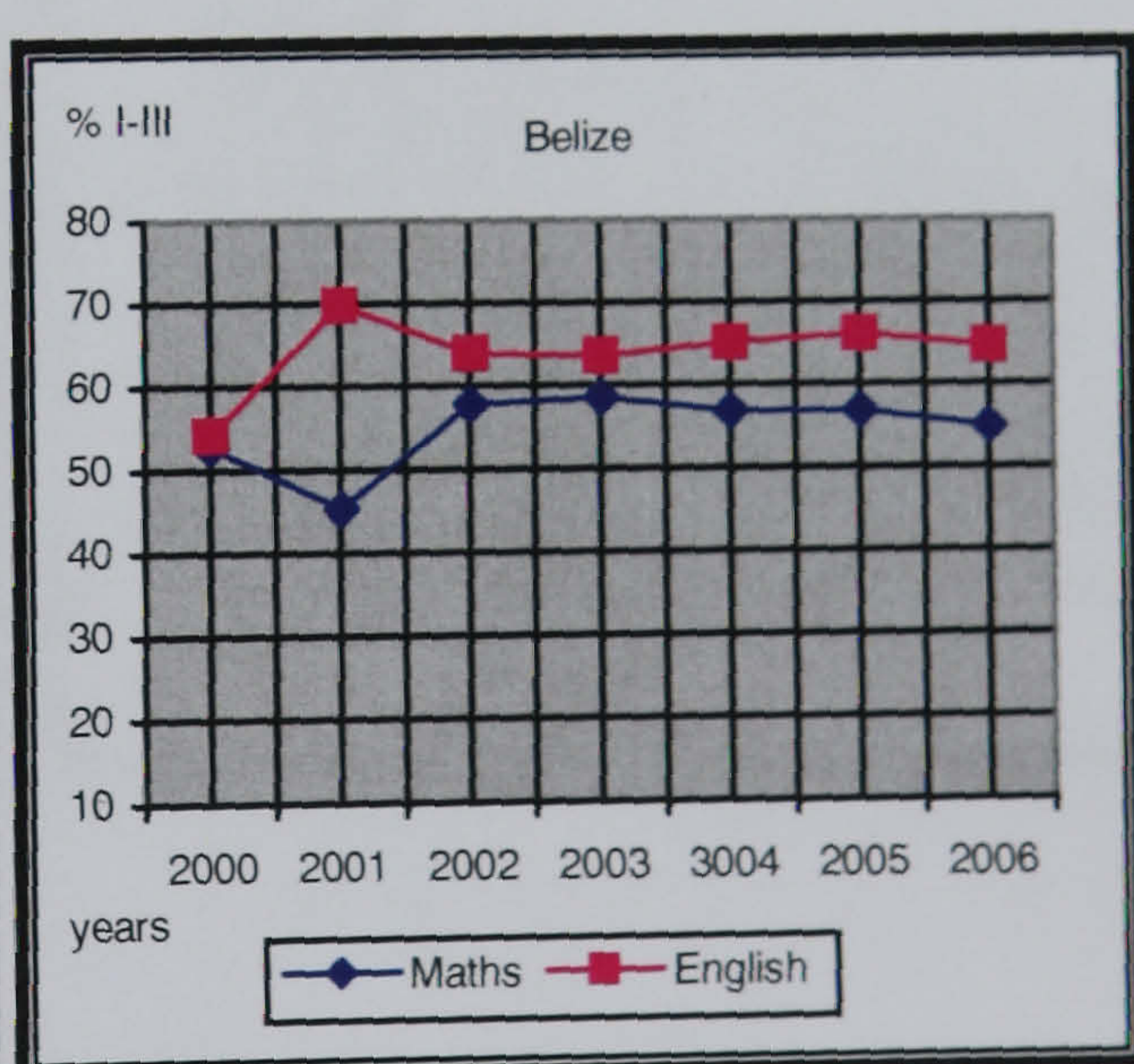
Student expectations/classroom realities (some pace of lessons here)
