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An Examination of the Pupil, Classroom and School Characteristics Influencing the Progress Outcomes of Young Maltese Pupils for Mathematics

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ABSTRACT

The current study examines the pupil, classroom and school level characteristics that influence the attainment and the progress outcomes of young Maltese pupils for mathematics. A sample of 1,628 Maltese pupils were tested at age 5 (Year 1) and at age 6 (Year 2) on the National Foundation for Educational Research Maths 5 and Maths 6 tests. Associated with the matched sample of pupils are 89 Year 2 teachers and 37 primary school head teachers. Various instruments were administered to collate data about the pupil, the classroom and the school level characteristics likely to explain differences in pupil attainment (age 6) and pupil progress. The administered instruments include: the Mathematics Enhancement Classroom Observation Record (MECORS), a parent/guardian questionnaire, a teacher questionnaire, a head teacher questionnaire and a field note sheet.

Results from multilevel analyses reveal that the prior attainment of pupils (age 5), pupil ability, learning support, curriculum coverage, teacher beliefs, teacher behaviours and head teacher age are predictors of pupil attainment (age 6) and/or pupil progress. Residual scores from multilevel analyses also reveal that primary schools in Malta are differentially effective. Of the 37 participating schools, eight are effective, 22 are average and seven are ineffective for mathematics. Also, in eight schools, within-school variations in teaching quality, amongst teachers in Year 2 classrooms, were also elicited. Illustrations of practice in six differentially effective schools compared and contrasted the strategies implemented by Maltese primary school head teachers and Year 2 teachers. A discussion of the main findings as well as recommendations for future studies and the development of local educational policy conclude the current study.

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During my lengthy Ph.D journey I also discovered that there is a particular joy to writing more freely. The following lines, which struggle in being called poetry, are a consequence of my needing to 'let go' at timely intervals throughout the progression of this research endeavour.

Ph.D Journey

Red, the colour of prospect
Adventures unforetold
Orange that of energy
Ideas to hold
Yellow one of planning
Placing imagination in space
Green, investigation
Peculiar data in place
Blue, commitment
Devotion to one's blend
Indigo of ingenuity
Constructions at every bend
Violet that of wisdom
Writhing til' the end
Now what accomplishment might transpire?
In colouring a trustworthy research end?

DECLARATION OF AUTHENTICITY

I hereby declare that, except where explicit attribution is made, the work presented in this thesis is entirely my own.

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CONTENTS

CHAPTER 2: EXAMINING PUPIL ATTAINMENT AND PUPIL PROGRESS WITHIN THE THEORETICAL CONTEXT OF EDUCATIONAL EFFECTIVENESS

CHAPTER 3: THE CHARACTERISTICS OF DIFFERENTIALLY EFFECTIVE SCHOOLS

CHAPTER 4: PUPIL AND PARENT CHARACTERISTICS INFLUENTIAL FOR PUPIL ATTAINMENT AND PUPIL PROGRESS

PART 2

CHAPTER 5: DESIGN AND METHODS

CHAPTER 6: CHARACTERISTICS OF THE PUPIL AND PARENT DATA

CHAPTER 7: CHARACTERISTICS OF THE SCHOOL AND CLASSROOM DATA

<u>PART 3</u>

PUPIL, CLASSROOM AND SCHOOL LEVEL PREDICTORS OF PUPIL ATTAINMENT (AGE 6) AND PUPIL PROGRESS FOR MATHEMATICS IN MALTA

CHAPTER 11: CONCLUSIONS AND RECOMMENDATIONS

LIST OF TABLES

LIST OF TABLES (continued)

LIST OF TABLES (continued)

LIST OF TABLES (continued)

LIST OF FIGURES

LIST OF FIGURES (continued)

LIST OF APPENDICES

RATIONALE

Studies such as The International Mathematics and Science Studies (TIMSS) by Mullis, Martin and Foy (2007) and the Progress in International Literacy Study (PIRLS) by Mullis et al. (2011) indicate considerable variations in pupil achievement across different countries in the world. Such studies are useful because they examine trends in pupil attainment and pupil progress in the basic skills. However, studies of this kind are not as focused in examining the differential effects of education for pupil achievement. Even though all pupils are capable of learning (Duncan et al., 2007), not all pupils learn at similar rates. This is because pupil achievement depends on the quality of educational opportunities and the time made available to pupils for learning when at school (Carroll, 1963).

Educational effectiveness research integrates the fields of teacher effectiveness research and school effectiveness research. The Comprehensive Model of Educational Effectiveness (Creemers, 1994) and The Dynamic Model of Educational Effectiveness (Kyriakides, Creemers & Antoniou, 2009) describe two theoretical mechanisms to examine the influence of pupil, classroom and school level factors for pupil achievement. The Model of Differentiated Teacher Effectiveness (Campbell et al., 2004) is another theoretical mechanism that examines the effects of teaching for pupil achievement.

Due to the systemic character of education, neither the classroom level nor the school level alone may be examined independently of each other (Reynolds et al., 2002). The concept that effectiveness is depends on a complex arrangement of conditions at the classroom level and the school level associated and connected with teacher and head teacher activity and practice has developed considerably since assertions made by Coleman et al. (1966) and Jencks et al. (1972) that schools in the United States of America are of no, or little, consequence for pupil achievement. In England, it was the work of Rutter and Madge (1976), Rutter et al. (1979) and of Mortimore et al. (1988) that demonstrated that schools impact differentially on pupil achievement. Other studies in the UK, such as the Effective Provision of Preschool Education Project (Sylva et al., 1999, 2004), the Effective Teachers of Numeracy (Askew et al., 1997) and the Mathematics Enhancement Project Primary (Mujis & Reynolds, 2000) continued to provide evidence as to the differential effectiveness of schools for pupil achievement.

In Malta, three school effectiveness studies were conducted prior to the current study. The first study, 'Literacy in Malta' conducted in 1999 (Mifsud et al., 2000) surveyed the attainment outcomes of the total population of Year 2 pupils for Maltese and English (Mifsud et al., 2000). The second study, 'Literacy for School Improvement', was a follow-up of the Literacy in Malta study. This second study examined the value-added outcomes of the total population of primary school pupils aged 9 and in Year 5 (Mifsud et al., 2004). The third study called 'Mathematics in Malta: the National Mathematics Survey of Year One Pupils (Mifsud et al., 2005) examined the attainment outcomes of Maltese pupils in schools at age 5 (Year 1). From this point forward this study is called 'The Numeracy Survey'. Results from value-added analyses from Literacy for School Improvement (Mifsud et al., 2004) showed pupil progress in Maltese and English to vary significantly across schools, from age 6 (Year 2) to age 9 (Year 5), even after controlling for characteristics at the pupil level such as age and gender and characteristics at the school level such as the size of the school.

The Numeracy Survey which examined the attainment outcomes of local pupils at age 5 (Year 1) for mathematics, highlighted the need to track pupils' achievement outcomes and to identify the predictors of pupil attainment and pupil progress in Malta for mathematics. Interest in tracking pupils' attainment and pupils' progress outcomes for mathematics is also informed by findings that show schools and teachers to influence pupil outcomes for mathematics more than for reading (Sammons, 2009; Teddlie & Reynolds, 2000). The decision to focus on the subject of mathematics was also informed by the first pupils in schools research template for Malta (Hutchison et al., 2005). The current study extends the pupils in schools template for the examination of pupils' literacy outcomes to a pupils in classrooms in schools template for the examination of pupils' mathematical outcomes in and over time.

The current study also germinated in the author's mind after years of service as a teacher trainer within the University of Malta. I noticed that educational stakeholders are engaged in an ongoing quest to provide the best in educational terms for young children. Many head teachers and teachers are driven by the question: how does my work support pupils in their learning? I soon noticed that education professionals such as teachers and head teachers could not be guided by local-specific research. Furthermore, they had no idea, and were not able to gain more specific knowledge, as to the real effect of their educational activity and practice for pupil learning. Moreover, local educational research still possesses limited knowledge as to the effect of instructional and organisational conditions and their association with effective and not as effective schools. This over-arching research aim led the author to question the relationship between pupil achievement and the ways in which instructional and organisational factors condition the effectiveness of classrooms and schools in Malta for mathematics. This in turn led to the formulation of three research aims to examine the associations and connections between pupil achievement and educational effectiveness. First, to identify the predictors of pupil attainment and pupil progress for mathematics in Malta. Second, to classify and characterise the differential effectiveness of local primary schools for mathematics. Third, to illustrate similarities and differences in the quality of head teacher and teacher strategies adopted and implemented during their practice in differentially effective schools. Identification of the characteristics that predict pupil achievement and the classification of factors associated with the effectiveness of schools and classrooms are better served through quantitative approaches.

Quantitative approaches are useful in measuring pupil achievement, identifying the predictors of pupil attainment and pupil progress and in classifying the effectiveness of educational conditions in schools and in classrooms. However, quantitative approaches alone are limited in qualifying the variations in effectiveness conditions characteristic of effective schools, and to a lesser extent the characteristics of not as effective schools. However quantitative approaches alone, cannot illustrate in further detail broader educational conditions such as the strategies adopted by head teachers and teachers that respectively influence and shape the organisational and instructional conditions necessary to support pupil attainment and foster pupil progress. Increasingly, mixed approaches are gaining ground as a third way (Tashakkori & Teddlie, 2007) in the employment of methods that are complementary (Gorard & Taylor, 2004) and integrated "because they invite multiplism in methods and perspectives" (Greene & Garacelli, 2003:6).

To examine the outcomes achieved by young pupils in Maltese primary schools for mathematics and the school and classroom level factors and characteristics associated and connected with differentially effective schools, the current study is organised in three parts. The first four chapters constitute the first part to the current study. These chapters, situate the current study within the broader Maltese context (Chapter 1) and within the teacher, school and educational effectiveness research bases (Chapters 2 to 4). Three chapters constitute the second part of the current study. Chapter 5 discusses the mix in design and in the adopted methodological approaches. Chapter 6 describes the characteristics of participating pupils and their parents besides discussing issues of reliability concerning pupils' age 5 and age 6 test scores. Chapter 7 describes the characteristics of participating head teachers in primary schools and of Year 2 teachers in classrooms besides ascertaining the construct validity of survey and observation instruments respectively used to measure teacher beliefs and teacher behaviours. The next four chapters constitute the third and final part to the current study. Chapter 8 identifies the pupil, the classroom and the school level predictors of pupil attainment (age 6) and pupil progress (from age 5 to age 6). Chapter 9 classifies the effectiveness of schools as measured by the value-added outcomes of pupils in classrooms in schools. This ninth chapter also describes similarities and differences in the school and classroom level characteristics that predict pupil progress. Chapter 10 qualifies the practice of primary school head teachers and Year 2 teachers through illustrations of the strategies implemented by these two groups of educational professionals in six differentially effective schools. Chapter 11 concludes the current study by recommending pathways for future research and recommendations as to the development of educational policy for educational effectiveness in Malta.

PART 1

CHAPTER 1

THE MALTESE AND THEIR EDUCATIONAL SYSTEM

Any act of research is framed by a local-specific reality. This first chapter describes the broader social and educational reality regarding primary schooling in Malta, the teaching of mathematics and the training of primary school teachers.

1.1 Malta and the Maltese

Malta and Gozo are the only two inhabited islands from the five islands that constitute the Maltese archipaelago. Malta has approximately 380,000 and Gozo 35,000 inhabitants. With just over 324 square kilometres, the islands cover an area five times smaller than Greater London. In 1964 Malta obtained self-rule from the British, became a republic in 1974, and in 2005 a member state of the European Union. In 2005, 5% of the Gross Domestic Product was spent on Education in Malta. This figure was highly comparable with the EU average expenditure of 5.1% (Eurostat, 2005). At the time, the net minimum wage amounted to 153 euros per week. Professionals in state or private employment earned an average of 250 to 500 euros per week (Eurostat, 2010). In Malta, English is a socio-positional good (Scriha, 1994). Most families (90%) are Maltese-speaking (Mifsud et al., 2000) yet English dominates at University (Mayo, 2005). A key element in the economic restructuring that Malta has embarked on since joining the EU concerns advancing the mathematical knowledge and skills of the local workforce. This is not surprising, since mathematical competence is associated with increased career opportunities (Parsons & Bynner, 1998) and better remuneration (Hutchison & Brooks, 1998). Mathematical skills are thus likely to continue to increase in importance worldwide (Halpern et al., 2007; Hoyles et al., 2010). This is especially in light of the negative consequences of leaving school with restricted skills (Murnane, 2008).

1.1.1 Schooling in the Maltese Islands

Schooling is obligatory for children between five and 16 years. State schools and kindergartens are free and located in nearly every town or village in Malta. Private Roman Catholic schools are supported through a government subvention and donations from parents. Private independent schools and kindergartens charge fees. Table 1.1 lists the number of state and private schools.

Table 1.1 *- Primary Schools in Malta and Gozo in 2005*

Primary schools	Malta	Gozo	Total schools
State schools	50	11	**61**
Private Roman Catholic schools	20	4	**24**
Private independent schools	15	0	**13**
Total	**85**	**15**	**100**

Mifsud et al. (2005) confirmed that 98% of Year 1 pupils attend kindergarten for two years before school. Entry to Year 1 is on a birth-year basis. This implies an 11-month difference between the youngest and eldest pupils. Pupils with statements of special needs attend mainstream schools. In state schools, Maltese is thought to be usually preferred over English by teachers during lessons. The opposite is usually thought to occur in private schools. In reality, lessons of mathematics in Maltese primary schools, whether state or private, are delivered using a mixture of Maltese and English (Camilleri, 1995; Said, 2006).

State schools stream pupils by ability at the start of Year 5 (age 9). At the end of Year 4 (age 8), state school pupils sit for examinations in Maltese, English, mathematics, religion and social studies. These examinations consist of non-standardised test items constructed by the Directorate for Quality. The legal maximum number of pupils in a classroom is 30. Therefore, the first 30 pupils with the highest average scores are placed in the highest ability A stream. Then the next 30 pupils with the next highest average scores are placed in the B stream and so on until all pupils have been streamed. In private schools, assessment starts earlier at the end of Year 1 (age 5) but pupils are not streamed in any way. At age 16, individuals can elect to attend the state funded Junior College, Higher Secondary School or the Malta College for the Arts, Sciences and Technology (MCAST) or the more selective fee-paying private sixth forms.

Courses offered by the vocational college MCAST are providing an alternative route for entry into degree courses at the University of Malta.

1.1.2 The Training of Education Professionals in Malta

Teachers and head teachers in Malta must be teacher-qualified and in possession of a teaching warrant in order to practise. However, individuals with a Masters in any area automatically qualify for a teaching warrant without having undergone the required teacher training. Head teachers require at least ten years in teaching experience. They must also possess the Diploma in Administration and Management from the Faculty of Education within the University of Malta to qualify for the post of head teacher.

The Faculty of Education was first established in 1982. Currently, the University offers a four-year degree course leading to a Bachelor in Education (Primary or Secondary). A two-year full-time PGCE route is also currently available for individuals with a Bachelor of Arts or Sciences who wish to train as secondary-school teachers. During the period 1946 to 1978 the training of teachers was conducted in Mater Admirabilis College (for females) and St. Michael’s College (for males). The period from 1979 to 1981 was politically turbulent. During this time, the two teacher training colleges were dismantled and teacher training moved to the Malta Polytechnic (now Junior College). During the last 35 years teacher training in Malta has undergone a steady period of change; which has resulted in a training system that is broadly similar to that in English universities.

1.1.3 Educational Developments in Malta Since 1946

In Malta, universal compulsory primary education was introduced in 1946. Secondary schooling became compulsory in 1971 and kindergarten education became freely available in 1978. What to teach pupils in Maltese schools has been the subject of many debates. In 1969, the British freed their grip on the syllabus. However, teachers found it challenging to manage pupil learning themselves without any guidelines as to what was required of them. Superficially, it appeared that educational practitioners were empowered by the removal of syllabi. However, teachers in state schools were restricted because they could not choose textbooks whilst teachers in private schools were exempt from observing this policy.

During the 1970's and 1980's, the aim of the then Labour government was to provide an equal education to all. Primary state education turned co-educational in the early 1970's and streaming abolished. This freed up physical space for the provision of kindergarten education and the setting up of Area Secondary Schools. These latter schools provided a vocational education to pupils who did not then pass the Lyceum examination and/or whose parents could not afford to send them to private schools. In 1976, streaming by ability was re-introduced following pressure from teachers. Fierce debate, concerning the merits of streaming, characterised the period from 1972 to 1976. In 1988, streaming by ability was once again abolished for Years 1 (age 5), 2 (age 6) and 3 (age 7). This situation remains in place up to today.

The period from 1990 to date witnessed a series of policy developments that concern the curriculum, the clustering of primary schools under a system of colleges and the abolition of streaming. The National Minimum Curriculum (NMC) by the Ministry of Education and Employment was approved by the Maltese parliament in 1999 and an updated version of the NMC approved in 2012. In the UK, the NMC extended the provisions made by the Education Reform 1988 Act. Similarly, the NMC for Malta listed a set of goals and objectives of what Maltese schools needed to achieve in terms of pupil learning. At the time, the NMC, did not provide subject-specific learning objectives and was not complemented by learning objectives which may now be found in the subject-specific syllabi. In view of these limitations, a few Education Officers at the time implemented changes based on their interpretation of the NMC. The resulting blanket introduction of the ABACUS series of textbooks in 2002, for mathematics, filled the void of a then syllabus-free curriculum for mathematics. A syllabus for mathematics was eventually introduced at the start of the scholastic year for 2007.

In 2008, all state primary schools in Malta and Gozo were clustered under nine colleges (eight in Malta and one in Gozo). This was established to serve as a buffer between the Directorates of Education and head teachers in schools with the intention of pooling limited financial and human resources and to keep check of the quality of educational provision across schools in colleges. The absence of a formal system that holds principals, head teachers and teachers accountable for the quality of the education provision implies that the success, or failure, of the college system cannot as yet be quantified. Even though an important driving force during the establishing of the college system was to establish procedures to keep better check of the quality of educational provision, this has not as yet transpired in the establishing of a system to systematically monitor pupils' attainment and pupils' progress outcomes as they progress through school.

The abolition of streaming at age 11 in September 2011 was driven by a recognition that pupils have the right to experience a more equitable form of educational provision. Unexpectedly, parents as well as academics who had been previously complaining about the pressures associated with streaming were lukewarm about this decision. They considered it impossible for teachers to deliver the same curriculum to all pupils. This bleak view may be justifiable in a system that lacks national standardised assessment and which does not systematically monitor the quality of educational provision so as to offer feedback for school and educational improvement.

1.1.4 Baseline Assessment

In England, baseline assessment was introduced to "ensure an equal entitlement for all children to be assessed on entry to school" (Qualifications and Curriculum Authority 1997:3). Traditionally, assessment in Malta is reliant on British models (Sultana, 1999) yet Malta still fails to follow suit with regards to baseline assessment. Therefore, schools, as yet, cannot provide a standardised measure of pupil outcome so as to judge the future performance of pupils (Sammons & Smees, 1998). In September 2011, Malta introduced a nationally standardised system to benchmark the outcomes of pupils aged 10 (Year 6) in the basic skills (mathematics, Maltese and English). This system which is compulsory for state schools but optional for private schools, replaced the practice of streaming pupils by ability at age 11. There are already indications that the benchmarking system is perceived in a league-table style fashion by parents and education authorities alike. In the absence of value-added data, the local version of the league-table mentality is likely to skew the perception of Maltese educational stakeholders.

1.1.5 ABACUS

The ABACUS textbook series for mathematics promotes a direct and interactive approach (Merrtens & Kirkby, 1999). When first introduced in 2002, book 1 was set for Year 1 (age 5), book 2 for Year 2 (age 6) and so on until Year 6. At that time, ABACUS 'R' was set for Years 1 (age 3) and 2 (age 4) of kindergarten. However, by the end of 2002 many teachers complained that pupils could not cope with the topics that were being covered. At the start of 2003 the Education Division set ABACUS 'R' for Year 1 (age 5), ABACUS book 1 for Year 2 and so on. An ABACUS lesson should take around an hour. During the mental warm-up, the emphasis is on revising previously taught strategies, counting and number facts. During the main session, the emphasis is on the explicit introduction of the topic. During the plenary, the emphasis is on reinforcing key mathematical skills, addressing common difficulties or misconceptions and concluding with feedback. The introduction of ABACUS was based on the assumption that teachers would be knowledgeable in direct and interactive methods of teaching. This led many teachers to remember events surrounding the introduction of the syllabus for New Maths in 1990. At the time, Darmanin had criticized the brusque manner in which New Maths was introduced (1990:278):

> In the Maltese context, central planning means that teachers are removed from all but the lower rungs of the implementation staircase…and as with New Maths, receive little or no indication of how to change their teaching to meet the demands of the new curriculum. Their lack of preparation for New Maths accounts for some of the resistance to it, that questions, the rationality of the planning and ultimate success of the implementation.

1.1.6 At Risk Pupils

Anders et al. (2010:1) describe pupils with special educational needs as those who have: "significantly greater difficulty learning than the majority of children of the same age" and have "a disability that prevents or hinders them from making use of educational facilities of a kind generally provided for children of the same age." Leroy and Symes (2001) also include pupils who may fail perhaps because of social circumstances. What is common to pupils with special educational needs and also to pupils who might be experiencing difficulty with learning due to social disadvantage is that both groups of children are at risk of experiencing some form of learning delay.

In Malta, the segregation of pupils with mental and/or with physical disability had been a cause for concern since the 1970's but nothing done to remedy this until some twenty years later (Bartolo, 2001). Nowadays, all pupils are fully included within mainstream education. Pupils with statements, qualify for one-to-one classroom-based support from a learning support assistant. The learning support assistant is similar in status to a teacher assistant in England. In Malta, the learning support assistant is not teacher trained. Learning support assistants must follow a two-year diploma course following recruitment if they wish to remain in full-time employment. Pupils who do not have statements of special educational needs but who find learning challenging are provided with learning support from an experienced teacher called a complementary teacher. In state schools, support from complementary teachers amounts to two lessons per week. Private schools are not obliged to offer this support but many do. Generally local educational professionals consider pupils with statements and pupils who find learning challenging as at risk of experiencing learning delay at school.

1.1.7 Homework

Unlike England (Hallam, 2004) and the United States of America (Gill & Schlossman, 2004), homework in Malta is rarely a topic for debate. Maltese parents tend to view homework favourably. Many parents consider the amount of homework assigned to their child as an indication of their child's academic development and prowess. In Malta, most pupils are assigned homework for mathematics on a daily basis. Maltese pupils are on average assigned more homework than their worldwide peers (TIMSS, 2007) Pupils with milder forms of special educational needs and pupils with learning needs with support from a complementary teacher are usually set the same homework as their typically-developing peers. It is only pupils with more serious forms of mental disability who are assigned homework that has been adapted to their cognitive needs.

1.1.8 The Attainment Outcomes of Maltese Pupils Aged 14 for Mathematics

Malta's participation in TIMSS 2007 (Mullins, Martin & Foy, 2007) placed the attainment outcomes of Maltese 14 year-old pupils 16th for mathematics from some 59 countries world-wide. After nine years of schooling, Maltese pupils achieve an average of 488 points (s.e = 1.2). This is significantly less than the average 500 points. TIMSS (2007:69) reports that 5% of Maltese pupils show advanced levels of mathematical attainment and "can organize and draw conclusions from information, make generalisations and solve non-routine problems". Next to a quarter (26%) of Maltese pupils attain a high level and "can apply their understanding and knowledge in a variety of relatively complex situations". Sixty percent (60%) attain an intermediate level and "can apply basic mathematical knowledge in straightforward situations." Most (83%) pupils attain a low level and "have some knowledge of whole numbers and decimals, operations and basic graphs." A noteworthy percentage (17%) of pupils does not even attain the low level.

TIMSS (2007) reports that in England, 8% of English pupils attain an advanced level, 35% attain a high level, 69% attain an intermediate level and 90% attain a low level. Only 10% of English pupils, 7% fewer than for pupils in Malta, did not at least attain the lowest level in England. When the attainment of Maltese pupils is compared to that of Chinese Taipei pupils, who top the international attainment table, a bleaker picture emerges. Close to half of Chinese pupils (45%) attain an advanced level, 71% attain a high level, 86% attain an intermediate level and 95% attain a low level. TIMSS (2007) also reports that the amount of instructional time devoted to mathematics in Malta averages at 127 hours per year. This is close to the TIMSS (2007) average of 120 hours per year. In Malta, no differences between the intended and the taught curriculum were registered since all of the TIMSS (2007) topics were covered by age 14. No differences in attainment were elicited between males and females.

1.1.9 What are The Predictors of Pupil Achievement in Malta?

The Literacy Survey (Mifsud et al., 2000) and Literacy for School Improvement (Mifsud et al., 2004) were the first two local studies, conducted in the school effectiveness tradition, to examine the outcomes of 4,554 Maltese pupils in all primary schools (n = 102) at age 6 (Year 2) and at age 9 (Year 5). The Numeracy Survey (Mifsud et al., 2005) was also the first local pupils in schools study to examine the attainment outcomes achieved by 4,662 pupils aged 5 (Year 1) for mathematics. These three studies were important for the current study because they identified a set of predictors for pupil attainment and/or pupil progress for Maltese, English and mathematics. Characteristics identified by these studies as predictors of pupil achievement included: age, prior attainment, sex, first language, years spent in preschool, whether pupils have some form of special educational or learning need, parental occupation and education, the marital status of parents, size and type of schools and the school district.

1.1.9.1 Which Schools are Effective?

The Literacy Survey (Mifsud et al., 2000) and Literacy for School Improvement (Mifsud et al., 2004) respectively examined the attainment of 4,554 pupils in all primary schools (n = 102) at age 6 (Year 2) and at age 9 (Year 5). This study also examined the progress outcomes of the same matched sample of pupils from age 6 (Year 2) till age 9 (Year 5) for Maltese and English. These studies were analytically limited to a quantitative approach. These studies in fact stopped short from examining the school level, and more importantly the classroom level, effectiveness factors at play across and within schools and their association to pupils' value-added outcomes. This implies that even though the results of these two studies could be used to identify the characteristics of effective schools for Maltese and English these studies refrained from doing so.

1.1.10 School Givens

The Maltese education system is organized similarly to that in England. A number of differences do exist. In state schools, the day starts at 8:30 a.m and finishes at 2:15 p.m in winter (from October until May). In private schools, the day usually starts at 8:00 a.m and finishes at 1:30 p.m for all girls' schools and between 2:15 and 3:15 p.m for all boys' schools. In summer, the day starts at 7:45 a.m and finishes at 12:30 p.m for private schools (summertime starts in May). In state schools, the day starts at 8:00 a.m and finishes at 12:30 p.m in summer (summertime starts in June). In state schools, holidays are from mid-July until late September. Private schools finish two weeks earlier than state schools. Private schools also start a new scholastic year some two weeks later than state schools. Teachers in the state and in the private sector teach the majority of lessons during the five days of the school week. As yet, local head teachers and teachers are not held accountable for pupil gain in learning. Head teachers are not obliged to monitor the quality of teaching activity and head teachers in state schools have little, if any, power concerning the terms of employment or re-deployment of teaching and/or support staff. Teachers are expected to plan and prepare for lessons and correct pupils' work. However, they are not expected to do so at school.

1.2 Summary

This first chapter described the context of primary schooling in Malta, the training of educational practitioners and the teaching of mathematics to young pupils. What transpires is that the Maltese value education. However, the blanket introduction of ABACUS in 2002 left many teachers feeling disempowered. Maltese education authorities strive to improve educational provision. However, this currently occurs within a pupil monitoring and school accountability vacuum. Therefore, teachers as well as head teachers have little reliable information as to the effect of their educational activity and practice.

Three school effectiveness studies for Maltese, English and mathematics have identified a limited set of characteristics that predict pupil attainment and/or pupil progress in Malta. However, Malta as yet has had no study that proceeds beyond the empirical examination of pupil attainment and pupil progress to explore the school and the classroom factors associated with differences in pupil achievement in and over time. The lack of data regarding pupil attainment, pupil progress and the effectiveness of schools and classrooms for mathematics raises the following question: which characteristics, particularly those associated with classrooms and schools, are likely to predict pupil attainment and pupil progress for mathematics in Malta? To further contextualise this question, Chapter 2 discusses the examination of pupil achievement as framed by the theoretical context of educational effectiveness.

CHAPTER 2

EXAMINING PUPIL ATTAINMENT AND PUPIL PROGRESS WITHIN THE THEORETICAL CONTEXT OF EDUCATIONAL EFFECTIVENESS

Identifying the predictors of pupil attainment and pupil progress, examining the effects of educational factors for pupil achievement and describing the practice of head teachers and teachers in Malta for mathematics situate the current study within the field of educational effectiveness. The theory of educational effectiveness is connected with that of teacher and school effectiveness, in conceptualising, how pupil achievement is influenced by a complex, dynamic and differentiated interplay of factors at the pupil, the classroom and the school level. No field of study is without its critics. Therefore, this chapter also overviews the arguments forwarded by critics of educational effectiveness research and the counter-arguments forwarded by proponents of this field

2.1 Why Examine the Achievement Outcomes of Younger Pupils?

The Effective Provision of Preschool Education examined the attainment and the progress outcomes for the cognitive, social and affective domains for some 3,000 pupils in 141 education centres from age 3 till age 7 (Sylva et al., 1999). Generally, the findings of this study show that: (1) it is better for young children to attend some type of preschool than not to attend preschool at all, (2) there are significant differences in the quality of preschool settings, (3) quality of preschool provision is linked with the improved cognitive and social development of young children, (4) the duration of preschool attendance after age 2 is linked with higher levels of cognitive development, increased independence and sociability, (5) children progress more in preschools that include structured interaction between educational staff and children, and that, (6) disadvantaged children benefit especially from quality preschool education.

In Malta, a study that tracks the attainment and the progress outcomes of young children is rare. Earlier in section 1.1.9, it was briefly discussed how three studies that were conducted in the school effectiveness tradition, The Literacy Survey (Mifsud et al., 2000), Literacy for School Improvement (Mifsud et al., 2004) and The Numeracy Survey (Mifsud et al., 2005) identified a number of school and pupil level characteristics that were elicited as predictors of pupil attainment (Maltese, English and mathematics) and pupil progress for Maltese and English. The availability of pupils' age 5 test scores for mathematics from The Numeracy Survey provided a golden opportunity to conduct a study to identify the pupil, classroom and school level predictors of pupil attainment and pupil progress and thus classify the differential effectiveness of schools. In so doing, the current study also sought to establish a template for the examination of the quality of the school and classroom contexts and processes as practiced by teachers in classrooms and head teachers in schools.

2.2 An Overview of Teacher Effectiveness Research

Teacher effectiveness research is rooted in the psychological, the behavioural and the pedagogical aspects of teaching and "…is essentially concerned with how best to bring about the desired pupil learning by some educational activity" (Kyriacou, 1997:9). Up to the 1960's, teacher effectiveness research was dominated by presage-product studies. These studies sought to identify the link between teacher attributes such as sex, age and teacher training with pupil outcome (Darling-Hammond et al., 2012; Kyriacou, 1997; Seidel & Shavelson, 2007). Borich (1996) attributes the difficulty in eliciting a direct association between teacher attributes and pupil outcome to the broadness of the definition of teacher experience. On the other hand, Chilodue (1996) elicited a significant relationship between teacher attributes and pupil outcome. Interestingly, he interpreted this relationship as to the different interpretation of teacher experience across cultures. Presage-product studies were dubbed as "black-box" research because they largely ignored teaching activity that was taking place in classrooms (McNamara, 1980).

During the process-product phase, the concept that successful teachers teach pupils in diverse ways than less successful teachers became central to the examination of teacher effects. Teaching-style studies developed dichotomies such as "non-directive versus directive" (Tuckman, 1968) or "progressive versus traditional" (Bennett, 1976). In the ORACLE study (Galton, Simon & Croll, 1980), the association between teaching style and pupil outcome was minimal. Croll (1996) re-analysed this data and found a weak but positive correlation of 0.29 between whole-class, small-group interaction and pupil progress. Studies that linked teaching styles with pupil outcome soon went out of fashion due to conceptual limitations. In fact, it is erroneous for a teaching style to vary over time and then associate this with pupil progress (Goldstein, 1979). Campbell et al. (2004) argue that investigating single teacher behaviours, rather than a cluster of behaviours as in teaching styles, is more useful because it is easier for teachers to address issues related to one behaviour at a time. An important development that occurred during the process-product phase refers to the examination of the effect of teaching conditions such as classroom climate, whole-class direct and interactive methods and diverse teaching strategies (Good et al., 1990; Rosenshine, 1979). During this phase, pupils were tested at the beginning and at the end of a study. This methodological development allowed the comparison of pupil outcomes over time. Researchers also observed teachers by administering structured instruments and/or questionnaires which facilitated the collation of richer forms of data.

From the late 1990's onwards, teacher effectiveness research has been characterized by constructivist approaches to teaching (Campbell et al., 2004). Recognition that teaching is a constructivist activity and is better served by direct methods and interactive approaches implies acknowledging the importance of factors broader to instruction such as: teaching conditions, the curriculum, teaching methods, classroom organization and time. Constructivism is as much a "philosophical position as an educational strategy" (Mujis & Reynolds, 2011:77). Constructivism implies that knowledge is constructed rather than perceived. In schools, this implies that pupils construct knowledge for themselves rather than merely receiving knowledge from the teacher. This implies that individual pupils learn things differently. Since learning is constructed and not received this implies that the way in which teachers guide and lead pupils, by the approaches, methods and strategies that they adopt and implement during lessons, is of paramount importance in supporting and fostering pupil learning.