Discipline factors
Peer effects

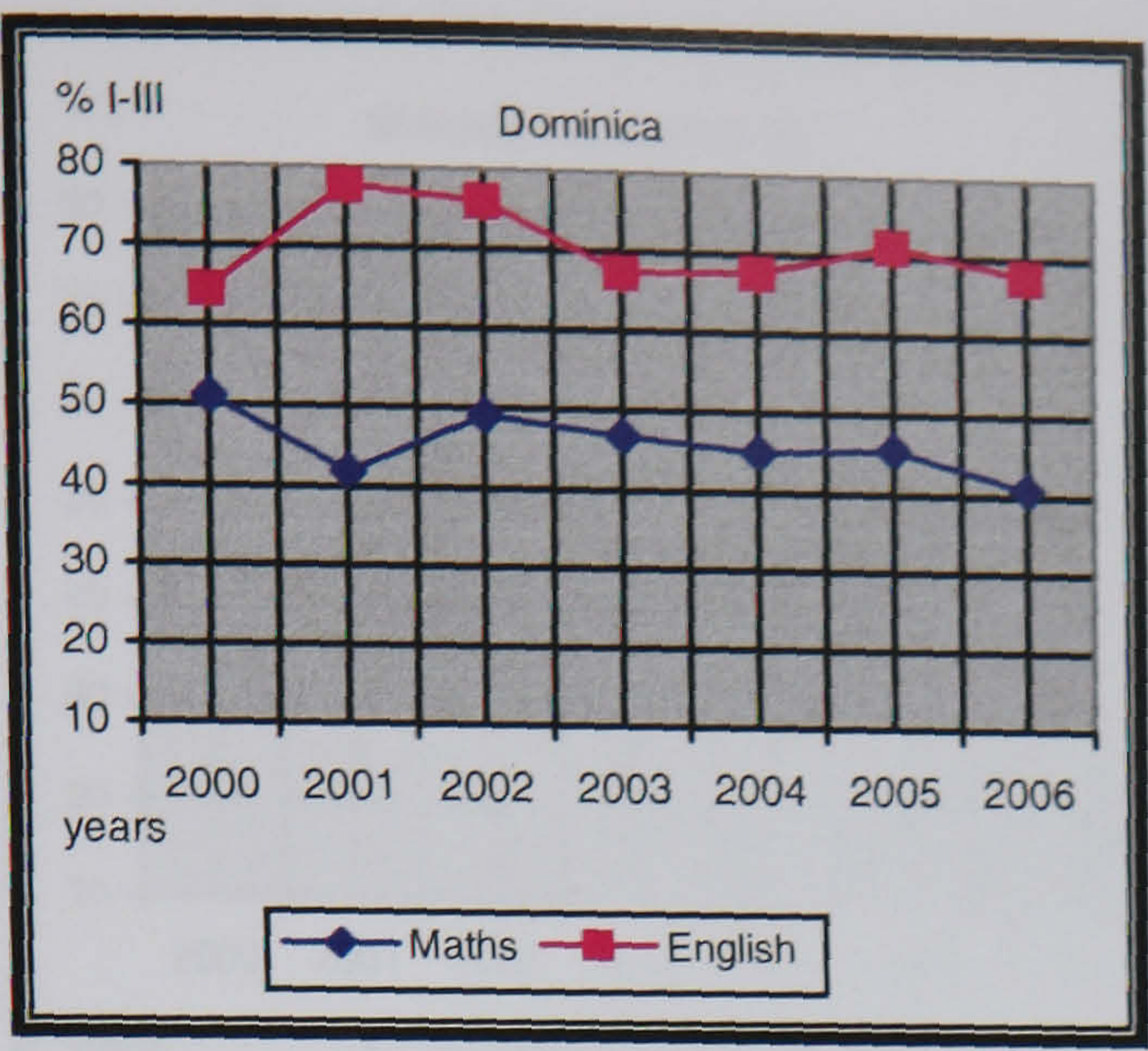
Appendix F: Comparison Pass Rates in the CXC/CSEC for