Teacher effectiveness research has also advanced by acknowledging the influence of direct instructional methods such as clear and structured presentations, pacing, modelling, use of conceptual mapping, interactive questioning, preparation and organization of seatwork, feedback about seatwork and possibly the differentiation of seatwork (Mujis & Reynolds, 2011). However direct instruction alone "is not necessarily the best strategy to use in all circumstances" (Mujis & Reynolds, 2011:50). This implies that learning (and teaching) are active, dynamic and more complex processes that search for meaning and that meaning is constructed within the social reality of the classroom which lies nested within the broader social reality of the school (Mujis & Reynolds, 2011). Therefore learning is contextualized by the practice of teaching. In turn, teaching should aim to contextualize learning in ways that enhance the development of pupils. A constructivist approach to teaching also implies that teaching is interactive. Mujis and Reynolds (2011) discuss how interactivity implies that teachers know when and how to use different types of questioning such as open, closed, process and/or product question to elicit a response for pupils after engaging pupils at an appropriate cognitive level. An interactive approach when teaching also implies that teachers know how to offer feedback when a pupils answers correctly to a question, when a pupil answers correctly but exhibits hesitation, when a pupil answers incorrectly or when a pupil answers part of a question correctly. The use of prompting, the amount of wait-time allocated by teachers to pupils to answer questions and the use of probing even when pupils supply the correct answers are also strategies employed by teachers who adopt interactive teaching approaches.

Consequently, increased knowledge about the educational benefits of teachers adopting direct methods coupled with interactive approaches has led to a recognition that the evaluation of teacher quality should: be approached from different input, process and output angles. Inputs are what teachers bring to the position of teaching. The background of teachers, qualifications, their experiences and their beliefs are amongst the contextual characteristics associated with teachers and teaching. Outputs refer to the outcomes associated with the array and complexity of teacher and teaching processes. Teacher outcomes, when considered as the result of classroom processes, are usually defined in terms of pupils' standardised gain on standardised tests of achievement. Teachers' contributions to the school as a community of teaching (and learning), the taking on of leadership roles and good relations with parents are also amongst the other outcomes that are related to teaching (Goe, Bell & Little, 2008). Teacher processes generally refer to the classroom interaction that occurs between teacher and pupils. In this way, Goe, Bell and Little (2008) argue for a broader conceptualization of teacher effectiveness by referring to the responsibilities of teachers within schools. Fenstermacher and Richardson (2005:190-191), describe why teachers should not be held solely responsible for pupil outcomes:

> …it makes sense to think of successful teaching arising solely from the actions of a teacher…Yet we all know that learners are not passive recipients of information directed at them. Learning does not arise solely on the basis of teacher activity.

Dynamic, complex and constructivist understandings of teaching, schooling and education raise the following question: are teachers effective across school-taught subjects as well as teaching and learning domains? Besides implying a differential concept of educational and school effectiveness, this question also implies a differentiated concept of teacher effectiveness (Campbell et al., 2004). An approach that is consistent with a broader conceptualisation of teacher effectiveness whereby pupil outcomes are viewed as influenced by various factors that extend “beyond the classroom” (2004: 58) and beyond the behavioural to include teaching dimensions such as subject knowledge, pedagogical knowledge, teacher beliefs and teachers’ sense of self-efficacy. Campbell et al. (2004:50) describe this phase as “more congruent with developments in psychology and a phase that is sympathetic about the constructivist nature of teacher beliefs, teacher behaviours and teacher knowledge.” Therefore, evaluation of the quality of teacher activity and/or practice should also examine teacher beliefs besides teacher behaviours, the quality of lessons as organized by teachers as well as teacher pedagogy.

Despite the diverse approaches to teacher effectiveness research, there is consensus as to the characteristics of an effective teacher. Porter and Brophy (1988) described effective teachers as teachers who: are clear about instructional goals, are knowledgeable about the curriculum and strategies to teach the curriculum content, communicate to pupils what is expected of them and give reasons for this, use instructional materials to clarify the curriculum content, adapt instruction to pupils’ individual needs, give pupils opportunities to master their learning, teach towards both lower and higher order cognitive objectives, monitor pupil understanding through feedback, integrate instruction across subject areas, and who are responsible for pupil outcome and who reflect about their practice. Mortimore et al. (1988) described effective teachers as teachers who: order the activities for the day, spend more time communicating with pupils about content rather than routines, limit disruption by keeping lower levels of noise and movement, focus lessons, spend more time asking questions especially higher-order questions, allow pupils responsibility for their work, maintain high levels of pupil involvement, have a positive classroom climate and who praise and encourage pupils. More recently, Campbell et al. (2003:58) described the main factors and characteristics associated with effective teachers (Table 2.1).

***Table 2.1** – Factors and Characteristics Associated with Effective Teaching*

	Examined factors and characteristics
Presage-product	**Psychological factors:** personality characteristics, attitude, experience and aptitude/achievement
Process-product	**Teacher behavior factors:**
	Quantity of academic activity
	Quantity/pacing of instruction**:** effective teachers prioritise and cover objectives to facilitate learning with minimal frustration. ***Classroom management*****:** effective teachers organize/manage the classroom environment efficiently for learning. Engagement rates are maximised. ***Actual teaching process*****:** students spend most of their time taught/supervised rather than working alone. Teacher talk is academic.
	Quality of organized lessons
	Giving information**:** structuring/clarity of presentation. ***Asking questions*****:** cognitive level of questions, type of questions, clarity of questions and wait-time following questions. ***Providing feedback*****:** the way teachers monitor pupil responses and how they react to correct, partly correct, or, incorrect questions.
	Classroom climate
	Businesslike and supportive environment
“Beyond the classroom”	**Pedagogical factors:** subject knowledge, knowledge, teacher beliefs and self-efficacy

2.3 An Overview of School Effectiveness Research

The first school effectiveness studies were of the input-output type. These studies were driven by a rejection of the assertions made by Coleman et al. (1966) and by Jencks et al. (1972) that pupil achievement is more strongly associated with social determinants rather than the more malleable school factors. The study by Coleman employed regression analysis that could not discriminate between the individual level of the pupil and the group level of the school. Besides mixing levels of data, Coleman also included school factors that were not very strongly related to achievement. Factors such as pupil expenditure, school facilities and number of library books. In spite of these limitations and the conclusion that schools do not influence pupil achievement, Coleman found that 5% to 9% of the variance between schools was accounted for by school factors. Ironically, this constituted a first benchmark as to the effects of schooling for pupil achievement (Daly, 1995). Other studies such as those by Hauser (1971) and Hauser et al. (1976) concluded that the variance in pupil achievement between schools was in the 15% to 30% range. However, after controlling for the contribution of socio-economic factors, only 1% to 2% of the variance was accounted for by schools.

Input-output studies, also known as education-production in function studies (Brown & Saks, 1986; Coates, 2003), such as those conducted by Mayeske et al. (1972), had serious methodological limitations due to issues of multicollinearity. These statistical issues not only plagued these early school effectiveness studies but also studies by Coleman (1966) and Hauser et al. (1976). In spite of these limitations, Mayeske et al. (1972) found that 37% of the variance was between schools and that this was accounted for by pupil and school variables. This “original input-output paradigm” (Teddlie & Reynolds, 2000:4) also proved limited because it did not include measures, that were better related to pupil outcome, such as school climate and school processes (Averch et al., 1971).

The inclusion of variables that measured school processes and the inclusion of additional pupil outcome variables led to the second stage of school effectiveness research characterized by input-process/product-output studies. Variables such as teacher characteristics (Hanushek, 1986), human resource characteristics (Summers & Wolfe, 1977), teacher behaviours (Murnane, 1975) and school climate (Brookover et al., 1979) were now included. Initially, such studies focused in dispelling the mistaken belief that schools made little difference for pupil achievement. Such studies therefore focused in researching conditions in primary schools associated with children from disadvantaged socio-economic backgrounds. Weber (1971) elaborated four case studies of four inner-city schools. This highlighted the importance of school processes such as leadership, high expectations, a good school climate and evaluation of pupil learning.

The inclusion of pupil level data that was now associated with specific teachers was an important development of later input-process/product-output studies. Teddlie and Reynolds (2000:7) explain how this “emphasized input from the classroom (teacher) level, as well as the school level; and it associated student-level output variable with student-level input variables, rather than school-level input variables." Research by Summers and Wolfe (1977) utilized datasets in which teacher input variables were associated with pupils taught by teachers. School level inputs, including the characteristics of the specific teachers were also included. Together the school and the teacher inputs explained 25% of the variance in gain scores achieved by pupils. Findings from such studies also indicated that variables related to school expenditure, such as teacher experience and teacher salary, did not demonstrate a consistent effect for pupil achievement (Hanushek, 1986). However, qualities associated with pupil, teacher and head teacher resources such as pupils' sense of control of their environment, head teachers' evaluations of teachers, quality of teacher education and teachers' high expectations for pupils were significantly associated with pupil achievement (Murnane, 1975; Summers & Wolfe, 1977).

Two important advances of input-process/product-output studies concerned the inclusion of psychosocial and school climate measures (Brookover et al., 1979) and the realization as to the importance of tests used to assess pupil achievement. In the Brookover et al. (1979) study, additional measures included pupils' sense of academic futility and self-concept, teacher expectations and academic/school climate. Brookover et al. (1979) examined the relationship between school climate variables, school level variables that referred to pupils' socio-economic status, racial composition of the school and the mean outcomes achieved by pupils at school. At this stage, Brookover et al. (1979) still had to grapple with serious issues of multicollinearity. For example, when socio-economic status and percent white were included first in the regression model, school climate only accounted for 4.1% of the school level variance in pupil achievement. When school climate was entered first the same two variables now accounted for 10.2% of the school level variance. When school climate, pupils' sense of academic futility and pupils' sense of control were entered first this explained approximately half of the school level variance. Research conducted during this stage also highlighted the importance regarding the choice of test to assess pupil achievement (Madaus et al., 1979). On tests that were curriculum specific, the variance between classrooms stood at around 40% (average of various tests). Madaus et al. (1979) indicated that classroom factors explained a larger proportion of the variance unique to classrooms on curriculum specific tests (17%) than standardised tests (5%). Issues of multicollinearity (Teddlie & Reynolds, 2000) and the lack of standardised measures of pupil achievement (Brimer et al., 1978) led researchers to focus in examining differences in schools serving disadvantaged areas.

The focus on equity and schooling led to the development of the input-process/product-output with school improvement model. At this third stage, proponents such as Edmonds (1979) were not merely content in describing the effects of effective schools. They also wanted to create effective schools, particularly for children from poorer urban areas. Research about effective schools (Edmonds, 1979; Lezotte & Bancroft, 1985; Weber, 1971), led to the development of the five factor model that identified leadership, vision, school climate, high expectations and the ongoing assessment of pupils as correlates of effective schools. These studies focused in examining the achievement outcomes of pupils from low socio-economic backgrounds. This led to much criticism about the sampling methods employed in these studies (Good & Brophy, 1986; Ralph & Fennessy, 1983). Wimpelberg, Teddlie and Stringfield (1989) argued that this highlighted the importance of the school context as an issue for further examination.

The inclusion of variables associated with context factors led towards the normalization of the science of school effectiveness research (Teddlie & Reynolds, 2000) and its importance highlighted by Scheerens (2004:1):

> The major task of school effectiveness research is to reveal the impact of relevant input characteristics on output and to “break open” the black box in order to show which process or throughput factors “work”, next to the impact of contextual conditions. Within the school it is helpful to distinguish a school and a classroom level and, accordingly, school organizational and instructional processes.

Studies now could explore effects across different schools with different contexts instead of sampling schools with similar contexts (Teddlie et al., 1985, 1990). The input-context/process-output model was established by advances in statistical techniques that were able to measure more accurately the multilevel effects of schooling in respect of the hierarchical structure of the data. More sophisticated forms of multivariate analyses also facilitated the examination of factors associated with the differential effectiveness of schools. More recent developments in structural equation modelling have strengthened statistical approaches to ascertain the structural, as opposed to the face validity, of constructs that undergird educational processes. The input-context/process-output model is still an important tool for school and educational effectiveness researchers. Increased recognition regarding the utility of mixing, combining and integrating research perspectives and approaches has meant that the input-context/process-product model has been developed and consolidated through studies that utilise both quantitative and qualitative approaches. Studies such as the Effective Provision of Preschool Education Project (Sylva et al., 1999, 2004) and the International School Effectiveness Research Project (Reynolds et al., 2002).

2.4 An Overview of Educational Effectiveness Research

Campbell et al. (2004) describe educational effectiveness as dual in sense. When used broadly the term refers to the different levels of an educational hierarchy (pupil, classroom and school). When used specifically, the term refers to interactions between the pupil, the classroom and the school levels of educational hierarchies. School effectiveness research is primarily concerned about the size of school effects. Therefore, the examination of teacher effects is a secondary research activity in school effectiveness research. The evolution of teacher effectiveness and school effectiveness research into that of educational effectiveness lies in the realisation that schools are made up of classrooms. Both schools and classrooms are respectively associated with head teachers and teachers. Therefore, schools through head teachers influence classrooms and associated teachers. Educational effectiveness research also indicates that whilst schools contribute towards differences in pupil achievement, a substantial proportion of differences in pupil achievement are explained by teachers and teaching (Creemers & Kyriakides, 2008; Sammons et al., 1997).

Creemers, Kyriakides and Sammons (2010) describe four important phases in the evolution of educational effectiveness research that refer to the examination of school effects, the characteristics of effective schools, the theoretical and empirical modelling of educational effectiveness and the establishing of connections between educational effectiveness research and the related field of school improvement. Table 2.2 adapts the discussion in Creemers, Kyriakides and Sammons (2010) Table 2.2 to highlight the links between educational, teacher and school effectiveness research

Table 2.2 *– The Four Phases of Educational Effectiveness Research*

Educational Effectiveness Research (Creemers, Kyriakides & Sammons, 2010)	**Teacher Effectiveness Research** (Campbell et al., 2004; Kyriacou, 1997)	**School Effectiveness Research** (Teddlie & Reynolds, 2000)
Phase 1 - size of school effects.	Presage-product phase: Examining the effect of teacher attributes for pupil outcome.	Input-output stage: Examining the effect of school attributes for pupil outcome.
Phase 2 - characteristics of effective schools	Process-product phase: Examining styles of teaching.	Input-process/product- output stage: inclusion of school processes
		Input-process/product-output stage: identification of the correlates of effective schools so as to improve schools for disadvantaged pupils.
Phase 3 – integrated/ comprehensive models of the effects of classroom /school level factors according to systemic criteria such as consistency, constancy, cohesion and control.	Process-product phase: focus on teaching approaches such as direct instruction and interactive methods.	Input-context/process-output stage: school effectiveness is also dependent on the context of schooling which can vary across schools. This introduces the concept that effectiveness is relative.
Phase 4 – modelling of dynamic/changeable effects of classroom and school factors in relation to dimensions such as frequency, focus, stage, quality and differentiation.	Beyond the classroom phase: focus on the differentiated and changeable nature of teaching across subjects and domains with implications for school and educational policy.	Input-context/process-output stage: the effectiveness of schools and of classrooms is differential and may not be stable over time due to changes in conditions at the pupil, the classroom, the school and the policy level.

2.4.1 Quality, Time and Opportunity

The earliest model that has been influential for teacher, school and educational effectiveness research is that by Carroll (1963). Carroll established that learning is proportional to the time spent by pupils, the time required by a pupil to learn and the opportunity for pupils to learn as made available by the teacher in the classroom. As an input-process-product model of teaching, this model considers how pupil input, quality of teacher interaction, time available for learning and quality of instruction influence learning. Extensions of this model have been conducted by including context variables that refer to the background of pupils and by integrating Carroll's model within a hierarchical model for the examination of the effects of primary schooling (Stringfield & Slavin, 1992).

2.4.2 An Integrated Model of School Effectiveness

Another model that was important for the evolution of educational effectiveness, which integrated aspects of Carroll's model (for example quality of school curricula, time on task and opportunity to learn) is the model by Scheerens (1992). Scheerens integrated the examination of school inputs in relation to pupil output by considering the contribution of school and classroom contexts and processes for learning (pupil output). (Figure 2.1).

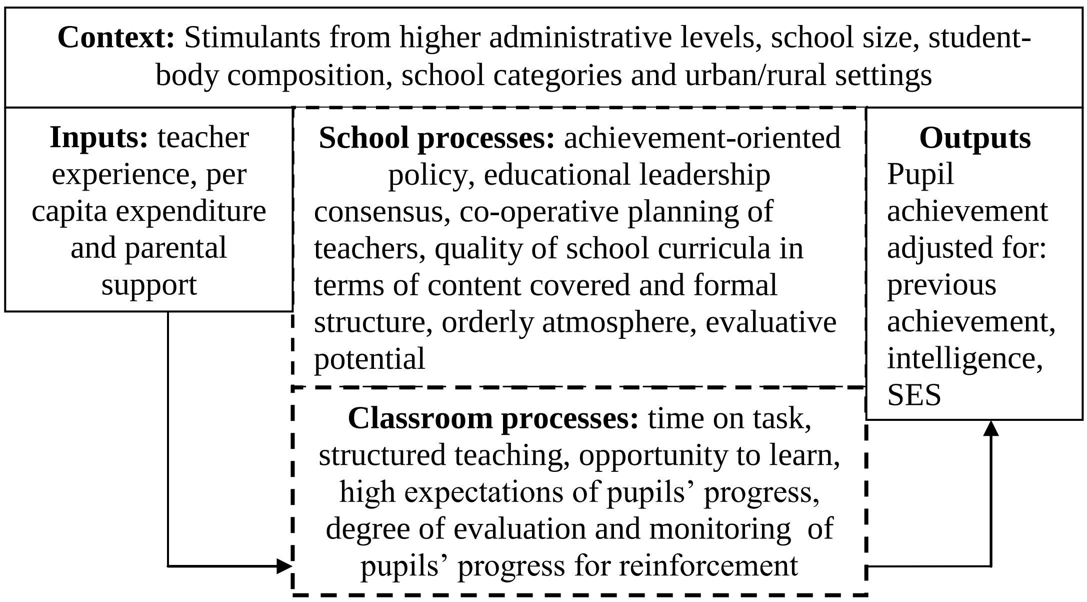

Figure 2.1 *– Integrated Effectiveness*

(Presentation of drawing slightly rearranged in illustration but not in content, Scheerens, 1992:14)

Probably, the most important limitation of the above model is that the model does not discriminate between processes at the classroom level and processes at the school level. In fact both the classroom and the school level are represented by the same educational tier. This limitation was soon resolved by the next model influential for the development of educational effectiveness.

2.4.3 The Comprehensive Model of Educational Effectiveness

In The Comprehensive Model of Educational Effectiveness, Creemers (1994) incorporated Carroll's (1963) and Scheerens' (1992) models (Figure 2.2).

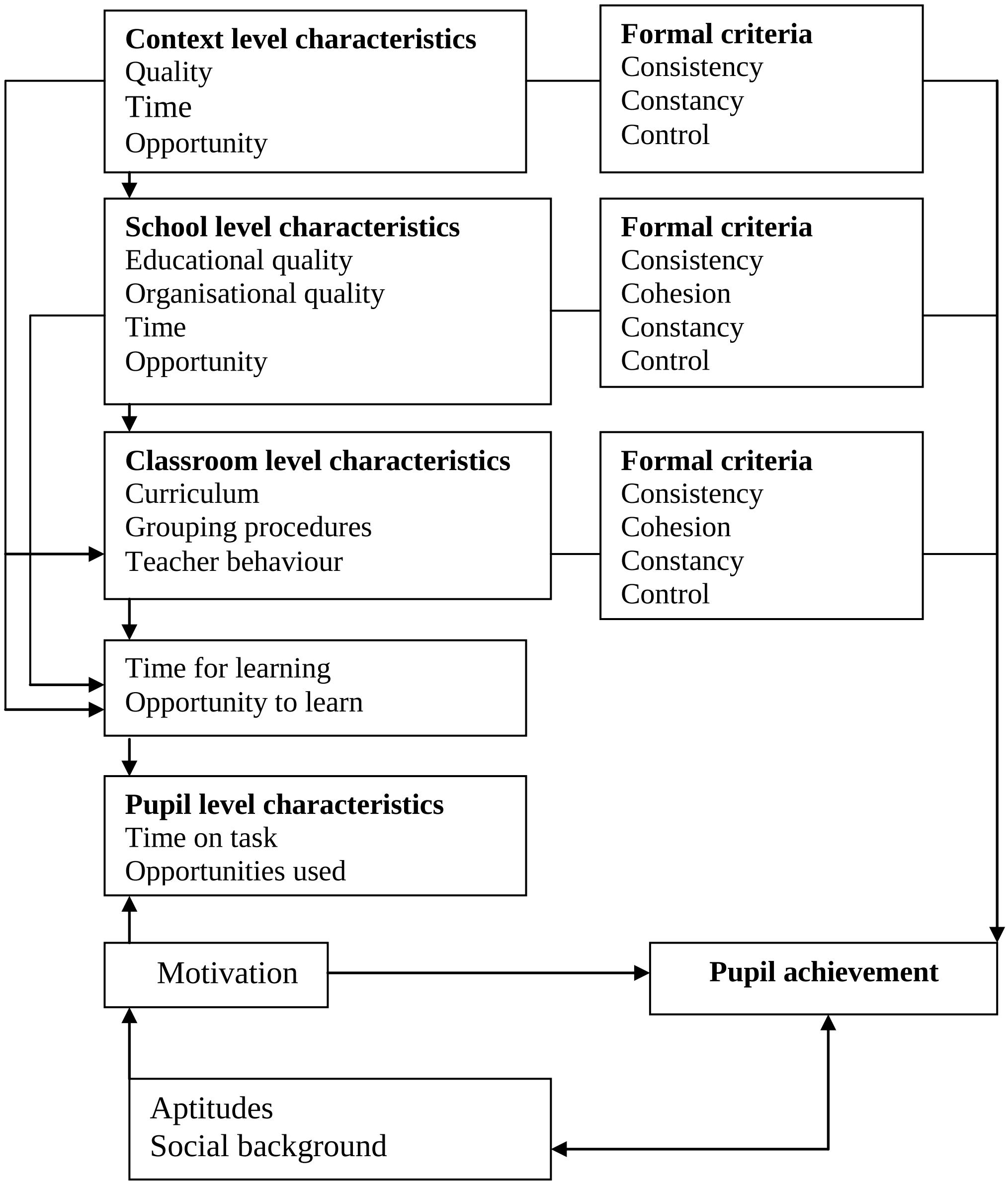

Figure 2.2 *– The Comprehensive Model of Educational Effectiveness*

(With slight adaptations from the model by Creemers, 1994:119)

In Figure 2.2 above, the pupil, the classroom, the school and the context level are now discernable. Conditions at the higher level of the school are considered to influence conditions at the lower level of the classroom. Similarly, factors at the pupil level such as motivation, aptitudes and social background are considered to influence conditions at the higher levels of the classroom and of the school. The context level is also considered to influence conditions at the classroom and school level At the context level, quality refers to the national assessment of pupils, the training of teachers and the funding of schools. Time and opportunity issues such as the scheduling of school time, the supervision of time scheduled (for teaching and for learning) and the provision of national curriculum guidelines are considered to influence educational policy.

At the school level, educational quality refers to factors such as agreement about instruction in classrooms, rules that regulate instruction and the school system or school policy for school evaluation. Organisational quality refers to school policy about intervention, supervision, professionalization and school culture. School level characteristics that refer to time include: the schedule of time, rules and agreement about the use of time as well as an orderly and quiet school environment. School level characteristics that refer to opportunity include: the school curriculum, consensus about the mission of the school as well as rules and agreement about the implementation of the school curriculum.

At the classroom level, quality refers to: the instruction of the curriculum, grouping procedures and teacher behaviour. In this way, Creemers (1994) acknowledged the central role of the teacher and the importance of the classroom level for pupil achievement. Quality of curricular instruction refers to: ordering of goals and content, structure and clarity of content, advanced organisers, evaluation, feedback and corrective instruction. Quality of grouping procedures refers to mastery learning, grouping by pupil ability and co-operative learning. These are viewed as dependent on differentiated material, evaluation, feedback and corrective instruction. The instructional quality of teachers is considered as reflected by behaviours such as: classroom management, homework, goal setting, structuring content, clarity of presentation, questioning, immediate exercises, evaluation, feedback and corrective instruction. Time for learning and opportunity to learn are considered as inter-dependent. Time for learning links with the opportunities made available for pupils to learn.

Creemers (1994) considered the levels above and below that of the classroom as reciprocal. The context, the school and the pupil level are considered to influence conditions at the meso level of the classroom. Creemers elaborated four criteria to describe the operation of effectiveness: consistency, cohesion, constancy and control. These criteria refer to the quality of interaction between predominantly instructional processes at the level of the classroom and predominantly organisational processes at the level of the school. Consistency which operates at the context, school and classroom level is defined, in Creemers and Reezigt (1996:215-216), as: "...conditions for effective instruction related to curricular materials, grouping procedures and teaching behaviour should be in line with each other." Cohesion, which operates at the school and at the classroom level implies that teaching staff must exhibit effective teaching characteristics. However, it is not enough for teachers to exhibit effective teaching characteristics. Teachers must also teach effectively and do so regularly in and over time. This implies that effective instruction must be provided during the entirety of pupils' school career. Therefore, the school must also have and retain control on learning goals and the school climate. For example through assessment, monitoring and evaluation. The principle of consistency, as a more comprehensive mechanism central to the integration and operation of effectiveness conditions in schools has been tried and tested in a number of studies (de Jong, Westerhof & Kruiter, 2004; Driessen & Sleegers, 2000; Kyriakides et al., 2000). However, research shows little support that consistency is a predictor of pupil achievement (Driessen & Sleegers, 2000; Kyriakides, 2008). Furthermore, the criterion of cohesion, constancy and control have hardly been researched. A reason for this is possibly related to the challenge faced by researchers with regards to: the measurement of these criteria, their operational definitions and their analysis.

In spite of being the first model to describe the reciprocity of factors associated with educational effectiveness, The Comprehensive Model of Educational Effectiveness (Creemers, 1994) does have its limitations. This model is predominantly instructional and assumes the equal treatment of pupils (Jamieson & Wikely, 2000). The model also assumes that pupils learn in conformity with the instruction as delivered by teachers

(Thrupp, 1999). Pupil learning is described in broader terms as pupil achievement and not in more specific terms such as pupil attainment (pupil achievement at one point in time) and pupil progress (pupil achievement over time) This model does not account for the possible influence of teacher-bound processes, other than teacher behaviours, such as teacher beliefs (Campbell et al., 2004). The main criterion of consistency and the related criteria of cohesion, constancy and control may not be necessarily stable over time (Mortimore et al., 1988; Kyriakides, Campbell & Gagatsis, 2000). This model does not consider the possibility that differences, as well as similarity, in teacher behaviour and other teacher processes may be just as influential in conditioning effectiveness (Murphy & Gipp, 1996; Arnot et al., 1998) and that the effectiveness of teachers may not necessarily be consistent across subjects and over time (Campbell et al., 2004).

2.4.4 The Dynamic Model of Educational Effectiveness

Creemers and Kyriakides (2006) extended the Comprehensive Model of Educational Effectiveness (Creemers, 1994) by: defining the dimensions of effectiveness for the context, school and classroom, including additional characteristics at the classroom level to explain differences in teaching quality, and, by including additional ways to evaluate pupil outcome that go beyond the cognitive and in respect of "the new goals of education" (Creemers & Kyriakides; 2006:149). The model is parsimonious because it: searches for interactions amongst factors operating between and within levels, searches for non-linear relations between educational effectiveness factors and pupil achievement, describes more measurable dimensions to define the function of effectiveness factors and describes the operation of educational effectiveness in a more complex, dynamic and time sensitive manner. The Dynamic Model of Educational Effectiveness in Figure 2.3 also highlights the integration of more constructivist notions about learning (Simons, van der Linden & Duffy, 2000) to more constructivist notions about teaching. The dimensions of: frequency, focus, stage, quality and differentiation extend the measurement of educational effectiveness in ways that are not narrowly focused on pupils' cognitive outcomes and on curricular aims (Kyriakides, Creemers & Antoniou, 2009).

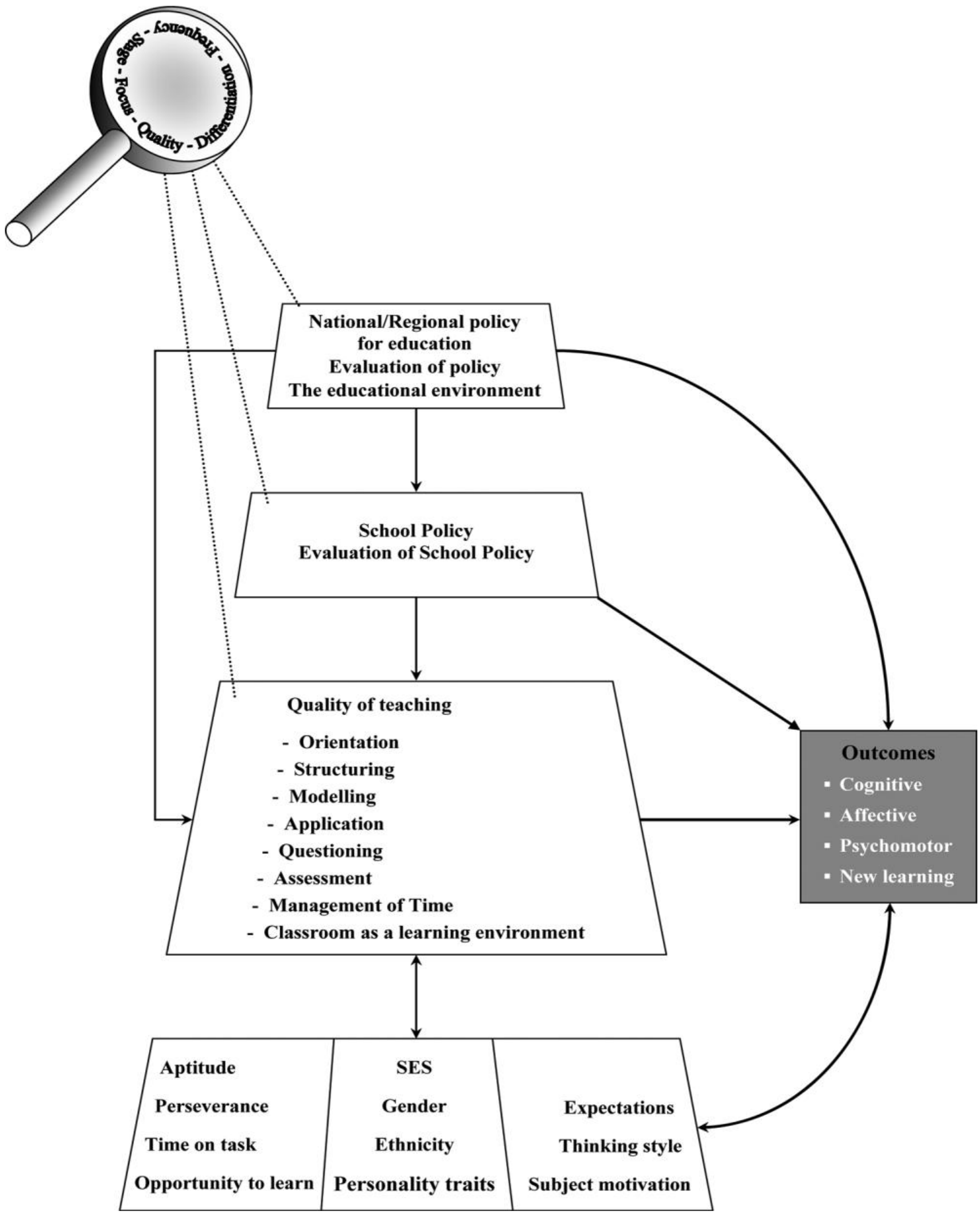

***Figure 2.3**– The Dynamic Model of Educational Effectiveness*

Reproduced from Kyriakides, Creemers & Antoniou (2009:64)

The Dynamic Model of Educational Effectiveness (Kyriakides, Creemers and Antoniou, 2009) is an improvement to The Comprehensive Model of Educational Effectiveness (Creemers, 1994) in that it addresses many of its limitations. This dynamic model moves beyond the instructional and also considers that pupil learning is also influenced by other factors such as: teaching orientation, expectations, ethnicity, personality, motivation and ways of thinking. This model refers to five dimensions of educational effectiveness: frequency, focus, stage, quality and differentiation. By defining the dimension of frequency, this model refers to the issue of quantity in the implementation of an effectiveness factor. By defining the dimension of focus, this model refers to the specific function of an effectiveness factor. By defining the dimension of stage and the time period in which an educational activity takes place, this model does not assume that the effect of processes at the classroom level are stable. By defining the dimension of control this model refers to the importance of quality of educational activities. By defining the dimension of differentiation this model considers that similarities as well as differences in educational activity are likely to influence the effectiveness of classrooms and schools. Therefore, this model offers additional definitions regarding the measurement of effectiveness concepts that seek to integrate the dynamic aspects with the changeable aspects of educational effectiveness factors.