Mathematics and English Language for Selected Caribbean Countries







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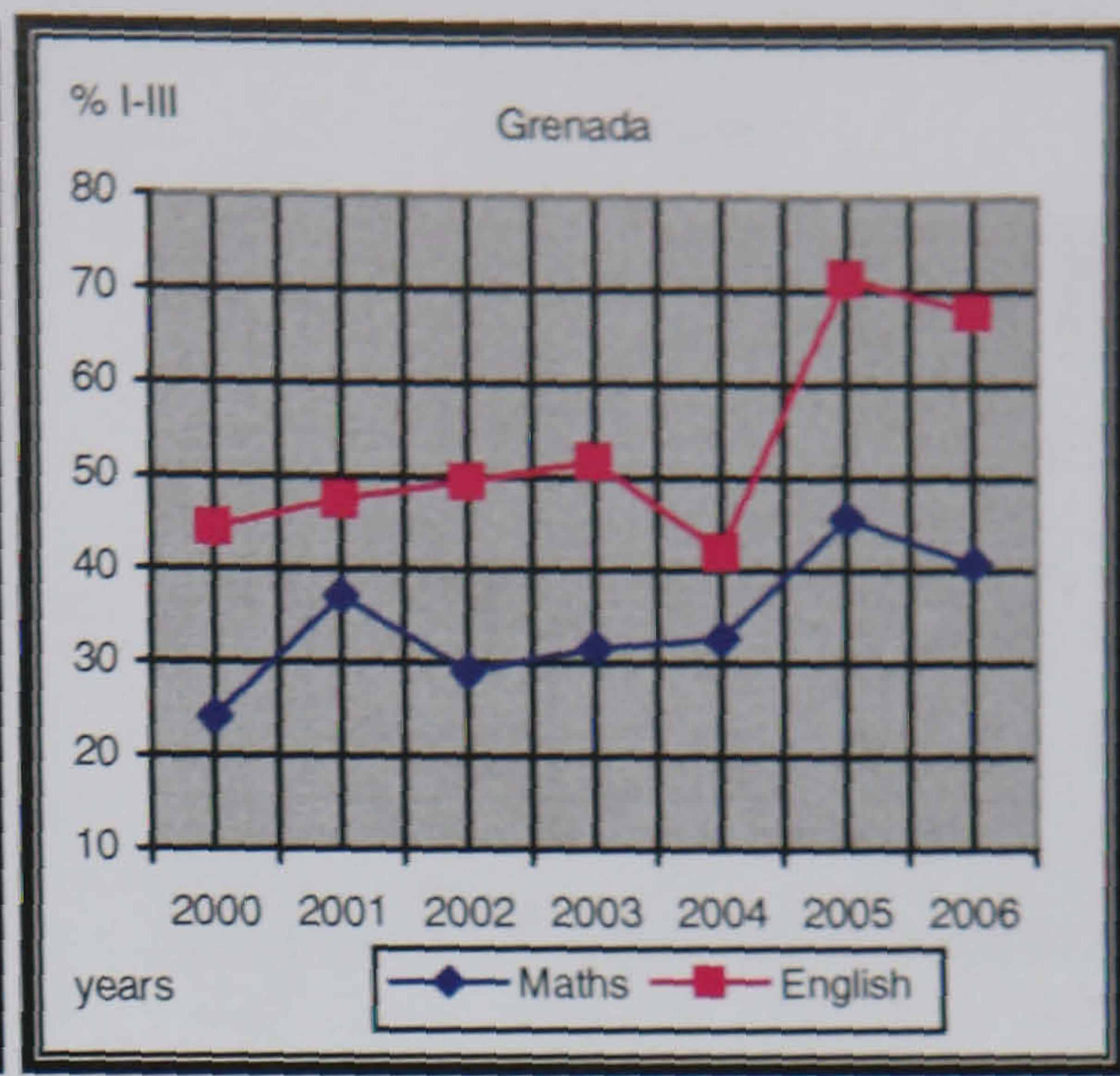
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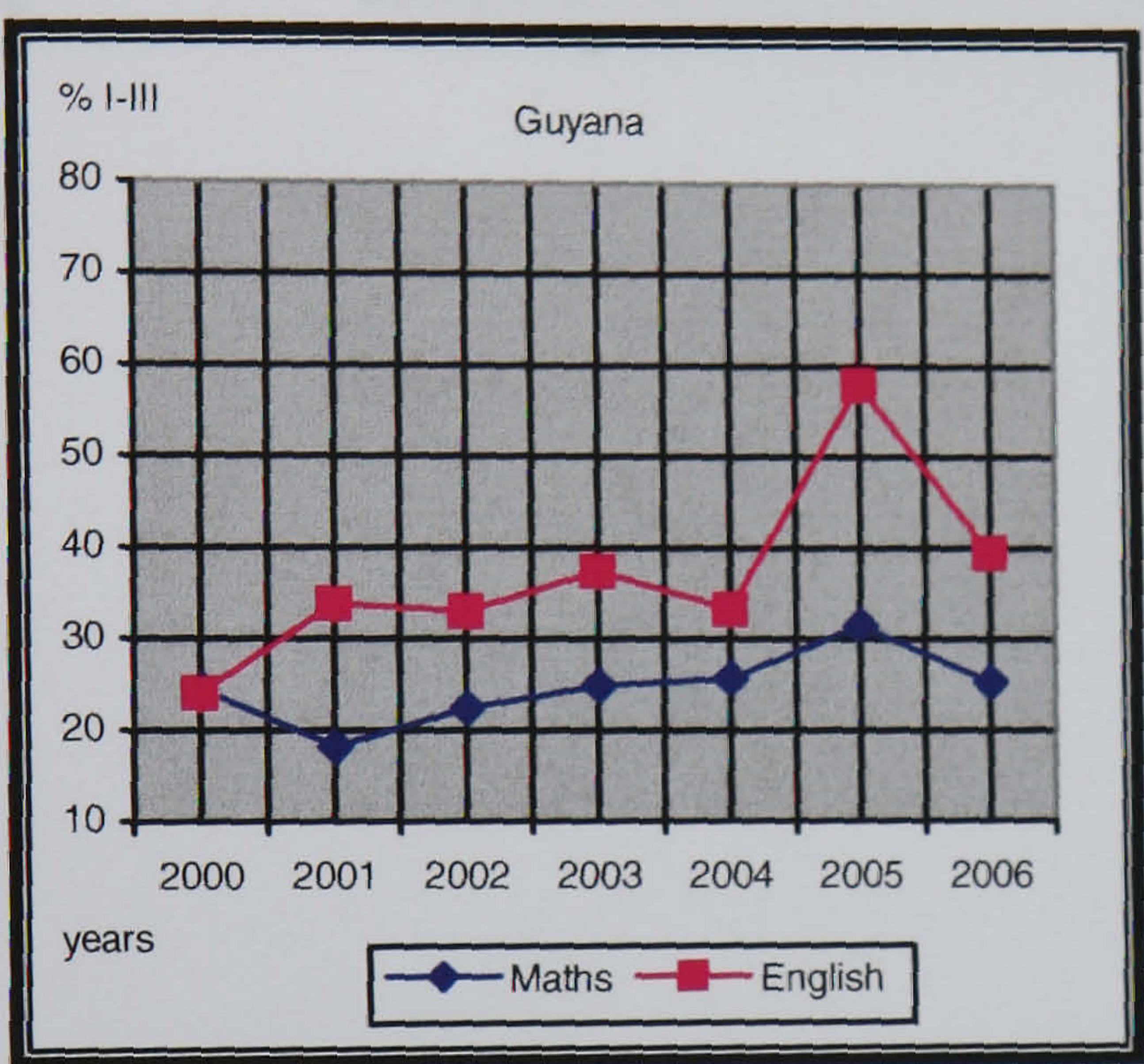
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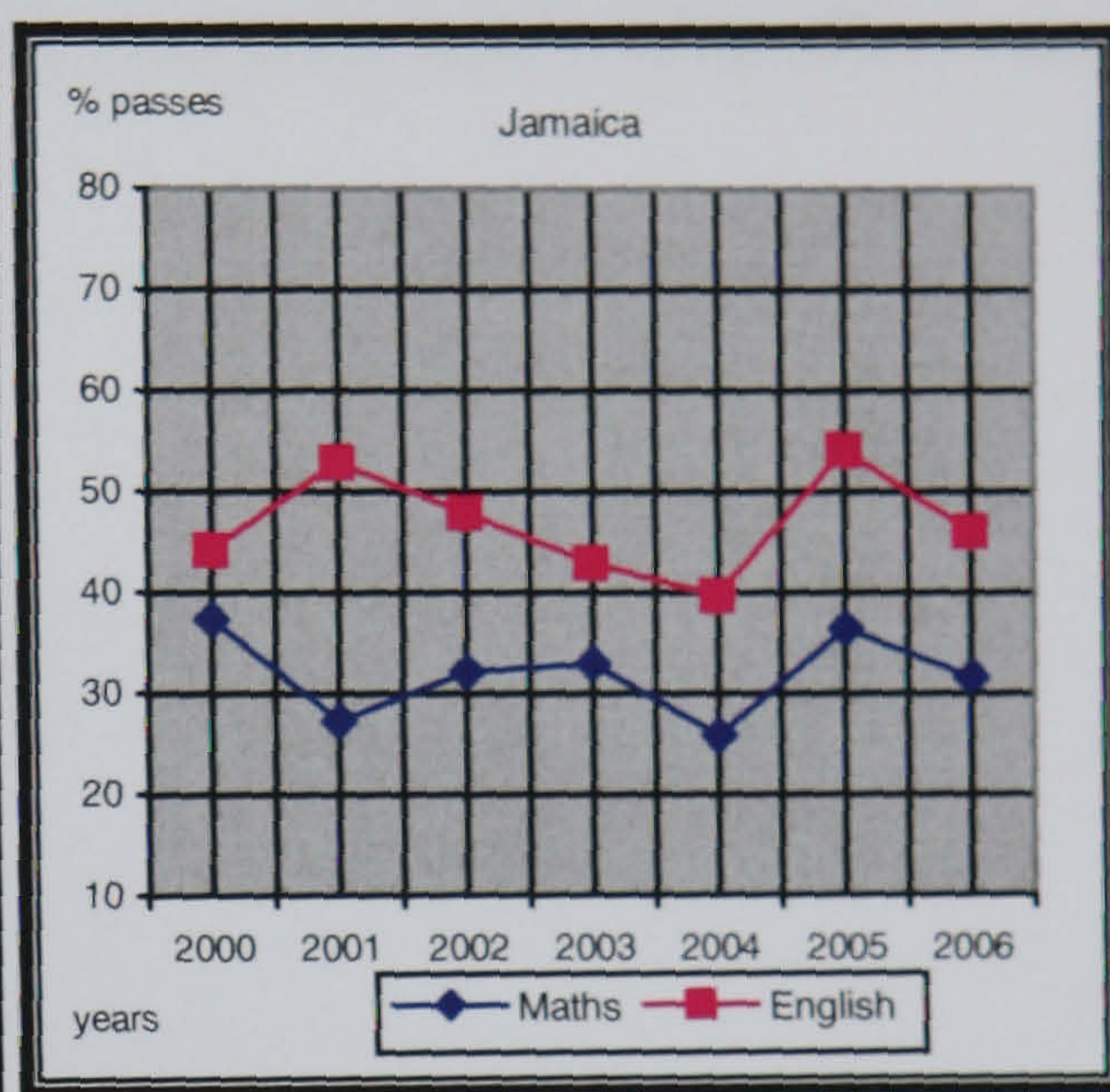