This model is not without its limitations. Although, non-cognitive measures of pupil outcomes have been acknowledged, pupil outcomes are still not defined more specifically in terms of pupil attainment and pupil progress. The school and context levels are still not considered in terms of the more specific processes that are likely to come into play across and within schools. For example, characteristics concerned with the quality of head teaching at the school level and the implications of policy decisions at the context level. An important and plausible reason for this lack in focus is offered by studies that repeatedly show the classroom level to explain a greater amount variance when pupils' gain in learning is examined (Campbell et al., 2004; de Jong, Westerhof & Kruiter, 2004; Mujis & Reynolds, 2003; Reezigt, Guldemond & Creemers, 1999). No reference is made to the criteria of consistency, cohesion, constancy and control present in the earlier model by Creemers (1994). Does this imply that the criteria of effectiveness have been replaced by the dimensions of effectiveness as operators of educational effectiveness? Or, that the criteria of educational effectiveness constitute diverse aspects of the dimensions of educational effectiveness? What is the operational connection between the criteria of effectiveness (consistency, cohesion, constancy and control) and the dimensions of effectiveness (frequency, focus, stage, quality and differentiation)?

2.4.5 The Model of Differentiated Teacher Effectiveness

The Model of Differentiated Teacher Effectiveness by Campbell et al. (2004), in Figure 2.4, is a teacher effectiveness model with important implications for models of educational effectiveness.

DIFFERENTIATED TEACHER EFFECTIVENESS: INSTRUCTIONAL ROLE			
Time stability	*Subject consistency*	*Differentiation – different people*	*Differentiation – working environment*
School year	Curriculum subjects	Group of students (sex, age, SES, learning needs)	School type
Phase of implementation of an educational policy	Areas within a subject	Colleagues	Availability of resourced support
Teaching periods	Difficulty of a teaching unit	Parents	School culture
Periods in relation to the assessment of a teacher	Type of teaching objectives		Community
DIFFERENTIATED TEACHER EFFECTIVENESS: ACROSS VARIOUS ROLES			

Figure 2.4 *– The Model of Differentiated Teacher Effectiveness*

Reproduced with slight adaptations in form not content from Campbell et al. (2004:82)

Campbell et al. (2004) argue that teacher effectiveness extends beyond the generic and recognizes that teachers can be effective with some pupils more than with other pupils, with some subjects more than with other subjects, in some contexts more than in other contexts, with some aspects of their professional work more than with other aspects of their work. Therefore, this model focuses on the specific dimensions of teacher effectiveness including: time stability, subject consistency and differentiation of people and workplace issues. Dimensions that are not inconsistent with the effectiveness dimensions in The Dynamic Model (Kyriakides, Creemers & Antoniou, 2009) and the effectiveness criteria in The Comprehensive Model (Creemers, 1994) of Educational Effectiveness.

Effective teachers are perceived as those who can accomplish the planned goals in line with the goals set by the school (Campbell et al., 2004). This model also acknowledges the challenges in examining teacher effects and frames these in terms of the criteria of consistency and the issue of stability. On page 74, Campbell et al. (2004) argue that "consistency refers to different criterion variables whereas stability has to do with different time points." Another strength of this model is that effective instruction is not viewed as solely influenced by the more overt teacher behaviours but also by more covert processes such as teacher beliefs. This model was deliberately limited by the authors to focus on the differentiated effectiveness of teachers and teaching in order to move beyond the generic. Consequently, the focus on differentiated teacher effectiveness is not framed by broader concepts about the differential effectiveness of schools as educational institutions for teaching and for learning.

2.4.6 The Multi-Dimensional Character of Educational Effectiveness

This section looks beyond the more universal models of educational effectiveness by Creemers (1994) and by Kyriakides, Creemers and Antoniou (2009) and beyond the specific model of teacher effectiveness as by Campbell et al. (2004) to establish theoretical connections between the operators of teacher, school and educational effectiveness in each of these models. Effectiveness at the classroom and the school level cannot be adequately examined without taking into account factors at each level of the educational hierarchy (de Jong, Westerhof & Kruiter, 2004; Mortimore et al., 1988; Opdenakker & Van Damme, 2000a; Teddlie & Stringfield, 1993). Creemers and Kyriakides (2006) recommend that the concept that educational effectiveness is differential should not be polarized against other models of effectiveness but should be incorporated as a refinement of generic models. Therefore, Table 2.2 below incorporates the criteria of effectiveness (Creemers, 1994) with the dimensions of effectiveness (Creemers, Kyriakides & Antoniou, 2009) with the concept of differentiated teacher effectiveness (Campbell et al., 2004).

Table 2.2 - *Forging Links between the Comprehensive, Dynamic and Differentiated Models of Educational and Teacher Effectiveness*

Differential effectiveness (Creemers & Kyriakides, 2006)				
Criteria	**Comprehensive model (Creemers, 1994)**	**Dimensions**	**Dynamic model (Kyriakides, Creemers & Antoniou, 2009)**	**Differentiated teacher effectiveness (Campbell et al., 2004)**
Consistency	Conditions for effective instruction are in line with one another	Frequency	The quantity of an activity associated with an effectiveness factor	
Cohesion	Teaching staff must exhibit effective teaching characteristics	Focus	The specific/general function of an effectiveness factor	
Constancy	Effective instruction must be provided during pupils' school career	Stage	The time period in which an activity takes place	
Control	Learning goals and school climate must be evaluated	Quality	The properties of an activity	
		Differentiation	The extent to which an activity is implemented similarly/dissimilarly across subjects	Instructional differentiation: time, stability, subject consistency, different people, different working environments
				Differentiation of teacher roles

In The Model of Differentiated Teacher Effectiveness, differentiation is limited to teachers' instructional differentiation and the differentiation of teacher roles. In The Dynamic Model of Educational Effectiveness the dimension of differentiation alongside with the dimensions of frequency, focus, stage and quality are not limited to the classroom level but also refer to the school and policy level. If the operation of educational effectiveness is determined by the frequency, focus, stage, quality and differentiation of educational, schooling and teaching activity, how do the effectiveness criteria of consistency, cohesion, constancy and control fit-in? In spite of their diverse functions, Figure 2.5 hereunder considers the connections between the criteria and the dimensions of educational effectiveness as operators of educational effectiveness acting at the policy, the school and the classroom level.

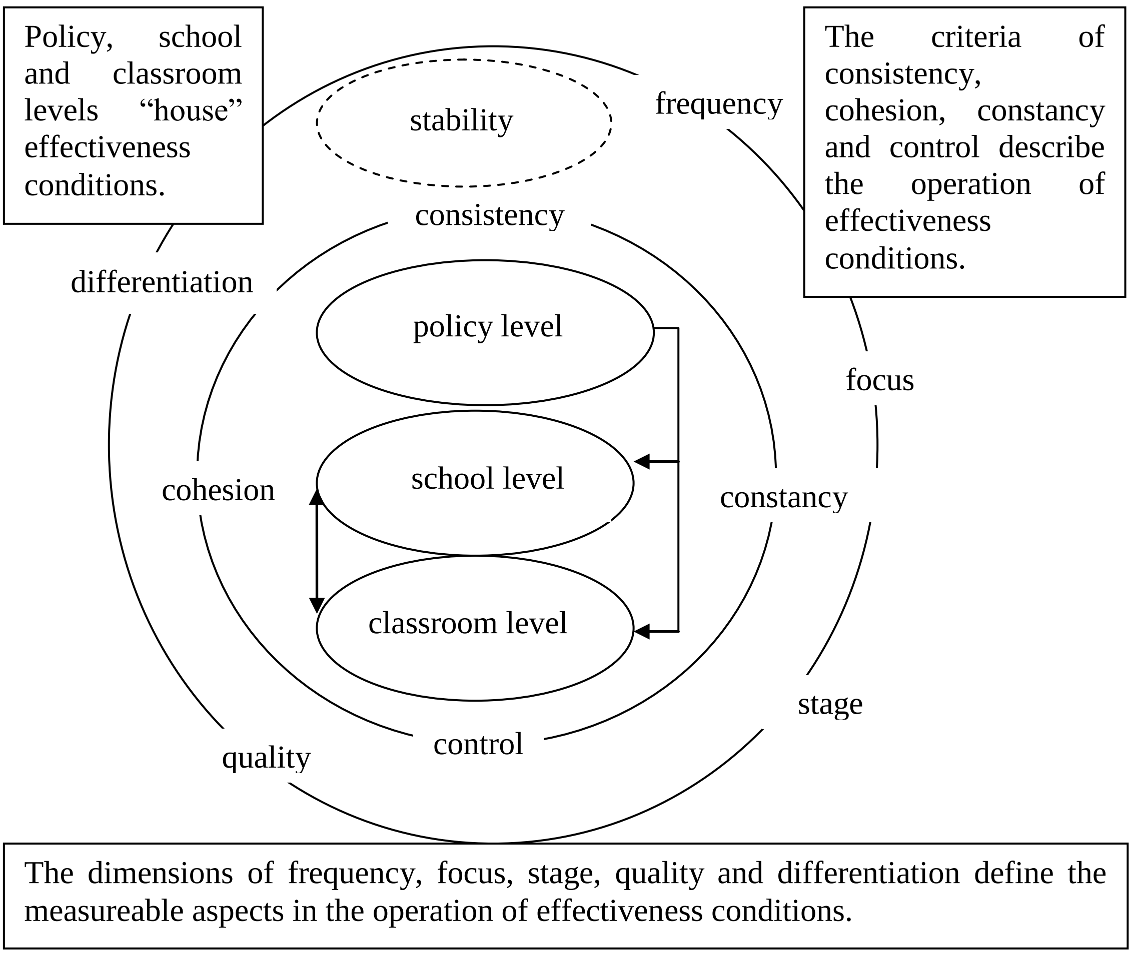

***Figure 2.5** – Operators of Educational Effectiveness*

In Figure 2.5 above, the operators of effectiveness are conceptualized in an atomic fashion. For example, frequency refers to the quantity of an activity characteristic of an effectiveness factor such as teacher behaviour and teacher beliefs. Consistency is a criterion that refers to conditions for effective instruction that are in line with one another. In Figure 2.5 above stability is included as an operator of effectiveness even though this was not discussed in Table 2.2. Stability refers to the regularity in the effect of educational factors and characteristics over time. Within the systemic operation of an organization no operator stands alone. Similarly, stability is connected to other operators such as constancy and stage. Consistency or the alignment of conditions for effective instruction, across and within schools, is partly controlled by the frequency and quality of instructional activity conducted by the teachers who manage classrooms and the quality of organisational activity by head teachers who manage schools. The alignment of conditions for effective instruction within schools implies that predominantly organizational conditions at the school level support conditions for effective instruction at the classroom level. Conversely this implies that when organisational conditions at the school level do not favour effective instruction at the classroom level than educational conditions are not as well aligned and that conditions are not as supportive for the development of an effective school.

The frequency and quality of school and classroom level activity can exert a positive or a negative influence for pupil progress. The strength and direction of this influence operates effectiveness There are also other criteria and dimensions other than consistency, frequency and quality that operate educational effectiveness. When activity at the classroom and at the school level is positive for pupil progress and the positive effects of such activity stable in and over time than this activity is effective. Conversely, when activity at the classroom and school level is negative for pupil progress and the negative effects of such activity stable in and over time than this activity is ineffective. Interplay between the criteria of effectiveness, other than consistency, and the dimensions of effectiveness, other than frequency, is also plausible. For example, for educational staff to exhibit cohesion, senior members of staff, such as the head teacher, must establish conditions for teaching staff to become aware of the influence of their activity for pupil progress, to implement activity positive for pupil progress in and over time and to vary their activity in respect of the learning needs of different groups of pupils.

2.4.7 The Language and Classification of Educational Effectiveness

Any research activity requires the use of language, to represent key concepts, notions and ideas. Creemers and Kyriakides (2008) describe educational effectiveness research as an attempt to establish theories that provide reasons for the why and the how some schools and classrooms are more effective than others in securing significantly increased rates of pupil achievement. Classifying the effectiveness of a school does not have the same impact, in human terms, as classifying the effectiveness of human subjects such as teachers. Therefore, the author calls for a more critical attitude regarding the language used to describe differentially effective schools but a more judicious use of the language used to describe differentially effective teachers.

The term “effective” is commonly used to refer to schools in which pupils progress far above the expectation for them on the basis of their prior attainment outcomes. In more recent years, educational effectiveness research is focusing more on schools in which pupils progress significantly below their expectation. The terms “more effective”, and “less effective” have been used by important studies such as ISERP (2002) to illustrate differences in the quality of school and classroom practice. Terms such “more successful” and “less successful” (Reynolds et al., 2012) and terms such as “medium effective” and “high effective” (Sammons et al., 2009) are also used regularly in the school and educational effectiveness literature. The terms “effective” and “ineffective” have also been briefly used to compare differences in school effectiveness by Teddlie, Kirby & Stringfield (1989)

If one adopts, the terms “more effective” and “less effective” to classify school or educational effectiveness, this implies that more effective schools are schools associated with pupils who are progressing significantly above expectation (+1 or +2 s.d). Conversely, this implies that schools associated with pupils who are progressing significantly below expectation (-1 or -2 s.d) are less effective. It also implies that schools in which pupils do not progress significantly above or below expectation are effective.

Should head teachers and teachers be satisfied in seeing that pupils develop “naturally” on the basis of their cognitive ability? Or, should head teachers and teachers see that pupils develop to their best potential and in spite of the different life chances associated with the lottery of birth and of socio-economic opportunity? The latter is the value position adopted by the current study. Once the value of effectiveness is based on the concept of pupil potential rather than pupil ability then the terms “more effective”, “effective” and “less effective” are accurate but not necessarily precise descriptors. If the value of education is to create, establish and maintain school and classroom environments that guide pupils towards the fullest of their potential, than effective schools are those schools associated with pupils who are progressing far above their expectation after adjusting for an array of pupil, classroom and school level factors. Does this imply that schools associated with pupils who are progressing far below their expectation are “ineffective”? If the value of effectiveness is now based on the concept of pupil potential, the answer can only be in the affirmative. What does one call schools in which pupils are not progressing significantly above or significantly below expectation (at 0 s.d)? For lack of a more elegant term, the term “average” is used.

Generally, effective schools are constituted by a majority of effective teachers (Berliner, 1985). This implies that the type of activity and practice within schools is not significantly dissimilar from one classroom to another or between the majority of classrooms. The term used in the current study to describe the regular spread of quality activity and practice within schools is “typical”. A study by Rivkin, Hanushek and Kain (2005) showed considerable within-school variation in teacher effectiveness. The Victorian Quality Schools Project, Hill et al., (1996) also elicited significant within-school variations in teacher quality. When differences in teaching quality between classrooms of the same year group are significant, this implies that effectiveness within schools differs in its spread. Since school and educational effectiveness is relative and can vary by extent (effective, average and ineffective) and by spread (typical or atypical) this implies a six-way classification system (Table 2.3).

Table 2.3 – *Classifying Educational Effectiveness*

Typical spread of effectiveness in schools		
Effective	**Average**	**Ineffective**
Pupils' value-added scores are at +1/+2 s.d. Schools are hence classified as effective. Most classrooms in the same school are effective.	Pupils' value-added scores are at 0 s.d. Schools are hence classified as average. Most classrooms in the same school are average.	Pupils' value-added scores are at -1/-2 s.d. Schools are hence classified as ineffective Most classrooms in the same school are ineffective
Atypical spread of effectiveness in schools		
Pupils' value-added outcomes vary significantly across classrooms of the same year group in the same school.		

In educational, school and teacher effectiveness research, it is usual to refer to teachers associated with pupils who are progressing significantly above expectation by the term "effective". However in Table 2.3 above, classrooms rather than teachers are called "effective", "average" and "ineffective". This approach is considered as more politically sensitive to adopt within the local educational professional context. This particular use of language was also inspired by a similar approach adopted by Teddlie, Kirby and Stringfield (1989). In their comparison of the characteristics associated with "effective" and "ineffective" schools, they refer to the characteristics of "teachers in more effective schools" in page 228 or to the characteristics of "the principal in school 1 (the more effective school)" in page 231. The author is of the view that although teachers are central to classrooms and that teaching behaviours and teaching beliefs likely to influence pupil progress, teacher and teaching factors alone do not determine school and educational effectiveness. Pupil achievement is not an accomplishment of the classroom level alone but an accomplishment of factors situated at both the classroom and the school level (Kyriakides, Campbell & Gagatsis, 2000). If pupil achievement was dependent only on the influence of teacher activity and practice then the terms "effective teachers", "average teachers" and "ineffective teachers" would not be considered, by the author of the current study, as less appropriate than "effective classrooms", "average classrooms" and "ineffective classrooms" Moreover, use of the term "effective", "average" or "ineffective" classrooms rather than in relation of teachers (or head teachers) serves to remind one about the influence of the classroom and the school context for teaching quality and consequently for pupil achievement (Goe, Bell & Little, 2008).

2.5 Limits or Flaws in Educational Effectiveness Research?

No area of research is devoid from criticism and educational effectiveness research is no exception. Reasons for the debate that educational effectiveness research attracts is probably due to the considerable political support that school and educational effectiveness research attracts in many westernized countries (Luyten, Visscher & Witziers, 2005) besides its connections with economic and social theory (Scheerens, 1997). There have been a number of important reviews about the knowledge base of school effectiveness research (Reynolds et al., 1994; Reynolds et al., 2000; Sammons, 1999; Scheerens & Bosker, 1997) and about the methodological advances in educational effectiveness research (Creemers, Kyriakides & Sammons, 2010). Criticism of school and educational effectiveness research comes in two forms. There are proponents from within the field who are cognisant about the limitations of educational effectiveness research but view such criticism positively as an opportunity to advance the field. Then, there are critics from outside the field who detect flaws concerning the political, atheoretical and methodological positions expounded by school and educational effectiveness researchers but who choose to view these negatively in order to limit the field.

Critics doubt the existence of the school effect (Gorard, 2010a; Slee & Weiner, 2001; Thrupp, 1999, 2001, 2010). Critics also argue that school and educational effectiveness research: is overly reliant on quantitative methods, positivist, hegemonic (Dahlberg & Moss, 2005), reductionist (Wrigley, 2004), serves political agendas, minimizes the importance of social composition in schools (Gorard, 2004; Slee, Weiner & Tomlinson, 1998; Thrupp, 1999, 2001, Wrigley, 2004), provides governments with a scientific justification for the political interpretation of policy/practice (Slee & Weiner, 2001), does not differentiate between factors that are school-based but not necessarily school-caused (Thrupp, 1999), produces an alternative research account (Gewirtz, 1998; Thrupp, 1999), holds flawed notions about teaching and learning (Rea & Weiner, 1998) that result from the coercive processes of social induction (Elliot, 1996) and that objectivity cannot be true (Ball, 1998). The focus on what schooling should do for pupil outcome, rather than what schooling should achieve for pupil learning, has led to a culture of blame (Rea & Weiner, 1998). Similarly, Elliot (1996:209) refutes that school-based processes should be judged on the basis of pupil outcome, in view of: "pupils' capacities for constructing personal meanings, for critical and imaginative thinking and, self-directing and self-evaluating their learning". Elliot considers it the responsibility of the teacher to establish outcomes for pupils. Effectiveness studies are also criticized because they remain under-theorised. Apparently, such studies do not tap into knowledge provided by sociological inquiry because they employ narrow indicators (Thrupp, 2001) and are dominated by the accountability agenda (Lingard et al., 1998).

On the other hand, proponents of effectiveness research such as Reynolds et al. (2012:15) believe that educational effectiveness research:

> has had some success in improving the prospects of the world's children over the last three decades – in combating the pessimistic belief that "schools make no difference", in generating a reliable knowledge base about "what works" for practitioners to use and develop, and in influencing educational practices and policies positively in many countries.

Reynolds et al. (2012) acknowledge that the success of educational effectiveness research is partly attributable to valid criticism that led educational effectiveness researchers to seek ways to advance the field. Reynolds et al. (2012) highlight four key themes central to criticism about educational effectiveness research. These themes are: a lack of methodological rigour particularly in the early studies of effective schools, an over-emphasis on schooling rather on social class influences, a neglect in the linking of the theory of educational effectiveness research with analyses and findings and a one-size-fits-all approach to research.

Not all forms of knowledge are equally valuable and integral. Amongst the critics who argue against the methodological, atheoretical and political stances in educational effectiveness research, Gorard (2010a:745) has been especially vociferous in his rejection of the “dominance of the school effectiveness model”. In response to this antagonistic position against educational effectiveness research, Reynolds et al. (2012) argue that Gorard’s (2010a & b, 2011) criticism about: relative error, random sampling and use of multilevel modelling techniques is flawed. Reynolds et al., (2012), also argue that Gorard’s (2010a) broader criticism of educational effectiveness research such as doubting the existence of the school effect, conflating educational effectiveness researchers with governments and the rejection of educational effectiveness research is unjust and invalid. On the other hand, proponents of educational effectiveness research, consider criticism as important in that it provides a springboard for the development of methodological and theoretical advances in the field. This is possibly the greatest point of divergence between hardened critics who consider educational effectiveness research as flawed and proponents of educational effectiveness research who acknowledge the limitations of educational effectiveness research but who instead choose to work towards advancing this field of study.

Very early studies of school effectiveness such as those by Mayeske et al. (1972), Bidwell and Kasarda (1980) and Ralph and Fennessy (1983) were unable to accurately detach the effects of the school with effects associated with pupil intake. Such criticism was answered by methodological developments that led to the stage four generation of input-context/process-product models (Teddlie & Reynolds, 2000). Early studies of this more methodologically sophisticated type such as those conducted by Hallinger and Murphy (1986) and Teddlie et al. (1990) paved the way forward for the “normal science” of school effectiveness (Teddlie & Reynolds, 2000:11). Particularly since 2000, the modelling of educational effectiveness has been consolidated by an increased focus on complexity that examines changes in pupil attainment over time. Increasingly, the longer-in-term effects of factors at the school and at the classroom level are also being examined alongside with the operators of educational effectiveness such as "consistency, stability, differential effectiveness and departmental effects" (Creemers, Kyriakides & Sammons, 2010:6).

Educational effectiveness research has been repeatedly criticized because it neglects to consider the determinate effects of social class and instead chooses to focus on the influences of schooling (Gorard, 2004; Slee, Weiner & Tomlinson, 1998; Thrupp, 1999, 2001; Wrigley, 2004). Does this automatically imply that the effects of social class are ignored by school or by educational effectiveness research? Based on what is usually elicited by the research, 12% to 15% of the variance is explained by the effects of the school. This suggests that whilst educational effectiveness research does not ignore the effects of social class, the findings might be interpreted in a way that shows educational effectiveness research to downplay the effects of social class. The verb "downplay" rather than "neglect" has been chosen in view of the statement made by Reynolds et al. (2012) in which they argue that more recent findings show the school level to explain between 30% to 50% of the variance and that educational effectiveness research considers the influence of social class. They base their argument on more recent findings that shows the variance accounted for by the school as considerably greater than the figure of 12% to 15% reported by the critics. Given these sharp differences in interpretation, it is essential to understand what the school effect is and how the school effect is measured.

At times, the terminology used to describe the school effect can be misleading (Coe & Fitz-Gibbon, 1998). The school effect is a measure of the between school variance that cannot be explained by intake characteristics of pupils in schools after controlling for such effects (Coe & Fitz-Gibbon, 1998). The school effect relies heavily on multilevel quantitative methods of analysis which usually offer a snapshot of the educational reality within schools (Luyten, Visscher & Witziers, 2005). The school effect is relative because pupils' value-added scores as achieved in a school are compared against the value-added scores of pupils in other schools (Goldstein, 1997). Relativity implies that effects are likely to vary in quantity and in quality across and within schools. School effects need not necessarily be strong for these to be influential. Weak school effects were elicited by Scheerens & Bosker (1997) for effectiveness factors such as: cooperation, school climate, monitoring, opportunity to learn, parental involvement, pressure to achieve and school leadership. For those who still choose to doubt the existence of the school effect, Luyten, Visscher & Witzers (2005:253) argue that in view of: “the enormous amount of resources (taxpayers’money) invested in education each year, it would be unethical not to consider its effects.”

An example of how school effects can lead to significant differences in pupils’ progress outcomes over time is discussed by Luyten, Tymms and Jones (2009). Using more sophisticated methods that account for the effects of assigning pupils to higher or lower grades on the basis of their birth-date and using both cross-sectional and longitudinal data, Luyten, Tymms and Jones (2009:146) show that the absolute effects of schooling “indicate that more than 50% of the progress pupils make over one-year period is accounted for by schooling.” This percentage figure differs considerably from the figure of 12% to 15% that is typically reported by studies, as well as by the critics of school and educational effectiveness research. However, the percentage figure of 50% is similar to that reported by studies that examine the variation between both the school and the classroom level (Hill & Rowe, 1996; Opdenakker & Van Damme, 2000b). What does the figure of 50% that is accounted for by the school for pupil progress over one year by Luyten, Tymms and Jones (2009) refer to? On page 146, “the figure of 50% refers to the impact of receiving education in the upper grade as opposed to the lower grade and is calculated as a percentage change in test score.” Also on the same page, these same authors also indicate that “the figure of 10% refers to the variation in the impact of schools.” On page 157 they discuss how the above-mentioned difference in percentage figures refer to two aspects of the same phenomenon.

> these percentages relate to an aspect of the effect of schooling that is different from what is expressed by the usually reported percentages of school level variance. When these percentages are converted to effect sizes that have been defined in relation to interventions in which there is a control and an experimental group, it is found that 10% to 15% school level variance corresponds to an effect size of .67 to.70.

The above discussion does not automatically resolve the debate as to whether educational effectiveness research examines appropriately the influence of social class. However, the above discussion does highlight the need for an increasingly balanced take when considering what the school effect represents. The ongoing discussion about the improved measurement of the absolute effect of the school over time shows that contrary to what the critics argue educational effectiveness research does not neglect to consider the influence of social class but instead prefers to focus on the more malleable influences of schooling. Findings by Hill and Rowe (1996), Opdenakker and Van Damme (2000), Luyten, Tymms and Jones (2009) and Guldemond and Bosker (1999) strongly suggest that the incremental effects year-on-year effects of variation accounted for by the school and also by the classroom levels are greater than when considering the school effect as a measure of the between school variance.

Earlier defenses of school and educational effectiveness research have also argued about the importance of conducting such research. Teddlie and Reynolds (2000) argue that the contribution of school effectiveness research is broader, than that of its critics, because it is not restricted to just examining the influence of social class. Townsend (2001) argues that even though critics allege a direct relationship between school effectiveness research and the management of schools, they then choose to ignore that at the root of much social injustice lie funding cutbacks for education. Luyten, Visscher and Witziers (2005:252) argue that discarding the objectivity ideal would reduce educational research to an intellectually anarchic exercise devoid in its potential for the “generating of information and knowledge that is valid regardless of ideological preferences.” Educational effectiveness research does not seek to eradicate ideological preferences nor does it seek to establish the supremacy of an ideology over another. However it does seek to safeguard objectivity via scientific and rigorous methods (Coe & Fitz-Gibbon, 1998). Increasingly the amalgamation of quantitative and qualitative methods have led to the development of dialectical approaches that highlight the reality of a “much more complex iterative approach” (Siraj-Blatchford et al., 2006:76) and the pragmatic use of mixed methods useful in refuting an either/or stance (Teddlie & Sammons, 2010).

Proponents of school and educational effectiveness research are aware that the analysis of data usually stops after the estimation of direct effects, the research questions are often addressed through quantitative methodologies (Coe & Fitz-Gibbon, 1998; Goldstein & Woodhouse, 2000; Scheerens & Bosker, 1997) and research focuses on the basic skills (Bosker & Visscher, 1999). However, rather than consider this to seriously limit educational effectiveness research, proponents call for a more sophisticated choice of variables that are not necessarily limited to the examination of direct effects (Coe & Fitz-Gibbon, 1998; Goldstein, 1997). Variables that are also broader, aimed at avoiding narrower approaches (Campbell et al., 2003; Luyten, Visscher & Witziers, 2005) and supportive of both qualitative and quantitative methods (Reynolds et al., 2002). For example these methodological and theoretical advances may be achieved through studies that: measure and illustrate the influence of school and classroom processes (Coe & Fitz-Gibbon, 1998; Scheerens & Bosker, 1997), consider teachers as sources of teaching variance (Luyten, 2003) and testing the generalisability of findings which may eventually contribute towards the formulation of a valid pan-European (2012) and international version (Reynolds, 2006) of The Dynamic Model of Educational Effectiveness (Creemers, Kyriakides & Antoniou, 2009). What distinguishes the proponents from the critics is that issues critical to educational effectiveness research are viewed as limitations that need to be considered further if educational effectiveness research is to continue advancing.

2.6 Summary

This second chapter commenced with justification regarding the need to conduct a local study to examine the achievement outcomes of young pupils. This was followed by an overview of teacher, school and educational effectiveness research. The chapter then reviewed three theoretical models with important implications for educational effectiveness. The Comprehensive Model of Educational Effectiveness (Creemers, 1994) and The Dyanmic Model of Educational Effectiveness (Creemers, Kyriakides & Antoniou, 2009) are two generic models of educational effectiveness. The former model is important for its criteria of effectiveness; namely consistency, cohesion, constancy and control. The latter model is important for its dimensions of effectiveness; namely frequency, focus, quality, stage and differentiation. Both have important implications for the current study because together they describe the policy, the school and the classroom operators of educational effectiveness. The Differentiated Model of Teacher Effectiveness (Campbell et al., 2004) is a theoretical device that explains the differential effectiveness of teachers in terms of the differentiation of teacher instruction and the differentiation of teacher roles. Though important and certainly useful, these three models raise a number of questions. For example, how do the criteria and dimensions that operate effectiveness function across and within differentially effective schools? How do these operators align in effective and ineffective schools? Which activity differentiates effective schools from ineffective schools? Which broader educational activity, differentiates the practice of education in effective and ineffective schools? What type of educational, teaching and instructional activity predicts pupil attainment and/or pupil progress? And, what type of educational practice is connected with what rate of pupil progress?

This chapter also reviewed four themes around which revolves criticism of educational effectiveness research. On the basis of Reynolds et al. (2012) defense, the reviewed themes concerned the: lack of methodological rigour, over-emphasis on schooling rather than on social class, neglect in the linkage of theory with the analyses and the findings and the adoption of a one-size-fits-all approach. Rather than reject of the effect of education as proposed by Gorard (2010a), educational effectiveness researchers and academics have seriously addressed its limitations to move this field of research ahead both theoretically and methodologically. This has only served to advance and consolidate knowledge and understandings as to how variations in educational quality lead to variations in pupil achievement. To further examine this connection, the following chapter reviews the characteristics of differentially effective schools.

CHAPTER 3
THE CHARACTERISTICS OF DIFFERENTIALLY EFFECTIVE SCHOOLS

What kind of head teacher and teacher practice and activity characterises effective primary schools and classrooms in Malta for mathematics? Does educational activity vary considerably depending on whether schools and classrooms are effective or ineffective? To examine these questions, this third chapter reviews the characteristics of head teacher and teacher practice and activity associated with effective, as well as ineffective, schools and classrooms.

3.1 Characteristics of Differentially Effective Schools

The Comprehensive Model of Educational Effectiveness (Creemers, 1994), The Dynamic Model of Educational Effectiveness (Kyriakides, Creemers & Antoniou, 2009) and The Differentiated Model of Teacher Effectiveness (Campbell et al., 2004) are based on the premise that conditions at the classroom level and the school level are likely to predict pupils' achievement outcomes. As mentioned earlier in section 1.1.9, The Literacy Survey (Mifsud et al., 2000), the Literacy for School Improvement (Mifsud et al., 2004) and The Numeracy Survey (Mifsud et al., 2005) identified a set of predictors for the attainment and/or the progress outcomes of young Maltese children for Maltese, English and mathematics. These studies hypothesised that characteristics such as age, prior attainment, sex, first language, years spent in preschool, special educational needs, parental occupation and education, the family structure, size of schools and classrooms and the school district were likely to predict pupil achievement. In Malta, characteristics associated with effective schools remain largely unknown. Table 3.1 lists four school level characteristics that were found to predict pupil attainment and/or pupil progress for language and number (Mifsud et al., 2000, 2004, 2005) in Malta.

***Table 3.1** – School Level Predictors of Pupil Attainment and Pupil Progress in Malta*

	Attainment			Progress	
School level	**Maltese (Age 6, Year 2) & (Age 9, Year 5)**	**English (Age 6, Year 2) & (Age 9, Year 5)**	**Maths (Age 5, Year 1)**	**Maltese (from Age 6 to Age 9)**	**English (from Age 6 to Age 9)**
Number of classrooms	Age 6^{ns}	Age 6^{ns}	**		
Number of classrooms	Age 9^{ns}	Age 9^{ns}		ns	ns
Type of school	Age 6*	Age 6***	ns	***	***
	Age 9***	Age 9***			
School district	Age 6***	Age 6**	na	***	***
	Age 9***	Age 9**			

na = data not available, ns = not significant, * significant at p < .05, ** significant at p < .01, *** significant at p < .001

Which other characteristics are predictors of the attainment and the progress outcomes of Maltese pupils? Which school and classroom characteristics are associated with differentially effective schools in Malta? There is no formula for producing an effective school (Cuttance, 1992). Yet, consensus does exist as to the characteristics of effective schooling (Reid et al., 1987) and effective teaching (Campbell et al., 2004). Also, pupil achievement is considered as an accomplishment of factors at the classroom and the school level (Kyriakides, Campbell & Gagatsis, 2000). In view of the important contribution of educational factors for pupil achievement, Table 3.2 lists the characteristics of effective schools.

***Table 3.2** – Factors Associated with Effective Schools*

Mortimore et al. (1988)	**Levine & Lezotte (1990)**	**Cotton (2002)**	**Scheerens & Bosker (1997)**	**Sammons (1999)**	**Marzano (2000) & Marzano (2003)**	**Creemers & Kyriakides (2008)**
	Focus on learning skills	Planning/ learning goals Use of time	Curriculum quality/opportunity: setting priorities, choice/application of methods/textbooks, opportunity to learn, satisfaction with curriculum and focus on basic subjects.		Content coverage, opportunity to learn, guaranteed/ viable curriculum, time	School policy on teaching
Record keeping	High expectations/ requirements and appropriate monitoring	High expectations, monitoring progress and alternative assessment	High expectations Records of pupil achievement and monitoring system/records on pupil performance.	High expectations. Monitoring of pupil progress and evaluating school performance	Challenging goals, effective feedback and monitoring	Evaluation of school policy on teaching. Evaluation of the learning environment

***Table 3.2** – Factors Associated with Effective Schools (continued)*

Mortimore et al. (1988)	**Levine & Lezotte (1990)**	**Cotton (2002)**	**Scheerens & Bosker (1997)**	**Sammons (1999)**	**Marzano (2000) & Marzano (2003)**	**Creemers & Kyriakides (2008)**
Parental involvement	Parental involvement			Home-school partnership	Parental/ community involvement	School policy on parental partnership
				Efficient organisation, structured lessons and adaptive practice Positive reinforcement: clear, fair discipline and feedback.		

***Table 3.2** – Factors Associated with Effective Schools (continued)*

Mortimore et al. (1988)	**Levine & Lezotte (1990)**	**Cotton (2002)**	**Scheerens & Bosker (1997)**	**Sammons (1999)**	**Marzano (2000) & Marzano (2003)**	**Creemers & Kyriakides (2008)**
Purposeful leadership of staff: involvement of deputy head and teachers	Leadership Practice-oriented staff development		School leader as time, educational and administrative leader, quality controller of teachers and initiator/facilitator of staff professionalization.	Firm and purposeful leadership School-based staff development.	Leadership, collegiality/ professionalism	
			Evaluation of school process factors, use of evaluation results, satisfaction with evaluation activities.			
				Pupils’ rights and responsibilities		

In comparison to effective schools, relatively little is known about the characteristics of ineffective schools. Research focuses more on successful schools than on less successful schools (Reynolds & Teddlie, 2001) because the associated processes tend to be more complex (Sammons, 2006) and less controllable (Reid, Hopkins & Holly, 1987). Research about ineffective schools is required because educational professionals are more likely to benefit by understanding the processes at play rather than by describing their performance (Davis & Thomas, 1989). Stringfield (1995a) argues that high reliability organisations, such as effective schools, have a strong system of working that is rigorously implemented across diverse organisational contexts. Jamieson and Wikely (2000) argue that this position has been too easily dismissed because of its connotations with the production of education. Reynolds et al. (2002) describe how across nine countries across the world the similarity between effective schools in terms of daily routines is striking.

The International School Effectiveness Research Project (Reynolds et al., 2002 indicated how integrating quantitative as well as qualitative methods, to measure and illustrate, the effect of education, schooling and teaching in different educational systems across the world identifies trends and illustrates patterns associated with differentially effective schools and differentially effective practice. This study mixed multilevel approaches with a longitudinal case study approach which generated descriptions of "contextually sensitive" practice in schools (Teddlie et al., 2002:17). Case studies of more effective, and also of less effective school, revealed the similarity in the experience of pupils. Many of the factors fundamental to school and educational effectiveness, such as teacher practice, travel across many countries world-wide, even though the more specific ways in which effectiveness is practiced can differ from one country to another (Reynolds et al., 2002).

The processes associated with ineffective schools are not merely the opposite of processes associated with effective schools (Table 3.3). For example, in effective schools the vision for the school is likely to be shared. In ineffective schools the curriculum tends to be implemented as set. However, this does not imply a lack of consensus amongst staff regarding the implementation of the curriculum as set. In

Table 3.3 the four areas or factors of leadership, vision, relationships and practice (Sammons, 2006; Scheerens & Bosker, 1997) are envisioned as influencing the quality of processes in schools and in classrooms.

Table 3.3 *– Effective and Ineffective Processes in Schools*

Effective processes (Teddlie & Reynolds, 2000)	**Areas (Sammons, 2006),** Factors (Scheerens & Bosker, 1997)	**Ineffective processes (Reynolds et al., 2002)**
Leaders monitor, select and replace staff.	**Professional leadership** (both area/factor).	Minimal staff monitoring. Focus on status quo.
Common school vision, orderly environment, positive reinforcement and unified teaching.	**Vision** (productive climate with focus on core skills, and appropriate monitoring)	Curriculum implemented as set, emphasis on order not goals and less time for mathematics.
Teachers are collegial/ collaborative.	**Relationships:** (parental involvement).	Staff dissatisfied and interaction limited. Weak parental involvement. Head teacher has difficulty communicating.
Consistency of practice, focus of academic time, teachers organize/ adapt/exhibit best practice	**Practice:** (practice-oriented staff development, instructional arrangements and high expectations)	Textbook followed closely, slow lesson pace, less open-ended questions, low expectations, limited interaction and moderate/low levels of time on task with group work predominant.

Teaching does not always have the desired positive effects for pupil attainment and pupil progress. Therefore, the effects of processes associated with teacher practice are differentially effective. Ko and Sammons (2010:15) describe teachers in effective classrooms as:

> Clear about instructional goals; knowledgeable about curriculum content and the strategies for teaching it; communicating to their students what is expected of them – and why; making expert use of existing instructional materials in order to devote more time to practices that enrich and clarify the content; knowledgeable about their students, adapting instruction to their needs and anticipating misconceptions in their existing knowledge; teaching students meta-cognitive strategies and giving them opportunities to master them; address higher-as well as lower level cognitive objectives; monitoring students' understanding by offering regular appropriate feedback; integrate their instruction with that in other subjects areas and accepting responsibility for student outcomes.

Ko and Sammons (2010:15) describe teachers in ineffective classrooms as:

> Inconsistent in approach to the curriculum and teaching, inconsistent in expectations for different learners that are lower for disadvantaged students from low SES families, emphasise supervision and the communicating of routines, low levels of teacher-student interactions, low levels of student involvement in their work, student perceptions of their teachers as not caring, unhelpful, under-appreciating the importance of learning and their work and more frequent use of negative criticism and feedback.

The descriptions by Ko and Sammons (2010) about the practice of teachers in effective and in ineffective classrooms remind one of the comparison made by Brooks and Brooks (1999) of traditional and constructivist classrooms. In constructivist classrooms, teachers: rely on the use of hands-on material, start from the whole and then move on to the parts of a topic, emphasise broader concepts and ideas, follow questions raised by pupils, prepare classrooms as learning environments where pupils can discover learning, get pupils to contribute their point of view to acquire a window as to pupil learning and/or pupil misconceptions and teachers view assessment as an integral aspect of teaching. The strategies adopted by teachers in a constructivist classroom environment as described by Brooks and Brooks (1999) are similar to the strategies employed by teachers during their practice in the description of effective classrooms offered by Ko and Sammons (2010). On the other hand, the description offered by Brooks and Brooks (1999) of traditional classrooms is not as clearly linked to the description of strategies employed by teachers in ineffective classrooms as described by Ko and Sammons (2010). Whilst constructivist teaching is gaining in importance amongst teachers, some researchers still exercise caution as to the effectiveness of constructivist teachers (Mujis & Reynolds, 2011). Discovery approaches alone do not lead to effective teaching and more prescribed approaches such as teacher guidance and instruction by the teacher are also required (Mujis & Reynolds, 2011). Spiro and DeSchryver (2009) argue that mixed findings as to the effectiveness of constructivist approaches is because these work better in less structured than in more structured teaching situations. Klieme and Clausen (1999) argue that before teachers can teach constructively they must first be effective teachers. Does this imply that non-effective teachers cannot be constructive in their teaching approach?. At which point during their development do effective teachers become constructivist? At which point in teachers' professional development do constructivist teachers become effective? Common ground in this chicken and egg dynamic, is that good classroom management and a positive classroom climate are central to both effective as well as constructivist teaching.

3.1.1 Leadership

Conceptually educational effectiveness research has integrated the fields of teacher effectiveness and school effectiveness research by examining the differential effects of classroom practice and teaching activity in conjunction with the differential effect of schools for pupil achievement. The links between teacher and school effectiveness research and the conceptual movement from the more specific examination of teacher effectiveness and the evaluation of teachers to the broader examination of teaching and the improvement of teachers and schools back to the more specific examination of school effectiveness is clear to trace (Teddlie, 2003). Although at times the chinks in the educational links are conceptually tighter in some areas more than others. One of these chinks refers to the influence of leadership for pupil achievement. In spite of the link between leadership, particularly head teacher leadership and school effectiveness it is harder to elicit a direct association between leadership and pupil achievement (Hallinger & Heck, 1996; Mortimore et al., 1988, Witziers, Bosker & Kruger; Sammons, Day & Ko, 2010).

The educational elements of leadership, vision, relationships and practice are synonymous with effective schools (Sammons, 2006) and leadership is a key element of effective schools (Maeyer et al, 2007). Leadership also facilitates the development of a common school vision, quality relationships and quality of practice via the improved organisation of education and instruction. Research indicates the existence of weak direct effects of leadership "on a range of important dimensions of school and classroom processes and point to modest but statistically significant indirect links with changes in school conditions that in turn lead to improvements in students' academic outcomes" (Sammons, Day & Ko, 2010:97). In spite of the centrality of educational leadership for pupil achievement, it is difficult to establish a direct linkage (Scheerens & Bosker, 1997). This is possibly due to the conceptual and methodological choices made by researchers (Hallinger & Heck, 1996; Witziers, Bosker & Kruger, 2003) and also the absence of intermediary variables between head teachers' leadership activity and pupil achievement (Teddlie & Reynolds, 2000) The importance of the choice of conceptual model when examining a direct linkage between leadership and pupil outcome was confirmed by Maeyer et al. (2007). Using more sophisticated methods of analyses that integrated both multilevel and latent techniques, they discovered that leadership influences the school climate in both indirect and in direct ways.

Similarly to the term "effectiveness", "the definition of leadership is arbitrary and very subjective" (Yukl, 2002:4–5). Leadership is reflected by its influence, values and vision (Bush, 2003; Leithwood, 2003). Leadership is about responsibility whilst headship is about the role of the head teacher. Effective head teachers exhibit leadership when they manage the curriculum (Murphy, 1990), establish common vision (Mortimore et al., 1988) and communicate positively with others (Teddlie, Peggy & Stringfield, 1989). In the United States of America, strong educational leadership was amongst the five factors first discovered as related to school effectiveness (Ralph & Fennessy, 1983). Quantitative studies about leadership usually conclude that school leaders have very weak direct effects on pupil outcome (Hallinger, 2005; Kyreothis, Pashiardis & Kyriakides, 2010; Robinson, Lloyd & Rowe, 2008). Sammons, Day and Ko (2011) consider the relationship between leadership and pupils' progress outcomes as mainly indirect. They argue that the positive effects of leadership for pupils' attainment and progress outcomes operate through factors such as teaching quality, a school climate that is favourable for learning and a school culture that promotes high expectations and considers academic outcomes as important.

In effective schools head teachers lead purposefully, instil a positive school climate and exhibit clarity of vision (Mortimore et al., 1988). In effective schools, head teachers lead when they manage the curriculum (Murphy, 1990), communicate positively with others (Teddlie, Peggy & Stringfield, 1989) and establish strong relationships (Hopkins, 2001). The practice of leadership requires a less dominant, more egalitarian position structured by a common experience of shared and sustained understanding about what produces pupil achievement (Hallinger & Heck, 1999). Robinson, Lloyd and Rowe (2008) described the characteristics of head teacher leaders. Head teacher leaders construct and promote instructional vision, develop and maintain a school culture built upon trust, collaboration and academic vision, procure and distribute resources such as materials, time, support and remuneration, support teachers' professional development, provide summative and formative monitoring of instruction. Head teacher leaders generate a school climate where disciplinary measures are in place but are not attributed importance that is greater than that dedicated to instructional issues (Spillane, Halverson & Diamond, 2004). Head teacher leaders exhibit instructional quality by monitoring, consulting and delegating (Hallinger & Hausman, 1993). They also plan, foresee the consequences of their practice, draw on past experiences, listen to what others have to say and examine conditions before committing (Elmore, 2000). Robinson, Lloyd & Rowe (2008) in their meta-analyses of studies examining the relationship between leadership and pupil outcome identified five dimensions of leadership including: establishing goals and expectations, securing of resources for instruction, the planning, evaluating and coordinating of teaching and the curriculum, promoting and participating in the development of teachers and ensuring an orderly and supportive environment.

Though preferably all head teachers should be leaders, not all leaders are head teachers. Teachers may also function as leaders (Katzenmeyer & Moller, 2001; Harris & Muijs, 2003). Effective teachers show leadership when they adapt their practice for pupil learning, support colleagues, organize classrooms so that pupils achieve their learning goals and act as managers when taking decisions in classrooms and with others at school (Katzenmeyer & Moller, 2001). Harris and Mujis (2003) view teacher leaders as education professionals who act as guide to others in modelling collegiality and in encouraging others to take on leadership roles. Teacher leaders do not however operate within a vacuum, it is important that the broader school context, is supportive of teacher leadership (Hopkins, 2001; MacBeath, 1998; Silns & Mulford, 2002). This only serves to highlight the central influence that head teacher leaders play in influencing conditions favourable for effective schools.

3.1.2 Teacher and Head Teacher Attributes

Teacher attributes such as experience and qualifications generally influence pupil outcomes indirectly (Borich, 1996; Costin & Grush, 1973). Limited evidence exists as to the direct effects of the personality of teachers for pupil achievement (Buddin, 2010; Chilodue, 1996). Research also shows a weak but direct association between teacher certification and pupil attainment (Darling-Hammond, 2000; Mandeville & Liu, 1997; Monk, 1994). Secondary school pupils taught by teachers with higher mathematical qualifications usually achieve higher scores for thinking than pupils associated with teachers with lower qualification levels (Mandeville & Liu, 1997). Darling-Hammond (2000) found teacher qualifications to be significant predictors of pupil attainment after controlling for poverty and English as a second language amongst American secondary school pupils. However, an earlier study by Byrne (1983) found no effect on pupil attainment depending on the subject knowledge of teachers; as indicated by teacher qualifications. Monk (1994) elicited a curvilinear relationship between teacher qualifications and pupil outcome; suggestive of a threshold effect. Research examining the association between head teacher attributes such as head teacher experience and qualifications with pupil achievement is harder to come by. This is probably due to the fact that head teachers are less proximal to pupils and also in view of the importance attributed to head teachers’ leadership roles. However, in view of the mixed findings regarding the association between pupil achievement and teacher attributes, the possibility that head teacher attributes such as experience and qualifications influence pupil outcome cannot be dismissed.

3.1.3 Type and Socio-Economic Composition of Schools

Pupils in private schools, particularly pupils in church schools, usually achieve more than pupils in secular schools (Dronkers, 2004; Dronkers & Robert, 2008; Murnane, 1984). Differences in pupil outcome across state and private schools also depends on whether achievement is considered in attainment or in progress terms. In 2005, the Phi Delta Kappan published a report of research on pupil achievement in public and state schools. This was based on an analysis of the National Assessment of Educational Progress published in 2000. It had been previously assumed, that the higher average outcomes in private schools meant that these schools were more effective in terms of pupil progress. However, re-analysis of the data on a nationally representative sample of 30,000 pupils in the fourth (9 to 10 years) and the eighth grades (13 to 14 years), in the United States of America, showed pupils in state funded schools to be out-performing pupils in private schools for mathematics, in progress terms, after adjusting for pupil background factors. The socio-economic composition of pupils in schools can have also have detrimental effects for pupil attainment and for pupil progress (Driessen & Sleegers, 2000; Dronkers & Robert, 2008; Mujis & Reynolds, 2000). Socio-compositional effects are largely a consequence of differences in parental income and parental education that are likely to vary across private and state schools. Diverse patterns of adult and child interaction are also likely to develop in schools that draw children from diverse socio-economic backgrounds (Dronkers & Robert, 2008). Mujis and Reynolds (2000) discovered that the contribution of socio-economic background at the school level is second only to the contribution of socio-economic background at the classroom level. More specifically, they found that at the school level socio-economic factors can account for as much as 6% to 10% of the variance.

3.1.4 Size of Schools and Classrooms

Smaller schools, in terms of the number of pupils on roll, are likely to foster a climate that: supports a high quality educational experience (Duke, Roberto & Trautvetter, 2009), impacts positively on pupil outcome (Cotton, 1996; Lindsay, 1982) and fosters better relationships amongst pupils, staff and parents (Bates, 1993). Quality of instruction is also likely to be better in smaller than in larger schools (Fouts, 1994; Walberg, 1992). The terms large or small used to describe schools tend to be arbitrary.

In the United States of America, small schools are those with 300 to 400 hundred pupils on roll. Large primary schools are those with more than 400 pupils on roll. On the basis of these criteria, the majority of primary schools in Malta are likely to be smaller in size.

Small classes impact positively on pupil outcome, particularly for pupils from the ethnic minorities and from disadvantaged socio-economic backgrounds (Boyd-Zaharias & Pate-Bain, 2000; Krueger & Whitmore, 1999). However, few studies that are not experimental in design provide evidence of the positive effects of smaller classes (Hanushek, 1999). Hedges (2000) compared three types of studies: small-scale randomized experiments such as the Tennessee–based Student-Teacher Achievement Ratio (STAR) project. The effects of each of these three types of studies are within the range of 0.13 to 0.18 standard deviations in favor of small classes. Hedges concluded that some studies offer some evidence of the overall positive effects of smaller classes. However, these effects may not be directly associated with fewer pupils. Effects are also likely to be associated with differences in the quality of processes in differently-sized classrooms. Bruhwiler and Blatchford (2009) systematically examined the association between class size, teacher quality, classroom processes and pupil outcomes in Switzerland. They found that small classes had a positive effect on the outcomes of secondary school pupils in Switzerland. In Switzerland, class size averages at 18.8 pupils in secondary and 19.3 pupils in primary schools. Teachers in smaller classrooms had more time to attend to pupils' learning needs and could therefore establish more opportunities for learning (Blatchford et al., 2001; Blatchford & Mortimore, 1994; Smith & Glass, 1980) by adapting instruction. (Houtveen & Reezigt, 2000). However, not all teachers adapt their practice to harvest the opportunities offered by smaller classrooms (Blatchford & Mortimore, 1994; Blatchford et al., 2007; Wright, Horn & Sanders, 1997).

Reasons as to why smaller classrooms are likely to enhance pupil outcome was addressed by Anderson (2000) who described class size as a contextual variable. Therefore, the number of pupils in a classroom is likely to exert an effect, even if at times indirect, on pupil outcome (Zahorik, 1999). Class size also influences how teachers behave in classrooms and what pupils do in classrooms before influencing learning. To further explain the relationship between class size and pupil achievement, Anderson (2000) developed a model that links reduced class size with student achievement. The reduced class size model predicts that smaller classes have direct positive effects because fewer disciplinary problems are likely to result as a consequence of increased instructional time. Combined with teacher knowledge, this produces greater opportunity for pupils to learn.

3.1.5 Teaching Processes

Time-on-task, lesson structure, curriculum coverage, group-work and the amount of homework assigned are associated with differences in teaching quality which then shape differences in pupil outcome. Levin and Nolan (1996) describe time on task as the time dedicated to teaching a subject and the time pupils spend actively engaged in learning. Various countries across the world mandate an average of 750 hours of school time (UNESCO-IBE, 2000). Mathematics is usually allocated a fifth of this time (Benavot & Amadio, 2004). Marzano (2003) argues that if opportunities for learning are to come in effect, then the time made available for learning must include enough time to make the curriculum viable. This implies that "a guaranteed and viable curriculum" is the school level factor with the greatest impact on pupil achievement. (Marzano, 2003:15). Whether, curriculum coverage really has the greatest impact may be however open to discussion. Scheerens and Bosker (1997) also connect curriculum coverage with time on task. However, time alone even when coupled with appropriate curriculum coverage does not suffice. Learning in pupils can only develop as long as the teacher is competent and the learning activities are effectively designed and implemented (Brophy, 1985). A focus on teaching and learning (Sammons, 1999) and a focus on learning important basic skills (Edmonds, 1979; Levine & Lezotte, 1990) must therefore complement curriculum cover and time on task.

Ensuring sufficient amounts of time for teachers to teach the curriculum and for pupils to process curricular objectives coupled with a focus on the basic skills are amongst the more prescribed elements of teaching. However, teachers "should encourage experimentation, contingency and fluidity" (Mujis & Reynolds, 2011:84) which is consistent with a constructivist approach. Although constructivist approaches mitigate against the creation of a “generic” (Mujis & Reynolds, 2011:83) lesson template there are key elements to a “constructivist lesson”. Mujis and Reynolds (2011) describe four lesson phases that are associated with constructivist teaching. The first phase is the start phase in which teachers link with pupils’ prior knowledge to introduce the topic of the lesson and to discover rules and definitions through activity. The second phase is the exploration phase in which pupils can work on the activity that involves real-life situations and/or materials as set by the teacher during the start phase. During this second phase, the teacher might focus pupils regarding the strategies that they could use to work-out the activity. The third phase is the reflection stage in which pupils analyse their work with the group and/or with the teacher. During this third phase, the teacher can scaffold learning through strategies such as questioning, probing, prompting and offering feedback. The fourth phase is the application and the discussion phase in which teachers convene the whole class to discuss the answers and conclude the lesson such as by revising the main points of the lesson.

Evidence regarding the positive contribution of small group work for pupil outcome is mixed. Seating arrangements of pupils are usually based on considerations about classroom management, differentiation of ability and classroom layout (Baines et al., 2009). Good et al. (1990) showed that small-group work can be negative for pupil achievement. Small-group work may lead to the reinforcement of pupil misconceptions because it is harder for teachers to monitor small groups rather than individual pupils or pairs of pupils. Small-group work demands greater teaching ability since it is a highly structured activity (Goods & Galbraith, 1996). It also requires substantial teacher effort and preparation (Reynolds & Muijs, 1999). In terms of time, the benefits of small group work are questionable (Townsend & Hicks 1997; Wood & Sellers, 1997). Mixed evidence about the positive influence of small-group work may also be linked with less experienced teachers who tend to engage more in small-group work (Brophy & Good, 1986). This implies that it is the quality of teacher processes and not just small-group work that impact positively upon pupil outcome.

Some homework offers pupils the opportunity to practice what they learn but above a certain level homework incurs no benefits for learning (Hallam, 2004). In a study of some 25,000 eighth grade pupils aged 13 to 14 years in 1,032 schools in the United States of America, Eren and Henderson (2008) found that homework contributes significantly towards pupil attainment but effects are usually only positive for high and low achievers. The link between homework and learning rests on three central assumptions (Eren & Henderson, 2008). First, ability varies and pupils need different amounts of time to complete the same amount of homework. Second, homework is good but only if assigned in reasonable amounts. Third, pupils have a limited amount of time for homework so this time should benefit all pupils regardless of their ability.

3.1.6 Teacher Behaviours

Quality teaching "maximizes learning for all" (Glatthorn & Fox, 1996:1) and without teachers pupil learning cannot be secured (Creemers, 1997; Munro, 1999; Scheerens & Bosker, 1997). The association between pupil achievement and teacher behaviours is well-documented (Brophy & Good, 1986; Creemers, 1994; Joyce & Weil, 1996; Luyten, 1994; Mujis & Reynolds, 2011; Rivkin, Hanushek & Kain, 2005). Effective teaching is associated with various teacher behaviours (Brophy, 1986) and it is "unlikely that one isolated behaviour will make the difference" (Mujis & Reynolds, 2000:278-279). Effective teachers of mathematics: emphasise academic instruction, view learning as their main teaching goal and spend most of their time on curriculum-based learning activities (Brophy & Good, 1986; Cooney, 1994). Effective teachers: adapt teaching strategies (Mortimore et al., 1988; Mujis & Reynolds, 2003), establish a positive classroom climate (Mujis & Reynolds, 2003), dedicate more time demonstrating and interacting with pupils (Rosenshine, 1979) and adapt the curriculum to focus on the acquisition of academic processes (Perfetto, Bransford & Franks, 1983). Quantity of academic activity, quality of lessons, a positive classroom climate, teachers' psychological factors, teacher behaviours, the quality of lessons and other factors such as teacher beliefs characterise effective teachers (Campbell et al., 2004). Effective teachers of mathematics are likely to adopt a direct and interactive approach in which assessment is central (Mujis & Reynolds, 2011). The direct approach implies that teachers: safeguard time, have clear objectives, stress the key parts of a lesson, make explanations clear and conclude with a plenary activity. The interactive approach implies that teachers: ask a high number of questions (especially higher order questions), offer pupils immediate and positive feedback, keep pupils actively engaged during seat-work and are available to pupils. However, does the constructivist philosophy, undergirding the amalgamation of direct and interactive approaches to teaching and learning travel well across different educational contexts? In his meta-analyses of over 800 studies, Hattie (2009) elicited various aspects of teacher/teaching activity which were associated with pupil progress (effect sizes listed in Table 3.5 are all at .40 and over).

Table 3.4 **–** *Effect Sizes from Hattie's (2009) Meta-Analyses of Teachers and Teaching*

Teacher/teaching influences	**Effect size**
Provide formative evaluation	.90
Micro-teaching	.88
Intervention for learning disability students	.77
Teacher clarity	.75
Reciprocal teaching	.74
Feedback	.73
Teacher-student relationships	.72
Spaced versus mass practice	.71
Meta-cognitive strategies	.69
Self-verbalisation/self-questioning	.64
Professional development	.62
Problem-solving teaching	.61
Not labelling students	.61
Teaching strategies	.60
Cooperative versus individualistic learning	.59
Study skills	.59
Direct instruction	.59
Mastery learning	.59
Worked examples	.57
Concept mapping	.57
Goals	.56
Peer tutoring	.54
Cooperative versus competitive learning	.54
Keller's PIS	.53
Interactive video methods	.52
Questioning	.46
Quality of teaching	.44
Expectations	.43
Behavioural organisers/adjunct questions	.41
Matching style of learning	.41
Cooperative learning	.41

A study that was particularly important in demonstrating the association between teaching and pupil achievement is The Gatsby-funded Mathematics Enhancement Project Primary by Mujis and Reynolds (2000). This study was designed to improve the teaching of mathematics in primary schools in the UK using whole-class interactive methods. The sample consisted of 78 teachers and 2,128 pupils and focused on the quantity as well as the quality of teacher behaviours (Mujis & Reynolds, 2000). This was achieved this by administering a classroom observation instrument called The Mathematics Enhancement Classroom Observation Record otherwise known by the acronym MECORS (Schaffer, Mujis, Kitson & Reynolds, 1998). All teachers in years 1, 3 and 5 were observed during lessons of mathematics. Inter-rater reliability between observers was established for four lessons and found to be very good at .81 ($p < .001$) when employing Cohen's Kappa. Pupils were tested twice yearly, once in March and again in July using a standardised test for numeracy from the National Foundation for Educational Research over a two-year period. Pupil progress was calculated in terms of the simple pupil gain in marks achieved by pupils. This was conducted by subtracting the score achieved by individual pupils in July from that previously achieved in March.

The Mathematics Enhancement Classroom Observation Record (MECORS) was used to take detailed notes about teaching during lessons of mathematics (MECORS A) and the behaviours observed of teachers (MECORS B). Trained observers first took detailed notes about: classroom organisation, individual seatwork, small group work, lecturing of the whole-class by the teacher in a non-interactive way and lecturing pupils in non-engaging ways; that is either through questioning or discussion. Observers also had to note pupils who were engaged on task and off task every five minutes. In this way, a detailed picture regarding the amount of time in minutes spent on task in classrooms with teachers per lesson could be calculated. After each observed lesson teacher behaviours were rated as follows: 1 (*rarely observed*), 2 (*occasionally observed*), 3 (*often observed*), 4 (*frequently observed*) and 5 (*consistently observed*). The behaviours observed of teachers were correlated with pupils' simple gain scores as (Table 3.5).

***Table 3.5** – Pearson Correlation Coefficients Teacher Behaviour Scales – Pupil Gain Scores.* (Mujis & Reynolds, 2001:283)

Scales	**Year 1 written (A)**	**Year 1 written (B)**	**Year 1 mental**	**Year 3 written**	**Year 3 mental**	**Year 5 written**	**Year 5 mental**
Classroom management	.12**	.21**	.26**	.34**	.15**	.34**	.17**
Behaviour management	.13*	.19**	.25**	.40**	.16**	.32**	.15**
Direct teaching	.24**	.22**	.32**	.32**	.14**	.36**	.22**
Individual practice	.18**	.17**	.26**	.35**	.15**	.34**	.21**
Constructivist methods	.09^{ns}	.03^{ns}	.07^{ns}	.04^{ns}	-.18**	.03^{ns}	-.09^{ns}
Mathematical language	.22**	.19**	.12*	-.01^{ns}	.09^{ns}	.13**	.01^{ns}
Varied teaching	.20**	.24**	.28**	.37**	.25**	.34**	.14**
Classroom climate	.17**	.23**	.21**	.28**	.13**	.36**	.16**
Time on task	.05^{ns}	.10*	.15**	.21**	.05^{ns}	.02^{ns}	.10*
Interactive	.16**	.11**	.16**	.26**	.10*	.03^{ns}	.01^{ns}
Seatwork (%)	-.12*	-.13**	-.13**	-.20**	-.07^{ns}	-.06^{ns}	-.03^{ns}
Small group (%)	.02^{ns}	.00^{ns}	.00^{ns}	-.14**	-.10*	-.14**	-.12**
Whole class lecture (%)	-.02^{ns}	-.05^{ns}	-.06^{ns}	-.07^{ns}	.22**	.30**	.07^{ns}
Transitions (%)	-.10*	.04^{ns}	-.06^{ns}	-.04^{ns}	-.08^{ns}	-.13**	-.02^{ns}

ns = not significant, ** = significant at the .01 level, * = significant at the .05 level

Classroom management, behaviour management, direct instruction, review and practice, interactive teaching, varied teaching and classroom climate were significantly and positively associated with pupils' simple gain in scores for mathematics even if weak (from .12 to .39). Percentage time on task, percentage of time spent on seatwork, percentage teaching the whole class interactively, percentage lecturing the whole class, percentage small group work and percentage of time spent on transitions were significantly and also weakly associated to pupils' simple gain scores (from .10 to .26). Weak, negative associations (from -.12 to -.20) were elicited between seat-work and pupil gain for Years 1 and 3. It was concluded, that the amount of time assigned to pupils by teachers to learn, the extent of the curriculum that teachers cover with their pupils, the way in which teachers structure lessons, the way that pupils' are seated, the engagement of pupils in group work and the amount of homework teachers assign are amongst the variety of teaching and teacher behaviours likely to influence pupils' simple gain scores. After adjusting for the contribution of individual and background variables, pupils taught by teachers who scored highly on the scale of effective behaviours achieved between 10% to 25% more than pupils taught by teachers who scored low on the effective teaching scale.

3.1.7 Teacher Beliefs

Other non-behavioural aspects of teaching, such as teacher beliefs, may also influence classroom practice via teacher instruction (Campbell et al, 2003). Beliefs are difficult to define and "messy in construct" (Pajares (1992:2). Descriptors include: "implicit theories" (Clark & Peterson 1986), "conceptions" (Ekeblad & Bond 1994), "personal pedagogical systems" (Borg, 1998), "judgements" (Yero, 2002) "perceptions" (Schulz, 2001), "pedagogical principles" (Breen et al., 2001) and "theories for practice" (Burns, 1996). Pajares (1992) argues that this confusion revolves around the distinction between knowledge and belief whilst McLeod (1992:579) distinguishes between beliefs, attitudes and emotions:

> …largely cognitive in nature, and are developed over a relatively long period of time. Emotions, on the other hand, may involve little cognitive appraisal and may appear and disappear rather quickly…Therefore we can think of beliefs, attitudes and emotions as representing increasing levels of affective involvement, decreasing levels of cognitive involvement, increasing levels of intensity of response, and decreasing levels of response stability.

Though more contestable than teacher behaviours, because less observable, teacher beliefs may be more influential than subject knowledge (Ernest, 1989; Pajares, 1992).