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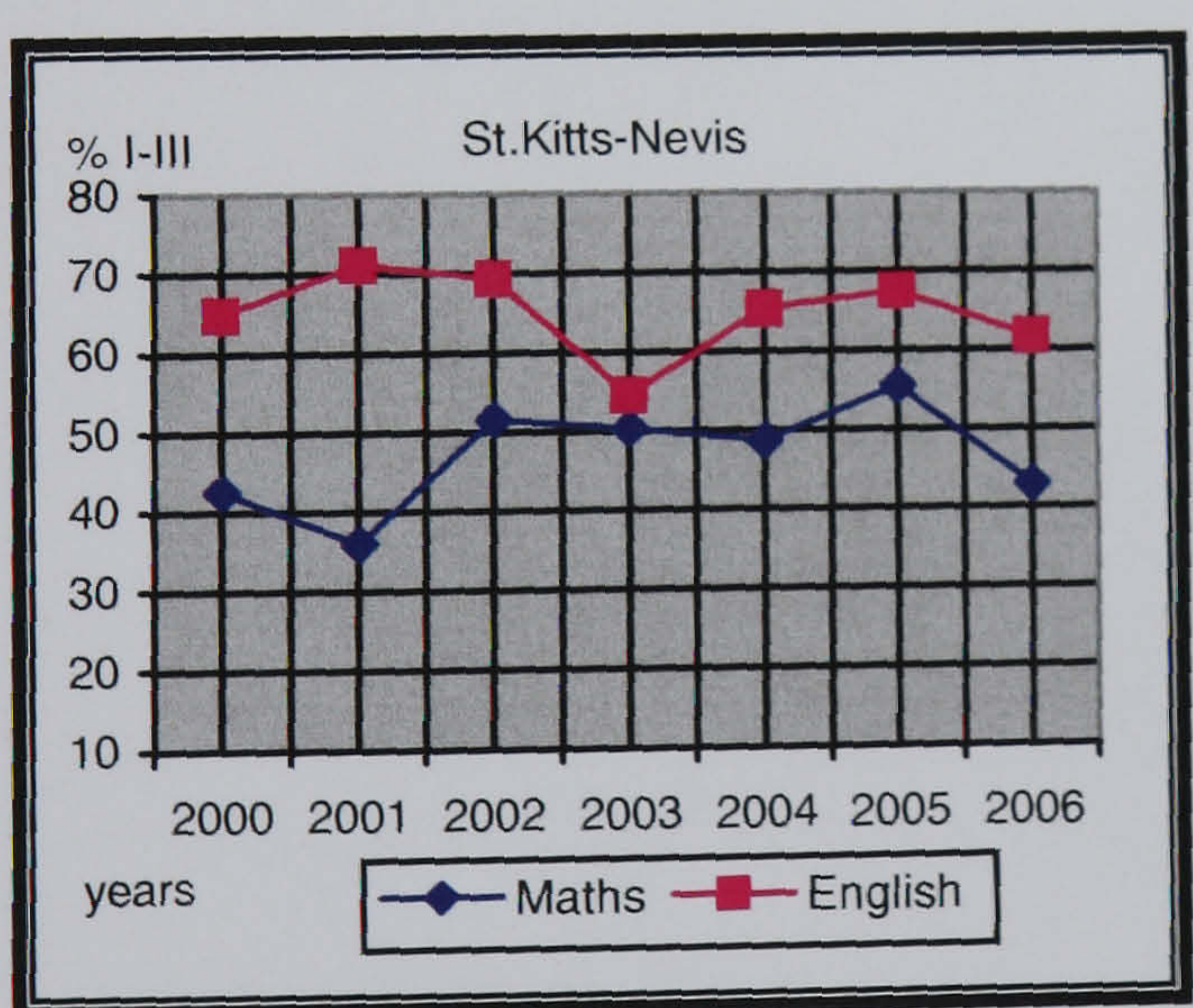
Maths English