A reason for this is that teacher practice also depends on less observable processes associated with what teachers bring into the classroom environment (Campbell et al., 2004; Shulman, 1986). Calderhead (1996:715) argues that "beliefs refer to suppositions, commitments, and ideologies," whilst knowledge refers to "actual propositions and understandings". Although teachers may be in possession of knowledge regarding for example addition, they might not be able to show pupils efficient methods of addition due to their beliefs. For example, not all teachers may believe that all pupils are able to learn. Since teacher beliefs influence instruction (Garofalo, 1989) and teaching (Askew et al., 1997; Baroody, 1987), teacher beliefs should be congruent with teaching methods (Hollingworth, 1989).

Askew et al. (1997) described the beliefs held by highly effective, and not as effective, teachers of numeracy in England. Highly effective teachers were found to hold beliefs that allowed them to make connections explicit for their pupils within and across mathematics topics and therefore exhibited a connectionist orientation. During lessons, highly effective teachers of mathematics used: a variety of words, symbols and diagrams, reasoned with pupils to address misconceptions and emphasized efficient methods; particularly those mental. Highly effective teachers believed it their responsibility to: discuss mathematical concepts, highlight connections between knowledge, skills and strategies, employ various forms of assessment to monitor and record pupil progress for planning, believe that pupils are able to become numerate and possess a richer repertoire of teaching strategies. In contrast, teachers who were not as effective did not make connections explicit because of their perceived differences about pupil ability. Less effective teachers emphasized the practice of standard methods, applied abstract word problems without considering alternative and more efficient ways of solving problems, used assessment to stress to pupils what they learnt rather than to inform their practice and exhibited a narrower repertoire of teaching strategies.

Quantitative evidence that associates teacher beliefs directly with pupil attainment or pupil progress is hard to come by. Nonetheless, the beliefs held by teachers are likely to shape pupils' experiences (Day et al., 2006), even if the relationship between pupil achievement and teacher beliefs is likely to be mainly indirect because of the decrease in proximity to pupils (Mujis & Reynolds, 2002). A questionnaire, formulated on the findings in the Askew et al. (1997) study was administered to survey the beliefs held by teachers (Mujis & Reynolds, 2002). The association between teacher beliefs and the simple gain in pupil scores was analysed using both multilevel and structural equation modelling techniques. Unfortunately, structural equation modelling techniques could not be used to account for the hierarchical structure of the data due to the relatively small sample of classrooms. As hypothesised teacher beliefs and self-efficacy had significant indirect effects on pupil gain as mediated by teacher behaviours. A connectionist orientation was positively related to pupil gain, a discovery orientation was negatively related to pupil gain and a transmission orientation was not significantly related with pupil gain. Since teacher orientations reflect different forms of teacher activity and are characterized by different teacher behaviours, this implies that teacher beliefs undergird teacher practice. This suggests that the beliefs of teachers of different orientations will be reflected through differences in teacher behaviours.

3.2 Summary

This chapter highlighted the importance of educational contexts and school and classroom processes for pupil attainment and pupil progress. On the ground, effectiveness is visible through a combination of head teacher leadership (Mortimore et al., 1988; Ralph & Fennessy, 1983) and high quality teaching (Hattie, 2009). In effective schools, head teachers lead rather than head. In ineffective schools, head teachers maintain the status quo. Teachers in effective classrooms are consistent, organized and positive in approach. Teachers in ineffective classrooms are inconsistent and disorganized. This raises the following questions: how do teaching processes, teacher behaviours and teacher beliefs differ depending on pupil progress? Are Maltese head teachers central to effective schools?

In view of the central and varying nature of head teachers’ and teachers’ activity and practice, variations in the effectiveness of primary schools in Malta are likely. However, school effectiveness is not only influenced by factors at the school and classroom level but is also influenced by factors at the pupil level. In view of this, the next chapter discusses the influence of pupil and parent characteristics for pupil achievement.

CHAPTER 4
PUPIL AND PARENT CHARACTERISTICS INFLUENTIAL FOR PUPIL ATTAINMENT AND PUPIL PROGRESS

Schools are differentially effective because of variations in the quantity and quality of educational activity as practised in classrooms and in schools. Schools and classrooms are also differentially effective because schools attract pupils from diverse backgrounds. In consideration of the important influence of background factors for pupil achievement, this fourth chapter reviews the pupil and parent characteristics that predict pupil attainment and pupil progress.

4.1 Which Pupil and Parent Characteristics are Likely to Predict Pupil Attainment and Pupil Progress in Malta?

Research about educational effectiveness highlights the importance of establishing a context supportive of quality teaching and in fostering a climate that supports better practice within schools. Although schools and classrooms can impact pupils' achievement outcomes in positive or in negative ways, pupil attainment and pupil progress is also influenced by pupils' background characteristics such as pupils' intake levels (Sammons, 1999) and prior attainment (Desforges & Abouchaar, 2003; Sammons, 1999; Sammons et al., 2004a; Sylva et al., 2004).

The Effective Provision of Preschool Education Project (Sammons et al., 2004a) elicited a moderately high correlation of 0.55 ($p < .01$) between children's initial assessment in early number concepts and their later attainment at age 6 on the Maths 6 (NFER) test. Prior attainment is also the best predictor of pupil progress for subjects such as mathematics (Campbell et al., 2004), English and Science (Feinstein & Duckworth, 2007). However, higher levels of prior attainment do not guarantee increased rates of pupil progress (Duckworth, 2007). This is because prior attainment is also influenced by other characteristics such as cognitive ability (Dreary et al., 2007) and socio-economic factors (Sammons, 2009). In Malta prior attainment, was also elicited as a predictor of pupil progress for Maltese and English (Mifsud et al., 2000, 2004) alongside with a number of pupil and parent characteristics (Table 4.1).

Table 4.1 *– Pupil Level Predictors of Pupil Attainment and Pupil Progress in Malta*

	Attainment			**Progress**	
Pupil level (age-adjusted)	**Maltese (Age 6, Year 2) & (Age 9, Year 5)**	**English (Age 6, Year 2) & (Age 9, Year 5)**	**Maths (Age 5, Year 1)**	**Maltese (from Age 6 to Age 9)**	**English (from Age 6 to Age 9)**
Prior attainment			na	***	***
Sex	Age 6***	Age 6***	*	ns	ns
	Age 9***	Age 9***			
First language	Age 6***	Age 6***	ns	**	ns
	Age 9***	Age 9***			
Years in preschool	Age 6***	Age 6***	***	ns	ns
	Age 9***	Age 9***			
Special needs	Age 6***	Age 6***	***	***	***
	Age 9***	Age 9***			
Father's occupation	Age 6***	Age 6***	***	***	***
	Age 9***	Age 9***			
Father's education	Age 6*	Age 6**	***	***	***
	Age 9***	Age 9***			
Mother's occupation	Age 6[na]	Age 6[na]	***	na	na
	Age 9***	Age 9***			
Mother's education	Age 6***	Age 6***	***	*	*
	Age 9***	Age 9***			
Family structure			***	na	na

na = not applicable, ns = not significant, * significant at p < .05, ** significant at p < .01, *** significant at p < .001

4.1.1 Age

Age influences pupil attainment and pupil progress in different ways. In the Effective Provision of Preschool Education (Sammons et al., 2004a), correlations for raw scores show older children at entry to Year 1 to achieve significantly higher scores than their younger counterparts for mathematics ($r = .19$, $p < .01$). Crawford, Dearden and Meghir (2007) also show that for English birth date matters. Their study based on data from the English National Database had a one in ten sample of pupils aged 5, 7, 11, 14, 16 and 18. They found that younger pupils perform worse on standardised tests of attainment than older pupils. Various processes appear to be involved in shaping the achievement outcomes of older and younger children Age impacts upon pupils' information-processing skills (Kinard & Reinharz, 1986). Older pupils are more likely to be placed in higher streams than younger pupils (Donofrio, 1977). This partly explains the discriminatory effect of age in primary (Sharp & Hutchison, 1997) and in secondary school (Bell & Daniels, 1990). The effect of age is also likely to combine with other characteristics that may disadvantage some pupils over others. In England, the number of younger children with statements is significantly higher than the number of older children with statements (Sammons et al., 2002).

4.1.2 Sex

Results from TIMSS (2007) show that across 57 countries, differences in pupil attainment at age 14 are not consistently registered depending on sex differences. This suggests that educational policy rather than the cognitive ability of boy and girl pupils come into play across the participating countries. Some studies report differences in the attainment outcomes of boy and girl pupils as emerging later on at school (Hyde, Fennema & Lamon, 1990; Kingdon & Cassen, 2007; Leahey & Guo, 2001). Differences have been known to occur at a much earlier age (Rathbun et al., 2004). In the Effective Provision of Preschool Education (Sammons et al., 2004b), girls were found to progress more than boys in the acquisition of early number concepts. However, at Key Stage 2 boys were out-performing girls Melhuish et al. (2006). This implies that boys and girls process mathematics in diverse ways (Gurian & Stevens, 2011). However, it does not automatically imply that this is due to differences in cognitive ability. The way in which teachers teach (Bloom, 1956; Snow, 2002) and the learning strategies that pupils adopt (Vermunt & Vermetten, 2004) are also likely to influence the attainment and progress outcomes of boy and girl pupils.

4.1.3 Pupils who Experience Difficulty with Learning

Identifying the learning needs of pupils from early on in their schooling career is important (Davie, 1996). There is a distinction to be made between pupils with statements and pupils experiencing difficulty with learning. Pupils with statements are children diagnosed with some form of cognitive, social and/or behavioural difficulty. Pupils experiencing difficulty with learning may not have a formal diagnosis of a special educational need. Nonetheless, these pupils may still find learning challenging. Both groups of pupils are educationally vulnerable and at risk of experiencing learning delay. Poverty is likely to increase educational vulnerability (Leroy & Symes, 2001).

In the UK, Some 38% of pupils with statements receive free school meals (Dockrell, Pearcy & Lunt, 2002).

It is questionable if the learning support that some pupils obtain at school is beneficial to their progression. Schlapp et al. (2001), argue that teacher assistants may contribute positively to learning by offering experiences such as: increased interaction with adults, increased exposure to learning activities and the opportunity to reinforce tasks. Mujis and Reynolds (2003) discovered that teaching assistants do not impact significantly on the outcomes of pupils that they support for mathematics. Jacob and Lofgren (2004) indicate that the effect of remedial support exhibits a non-linear relationship with pupil outcome. Blatchford et al. (2007) show concern about the contribution of teaching assistants who spend most of their time in a "direct pedagogical role" (Blatchford et al., 2009:680) rather than assisting teachers directly. More recent findings elicited a negative relationship between the support offered by teacher assistants and pupil progress for English and mathematics (Blatchford et al., 2011). The more support a pupil obtained the less progress the pupil registered.

4.1.4 Socio-Economic Background

There is a strong relationship between socio-economic background and mathematical achievement (Ginsburg & Russell, 1981; Sacker, Schoon, & Bartley, 2002). Pupils are likely to experience differences in the quality of their home backgrounds because of differences in their socio-economic background (Campbell & Ramey, 1994; Majoribanks, 1994; Sipe & Curlette, 1996). Socio-economic background of families can influence pupil achievement via parental involvement, parental aspirations and school composition, psychological adjustment of pupils (Sacker et al., 2002) and can disadvantage some pupils, over others, due to differences in home resources (Spencer, 1996).

Cognitive disadvantage is more prevalent amongst pupils with parents from the manual classes than amongst pupils with parents from the professional classes (Feinstein, 2003). In the Effective Provision of Preschool Education (Sammons et al., 2004a), the positive influence for pupil attainment at age 6 for mathematics associated with better educated mothers who held a degree was greater in comparison with mothers who had not achieved a degree (ES = .55, $p < .05$). Pupils aged 6 with unemployed fathers achieved significantly lower levels of attainment at age 6 in comparison to pupils with fathers in full-time employment (ES = .20, $p < .05$). The net attainment was around six standardised marks (ES = .44, $p < .05$) for mathematics for children from professional non-manual backgrounds and children from semi-skilled manual backgrounds. Differences between children from the professional non-manual backgrounds and children from the unskilled manual group were wider still (ES = .68, $p < .05$). Pupils with better reasoning skills tend to have more affluent backgrounds (Nunes et al., 2009). Pupils with parents from professional backgrounds are also more likely to have experienced higher rates of verbal interaction (Kingdon & Cassen, 2007). The influence of education increases in importance when the influence of socio-economic background is strong (Luyten, 1994). The achievement gap between pupils drawn from the higher and from the lower socio-economic groups may correspond to as much as 12 months in mental age (Meijnen, Lagerwei & Jong, 2003). It is also known to amount to much as 15% of the variance in test scores for mathematics (Mujis & Reynolds, 2003).

4.1.5 Family Status

Pupils living with both parents get to spend more time with their parents than pupils whose parents are not living together. Parents who are living together are more likely to communicate more with teachers than separated parents (Lareau, 2002). Pupils from single-parent families are more likely to experience a decrease in the quality of their general well-being (Barrett & Turner, 2005) and access to fewer educational resources (Hampden-Thompson & Johnston, 2006; Lareau, 2002). Differences in family structure can also lead to educational disadvantage in pupils because it impinges on the quality of interaction within families (Chiu & Xihua; 2008).

4.1.6 Preschool

Quality preschool education is positively associated with child development (Melhuish, 2004). In the United States of America, the Perry Preschool Project (Schweinhart & Weikart, 1997), still continues to confirm the importance of quality preschool provision in securing opportunities later on in life. Locally, the findings of The Numeracy

Survey (Mifsud et al., 2005) show that the minority of pupils who did not attend preschool achieved significantly lower scores at age 5 then the majority of pupils who attended preschool for two years. In the UK, The Effective Provision of Preschool Education (Sammons et al., 2004) confirmed the lasting effects of preschool throughout Key Stage 1. Quality of preschool setting was significantly associated with pupil performance on standardised tests for reading and for mathematics (age 6). A year later at age 7 the association between quality of preschool setting and attainment in the basic skills was weaker but still significant. Rates of progress varied depending on the quality of the preschool centre. Starting preschool earlier between the ages of two and four was associated with higher intellectual development and increased peer sociability. However, there was some evidence to indicate that starting preschool before 2 years of age led to a slight increase in behavior problems for some pupils. This study also confirmed the positive impact of quality preschool education for educationally vulnerable children. At the start of preschool, one in three children were considered at risk of experiencing learning difficulty. This ratio dropped to one in five by the time children started school.

4.1.7 First Language

"The interaction between mathematic achievement and language is real" (Abedi & Lord, 2001). Pupils taught in a language other than their mother tongue usually under-achieve in mathematics (Gillborn & Gipps, 1996). Pupils need to be sufficiently proficient in a language before they are able to solve mathematical operations and problems in that language. When the language of mathematical instruction differs from the first language of the pupil, pupils may under-perform because the language requirement is too high for them. Consequently this influences their mathematical development. The language gap can have important consequences for pupil achievement when pupils are tested (Bailey, 2000). Locally, the findings of The Literacy Survey (Mifsud et al., 2000), Literacy for School Improvement (Mifsud et al., 2004) and The Numeracy Survey (Mifsud et al., 2005) repeatedly show that it is only around 10% of Maltese pupils, in a given year group, with English as a first language. Therefore, 90% of Maltese pupils stand a greater chance of under-achieving in mathematics if teaching is mainly in English. The findings of the three above mentioned surveys show that Maltese pupils who speak English at home usually have parents with professional/managerial backgrounds.

4.1.8 Private Tuition

International studies such as TIMSS (Beaton et al., 1996) and PISA (OECD, 2001) show that private tuition is prevalent in many countries. Tansel and Bircan (2006) argue that private tuition is prevalent in countries with competitive examination entry to University or in countries with fewer universities or limited financial resources available for higher education. In Turkey, Unal et al. (2010) discovered that 15-year old pupils from more economically affluent backgrounds are more likely to attend private tuition for mathematics. Other studies also attest to the positive impact of private tutoring for pupil achievement (Creemers & Kyriakides, 2008; Ireson, 2004; Kyriakides, 2005; Kyriakides & Luyten, 2008; Teddlie & Reynolds, 2000). After reviewing private tutoring schemes from different countries, Bray and Kwok (2003) concluded that private tuition in developing countries is associated with the decreased levels of pupil attainment and/or pupil progress that is achieved on international benchmarks. Mixed reactions as to the effect of private tuition is connected with the uncertainty as to the effects of private tuition for pupil attainment and pupil progress.

4.1.9 Regional Differences

The development of children depends on the interaction between characteristics individual to pupils and the various social and environmental forces operating through their experiences (Boyce et al., 1998; Bronfenbrenner, 1979; Earls & Carlson, 2001). Neighbourhoods account between five to ten percent of the variance associated with differences in pupil outcome (Leventhal & Brooks-Gunn; 2000). The experiences associated with the regions that pupils reside in are also likely to shape their development (Anderson, 2003; Fullan, 1985) and to act as agents of socio-economic advantage/disadvantage (Boyle et al., 2007).

4.2 Summary

This chapter identified some pupil and parent characteristics known as predictors of pupil achievement such as: age, sex, ability, socio-economic background, family status, length of time spent at preschool, first language, private tuition and regional/area differences in the hometown of pupils. This chapter also concludes the first part to the current study. On the basis of the literature reviewed in this first part three implications can be drawn. First the description of local educational context in Malta in Chapter 1 indicates that in the absence of a system to monitor and track the attainment and the progress outcomes of pupils leaves policy-makers and educational professional in the dark regarding the factors and characteristics that predict pupil achievement. Second, the integration of effectiveness concepts from the fields of teacher and school effectiveness research within the field of educational effectiveness in Chapter 2 is indicative of the multidimensional character of educational effectiveness which implies the differential effectiveness of schools and classrooms. Third, the centrality and influence of educational factors such as head teacher leadership and teacher/teaching processes in Chapter 3 after considering variations in pupil achievement due to differences in pupils' background in Chapter 4 may not always be evidenced in direct ways. This is viewed by the current study as an important reason to incorporate qualitative data that illustrates similarities and differences in head teacher and teacher practice in differentially effective schools. Therefore the first part, sets the frame for Chapter 5 (Part 2) that discusses the design and methods employed by the current study.

PART 2

CHAPTER 5

DESIGN AND METHODS

To examine the relationship between pupil achievement and the effectiveness of schools and classrooms for mathematics in Malta, this fifth chapter first discusses the design employed by the current study. The chapter then proceeds to discuss the methods required for the administration of the research instruments and the use of mixed approaches for the collation of the quantitative and the qualitative data.

5.1 The Mix in Design

The design of the current study aims to: (1) identify the predictors of pupil attainment and of pupil progress, (2) classify and characterize the differential effectiveness of local primary schools, and (3) illustrate head teacher and teacher practice in a selection of differentially effective schools. Therefore, the current study was designed to collate: (a) numerical data about the age 5 (Year 1) and the age 6 (Year 2) outcomes of a nationally representative sample of pupils, (b) numerical data about attributes, beliefs and behaviours of Year 2 teachers as well as the attributes of head teachers, and to collate (c) textual data about the practice of head teachers and teachers. Increasingly the application of mixed methods in research is viewed as the third way to broach the dichotomy connected with qualitative and quantitative divide (Brannen, 2005; Creswell, 2009; Tashakkori & Teddlie, 2003). Tashakkori and Teddlie (2003) regard mixed methods as the integration of qualitative and quantitative techniques so as to address research questions that: (1) other methodologies alone cannot examine, (2) provide stronger and clearer inferences, and (3) offer the opportunity for the presentation of divergent views. In view of these considerations, care was taken to ensure that the design of the current study fulfilled pre-established quality criteria to support discriminant multilevel analysis at the pupil, classroom and school level (Goldstein & Spiegelhalter, 1996; Scheerens, 1992) and the capacity to support the complementary application of a qualitative approach (Gorard & Taylor, 2004) by the inclusion of a case study approach. The overall design considerations of the current study are illustrated in Figure 5.1.

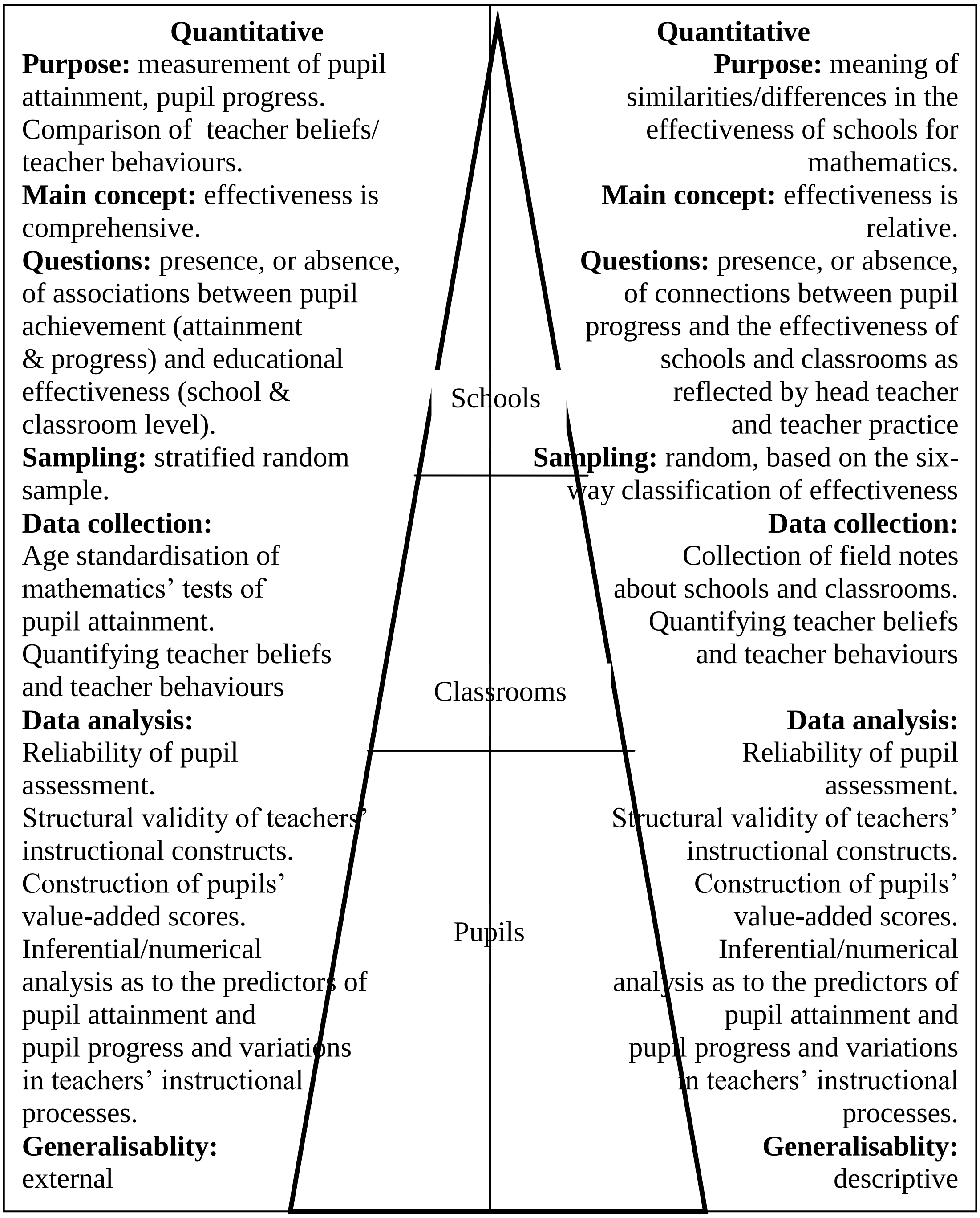

***Figure 5.1** – An Overall Design Model for The Current Study*

The more specific theoretical framework in Figure 5.2 that was used as a more formal research framework for the current study is mainly taken from The Comprehensive Model of Educational Effectiveness (Creemers, 1994).

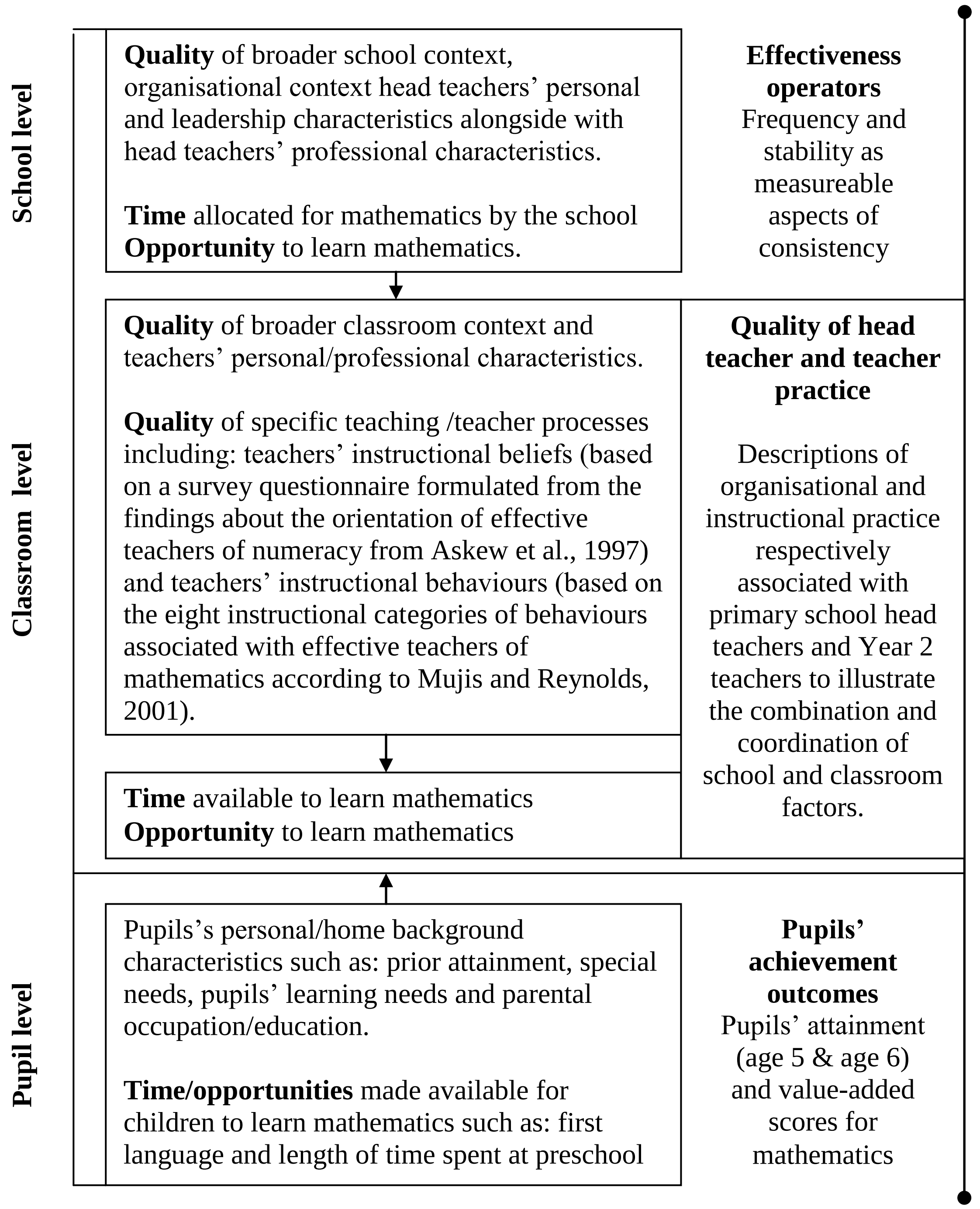

Figure 5.2 *– A Model for the Examination of Pupil Progress and School Effectiveness for Mathematics in Malta*

The above model was slightly adapted for the purposes of the current study. For example, Figure 5.1 excludes measures of pupil aptitude and pupil motivation. Reasons for restricting the study were linked to human and financial constraints. This decision was also informed on the basis of the greater contribution of the cognitive domain than the affective domain for pupil achievement (de Jong, Westerhof & Kruiter, 2004). Various effectiveness studies incorporate both the school and the classroom level (de Jong, Westerhof & Kruiter, 2004; Kyriakides, 2005; Mortimore et al., 1988; Opdenakker & Van Damme, 2000a; Teddlie & Stringfield, 1993). Usually the classroom level explains a greater proportion of the variance in pupil achievement than the school level.

At the pupil level of the research framework in Figure 5.1, a number of characteristics associated with differences in background such as: prior attainment, pupil ability and parental occupation and education are considered as likely candidates to serve as predictors of pupil attainment and/or pupil progress. A number of other characteristics associated with the time and opportunities for pupils to learn mathematics such as: length of time spent at preschool and first language are also included. At the classroom level, the study framework considers teacher beliefs as likely predictors of pupil attainment and/or pupil progress. This ties-in with the notions advanced by Campbell et al. (2004) that quality of teacher instruction is likely to be influenced by processes that extend beyond the classroom and beyond the behavioural. The current study considers it possible that the instructional beliefs held by teachers may be directly associated with pupil attainment and/or pupil progress. This hypothesis is counter to that advanced by Mujis and Reynolds (2003). Also at the classroom level the examination of teacher behaviours is based on the eight-factor categorization of effective teaching by Mujis and Reynolds (2001). Teacher behaviours such as: classroom management, the maintaining of appropriate behaviour in the classroom, providing pupil with opportunities for review and practice, teachers exhibiting skills in questioning, the implementation of enhancement strategies in mathematics, the implementation of a variety of teaching methods and the establishing of a positive classroom climate are also considered as likely predictors of pupil attainment and/or pupil progress. At the school level, contextual factors such as the size of the school and head teacher attributes are also considered as likely predictors of pupil attainment and/or pupil progress. Pupil achievement is considered as an outcome of: school/classroom level factors (Kyriakides, Campbell & Gagatsis, 2000), the practice of head teachers in their role as leaders (Bush, 2003; Leithwood, 2003; Mayer et al., 2007, Sammons, Day & Ko, 2010) and teacher practice (Campell et al., 2004).

5.1.1 Frequency, Stability and Consistency

In The Comprehensive Model of Educational Effectiveness (Creemers, 1994), consistency is the lead criterion for the operation of effectiveness. The Dynamic Model of Educational Effectiveness (Creemers, Kyriakides & Antoniou, 2009) offers the dimensions of frequency, focus, stage, quality and differentiation as operators of effectiveness. In the Model of Differentiated Teacher Effectiveness teachers are viewed as differentially effective in their instruction and in their roles as teachers (Campbell et al., 2004). This implies that teachers in the same school need not be associated with similarly achieving classroom-groups of pupils. The points raised above imply different permutations with regards to the connection between head teacher and teacher practice and pupil progress which is then reflected by the differential effectiveness of schools

In the current study, frequency and stability are considered as more specific operational aspects of the broader operational phenomena of consistency. Unlike the broader definition provided by Creemers and Reezigt (1996:215-216) of consistency as: "...conditions for effective instruction related to curricular materials, grouping procedures and teaching behaviour should be in line with each other", the current study also considers consistency in more specific terms as the increased frequency and the increased regularity of school and classroom activity and practice positive for pupil learning over time. Whilst, consistency implies that curricular materials, grouping procedures, teaching behaviours, and in the current study teacher beliefs, are frequently and repeatedly aligned in ways that are positive for the development of effective schools (Creemers & Reezigt, 1996; de Jong, Westerhof & Kruiter, 2004) a lack of consistency implies that the infrequent and the irregular implementation of effectiveness conducive conditions over time are not positive for the development of effective schools. Therefore a lack of consistency, or inconsistencies, in the alignment of organisational and instructional conditions are more likely to be found in ineffective schools than in effective schools.

In the current study, frequency is defined as the quantity of a classroom or school based condition in time whilst stability is defined as the quantity of a classroom or school based condition over time. If frequency and stability are measurable, is consistency measurable? If one approaches this question quantitatively than a high correlation between instructional variables might be taken as evidence of consistency. For example, a high positive correlation between significant increases in pupil progress, increased curriculum coverage and increased frequency in effective teacher behaviours would provide direct evidence of the increased prevalence of consistency, or the increased alignment of educational conditions, with positive effects for pupil progress. Similarly, a high correlation between a significant "decrease" in pupil progress, decreased curriculum coverage and decreased frequency in effective teacher behaviours would also provide direct evidence of the lack of consistency, or increased misalignment of educational conditions, with negative effects for pupil progress.

There are currently a number of difficulties that limit the adoption of a quantitative approach to the examination of consistency. The most important concerns the fact that this is the first pupils in classrooms in schools study for Malta. Repeated local data about important educational characteristics such as teaching quality do not exist and nothing is known about the quality of head teacher and teacher activity and practice over time. Therefore, the contexts and processes associated with similarities and differences in educational quality in Maltese primary schools need to be repeatedly researched before a robust local-specific concept and construct of consistency can be established.

The current study considers illustration as a qualitative device to illuminate the operation of consistency as this is reflected by the combination and coordination of predominantly organisational processes associated with head teachers in schools and predominantly instructional processes associated with teachers in classrooms. In the current study, the illustration of effectiveness is based on the six-way classification of effectiveness as described in section 2.4.7, Table 2.3. In the first scenario, "typical effective" schools are schools associated with pupils whose value-added scores are significantly above expectation (+2, +1 s.d) and with a majority of Year 2 classrooms associated with pupils whose mean rates of progress are also significantly above expectation (+2, +1 s.d). In the second scenario, “typical average” schools are associated with pupils whose value-added scores do not depart significantly from expectation (0 s.d) and with a majority of classrooms associated with pupils whose mean rates of progress do not depart significantly from expectation (0 s.d). In the third scenario, “typical ineffective” schools are associated with pupils whose value-added scores are significantly below expectation (-2, -1 s.d) and with a majority of classrooms associated with pupils whose mean rates of progress are significantly below expectation (-2, -1 s.d). In the fourth scenario, “atypical effective” schools (+2, +1 s.d) do not have a majority of effective classrooms. In the fifth scenario, “atypical average” schools (0 s.d) do not have a majority of average classrooms. In the sixth scenario, “atypical ineffective” schools do not have a majority of ineffective classrooms.

5.1.2 Research Questions and Hypotheses

The aims of the current study to: (1) identify the predictors of pupil attainment and pupil progress, (2) classify and characterise the differential effectiveness of schools, and to (3) illustrate head teacher and teacher practice in differentially effective schools that were further informed following a review of the teacher, school and educational effectiveness literature led to the formulation of the following research questions:

1. what are the predictors of pupil attainment and pupil progress in Malta for mathematics after adjusting for factors at the pupil, the classroom and the school level?
2. do the pupil, classroom and school level predictors of pupil progress differ across (and possibly within) differentially effective schools? Within this research question lie the following research questions: how do the broader school and classroom characteristics and teaching/teacher/instructional characteristics (beliefs and behaviours) differ across (and possibly within) differentially effective schools?
3. how does the practice of head teachers and Year 2 teachers differ across and within differentially effective schools?

The first two research questions necessitate the: measurement of pupil attainment and the effect of pupil, classroom and school level predictors of pupil achievement, the classification of effective, average and ineffective schools (and classrooms) and the characterization as to variations in effectiveness conducive conditions across schools and within schools. Examination of these two research questions are better served by the application of multilevel techniques that ask for a quantitative approach. The third research question concerns comparing and contrasting the strategies adopted and implemented as part of the practice of head teaching and teaching in differentially effective schools. The examination of the third research question is better served by the application of a case study approach to illustrate the strategies connected with the practice of head teaching and teaching that requires a qualitative approach.

5.1.2.1 What are the Predictors of Pupil Attainment (Age 6) and Pupil Progress for Mathematics?

For the pupil level, and from the findings of The Literacy Survey (Mifsud et al., 2000), Literacy for School Improvement (Mifsud et al., 2004), The Numeracy Survey (Mifsud et al., 2005) and other foreign studies, it is hypothesised that age, socio-economic background, family status, prior attainment, sex, length of time at preschool, first language, pupil ability, private tuition and regional/area differences in the home towns of pupils are likely to predict pupil attainment and/or pupil progress. For the classroom level, it is hypothesised that broader characteristics contextual to classrooms, teaching and teachers' instructional processes are likely to predict pupil attainment and/or pupil progress (Hattie, 2009; Mujis &Reynolds, 2000). On the basis of findings by Askew et al. (1997) and considerations by Campbell et al. (2004), teacher beliefs may predict pupil attainment and/or pupil progress. On the other hand, evidence from Mujis and Reynolds (2003) indicates that it is more likely that teacher beliefs are indirectly associated with pupil progress. However, since the current study is the first pupils in classrooms in schools study to examine the association between pupil progress and school effectiveness, for Malta for mathematics, the possibility of direct linkage between teacher beliefs and pupil attainment/pupil progress cannot be immediately discounted. On the basis of findings from the literature, it is unlikely that teacher attributes such as experience and qualifications will predict pupil attainment and/or pupil progress (Borich, 1996). However, this possibility cannot be completely discounted in the light of findings by Childodue (1996) and Darling-Hammond (2000).

For this reason such variables were included at the classroom level. At the school level, it is hypothesised that broader school level characteristics contextual to schools, such as the type of school and head teacher attributes such as age and experience may predict pupil attainment and/or pupil progress.

5.1.2.2 How Do the Predictors of Pupil Progress Differ Across Differentially Effective Schools?

Earlier in Chapters 2 and 3, it was discussed how effective schools and ineffective schools are characterised by differences in the quantity and quality of activity and practice in educational environments such as schools and classrooms. Teacher and teaching characteristics (Hattie, 2009), teacher behaviours (Mujis &Reynolds, 2000) and possibly teacher beliefs (Campbell et al., 2004) are likely to come into play in predicting pupil attainment and pupil progress, for mathematics, in Malta. Since pupil progress and educational effectiveness are inter-dependent, and since this relationship is mediated by school and classroom level effectiveness, it is hypothesised that factors associated with teaching and teachers' instructional processes are also likely to vary in quantity and/or quality across, and possibly within, effective and ineffective schools.

5.1.2.3 How Does Practice Differ Across and Within Differentially Effective Schools?

In Chapter 3 it was discussed how head teacher leaders (Elmore, 2000; Mortimore et al., 1998; Sammons, 2006) and teachers who are consistent about instructional goals and knowledgeable about the curriculum (Ko & Sammons, 2010) are generally associated with effective schools. However, head teachers who maintain the status quo, follow the curriculum as set, monitor staff minimally and teachers who follow the textbook too closely, adopt a slow lesson pace, interact minimally with pupils and hold low expectations for pupils are generally associated with ineffective schools (Reynolds et al., 2002). Therefore, it is hypothesised that head teacher and Year 2 teacher practice is also likely to vary in Malta across and in schools.

5.1.3 Preparing for the Collation of Data

Preparatory work regarding the data collation exercises were managed by the author as two inter-related projects (Table 5.1).

***Table 5.1** – Preparing for the Collation of Data*

Project A - Pupil/parent data	Project B - Teacher/classroom and head teacher/school data
Phase 1 (September 2003) - permission to access schools and use The Numeracy Survey data.	**Phase 1 (October 2003) -** permission from schools to conduct observations.
Phase 2 (March 2004) - conducting the pilot study to assess the feasibility of project A.	**Phase 2 (October to February 2004) -** conducting the pilot study to assess the feasibility of project B.
Phase 3 (March 2004) - recruiting schools for the main study	**Phase 3 (March 2004) -** recruiting classrooms for the main study
Phase 4 (September 2004) – confirming participation of schools	**Phase 4 (September 2004) -** confirming participation of schools

Phase one of Project A and B focused on obtaining permission to acceed to schools and to The Numeracy Survey (Mifsud et al., 2005) data. During this first phase, permission from the relevant state and private school authorities was sought. Access to state schools was granted (by the then Education Division) on condition that any publication of results did not preceed those of The Numeracy Survey. The data collation exercises and the holding of the data also had to conform to legal requirements (Data Protection Act, 2004). During phases two and three, the focus was on recruiting schools to participate in the pilot and the main studies. During phase two, the objective was to obtain informal acceptance from head teachers in the pilot study schools. Following this, a detailed explanation was provided to head teachers so that they were aware of the commitment that this project entailed. Year 2 teachers targeted for participation in the pilot study were also informally advised about this. After, the author arranged a meeting with the pilot study Year 2 teachers. This was conducted to explain further the study and to answer queries and/or discuss concerns from teachers. Written parental consent regarding pupil participation was also sought during this second phase. During phase three, schools recruited for the main study were contacted following the same procedure in phase two. In phase four, schools were allowed to reconsider their participation, since up to six months could have elapsed between their initial commitment and the onset of the main data collation exercises.

5.1.4 Ethical Considerations

Socio-educational research incorporates understandings about the processes organising schools and the contexts shaping the quality of interaction within schools (Scott & Usher, 1999). The examination of pupil attainment and pupil progress and the classification of school and classroom level effectiveness is also regulated by rules (Pring, 2004). During June and July 2003, a number of ethical issues had to be considered to facilitate the author in the drawing-up of a plan to collect data in a manner respectful of the local educational reality (Simons, 1995). This included: obtaining access to data and participants, guaranteeing participant confidentiality and anonymity of and establishing conduct rules for the researcher. Ethical guidelines provided by the British Educational Research Association (2004) highlighted the need for: (1) voluntary and informed consent from parents, teachers and head teachers prior to the study being underway, (2) parental, teacher and head teacher rights to withdraw from the study, (3) the establishing of procedures to minimise pupil discomfort during assessment, and (4) recognition of the burden that research might impose on participants and their right to privacy.

5.1.4.1 Obtaining Access to The Numeracy Survey Data and Participants

Permission to obtain access to The Numeracy Survey (Mifsud et al., 2005) data and to participants was dealt with during September 2003. The then Education Division had strongly advised that feedback to participants could only be given in consultation with them. However, this requirement went counter to the Data Protection Act. This act, upholds the right of participants to be provided with feedback once permission for participation is given. A few parents wished to be provided with general feedback regarding the mathematical attainment of their children. The Education Division was concerned that if parents were given this information educational professionals could be held responsible for pupil performance. Around half of head teachers and a third of teachers also voiced this concern. This problem was handled by providing feedback to parents who requested it, in the presence of the concerned stakeholders. Twenty-seven (27) mothers had requested information as to how their child had fared when tested. Eleven (11) mothers eventually attended the individual meetings.

5.1.4.2 Confidentiality, Anonymity and Code of Conduct

Head teachers, teachers, pupils and parents were all guaranteed confidentiality as well as anonymity. Head teachers, teachers and parents: (1) could withdraw participation at any point during the current study without penalty, (2) were informed that findings would only be published in an aggregate form, (3) were assured that any commentary would be presented in generic terms so as not to single out schools and/or participants, and (4) that no information would be provided to third parties without the necessary permission. In connection with the last point, head teachers could not gain access to information concerning teachers. Likewise, teachers could not gain information about other teachers and/or head teachers. Similarly, parents could only obtain information about their children. Notes taken by researchers, teachers and head teachers were copied to the person concerned immediately after the data was collected. Head teachers and teachers were given the opportunity to clarify and/or strike off any comments made about them during school and classroom observations.

Researchers were guided about their conduct in schools and provided with written guidelines (Appendix 5.1). A team of female researchers were recruited from the pool of researchers employed by The Numeracy Survey (Mifsud et al., 2005) a year earlier. The author of the current study was one of these researchers. Care was taken to ensure that researchers were not assigned the same school they had administered the test in a year previously or to schools in the same town/or village that they lived in. Researchers were required to attend a training session that lasted around two and a half hours prior to the administration of the test. During training, researchers were handed a testing protocol (Appendix 5.2). Researchers could only test pupils before noon but could give pupils a five-minute break if required. The description of researchers as unobtrusive is a myth (Maudsley, 2011). Any research findings whether quantitative

(Langdridge & Hagger-Johnson, 2009), qualitative (Flick, 2009) or multi-method (Brewer & Hunter, 2006) results from the administration of a sensitive research act. To minimize bias through inappropriate interaction, researchers in the current study did not intervene, proffer advice or react during observations; as long as they were not impolite to participants.

5.1.5 Variables

Models are powerful devices for representing the socio-educational reality within schools (Goldstein, 1998; Snijders & Bosker, 1999). More sophisticated models, such as multilevel models, require more sophisticated forms of multivariate analyses. Therefore, such models also require a greater number of variables (Sammons & Smees, 1997) to generate sufficient data for the operationalisation of the related research questions. Variables listed and described in Table 5.2 were required to operationalise the examination of the characteristics of pupils and their parents as predictors of pupils' prior attainment and pupils' progress outcomes.

Table 5.2 *– The Pupil Level Variables (Quantitative)*

Variable name	**Description of variable.**
Attainment (age 5 and age 6)	The age-standardised scores of pupils.
Sex (pupils)	Boy or girl pupils
At risk	Pupils at risk of experiencing difficulty in learning mathematics at school.
Father's and mother's occupation	Categories include: professional, managerial/administrative, higher clerical/skilled craftsmen, skilled manual workers, semi-skilled/un-skilled workers, at home without state benefit or home-maker and not gainfully occupied.
Father's and mother's education (highest level of qualification)	Categories include: no schooling, primary, secondary, sixth form and tertiary.
Parental status (marital)	Categories include: parents together, parents not together and children in care.

***Table 5.2** – The Pupil Level Variables (continued)*

Variable name	Description of variable.
Home district	The geographical region/area/district in which pupils reside in. Categories include: the Southern Harbour, the Northern Harbour, the South Eastern district, the Western District, the Northern District and Gozo.
First language	The language (Maltese or English) spoken predominantly by pupils at home.
Preschool	The length of time spent by pupils in preschool. Categories include: no preschool, 1 year, 2 years and 2^+ years.
Private tuition (age 6 only)	Pupils who attend private lessons in mathematics. Categories include: private tuition and no private tuition.
Seating arrangements	The seating arrangements of pupils in classrooms. Categories include: individual, pairs and groups.
Learning support assistant support	Pupils with statements with in-class support. Categories include: with learning support and without learning support.
Complementary teacher support	Pupils without statements with out-of-class complementary teacher support.

Similarly, variables in Table 5.3 were required to operationalise the examination of the characteristics of teachers and classrooms as predictors of pupil attainment and pupil progress.

***Table 5.3** – The Classroom Level Variables*

Variable name	Description of variable
Class size	Categories include: small (15 pupils or fewer), medium (16 to 25 pupils) and large (26 to 30 pupils).
ABACUS (number of topics)	Number of mathematics topics covered by teachers from ABACUS. Categories include: up to winter (22 topics), up to spring (19 topics) and up to summer (22 topics).
Occupation of fathers/mothers	Aggregated variables that refer to the occupational category of the fathers/mothers of pupils. Categories include: 1 (*low*), 2 (*medium*) and 3 (*high*).

***Table 5.3** – The Classroom Level Variables (continued)*

Variable name	Description of variable
Education of fathers/mothers	Aggregated variables that describe the classroom context in terms of the highest qualification achieved by the fathers/mothers of pupils. Categories include: 1 (*low*), 2 (*medium*) and 3 (*high*).
Lesson duration	Duration in minutes of the lesson of mathematics.
Predominant language of instruction	Language spoken predominantly by the teacher during lessons. Categories include: Maltese, English, Maltese/English and English/Maltese.
Mental warm-up	Duration in minutes of the mental warm-up.
Explanatory	Duration in minutes of explanatory activities.
Set tasks	Duration in minutes pupils spend on writing tasks.
Plenary	Duration in minutes of the plenary session.
Homework	Number of times per week that mathematics homework is assigned to pupils by their class teacher.
Sex	Male or female.
Age	The age-bands teachers. These include: 20-24, 25-34, 35-44, 45-54 and 55-61.
Teaching qualification	Categories include: college-trained, Bachelor in Education, Post Graduate Certificate in Education and not teacher trained.
First language	First language of a teacher (Maltese or English).
Length of time teaching primary	Length of time (in years) teachers taught at primary school. Categories include: 1 to 5, 6 to 10, 11 to 15 and 16^{+}
Teacher beliefs	Aggregated variables based on responses provided by Year 2 teachers to a list of belief items about teaching and learning. These include: 1 (*agree*), 2 (*do not know*) and 3 (*disagree*).
Teacher behaviours	Aggregated variables based on ratings about the frequency of teacher behaviours according to the classroom observation instrument MECORS (B). These include: 1 (*rarely observed*), 2 (*somewhat observed*) and 3 (*frequently observed*).

Similarly, variables in Table 5.4 below were required to operationalise the examination of the characteristics of head teachers and schools as predictors of pupil attainment and pupil progress.

***Table 5.4** – The School Level Variables*

School	Description of variable
Type of school	Whether a school is in the state or private sector.
Size of school	Number of Year 2 classrooms. Categories include: small (1-2), medium (3-4) and large (5-6).
School days	Number of school days.
Occupation of fathers/mothers	Variables that describe the school context in terms of the occupations of the fathers/mothers of pupils. The constructed variables range from 1 (*low*), 2 (*medium*) to 3 (*high*).
Education of fathers/mothers	Aggregated variables that describe the school context in terms of the education qualifications of the fathers/mothers of pupils. These include: 1 (*low*), 2 (*medium*) and 3 (*high*).
Sex	Whether a head teacher is male or female
Age	The age-bands of head teachers in years. These include: 20-24, 25-34, 35-44, 45-54 and 55-61.
First language	First language of a head teacher (Maltese or English).
Teaching qualification	Categories include: college-trained, Bachelor in Education, Post Graduate Certificate in Education (PGCE) and not teacher trained.
Experience teaching	Length of time in years a head teacher spent teaching at primary level. Categories include: 1-5, 6-10, 11-15 and 16 $^{+}$.
Experience head teaching	Length of time in years a head teacher spent in the job. Categories include: 1-5, 6-10 and 11^{+}.

The total time in days that pupils spent at school were calculated, for the pupil, classroom and school level, as follows: (1) school days were counted from the first day till the last day of school, (2) public holidays, saints' days, mid-term break, Christmas/ Carnival/Easter/summer holidays were deducted from the total number of school days, (3) parents' days when held during school hours, school development days and full-day outings were also deducted and (4) days that individual pupils were absent were deducted. In 2005, the number of school days for state schools ranged from a minimum of 228 days to a maximum of 234 days. For private schools this ranged from 201 days to 207 days.

Time available for instruction was also calculated. State schools start at half-past eight in the morning and finish at half-past two in the afternoon. Private schools usually start at eight in the morning and usually finish between half-past one and half-past three in the afternoon. Pupils in state schools spend six hours at school. Pupils in private schools between five and a half hours to a maximum of seven and a half hours at school. Time spent by individual pupils in lunch-time and play-time was deducted to calculate the amount of time available for instruction. The amount of time spent by pupils during lessons of mathematics was calculated for the pupil, classroom and school level. Time scheduled for mathematics in each school was multiplied by the number of days attended by individual pupils. Lessons ranged from a minimum of 30 minutes to a maximum of 90 minutes. In state and in private schools time spent by pupils attending lessons of mathematics range from a minimum of 111 hours (equivalent to 4.62 days) to a maximum of 333 hours (equivalent to 13.87 days). It was also possible to calculate the amount of time that individual pupils spent engaged in the warm-up, introductory, explanatory, seat-work and plenary phases of lessons of mathematics.

5.2 The Mix in Methods

Mixed methods bridge the quantitative/qualitative divide (Brannen, 2005; Creswell, 2009; Johnson & Christensen, 2004), refutes an either/or stance (Teddlie & Sammons, 2010), are pragmatic (Greene & Garacelli, 1997), dialectical (Sammons et al., 2005), iterative in approach (Siraj-Blatchford et al., 2006) and answer questions that quantitative/qualitative approaches alone cannot answer (Tashakkori & Teddlie, 2003). Mixed methods enable newer forms of synergistic knowledge (Day, Sammons & Gu, 2008) in a complementary (Gorard & Taylor, 2004) and integrated (Tashakkori & Creswell, 2007) fashion. In the current study, the mix in methodological approach was first reflected by the timing and the sequencing of the research instruments (Figure 5.3).

		The research instruments administered during the main data exercise		
Pupil assessment (age 5)	**Pilot Study**	**Classroom observation tools**	**Survey questionnaires**	**Pupil assessment (age 6)**
Conducted by the Numeracy Survey (Mifsud et al., 2005)	Parent/guardian, teacher and head teacher questionnaires in June 2004	MECORS (A, qualitative/ B, quantitative) Jan-Feb 2005 Mar to Apr2005	Parent/guardian questionnaire Teacher questionnaire Head teacher questionnaire	Conducted by the current study
Maths 5 May 2004	Re-piloting of teacher and head teacher questionnaires in November 2004	**Field notes** Jan-Feb 2005 Mar-Apr2005		**Maths 6** May 2005
	The current study			

***Figure 5.3** – Timing of the Research Instruments*

Concurrently with the piloting and the administration of the research instruments, the mixed approach to the current study was consolidated by the planning of a multilevel strategy and a complementary case study strategy. This then led to the planning of operationalisation and an analytical strategy for the current study as indicated in Figure 5.4.

<table>
<tr><td rowspan="2">School level</td><td colspan="2">Instruments: the head teacher questionnaire (quantitative), field notes (qualitative) and school profiles (qualitative).</td></tr>
<tr><td>Analysis: multilevel methods to identify the school level predictors of pupil attainment/progress and to examine the contribution of the broader school context (field notes) and head teachers’ personal/professional attributes (head teacher questionnaire) thus enabling the classification of school level effectiveness and the characteristics of differentially effective schools.</td><td>Analysis: case study approach to illustrate head teachers’ organisational strategies employed during their practice.</td></tr>
<tr><td rowspan="2">Classroom level</td><td colspan="2">Instruments: MECORS (A) (qualitative), MECORS (B) (quantitative), field notes (qualitative) and the teacher questionnaire (quantitative).</td></tr>
<tr><td>Analysis: multilevel methods to identify the classroom level predictors of pupil attainment/progress and to examine the contribution of the broader classroom and teaching context, teachers’ personal/professional attributes (teacher questionnaire), teacher beliefs (teacher questionnaire) and teacher behaviours (MECORS B) thus enabling the classification of classroom level effectiveness and the characterisation of differentially effective classrooms.</td><td>Analysis: case study approach to illustrate teachers’ instructional strategies employed during their practice.</td></tr>
<tr><td rowspan="2">Pupil level</td><td>Instruments: Maths 5 test (quantitative), Maths 6 test (quantitative) and the parent/guardian questionnaire (quantitative)</td><td></td></tr>
<tr><td>Analysis: Multilevel methods to identify the pupil level predictors of pupil attainment/progress. More specifically to: examine pupils’ attainment outcomes and pupils’ value-added outcomes on standardised tests of mathematics at age 5 (Maths 5) and at age 6 (Maths 6) and to identify the pupil and parent characteristics significant for pupil achievement.</td><td></td></tr>
</table>

***Figure 5.4** – The Research Instruments and the Analytical Approach*

5.2.1 A Sampling Framework

Multilevel methods require samples of participants that are sufficiently large and robust for discriminant analysis, yet small enough to retain efficiency (Mok, 1995). Following the recommendations by Teddlie and Stringfield (1993), a multistage and stratified method of sampling was employed to target pupils/parents, Year 2 teachers/ classrooms and head teachers/primary schools for entry into the current study. Confidence intervals in Table 5.5, calculated according to the formula by Yamane (1967) in Appendix 5.3, estimated the number of pupils.

Table 5.5 *– Estimating the Number of Pupils for the Main Study*

Confidence interval	Margin of error	Estimated sample size
95%	0.05	368
96%	0.04	452
97%	0.03	583
98%	0.02	823
99%	0.01	1,400

Classrooms had to exceed 50 (Maas & Hox, 2001) and schools 30 (Kreft, 1996). To leave room for attrition, 41 schools, 99 classrooms and 2,200 pupils were targeted for inclusion in the main data collection exercise. This was comfortably greater than the 1,400 pupils required to attain the 99th percentile. At this stage, it was decided that eight schools would be randomly sampled for the pilot study. The sampling of the schools for the main and pilot studies was conducted according to the framework in Figure 5.5 below.

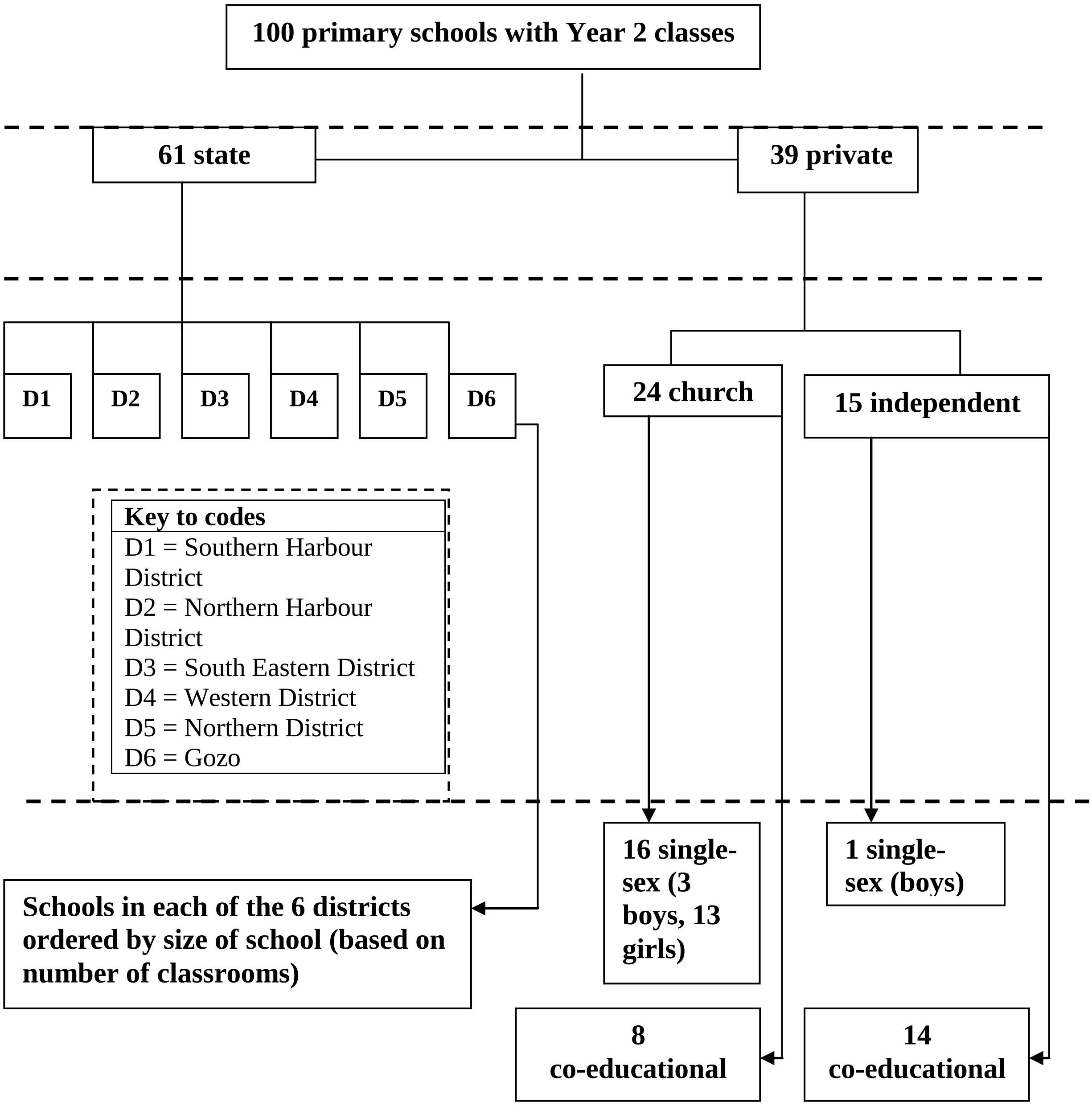

Figure 5.5 *– Strata of the Year 2 Population of Primary Schools in Malta in 2005*

Following the above sampling plan, percentage figures were calculated for each of the four stratum (Table 5.6).

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Table 5.6 *– Percentage Figures of the Stratified Primary School Population*

100%: N schools = 100 (1st stratum)	
61% state: N = 61 (2nd stratum)	**39% private: N = 39 (2nd stratum)**
State by district (3rd stratum)	**Private by type (3rd stratum)**
Southern Harbour: 21.31%, N = 13	Church: 64.10%, N = 25
Northern Harbour: 19.67%, N = 12	Independent: 35.90%, N = 14
South Eastern: 18.03%, N = 11	
Western: 11.48%, N = 7	
Northern: 11.48%, N = 7	
Gozo: 18.03%, N = 11	
State by district and size (4th stratum)	**Private by sex (4th stratum)**
Southern Harbour: Large: 30%, N = 3, Small: 70%, N = 10	Church: Boys: 16%, N = 4, Girls: 52%, N = 13, Co-educational: 32%, N = 8
Northern Harbour: Large: 16.67%, N = 2, Medium: 33.33%, N = 4, Small: 50%, N = 6	Independent: Boys: 7.69%, N = 1, Co-educational: 92.31%, N = 12
South Eastern: Large: 18.18%, N = 2, Medium: 18.18%, N = 2, Small: 63.64%, N = 5	
Western: Large: 14.29%, N = 1, Medium: 42.86%, N = 3, Small: 42.86%, N = 3	
Northern: Large: 28.57%, N = 2, Medium: 28.57%, N = 2 Small: 42.86%, N = 3	
Gozo: Small:100%, N = 11	

To select the 41 schools, the name of each state school was placed in a white bag and the name of each private school in a brown bag. Schools were drawn up one by one until the target sample was achieved. When a school that had been previously selected was drawn-up again, the name of this school was returned in its bag in respect of probability. Eventually 41 schools, 99 teachers and 1,937 pupils were randomly selected. Percentage figures were then calculated for each of the four stratum in the target sample (Table 5.7).

Table 5.7 *– Number of Schools in the Stratified Target Sample*

100%: n schools = 41 (1st stratum)	
65% state: n = 27 (2nd stratum)	**34% private: n = 14 (2nd stratum)**
State by district (3rd stratum)	**Private by type (3rd stratum)**
Southern Harbour: n = 6	Church: n = 10
Northern Harbour: n = 6	Independent: n = 4
South Eastern: n = 4	
Western: n = 3	
Northern: n = 3	
Gozo: n = 5	
State by district and size (4th stratum)	**Private by sex (4th stratum)**
Southern Harbour: Large: n = 2 Small: n = 4	Church: Boys: n = 3 Girls: n = 4 Co-ed: n = 3
Northern Harbour: Large: n = 1 Medium: n = 1 Small: n = 4	Independent: Boys: n = 1 Co-educational: n = 3
South Eastern: Large: n = 1 Medium: n = 2 Small: n = 1	
Western: Large: n = 1 Medium: n = 1 Small: n = 1	
Northern: Large: n = 1 Medium: n = 1 Small: n = 1	
Gozo: Small: n = 5	

Of the 2,086 pupils, 99 teachers and 41 schools originally targeted, 1,736 pupils in 89 classrooms and 37 schools achieved entry to the main study. The chi-square test was used to check for differences in the number of pupils; from the target sample to the achieved sample. This could only be conducted for the two upper-most strata because some cases at the two lower-most strata were fewer than five. No significant differences were elicited at the first ($\chi^2 = 0.225^{ns}$, df = 1, p > 0.05) and the second strata ($\chi^2 = 0.037^{ns}$, df = 1, p > 0.05). The loss of 350 pupils from the originally intended sample to the target sample did not lead to a significant loss in the number of pupils. Table 5.8 lists reasons for pupil attrition.

***Table 5.8** – Reasons for Pupil Attrition in the Main Study*

Pupil lost (n = 350)	**Pupils (n = 2,086)**	**Schools (n = 41)**	**Classrooms (n = 99)**	**Reason for attrition**
Minus 60 pupils (two classes)	2,226	40	97	Two teachers did not wish their pupils to be tested for fear that this would be used in some way against them
Minus 30 pupils (one class)	2,196	39	96	Outbreak of chicken-pox.
Minus 90 pupils (three classes)	2,106	38	93	Outbreak of chicken-pox.
Minus 170 pupils (4 classes)	1,736	37	89	Most parents in one school did not wish their children to participate in the study.

5.2.1.1 Sampling the Pilot Schools

Eight primary school head teachers, 17 Year 2 teachers and 356 pupils and their parents were recruited for the pilot study. The number of schools was restricted to eight (seven from Malta and one from Gozo). This number was deliberately limited to retain a sufficient number of schools for sampling into the main study. Of the eight pilot schools, one was from the private independent sector, another from the private church sector and six from the state sector. Pilot schools were randomly selected using the same sampling procedure as the one used for the main study.

5.2.2 The Major Quantitative and The Minor Qualitative Strategy

As indicated earlier in Figure 5.3, the main strategy adopted by the current study is multilevel. This quantitative strategy was employed in connection with the measurement of pupil attainment and pupil progress as well as the identification of the predictors of pupil attainment (age 6) and pupil progress at the pupil, the classroom and the school level. This ties-in with the first research question: what are the predictors of pupil attainment/pupil progress for mathematics after adjusting for factors at the pupil, classroom and school level? Identifying the predictors of pupil achievement in conjunction with the classification of “effective”, “average” and “ineffective” schools allows the evaluation of similarities and differences with regards to the pupil, classroom and school level predictors of pupil progress across differentially effective schools. This ties-in with the second research question: how do the pupil, classroom and school level predictors of pupil progress differ across (and possibly within) differentially effective schools? Quantification alone does not yield sufficient detail about the quality of head teacher and Year 2 teacher strategies in differentially effective schools. Detailed records about the routines and strategies of head teachers and Year 2 teachers, which were used to elaborate case studies of practice, were maintained in the school and the classroom profiles. The case study approach was adopted to avoid the pitfalls of adopting an overly narrow and empirical definition of effectiveness (Elliot, 1996; Campbell et al., 2004; Goe, Bell & Little, 2008; Thrupp, 2001) and to focus on head teachers and teachers in broader ways. This ties-in with the third research question: how does the practice of head teachers and Year 2 teachers differ across and within differentially effective schools?