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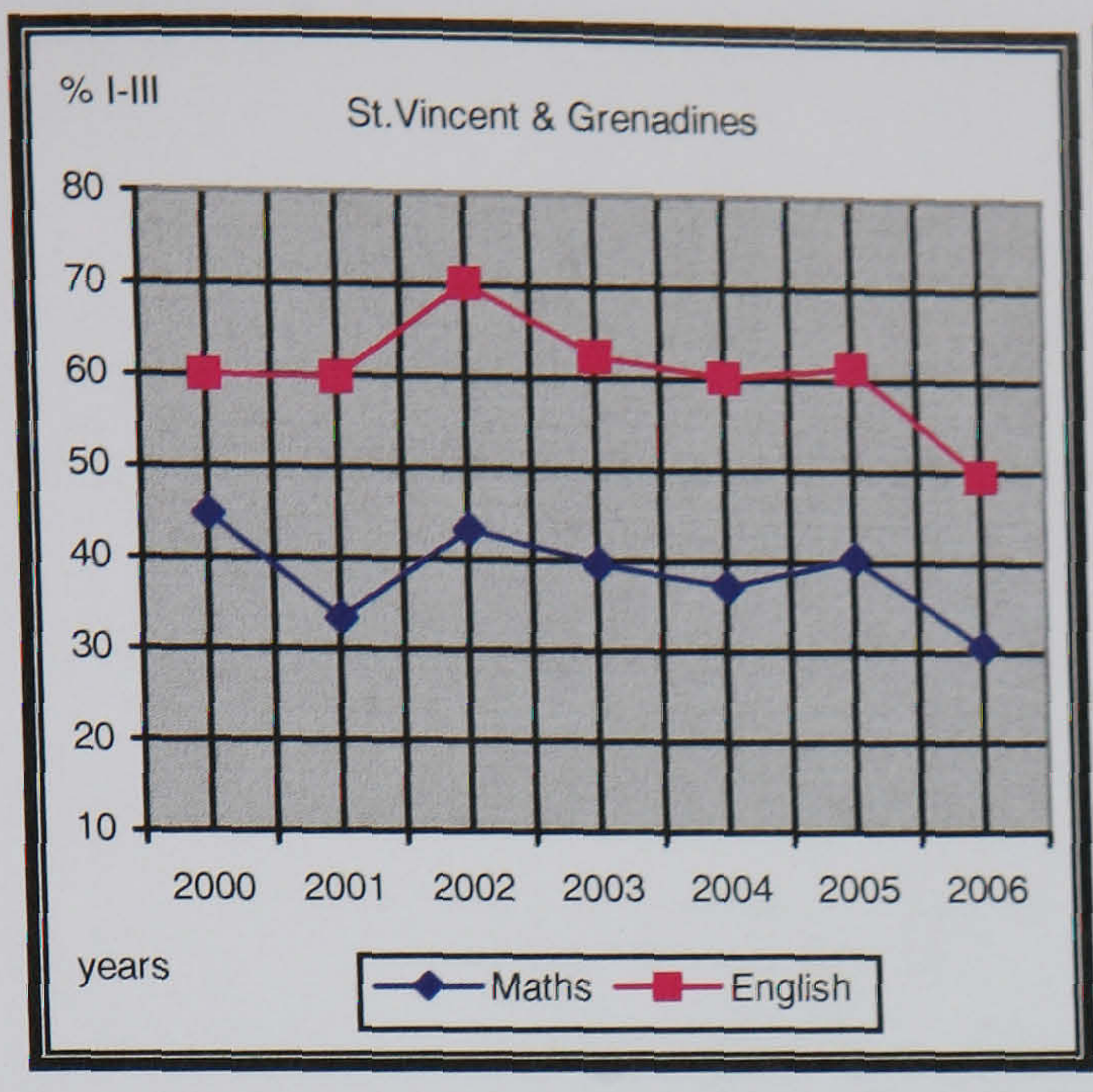
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