5.2.2.1 The Models for Attainment (Age 6) and Progress (Quantitative - Multilevel)

Various similar steps were involved in the construction of two multilevel models for the examination of pupil attainment (age 6) and pupil progress between the age of 5 (Year 1) and 6 (Year 2). The analysis of pupils’ age 5 scores was limited to the pupil level. No explanatory variables for the classroom level were collected as part of The Numeracy Survey (Mifusd et al., 2005). Therefore, it was not possible to identify the predictors of pupil attainment at age 5 on a like-with-like basis with the predictors of pupil attainment at age 6. With regards to the construction of the models for pupil attainment (age 6) and pupil progress, a null model was first constructed through use of the software MLwiN. Then the age-standardised age 5 or age 6 scores of pupils were set as the independent variable in each model. After this, a pupil/parent model was constructed by including pupil level variables already listed in Table 5.2. The addition of prior attainment transformed the pupil/parent model from one for the examination of attainment (age 6) to one for the examination of progress. A teacher/classroom model was then constructed. Variables in this model refer to teacher attributes and broader teaching conditions in classrooms (Table 5.3). After this, a teacher beliefs model was constructed by including the relevant variables to the teacher/classroom model. Variables in this model refer to responses given by Year 2 teachers to statements about beliefs regarding the teaching (and learning) of mathematics (Table 5.3). This was followed by the construction of a teacher behavior model. Variables in the teacher behaviour model refer to the frequency of effective behaviours observed of Year 2 teachers during lessons of mathematics (Table 5.3). Finally, a head teacher/school model was constructed by including variables to the teacher behaviour model. These variables refer to broader conditions at school and head teacher attributes (Table 5.4). This step was the same in the models for attainment (age 6) and progress.

5.2.2.2 The School and Classroom Profiles (Qualitative – Case Study)

Elliot and Lukeš (2008) argue that the purpose of case studies is to complement the study of samples rather than to supplant their study. In the current study, the study of the samples (and of the characteristics) of pupils and their parents, Year 2 teachers in classrooms and primary school head teachers in schools refers to data that is hierarchical in structure. However, the levels of data also house within them layers of data that concern the practice of head teachers and the practice of teachers within the systemic organisation of education in schools and in classrooms. Therefore, a case study approach was adopted by the current study to provide a richer picture about the activity and practice characterising head teachers and teachers following the classification of differentially effective schools (and classrooms). Elliot and Lukeš (2008:88) also consider that case studies refer to: “a form of inquiry into a particular instance of a general class of things that can be given sufficiently detailed attention to illuminate its educationally significant feature". This implies the more open character of case studies. Therefore, the current study sought to provide a more structured framework for the textual data yielded by the field notes and MECORS (A) about conditions in schools and classrooms and about the practice of head teachers and teachers were employed to maintain 89 classroom profiles and 37 school profiles. Data held within the school and classroom profiles then contributed towards the elaboration of case studies of head teacher and teacher practice. Profiles were compiled according to critieria in Table 5.9.

***Table 5.9** – Criteria for the School and the Classroom Profiles*

School level criteria	**Research instrument**
Type of school	Field notes
Size of school	Field notes
Predominant socio-economic composition of pupils in school	Parents'/guardians questionnaire and field notes
Sex of head teacher	Head teacher questionnaire and field
Age range of head teacher	Head teacher questionnaire and field
Head teacher experience of teaching at primary	Head teacher questionnaire and field notes
Leadership	
Monitoring of teachers by the head teacher	Field notes
Involvement of head teacher with	Field notes
Selection of teachers by the head teacher	Field notes
Replacement of teachers by the head	Field notes
Vision	
Availability of school development plan	Field notes
Implementation of school curriculum	Field notes
Climate and order	Field notes
Time scheduled for mathematics	Field notes
Relationships	
Forming of relationships with teachers	Field notes
Parental involvement	Field notes
Practice	
Head teacher involvement of teachers	Field notes
Head teacher monitoring of staff	Field notes
Head teacher discusses instructional	Field notes
Head teacher discusses curricular issues	Field notes

***Table 5.9** – Criteria for the School and the Classroom Profiles (continued)*

Classroom level criteria	**Research instrument**
Size of classroom	Field notes
ABACUS topics covered	Field notes
ABACUS topics not covered	Field notes
Socio-economic composition of classroom	Parent/guardian questionnaire and MECORS (A)/field notes
Sex of teacher	Teacher questionnaire and MECORS (A)/field notes
Age range of teacher	Teacher questionnaire and MECORS (A)/field notes
Teaching qualifications	Teacher questionnaire and MECORS (A)/field notes
Lessons	**Research instrument**
Duration in minutes	MECORS (A)
Disruptions to lessons in minutes	MECORS (A)
Duration of mental warm-up	MECORS (A)
Number of explanatory activities	MECORS (A)
Duration of each explanatory activity	MECORS (A)
Duration of plenary	MECORS (A)
Number of times per week mathematics homework is assigned	MECORS (A)
Nature of mathematics homework	MECORS (A)
Instructional practice	
Year 2 teachers' observed behaviours	MECORS (A)

5.2.3 Administration of the Research Instruments

Various instruments were administered to collate numerical and textual data for the pupil, classroom and school level. These included: Mathematics 6 (NFER), the classroom observation instrument MECORS, the parent/guardian questionnaire, the teacher questionnaire, the head teacher questionnaire and field notes. The author of this study and another educational professional were the two researchers who administered MECORS and took field notes. Forty-one (41) researchers were initially recruited to administer the Mathematics 6 test (NFER); one of whom was the author. The researchers were recruited from a larger pool of researchers who had participated in The Numeracy Survey (Mifsud et al., 2005) a year earlier. The selected researchers were either teacher trained or students in their final year of the Bachelor in Education (Honours) degree course. Following the loss of the 349 pupils (see Table 5.8), the number of researchers was reduced to 37. The author remained one of these researchers.

5.2.3.1 Maths 5 (Pupil Level)

Mathematics 5 (NFER) was first administered in Maltese primary schools in 2005 as part of The Numeracy Survey (Mifsud et al., 2005). From this point onwards this test is referred to as Maths 5. This test assesses four process areas in mathematics: understanding number, non-numerical processes, computation and knowledge and mathematical application. Table 5.10 draws on Maths 5 to define these four process areas from the test administration booklet (NFER-Nelson with Patilla, 1999a:3).

Table 5.10 *– Cognitive Process Areas in Maths 5*

Process areas	Description
Understanding number	These questions require pupils to demonstrate an understanding of basic numerical concepts and processes. The challenge[…]lies in the understanding of the process rather than in the performance of a numerical operation (if any).
Non-numerical processes	These questions require an understanding of non-numerical mathematical concepts and processes... The questions do not have any significant numerical content that needs to be considered by the pupils.
Computation and knowledge	[…]questions in this category can be answered directly upon recall of one or more mathematical facts or terms. All these
Mathematical application	[…] This first involves determining from the content the required operation before performing the calculation (if any).

Maths 5 was administered orally so that limitations in the reading ability of pupils did not bias their scores. Guidelines in English for administration of the test were obtained from Hagues et al. (2001). A copy of these were supplied to researchers The Maths 5 test was age-standardised for Malta using the Schagen (1990) method by an experienced statistician as part of The Numeracy Survey. Cronbach's alpha shows the internal reliability of this test to be acceptable at 0.75 although this is slightly lower than that ($\alpha = 0.81$) reported for the UK. Differential item analysis conducted on each of the 24 items in Maths 5 for Malta did not elicit any serious bias (Mifsud et al., 2005).

5.2.3.2 Maths 6 and the Pilot (Pupil Level)

Mathematics 6 (NFER) is the next test in the Mathematics 5 – 14 series. From this point onwards this test is referred to as Maths 6. This test consists of 26 items categorised around five process categories: understanding number, non-numerical processes, computation and knowledge, mathematical interpretation and mathematical application. Mathematical interpretation in Maths 6 is additional to the four process areas in Maths 5. The definition of mathematical interpretation from page 3 of the Maths 6 test administration booklet follows: "pupils have to interpret information from charts and diagrams. A calculation may or may not be involved." (NFER-Nelson with Patilla, 2001:3) Said (2006) illustrates the connection between items in Maths 6 with ABACUS topics (Table 5.11).

***Table 5.11** – Connections between Maths 6 Test Items and Topics in ABACUS*

Item	Description	ABACUS Topic
1	Simple sets	Data handling and problem-solving
2	Identifying 2D shapes	Shape and space
3	Sharing money	Money
4	Properties of 2D shapes	Shape and space
5	Doubling	Multiply and divide
6	Simple subtraction	Addition and subtraction
7	Adding on	Addition and subtraction
8	Grouping	Data handling and problem-solving
9	Flat shapes odd one out	Shape and space
10	Simple block graph	Data handling and problem-solving
11	Ordinal numbers	Number
12	Adding ten	Addition and subtraction
13	Simple bill	Money
14	Simple addition	Addition and subtraction
15	In between numbers	Number
16	Pairing	Multiply and divide
17	Identifying 3D shapes	Shape and space
18	Subtraction	Addition and subtraction
19	Addition with money	Money
20	Ordering numbers	Number
21	Recognition of simple fractions	Fractions
22	Stories of nine	Number
23	Size	Measurement and estimation
24	Straight and curved lines	Shape and space
25	Story sum	Multiply and divide
26	Telling the time	Time

When Maths 5 was administered in 2005, parents of participating pupils were asked to select, prior to testing, whether their child would be tested in Maltese or in English. Therefore, Maths 6 required translation from English to Maltese. A first translation was conducted by the author prior to the pilot study. This translation was checked by a teacher of Maltese who was blind to the English version. This teacher then conducted the translation back to English. Afterwards, two primary school teachers, in two different pilot schools, blind to one another, translated this version of the test in English back to Maltese. This Maltese version of Maths 6 was employed for the pilot study. Following the pilot study, the author felt that the Maltese version of the Maths 6 test still required improvement. Improvements were continuously underway during January and February 2004. The purpose of this was to update the language of testing and to render Maths 6 test more accessible to pupils aged 6. To confirm that the updated Maltese version did not deviate substantially from the original English version, the Maltese version was translated back into English by an additional Year 2 teacher. Changes between the first and final versions of the test in Maltese are in Appendix 5.4.

A team of 37 researchers, one of whom was the author, administered Maths 6 during the first two weeks of May 2005. Two weeks earlier, class teachers had distributed a pilot version of the parent/guardian survey questionnaire to pupils in Maltese and English. In the questionnaire, information was provided about the research project, the duration of the test and the right of parents and pupils to strict confidentiality/anonymity. Maths 6 was administered to small groups of not more than five pupils at a time and took between 30 and 50 minutes. Researchers were allowed to give pupils a break mid-way. Responses to the Maths 6 test are reliable at $\alpha = 0.81$. This is the same as that reported for Britain during the standardisation of Maths 6 with a sample of UK pupils.

5.2.3.3 The Parent/Guardian Questionnaire and the Pilot (Pupil Level)

Surveys describe conditions, identify standards for comparison and map relationships between events (Cohen & Manion, 1990). Survey questionnaires were administered to gather data at the pupil, classroom and school level. Questionnaires were administered to the parents or to the guardians of pupils during June 2004 for the pilot study and during the last week of April 2005 for the main study. The parent/guardian survey questionnaire was collected exactly one week after its initial distribution. The objectives of this survey were to obtain parental permission prior to the testing of pupils and to obtain information about pupils and their parents. With the exception of the accompanying covering letter, this questionnaire was largely based on the questionnaire employed by The Numeracy Survey (Mifsud et al., 2005) a year earlier. A copy of the English and the Maltese version of the letter and the questionnaire (Appendix 5.5 and 5.6 respectively) were distributed amongst pupils targeted for recruitment into the current study. This exercise was conducted twice, for the pilot study and for the main study. Year 2 teachers asked pupils to deliver the questionnaire to their parents. Parents were requested to return the letter and the questionnaire one week later. Minimal cosmetic changes were made to the consent form and the survey questionnaire between the pilot study and the main study stages.

5.2.3.4 MECORS and the Pilot (Classroom Level)

The Mathematics Enhancement Classroom Observation Record (MECORS) is the classroom observation tool that was selected for the purposes of collecting and collating data about the quantity and quality of teachers' behaviours. Instruments such as Quality, Appropriateness, Incentives and Time Framework also known by the acronym QAIT (Schaffer et al., 1998) and the instrument by van de Grift et al. (2004). Quality of Teaching Instrument (QoT) were also available during the design phase of the current. MECORS was preferred because observation items refer to a wider range of teacher behaviours formulated on direct and interactive methods of teaching. MECORS was also considered as a more suitable classroom observation tool for Malta because of its successful application in the UK. It was also preferred because this instrument was designed to collate both quantitative and qualitative forms of the same data. At 0.81 ($p < 0.001$) inter-rater reliability between four researchers for MECORS is high (Mujis & Reynolds, 2001). Part A, of MECORS is designed to systematically collate notes about conditions observed during lessons of mathematics by a trained researcher. Part B of MECORS yields quantitative data based on ratings of teacher behaviours according to the following eight instructional categories: classroom management techniques, the maintaining of appropriate classroom behaviour, teachers focusing and maintaining attention on the lesson, teachers providing pupils with review and practice, skills in questioning, mathematics' enhancing strategies, variety of teaching methods and the establishing of a positive classroom climate. In MECORS (B), observations made about teachers were rated on a 5-point Likert scale ranging from: 1 (*not consistently observed*), 2 (*occasionally observed*, 3 (*sometimes observed*), 4 (*frequently observed*) to 5 (*consistently observed*). The wording on this 5-point scale was slightly adapted for Malta following the pilot study. *Not consistently observed* was modified to *never observed*. This change allowed the possibility that some teacher behaviours might not be observed.

MECORS was first piloted in Malta during May 2004 in 17 classrooms located in eight pilot study schools. Each Year 2 pilot study teacher was observed twice. The initial round of observations took place during the first week in May 2004. The second round of observations took place during the third week in May 2004. Each pilot observation lasted from 45 to 90 minutes. During lessons, the researcher took detailed notes about the teaching of mathematics. Immediately after each lesson, the researcher rated the instructional behaviour for each teacher observed in MECORS (B). Photocopies of notes were given to teachers immediately after this. Teachers could ask to strike out and amend notes that were not to their liking following discussion with the researcher. However, no teacher availed themselves of the option.

The 17 teachers participating in the pilot study reported that they felt that items in MECORS (B) were generally suitable in describing teaching behaviours. However, all pilot teachers expressed concern about the following statements: "starts lesson on time; within 1 minute" (item 2), "uses time during class transitions effectively" (item 3), "sees that disruptions are limited" (item 5), "emphasizes the key points of the lesson" (item 16), "uses a brisk pace" (item 18) and "re-teaches if error rate is high" (item 23). In connection with: "starts lesson on time; within 1 minute" (item 2) all teachers expressed concern that this was overly high in teacher expectation. All teachers expressed themselves as unable to achieve this; partly because of the young age of their pupils. For the behavior: "uses time during class transitions effectively" (item 3), all teachers but one felt that they were unable to use this time effectively. The reason for this being that they had never been trained how to do so. Teachers also felt that the number of school matters that they were expected to deal with hindered their ability to use this time appropriately. Many teachers admitted that they used transition time to deal with administrative matters such as distributing letter circulars to pupils to hand over to their parents. All teachers emphasised that it was difficult to limit disruption during a lesson because came mainly from outside the classroom from senior members of staff. Twelve (12) teachers said that the practice of emphasizing the key points of a lesson, as part of item 16 in MECORS (B) did not happen at all in Maltese classrooms. Teachers thought this behaviour was not appropriate because it removed the element of surprise. For example, with regards to: “teacher uses a brisk pace” (item 18), teachers argued that they could not keep a brisk pace since most pupils in their class were Maltese-speaking. For: “the teacher re-teaches if error rate is high” (item 23), all teachers felt that re-teaching would jeopardize the amount of topics they were able to cover. In view of the concerns raised by teachers for these items, the author revised item 2 to: “teacher starts lesson on time; within 5 minutes”. This revision was considered as more realistic of the then local situation. No further items were revised or struck off MECORS (B) because the author considered it important to record whether teachers engaged in this behaviour or not. The slightly revised version of MECORS which was used in the current study is in Appendix 5.7.

5.2.3.5 Inter-Rater Reliability for Ratings of Teacher Behaviours in MECORS (B) (Classroom Level)

During the main data collection exercise the behaviours of 89 Year 2 teachers were observed twice. Lesson observations were conducted in January/February 2005 and in March/April 2005. The same observation order was respected in each round. Teachers were twice-observed but not by the same researcher. This decreased the possibility that researchers would be influenced by their earlier observation. A preliminary round of observations had been conducted, between October and mid-December 2004, to establish inter-coder and inter-rater reliability between the two researchers. Initially, the researchers, who were not seated next to each another, observed the same eight lessons of mathematics in eight schools. During this period researchers met, following their lesson observations for the day, to discuss the utility of the observation items.

Following this, the two researchers (one of whom was the author) together observed another 25 lessons for mathematics. Following each observation, which lasted from 45 to 90 minutes, researchers completed MECORS (B). During this rating stage, each researcher was not in view of the other. The achieved overall agreement was high ($k = 0.89$, $p < .001$). During this period, no teacher was observed: “summarizing the lesson” (item 22), “connecting new material” (item 45) and “connecting new material to other areas of mathematics” (item 46). The item: “teacher uses a brisk pace” (item 18) proved particularly challenging for the researchers to agree upon. Eventually, moderate agreement was achieved ($k = 0.67$, $p < 0.001$). Establishing agreement for: “teacher uses appropriate wait-time between questions and responses” (item 32) also proved challenging but was ultimately achieved ($k = 0.71$, $p < .001$). Table 5.12 below describes the agreement achieved between the two raters as indicated by the kappa (k) statistic. Unless otherwise indicated all items in Table 5.12 are significant at $p < .001$.

***Table 5.12** – Researcher Judgement in MECORS (B)*

Item	Classroom management	Judgement	k
1	Rules and consequences are clearly understood by pupils	low	0.863
2	Starts the lesson on time (within 5 minutes)	low	0.949
3	Uses time during class transitions effectively	high	0.804
4	Takes care that tasks/materials are collected and distributed effectively	low	0.915
5	Limited disruptions in class	low	1.000
	Classroom behaviour		
6	Uses a reward system to manage pupil behaviour	low	1.000
7	Corrects behaviour immediately	low	0.702
8	Corrects behaviour accurately	low	0.841
9	Corrects behaviour constructively	high	0.954
10	Monitors the entire classroom	low	0.918
	Attention on lesson		
11	Clearly states objectives/purposes of the lesson	low	1.000
12	Checks for prior knowledge	low	0.875
13	Presents material accurately	low	0.836
14	Presents material clearly	low	0.781
15	Gives detailed directions and explanations	low	0.717
16	Emphasises key points of the lesson	low	0.960
17	Academic in focus	high	0.803
18	Uses a brisk pace	high	0.666
	Review and practice		
19	Clearly explains tasks	low	0.704
20	Offers effective assistance to individuals/groups	low	0.920
21	Checks for understanding	low	0.881
22	Teacher or pupils summarise the lesson	low	0.000^{ns}
23	Re-teaches if error rate is high	high	0.835
24	Approachable to pupils with problems	high	0.872
	Skills in questioning		
25	Uses a high frequency of questions	high	0.761
26	Asks academic questions	low	0.793
27	Asks open-ended questions	high	0.788
28	Probes further when responses are incorrect	high	0.732
29	Elaborates on answers	low	0.914
30	Asks pupils to explain how they reached their solution	low	0.951
31	Pupils are asked for more than one solution	low	0.922
32	Uses appropriate wait-time between questions/responses	high	0.705
33	Notes pupils’ mistakes	low	0.912
34	Guides pupils through errors	low	0.916
35	Clears-up misconceptions	high	0.906

ns = not significant

***Table 5.12** – Researcher Judgement in MECORS (B)(continued)*

Item	Skills in questioning (continued)	Judgement	k
36	Gives immediate academic feedback	low	0.867
37	Gives accurate academic feedback	low	0.740
38	Gives positive academic feedback	high	0.912
	Mathematics enhancement strategies		
39	Uses realistic problems and examples	low	0.909
40	Encourages/teaches pupils to use a variety of problem-solving strategies	low	0.881
41	Uses correct mathematical language	low	1.000
42	Encourages pupils to use correct mathematical language	low	0.874
43	Allows pupils to use their own problem-solving strategies	low	0.916
44	Implements quick-fire mental questions strategy	low	0.841
45	Connects new material to previously learnt material	low	0.000^{ns}
46	Connects new material to other areas of mathematics	low	0.000^{ns}
	Teaching methods		
47	Uses a variety of explanations that differ in complexity	high	0.809
48	Uses a variety of instructional methods	low	0.915
49	Uses manipulative materials/instructional aids/resources (number lines/coins)	low	0.839
	Classroom climate		
50	Communicates high expectations for pupils	high	0.743
51	Exhibits personal enthusiasm	high	0.743
52	Displays a positive tone	high	0.865
53	Encourages pupil participation/interaction	high	0.910
54	Conveys genuine concern (emphatic, understanding, warm and friendly)	low	0.957
55	Knows and uses the pupils' names	low	1.000
56	Displays pupils' work in the classroom (ample amount, attractively displayed, current work)	low	0.806
57	Prepares an inviting/cheerful classroom	high	0.866

ns = not significant

5.2.3.6 Inter-Coder Reliability for Notes about Teacher Behaviours in MECORS (A) (Classroom Level)

It is important to establish trustworthiness of judgement between researchers (Tinsley & Weiss, 2000). Ratings for teacher behaviour in MECORS (A) were classified according to eight categories in MECORS (B). This process enabled the mapping of data equivalent to 178 hours in lesson observation time. Phrases rather than words were preferred as the unit of analysis because phrases are similar to utterances in that they refer to an object-related act of speech (Bahktin, 1986). In MECORS (A), phrases were mapped onto a four by four matrix by the author of the current study under one, or more, of the eight instructional categories in MECORS (B) in Table 5.13. Then the other researcher assigned the same phrases onto an identical blank matrix. This procedure was conducted three times over. After each stage, researchers discussed why they had included phrases under one, or more, categories. This was conducted to develop a shared research understanding with the aim of achieving reliability of judgement. Internal reliability for each of the eight instructional categories in MECORS (B) was usually good at kappa: 0.70 for classroom management, 0.71 for classroom behaviour, 0.77 for focusing attention on lesson, 0.78 for review/practice, 0.76 for skills in questioning, 0.78 for mathematics' strategies, 0.73 for teaching methods and 0.78 for classroom climate. A sample of coded text from MECORS (A) is in Appendix 5.8. A sample of coded text from the field notes is available in Appendix 5.13.

***Table 5.13** – Itemised Agreement between Coders for MECORS (A)*

Classroom management (item)	**Coder 1**	**Coder 2**
Sees that rules/consequences are clearly understood (1)	133	124
Starts lesson on time; within 5 minutes (2)	175	177
Uses time during class transitions effectively (3)	125	93
Tasks/materials are collected/distributed effectively (4)	205	145
Sees that disruptions are limited (5)	100	98
Total	**738**	**637**
Classroom behaviour		
Uses a reward system to manage pupil behaviour (6)	89	92
Corrects behaviour immediately (7)	106	102
Corrects behaviour accurately (8)	99	94
Corrects behaviour constructively (9)	115	64
Monitors the entire classroom (10)	111	70
Total	**520**	**422**
Attention on lesson		
Clearly states the objectives/purposes of the lesson (11)	179	186
Checks for prior knowledge (12)	748	750
Presents material accurately (13)	350	337
Presents material clearly (14)	367	358
Gives detailed directions and explanation (15)	285	263
Emphasises key points of the lesson (16)	105	127
Has an academic focus (17)	569	578
Uses a brisk pace (18)	234	221
Total	**2,837**	**2,820**
Review and practice		
Explains tasks clearly (19)	553	552
Offers assistance to pupils (20)	302	290
Summarises the lesson (22)	146	133
Reteaches if error rate is high (23)	188	245
Is approachable for pupils with problems (24)	561	516
Uses a high frequency of questions (25)	147	156
Asks academic mathematical questions (26)	142	127
Asks open-ended questions (27)	223	193
Total	**2,262**	**2,212**

***Table 5.13** – Itemised Agreement between Coders for MECORS (A) (continued)*

Skills in questioning (item)	**Coder 1**	**Coder 2**
Probes further when responses are incorrect (28)	221	225
Elaborates on answers (29)	786	727
Asks pupils to explain how they reached solution (30)	73	87
Asks pupils for more than one solution (31)	89	93
Appropriate wait-time between questions/responses (32)	96	101
Notes pupils' mistakes (33)	378	346
Guides pupils through errors (34)	421	432
Clears up misconceptions (35)	186	180
Gives immediate mathematical feedback (36)	201	175
Gives accurate mathematical feedback (37)	226	231
Gives positive academic feedback (38)	129	119
Total	**2,806**	**2,716**
Mathematics enhancement strategies		
Employs realistic problems/examples (39)	56	46
Encourages/teaches the pupils to use a variety of	46	32
Uses correct mathematical language (41)	89	76
Encourages pupils to use correct mathematical language (42)	11	8
Allows pupils to use their own problem-solving strategies (43)	17	15
Implements quick-fire mental questions/strategies (44)	13	8
Connects new material to previously learnt material (46)	14	15
Total	**246**	**200**
Teaching methods		
Uses a variety of explanations that differ in complexity (47)	967	845
Uses a variety of instructional methods (48)	945	982
Uses manipulative materials/instructional aids/resources	1,603	1,671
Total	**3,515**	**3,498**
Classroom climate		
Communicates high expectations for pupils (50)	499	463
Exhibits personal enthusiasm (51)	648	733
Displays a positive tone (52)	739	680
Total	**1,886**	**1,876**

5.2.3.7 The Teacher Survey Questionnaire and the Pilot (Classroom Level)

The teacher survey questionnaire was administered to Year 2 teachers during March 2005. These were collected a week to the day after they had been distributed. Part A of the questionnaire required respondents to provide information about the personal and professional characteristics of teachers. Part B asked teachers to answer to statements about beliefs concerning the teaching and learning of mathematics. Statements were created from findings from the Effective Teachers of Numeracy Study conducted in the UK by Askew et al. (1997). Belief statements which had to be answered by teachers were organized on a 5-point Likert scale that included: 1 (*strongly agree*), 2 (*agree*), 3 (*do not know*), 4 (*disagree*) and 5 (*strongly disagree*).

The pilot study version of this questionnaire was piloted during June 2004 (Appendix 5.9). At this stage, statements in part B were similar in terminology to the findings in the Askew et al. (1997) study. The first section in part B of the pilot questionnaire was called: "beliefs about what it is to be a numerate pupil". The second section was called: "beliefs about pupils and how they learn to become numerate". The third section was called: "beliefs about how best to teach pupils to become numerate". Ten of the 17 teachers participating in the pilot study recommended changes. They pointed out that no beliefs regarding the use of Maltese or English and no statements as to why pupils need to learn mathematics were included. Items which teachers had difficulty in completing included: "the use of methods of calculation which are both efficient and effective" (item 1), "confidence and ability in mental methods" (item 2), "selecting a method of calculation on the basis of both the operation and the numbers involved" (item 3), "awareness of the links between different aspects of the mathematics curriculum" (item 4), "selecting a method of calculation primarily on the basis of the operation involved" (item 9), "pupils have strategies for calculating but the teacher has the responsibility of helping them refine their methods" (item 19), "teaching and learning are seen as complementary" (item 32), "numeracy teaching is based on dialogue between teacher and pupils to explore understandings" (item 33), "teaching is seen as separate from and having priority over learning" (item 37) and "learning is seen as separate from and having priority over teaching" (item 42).

Following the pilot study, part B of the questionnaire was updated by changing the wording as recommended by the 17 pilot study teachers. However, items recommended for exclusion were not eliminated but reworded. In view of the extensive changes made, this questionnaire was once again piloted with the same group of pilot study teachers in November 2004. The final version is in Appendix 5.10.

5.2.3.8 The Head Teacher Survey Questionnaire and the Pilot (School Level)

The head teacher survey questionnaire was piloted with eight head teachers. Feedback obtained from head teachers during the pilot stage generally confirmed that the head teacher survey questionnaire was easy to understand and complete. The head teacher questionnaire was administered in order to collect and collate data about the personal and the professional characteristics of primary school head teachers in Malta. The head teacher questionnaire in Appendix 5.11 is highly similar to part A of the teacher survey questionnaire. This was deliberate, so that the information collated about head teachers and about teachers could be compared on a like with like basis. Questionnaires were collected exactly one week to the day after these were distributed.

5.2.3.9 Field Note Sheet (School Level)

In addition to the parent/guardian questionnaire, the teacher questionnaire and the head teacher questionnaire, field notes about the broader school context and about the practice of head teachers were also taken. These field notes were taken by the same two researches responsible for the distribution and administration of the instruments. One of these two researcher was the author. Field notes were taken during the same administration period of MECORS (A). The field note sheet was piloted during June and November 2004 (Appendix 5.12) and has two sections. In the first section, researchers took notes about broader conditions such as the type and size of school and also about the role of the head teacher on the basis of criteria (leadership, vision, relationships and practice) listed in Table 5.14. Notes about classroom conditions such as the size of the classroom and about instructional conditions such as the number of times in a week that mathematics' homework was assigned were also taken.

In the second section of the field note sheet, researchers asked the head teacher questions about the role they adopted. The interview schedule was semi-structured in that researchers were flexible as to the order of the questions and were encouraged to "follow" issues emerging from the interview as necessary. The objective of the interviews with head teachers was to focus on confirming and/or elaborating further textual information noted in the field note sheet. Two interviews per head teacher were held over a 12-week period during January/February 2005 and March/April 2005. These were held on the day, usually on a Thursday or a Friday, following the last lesson observed in that school. All researchers asked the following questions:

- what do you think about head teaching? How do you maintain order? (Approach to head teacher role).
- is there a school-wide timetable? Why do you not have a school-wide timetable? (Vision and practice).
- at what time (in the day) do teachers (Year 2) teach mathematics? (Vision and practice)
- do you monitor staff? Do you or the assistant head teachers think that staff should be monitored? Does the school have a programme for monitoring teachers? (Leadership, vision and practice). (Leadership, vision and practice).
- do you, or the assistant head teacher, watch any lessons delivered by teachers? (Leadership, vision and practice).
- are you writing-up, or updating, the school development plan?
- do you do administrative tasks? Do you delegate administrative tasks to assistant head teachers and/or to teachers?
- what are your curricular responsibilities? When do you discuss curricular and instructional issues with staff?
- what do you think about parental involvement? How many Parents' Days do you hold throughout the school year?
- how do you establish good relations with your staff? What do you do when staff disagree?

As in MECORS (A), phrases from the field observations and answers to the above questions were mapped onto a four by four matrix by the author of the current study under one, or more, of the following areas: leadership, vision, relationships and practice (Table 5.14). Then the other researcher assigned the observations/utterances onto an identical blank matrix. This procedure was conducted three times over. The agreement that was eventually achieved (k = 0.82) was good at 0.87 for leadership, 0.70 for vision, 0.67 for relationships, 0.82 for practice A sample of coded text from the field notes is available in Appendix 5.13.

Table 5.14 *– Itemised Agreement between Coders for the Field Notes*

Leadership	**Coder 1**	**Coder 2**
Monitoring of Year 2 teachers	139	121
Involvement of teachers	187	163
Selection of teachers	59	52
Replacement of teachers	65	55
Category total	**450**	**391**
Other	102	161
Total	**552**	**552**
Vision		
Availability/writing of school development plan	37	39
Implementation of school curriculum	36	40
Climate and order	35	29
Time-tabling	57	40
Category total	**165**	**148**
Other	68	84
Total	**232**	**232**
Relationships		
Fostering relationships amongst teachers	85	65
Parental involvement	40	30
Category total	**125**	**95**
Other	54	84
Total	**179**	**179**
Practice		
Time scheduled for mathematics	42	37
Head teacher discusses monitoring	42	35
Head teacher discusses involvement	42	32
Head teacher discusses instructional quality	127	116
Head teacher discusses curricular issues	131	115
Category total	**384**	**335**
Other	54	84
Total	**438**	**419**

In the current study, quality of head teacher practice is established indirectly on the basis of the value-added scores achieved by pupils in classrooms in schools. In this way, the strategies of head teachers in schools associated with pupils whose rates of progress are significantly above expectation are considered as better than the strategies adopted by head teachers associated with pupils whose rates of progress are significantly below expectation.

5.3 Summary

This chapter commenced with the design of an educational effectiveness research framework that combines quantitative methods for the examination of pupil progress in classrooms in classrooms in schools for mathematics with qualitative approaches for the examination of the factors and characteristics associated and connected with head teacher and teacher practice. The current study then presented the research framework for the current study which was mainly based on The Comprehensive Model of Educational Effectiveness (Creemers, 1994) with some elements from The Dynamic Model of Educational Effectiveness (Creemers, Kyriakides & Antoniou, 2009) and The Model of Differentiated Teacher Effectiveness (Campbell et al., 2004). This was followed by a discussion of the: research questions/hypotheses, ethical considerations and the pupil, classroom and school level variables.

The methods section discussed the timing and sequencing of the research instruments, the multilevel strategy and the case study approach, the research instruments and their administration, alongside with issues relating to inter-rater and inter-coder reliability. This chapter stopped short in discussing issues about the reliability of pupils' age 5 (Year 1) and age 6 (Year 2) scores and the validity of belief and behaviour constructs undergirding the responses and observations associated with the Malta sample of 89 Year 2 teachers. These issues of reliability and validity are respectively discussed in Chapters 6 and 7 following.

CHAPTER 6

CHARACTERISTICS OF THE PUPIL AND PARENT DATA

To ascertain the integrity of the pupil level data, this chapter describes the characteristics of pupils and parents and discusses the reliability of test scores achieved by pupils at age 5 and at age 6. This chapter also conducts single level analyses to provide preliminary information about the relationship between pupil outcome and their background.