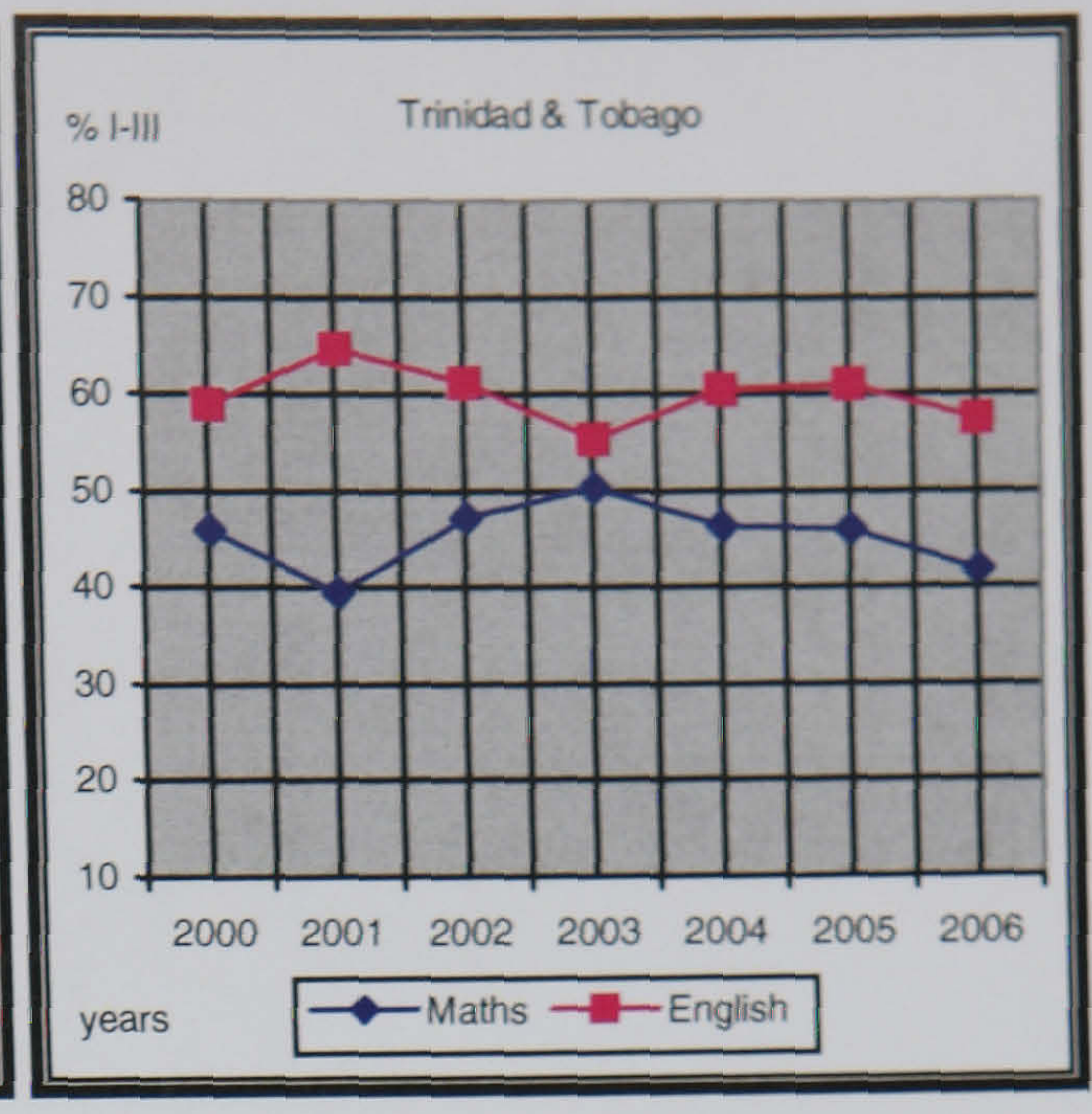
English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