6.1 The Achieved and the Matched Samples

Thirty-seven (37) schools/head teachers, 89 teachers/Year 2 classrooms and 1,736 pupils constituted the achieved sample. The number of pupils whose age 6 test scores could be matched with their age 5 test scores amounted to 1,628 or 34.92% of the total population of Year 2 pupils. No pupil in the matched sample moved school from age 5 (Year 1) to age 6 (Year 2). It is useful to note that from this point onwards analyses were conducted utilising data from the matched sample of pupils/parents (n = 1,628) unless otherwise indicated. No significant differences in the number of pupils between the achieved (n = 1,736) and the matched sample (n = 1,628) were elicited depending on: age, ($x^2 = 4.94$, df = 3, p = 0.176), sex ($x^2 = 1.99$, df = 6, p = 0.921), special needs ($x^2 = 2.44$, df = 1, p = 0.118), father's occupation ($x^2 = 0.757$, df = 6, p = 0.993), mother's occupation ($x^2 = 1.99$, df = 6, p = 0.921), father's education ($x^2 = 1.560$, df = 4, p = 0.817), mother's education ($x^2 = 2.260$, df = 4, p= 0.689), home district ($x^2 = 2.261$, df = 5, p = 0.812), parental status ($x^2 = 0.001$, df = 1, p = 0.970), first language ($x^2 = 1.99$, df = 6, p = 0.921) and private lessons ($x^2 = 0.001$, df = 1, p = 0.989). This implies that the difference of 308 pupils between the achieved and the matched samples (see Table 5.8) does not significantly impact significantly representation of the matched sample. The age 5 and age 6 scores of individual pupils on the Maths 5 and the Maths 6 tests were stored in EXCEL, SPSS and MLwiN datasets. These datasets also housed information about the characteristics of: pupils/parents, teachers in Year 2 classrooms and head teachers in primary schools. Table 6.1 below describes the characteristics of pupils and parents in the matched sample.

Table 6.1 *– Characteristics of the Matched Sample of Pupils and Parents*

	Categories	**Pupils (n=1,628)**	**%**
Age	Youngest pupils	372	22.85
	Younger pupils	432	26.53
	Elder pupils	409	25.12
	Eldest pupils	415	23.22
Sex	Boy	908	55.77
	Girl	720	44.23
Pupil needs	Typically-developing	1,361	83.59
	Pupils with statements	75	4.61
	Pupils with learning difficulty	194	11.80
Occupation			
Father	Professional	121	7.43
	Managerial/administrative	229	14.07
	Higher clerical/skilled	325	19.96
	Skilled manual workers	567	34.83
	Semi-skilled/unskilled workers	184	11.30
	At home without state benefit	5	0.31
	Not gainfully occupied	197	12.10
Mother	Professional	78	4.79
	Managerial/administrative	65	3.99
	Higher clerical/skilled	173	10.63
	Skilled manual workers	99	6.08
	Semi-skilled/unskilled workers	34	2.09
	At home without state benefit	1,094	67.20
	Not gainfully occupied	85	5.22
Education			
Father	No schooling	3	0.18
	Primary	190	11.67
	Secondary	959	58.91
	Post secondary/vocational	276	16.95
	Tertiary	200	12.28
Mother	No schooling	1	0.06
	Primary	26	1.60
	Secondary	1,035	63.57
	Post secondary/vocational	329	20.21
	Tertiary	237	14.56
Family status	Parents living together	1,446	88.82
	Parents not together	166	10.20
	Children in care	16	0.98
Home district	Southern Harbour	426	26.17
	Northern Harbour	378	23.22
	South Eastern District	234	14.37
	Western District	158	9.71
	Northern District	310	19.04
	Gozo and Comino	122	7.49

***Table 6.1** – Characteristics of the Matched Sample of Pupils and Parents (continued)*

	Categories	**Pupils (n=1,628)**	**%**
First language	Maltese	1,442	88.57
	English	186	11.36
Preschool	No preschool	22	1.35
	Less than 2 years	76	4.66
	2 years in preschool	1,442	88.57
	More than 2 years	88	5.40
At risk pupils	Pupils with statements without support from a learning support assistant	26	29.85
	Pupils with statements supported by a learning support assistant	47	70.15
	Pupils without statements supported by a complementary teacher	194	11.92
Private lessons	Pupils who attend private lessons	78	4.79

6.2 Socio-Economic Characteristics

The 1,628 pupils and parents in the matched sample represent a cross-section of the Maltese population. Comparing the characteristics of the matched sample with the characteristics of the Maltese population provides information about the generalisability of findings for: the language spoken by pupils at home, the socio-economic background of pupils and the distribution of pupils/parents across districts in Malta and Gozo. This was possible because The Numeracy Survey (Mifsud et al., 2005), the current study and the National Census (2005) adopted a common classification system called The Nomenclature of Territorial Units for Statistics (NUTS).

6.2.1 First Language

Census (2005) data reveals that 90.2% of Maltese residents are Maltese-speaking, 6% are English-speaking and 3.8% speak another language at home. In the current study, 90.5% of pupils aged 6 speak Maltese at home and 9.5% of pupils speak English. The percentage of pupils with Maltese or English as their first language is similar to that reported in the National Census.

6.2.2 Father's Occupation

Census (2005) reports that 17.73% of fathers in the Maltese population hold professional, managerial or administrative occupations. A slightly higher figure of 21.50% for fathers was elicited by the current study. Census (2005) also reports that 22.23% of the male population occupied semi-skilled or unskilled jobs. The current study reported a considerably lower figure of fathers (11.30%) occupying semi-skilled or unskilled jobs (Table 6.2).

Table 6.2 - *Father's Occupation*

Fathers' Occupation	**Census (2005)**	**Census (%)**	**The current study**	**(%)**
Professional	10,122	9.10	121	7.43
Managerial/administrative	9,595	8.63	229	14.07
Higher clerical/skilled craftsmen	42,921	38.59	325	19.96
Skilled manual workers	16,679	15.00	567	34.83
Semi-skilled/unskilled workers	24,723	22.23	184	11.30
At home without state benefit or home-maker	0	0.00	5	0.31
Not gainfully occupied	7,177	6.45	197	12.10
Total	**111,217**	**100.00**	**1,628**	**100.00**

This discrepancy is largely attributable to two reasons. First, Census (2005) data included all gainfully occupied males. Second, males represented a cross-section of the population associated with pupils aged 5 to 6. Fathers participating in the current study were also more likely to be younger and better qualified. The latter reason is partly attributable to increased government investment in higher education during the ten years prior to the current study.

6.2.3 Mother's Occupation

In comparison with figures from Census (2005), mothers are also under-represented across all occupational categories. This was not unexpected since only a third of mothers participating in the current study were found to be in employment (Table 6.3).

Table 6.3 *– Mother's Occupation*

Mother's Occupation	**Census (2005)**	**Census (%)**	**The current study**	**(%)**
Professional	7,879	14.74	78	4.79
Managerial/administrative	2,755	5.15	65	3.99
Higher clerical/skilled craftsmen	19,674	36.81	173	10.63
Skilled manual workers	10,707	20.03	99	6.08
Semi-skilled/unskilled workers	8,429	15.77	34	2.09
Unemployed	0	0.00	1,094	67.20
Not gainfully occupied	4,006	7.49	85	5.22
Total	**53,450**	**100.00**	**1,628**	**100.00**

The category not gainfully occupied refers to mothers who are not in paid employment and who qualify for social benefit. In the current study, there is an over-representation of mothers in the professional and managerial/administrative categories. This is possibly partly attributable to higher remuneration and flexible working conditions for better qualified women.

6.2.4 Father's Education

In comparison with the National Census (2005) data the current study reports an under-representation of fathers who only completed their education up to primary level (Table 6.4).

Table 6.4 *– Father's Education*

Father's Education	**Census (2005)**	**Census (%)**	**The current study**	**(%)**
No schooling	3,150	1.92	3	0.18
Primary	36,489	22.23	190	11.67
Secondary	77,501	47.22	959	58.91
Post-secondary/vocational	29,536	18.00	276	16.95
Tertiary	17,447	10.63	200	12.29
Total	**164,123**	**100.00**	**1,628**	**100.00**

6.2.5 Mother's Education

In comparison with National Census (2005) data, the current study also reports an under-representation of mothers who only completed up to primary level. The current study also reports an over-representation of mothers who qualified up to the secondary and post-secondary or the vocational level (Table 6.5).

Table 6.5 *– Mother's Education*

Mother's Education	Census (2005)	Census (%)	The current study	(%)
No schooling	4,951	2.93	1	0.07
Primary	49,151	29.08	26	1.77
Secondary	74,343	43.99	1,035	70.41
Post-secondary/vocational	25,852	15.30	329	22.38
Tertiary	14,717	8.71	237	5.37
Total	**169,014**	**100.00**	**1,628**	**100.00**

6.2.6 Regional Distribution

Table 6.6 compares the regional distribution of pupils in the matched sample with that elicited in the wider population by Census (2005).

Table 6.6 - *Regional Distribution*

Region	Census (2005)	Census (%)	The current study	(%)
Southern Harbour	81,047	20.01	426	26.17
Northern Harbour	119,332	29.47	378	23.22
South Eastern	59,371	14.66	234	14.37
Western District	57,038	14.08	158	9.71
Northern District	57,167	14.12	310	19.04
Gozo and Comino	31,007	7.66	122	7.49
Total	**404,962**	**100**	**1,628**	**100.00**

With the exception of the Western District, the distribution of pupils/parents as reported by this study is comparable to the distribution of the wider population in the Census (2005). The under-representation of participants from the Western District is attributable to the fact that residential property in this region is very expensive and therefore not as attractive to younger couples.

6.3 Language Bias (Maths 6)

Logistic regression techniques (Kim, 2001; Zumbo, 1999) were employed to check for the severity of language bias for outcomes achieved by pupils on the 26 test items in Maths 6. The achieved sample of 1,736 pupils was employed for these analyses. The majority of pupils in the achieved sample (n = 1,703) took the test in Maltese. The remaining 232 pupils took the test in English. Differential item functioning (DIF), compares patterns of uniform similarities (uniform DIF) with patterns of systematic differences (non-uniform DIF). The classification of differences for use with tests involving back-translation as developed by Gierl, Rogers & Klinger (1999) was adopted. Cut-off points are: negligible or A-level differences (chi-square not significant, R^2 up to 0.034), moderate or B-level differences (chi-square significant, R^2 between 0.035 and 0.070) and large or C-level differences (chi-square is significant, R^2 at or over 0.071).

Most test items in Table 6.7 exhibit negligible DIF. Sireci (1997) recommends removing items exhibiting large differences. However, Gierl, Rogers & Klinger (1999) argue that this might upset the overall balance in a test, especially when the difference in marks is very small. The total marks for moderate and large DIF items in Table 6.7 amounts to 1.84 marks. Since the maximum difference in marks could amount to as much as 72 marks on the standardized Maths 6 scale that ranges from 69 to 141, 1.84 marks is minimal. Therefore, the seven test items in Table 6.7 exhibiting moderate to large DIF were retained.

***Table 6.7** – Severity of Uniform and Non-Uniform Differences in Maths 6*

Item	Item description	DIF R^2	p value	DIF favours	Severity of non-uniform DIF
1	Simple sets	0.002	*		Negligible
2	Identifying 2D shapes	0.018	***		Negligible
3	Sharing money	0.018	***		Negligible
4	Properties of 2D shapes	0.010	***		Negligible
5	Doubling	0.157	***	English	Large
6	Simple subtraction	0.044	***	English	Moderate
7	Adding on	0.024	***		Negligible
8	Grouping	0.027	***		Negligible
9	Flat shapes odd one out	0.014	***		Negligible
10	Simple block graph	0.000	ns		Negligible
11	Ordinal numbers	0.029	***		Negligible
12	Adding ten	0.114	***	Maltese	Large
13	Simple bill	0.062	***	Maltese	Moderate
14	Simple addition	0.020	***		Negligible
15	In between numbers	0.043	***	English	Moderate
16	Pairing	0.011	***		Negligible
17	Identifying 3D shapes	0.001	ns		Negligible
18	Subtraction	0.084	***	English	Large
19	Addition with money	0.054	***	Maltese	Moderate
20	Ordering numbers	0.004	ns		Negligible
21	Recognition of simple	0.032	***		Negligible
22	Stories of nine	0.027	***		Negligible
23	Size	0.014	***		Negligible
24	Straight and curved lines	0.020	***		Negligible
25	Story sum	0.009	***		Negligible
26	Telling the time	0.044	ns	Maltese	Moderate

ns = not significant, *p < .05, ***p < .001

6.4 Age-Standardisation (Maths 6)

Age-standardisation statistically controls for the impact of age on pupil outcome. The outcome scores of 1,736 pupils, in the achieved sample, for Maths 6 were age-standardised by a commissioned statistician (Appendix 6.1). The age-standardisation procedure employed is that of Schagen (1990) and is the same technique employed for the age-standardisation of pupils' Maths 5 test scores by The Malta Numeracy Survey (Mifsud et al., 2005). The age-standardised scale of the Maths 5 and the Maths 6 tests ranges from 69 to 141. The lowest score achieved by Maltese pupils on the Maths 6 test was 69 and the highest score 134. The distribution of pupils' age 5 (Figure 6.1) and age 6 (Figure 6.2) scores was checked for normality because hierarchical and effect statistics require normality (Goldstein, 2004). The Kolgorov-Smirnov *Z* test checked for normality in the matched sample of pupils' age 5 scores ($Z = 1.070$, $p = 0.202$) and age 6 scores ($Z = 1.316$, $p = 0.063$). The distribution of pupils' age 5 and age 6 test scores indicate a ceiling effect. This effect was also reported by the Literacy Survey (Mifsud et al., 2000) and The Literacy for School Improvement Survey (Mifsud et al., 2004) and appears as a consistent feature of pupil achievement in Malta.

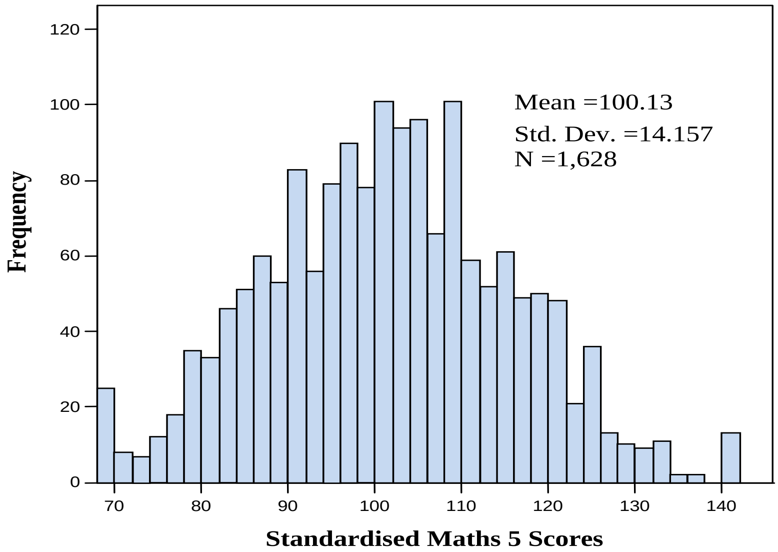

***Figure 6.1** – Distribution of Age-Standardised Scores (Age 5)*

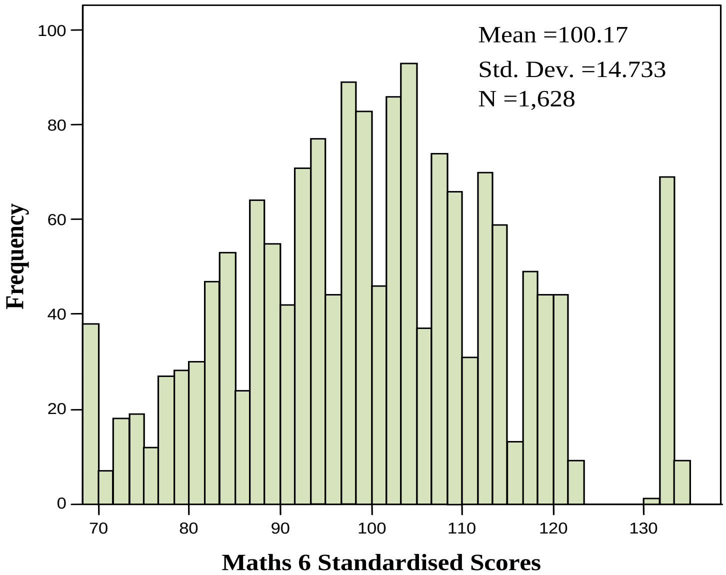

***Figure 6.2** – Distribution of Age-Standardised Scores (Age 6)*

6.5 Responses Scored Correctly (Maths 5 & Maths 6)

It is useful to compare the responses scored correctly by Maltese pupils with those achieved by UK pupils at age 5 (Figure 6.1) and age 6 (Figure 6.2).

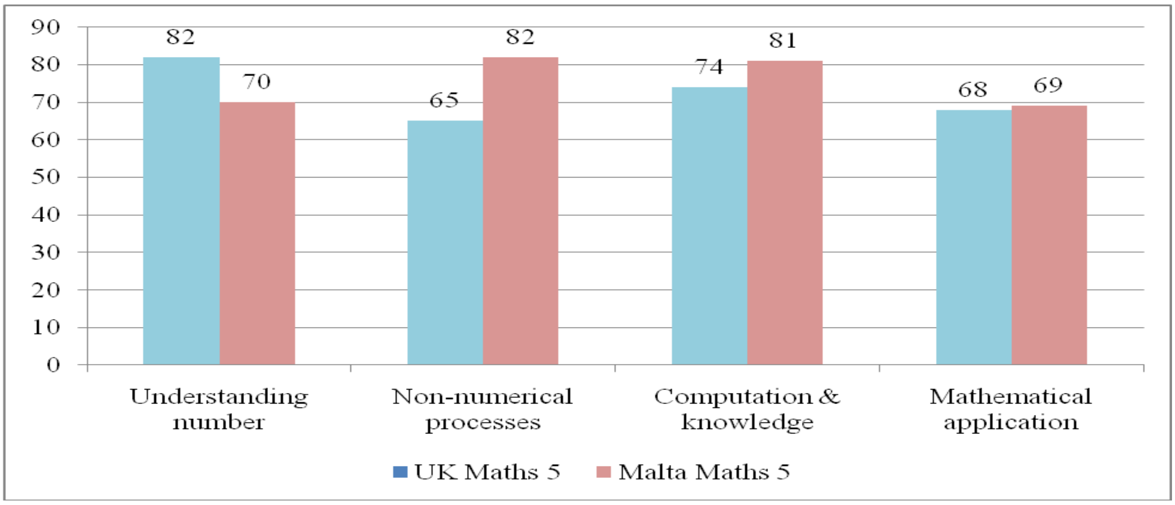

***Figure 6.3** – Percent Correct Responses for Maths 5 (UK & Malta Samples)*

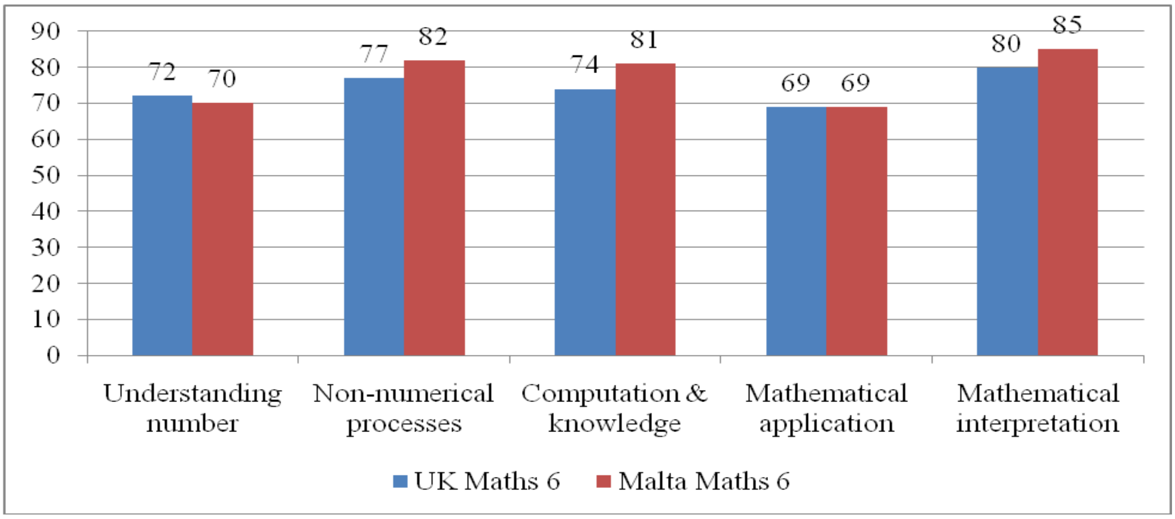

***Figure 6.4** – Percent Correct Responses for Maths 6 (UK & Malta Samples)*

There are 24 test items in Maths 5 and 26 test items in Maths 6. Pupils could achieve a minimum of zero marks on each test and a maximum of 24 marks (Maths 5) and 26 marks (Maths 6). Responses scored correctly by Maltese pupils are listed in Table 6.8.

Table 6.8 *– Percent Correct of Items in Maths 5 and Maths 6*

Maths 5 items	(%)	Maths 6 items	(%)
Understanding number	**70.02**	**Understanding number**	**70.02**
Counting fingers and thumbs (1)	86.00	Stories of (7)	75.60
Number pad (4)	90.00	Ordinal numbers (11)	81.10
Matching dots (6)	88.50	Stories of (12)	55.10
Domino (8)	81.60	Between numbers (15)	85.30
Money (13)	89.30	Value of numbers (20)	90.00
Counting (16)	58.20	Recognition of fractions (21)	81.80
Comparing numbers (18)	96.00	Stories of (22)	82.40
Counting shapes 1 (23)	74.00		
Non-numerical processes	**81.65**	**Non-numerical processes**	**81.65**
Reasoning (7)	81.10	Shapes – properties (4)	75.70
Comparing shapes (12)	64.50	Shapes – properties (9)	88.60
Repeating patterns (19)	35.00	Size (23)	90.60
Copying patterns (20)	63.80	Shapes – properties (24)	71.00
Describing shapes (22)	39.10		
Computation/knowledge	**80.68**	**Computation/knowledge**	**80.68**
Clocks (2)	91.60	Shapes (2)	80.20
Triangles (10)	56.50	Doubles (5)	70.80
Weighing (17)	53.30	Shapes – recognition (17)	82.10
		Subtraction (18)	87.20
		Addition with money (19)	69.30
		Clock, hours (26)	93.00
Mathematical application	**68.87**	**Mathematical application**	**68.87**
Addition (3)	27.90	Story sums – sharing (3)	82.80
Comparing heights (5)	27.80	Story sums – subtraction (6)	88.90
Half full (9)	61.50	Patterns (8)	68.60
Ordering (11)	74.10	Bills (13)	73.20
Shopping (14)	29.20	Addition (14)	91.80
Subtraction (15)	69.20	Pairs (16)	32.80
Sorting shapes (21)	91.60	Story Sums - multiplication	43.00
Counting shapes (24)	79.60		
		Mathematical interpretation	**84.60**
		Sets (1)	93.20
		Bar graphs – addition (10)	76.00

6.6 Pupils' Age 5 and Age 6 Outcomes

Differences in pupil attainment partly depend on differences in pupil background. The age-standardised scores of pupils in Figure 6.5 illustrate a moderate but highly significant relationship (r = .521, p < .001) between prior attainment at age 5 (Year 1) and later attainment at age 6 (Year 2). The scatterplot highlights a number of outliers. Leverage effects were excluded because the outliers refer to pupils who were distributed across the 37 participating schools.

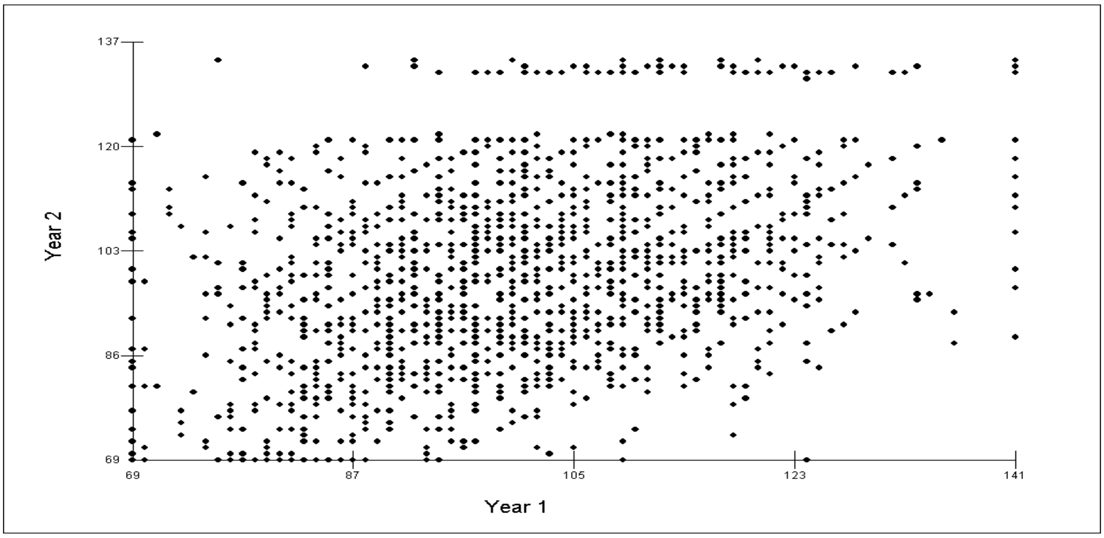

***Figure 6.5** – Scatterplot for Pupil Outcomes at Age 5 (Year 1) and at Age 6 (Year 2)*

On average, the same cohort of 1,628 pupils scored an average of 100.12 marks at age 5 (s.d = 14.70) and 100.13 marks at age 6 (s.d = 14.55). At age 5, pupils attaining between a minimum of 114.8 marks and a maximum of 129.5 marks are achieving significantly above average at +1 and +2 standard deviations respectively. Also at age 5, pupils attaining between a maximum of 85.4 marks and a minimum of 70.7 marks are achieving significantly below average at -1 and -2 standard deviations respectively. At age 6, pupils attaining between a minimum of 114.7 marks and a maximum of 129.2 marks are achieving significantly above average +1 and +2 standard deviations. Also at age 6, pupils attaining between a maximum of 85.6 marks (-1 s.d) and a minimum of 71.0 marks are achieving at -1 and -2 standard deviations respectively. At age 5, 14.68 marks are equivalent to one standard deviation. At age 6, 14.57 marks are equivalent to one standard deviation.

6.6.1 Sex, Special Needs and Support with Learning

Other background characteristics besides age are likely to contribute significantly towards differences in pupil outcome. Table 6.9 reports no significant differences in the age 5 and age 6 attainment outcomes of Maltese pupils depending on sex.

***Table 6.9** – Mean Age 5 and Age 6 Pupil Outcomes by Sex*

Sex	Mean (age 5)	s.d	Mean (age 6)	s.d
Boy (n = 908)	99.87	15.05	99.74	14.58
Girl (n = 720)	100.41	13.95	100.57	14.83

Table 6.10 describes significant differences in pupils' age 5 and age 6 outcomes between typically-developing pupils and at risk pupils.

***Table 6.10** – Mean Age 5 and Age 6 Outcomes for Typically-Developing Pupils and At Risk Pupils*

	Mean (age 5)	s.d	Mean (age 6)	s.d
Typically-developing pupils (age 6, n = 1,381)	**101.00**	**14.40**	**101.00**	**14.46**
At risk pupils (age 6, n = 267)	**93.50**	**14.72**	**90.01**	**15.70**
Pupils with statements without any form of learning support (age 6, n = 26)	90.02	14.07	91.81	14.90
Pupils with statements supported by a learning support assistant (age 6, n = 47)	93.28	14.61	89.78	16.67
Pupils with learning difficulty supported by a complementary teacher (age 6, n = 194)	93.90	14.85	91.64	16.64

On average, at risk pupils aged 5 achieved significantly lower scores than their typically-developing peers ($F = 10.437$, $df = 1$, $p < .001$). Even at age 6, at risk pupils achieved significantly lower scores than typically-developing pupils ($F = 35.585$, $df =$

1, p < .001). The scores achieved by at risk pupils with statements but not receiving any form of learning support also achieve significantly less than typically-developing pupils. At age 5, at risk pupils with statements but not supported by a learning assistant achieved around three marks less than pupils with statements supported by a learning support assistant or pupils with learning difficulty supported by a complementary teacher. Given the rather small number of pupils with statements without learning support and also because not all pupils with statements at age 6 would have been diagnosed at age 5, mean scores for this group of at risk pupils should be treated with caution. No significant differences in pupils' age 6 outcomes were elicited between at risk pupils with statements supported by a learning support assistant and at risk pupils with learning difficulty supported by a complementary teacher (F = 1.738, df = 1, p = .188).

6.6.2 Father's Occupation

In Table 6.11, the mean scores achieved by pupils at age 5 and at age 6 vary significantly depending on father's occupation (age 5, F = 8.831, df = 6, p < .001; age 6, F = 5.200, df = 6, p < .001).

Table 6.11 *– Mean Age 5 and Age 6 Pupil Outcomes by Father's Occupation*

Father's occupation	Mean age 5 score	s.d	Mean age 6 score	s.d
Professional (n = 121)	104.00	15.40	104.00	14.50
Managerial (n = 229)	104.00	13.60	104.00	13.30
Higher clerical (n = 325)	101.00	14.00	100.00	15.20
Skilled manual (n = 567)	99.40	14.00	98.80	14.30
Semi/un-skilled (n = 184)	99.50	13.40	100.00	15.08
Unemployed (n = 5)	91.10	11.80	90.00	14.10
Other (n = 197)	94.80	16.30	97.30	15.40

At age 5, pupils whose fathers are in professional/managerial occupations achieve higher scores than pupils whose fathers are in the unemployed or other category. The difference in scores between pupils with professional fathers and pupils with unemployed fathers is 12.9 marks. This approximates three-quarters of a standard deviation. At age 6, pupils with fathers in the professional or managerial occupations achieved considerably higher scores than pupils with fathers in the unemployed or in the other category. The gap in attainment widened to approximately one standard deviation over one year.

6.6.3 Mother's Occupation

In Table 6.12, the mean scores achieved by pupils at age 5 and at age 6 varied significantly depending on mother's occupation (age 5, $F = 7.830$, $df = 6$, $p < .001$; age 6, $F = 4.460$, $df = 6$, $p < .001$). Pupils with mothers in professional or managerial occupations repeatedly achieved the highest scores.

Table 6.12 *– Mean Age 5 and Age 6 Pupil Outcomes by Mother's Occupation*

Mother's occupation	**Mean age 5 score**	**s.d**	**Mean age 6 score**	**s.d**
Professional (n = 78)	107.00	15.90	106.00	16.00
Managerial (n = 65)	105.00	15.00	106.00	13.10
Higher clerical (n = 173)	103.00	13.50	102.00	14.60
Skilled manual (n = 99)	101.00	15.10	101.00	11.80
Semi/un-skilled (n = 34)	96.80	14.80	97.20	14.50
Unemployed (n = 1,094)	99.10	14.30	99.30	14.70
Other (n = 85)	94.80	16.30	96.50	13.20

The difference in marks, between the higher and the lower end of the occupational ladder amounts to 12.20. This approximates three-quarters of a standard deviation and is similar to that elicited for father's occupation. At age 6, pupils whose mothers are in managerial occupations have caught up with pupils whose mothers are in professional occupations. Pupils with mothers in the other category still achieve the lowest score. At age 6, the difference between the highest and the least attaining pupils averages 9.50 marks. This implies a narrowing in the attainment gap depending on mother's occupation. Interestingly, the mean age 5 and age 6 outcomes of pupils with stay at home (unemployed) mothers are dissimilar to the outcomes of pupils whose mothers are gainfully occupied.

6.6.4 Father's Education

In Table 6.13, the mean scores achieved by pupils vary significantly depending on father's education (age 5, $F = 7.953$, $df = 4$, $p < .001$; age 6, $F = 3.799$, $df = 4$, $p < .001$).

***Table 6.13** – Mean Age 5 and Age 6 Pupil Outcomes by Father's Education*

Father's education	Mean age 5 score	s.d	Mean age 6 score	s.d
No schooling (n = 3)	na	na	na	na
Primary (n = 191)	96.60	14.10	96.00	15.10
Secondary (n = 959)	99.80	13.90	99.30	14.40
Sixth form (n =276)	100.00	15.30	102.00	15.10
Tertiary (n = 200)	104.00	15.00	103.00	14.80

At age 5, pupils with fathers who had only attended primary school achieved the lowest marks. Pupils with fathers who achieved a tertiary level qualification achieved the highest marks. The gap of 7.4 marks approximates half a standard deviation. At age 6, the gap between the highest and the lowest achieving pupils amounted to seven marks. This implies that the gap in marks is maintained from ages 5 to 6.

6.6.5 Mother's Education

In Table 6.14, the mean scores achieved by pupils varied significantly depending on the mother's education (age 5, $F = 8.714$, $df = 4$, $p < .001$; age 6, $F = 3.958$, $df = 4$, $p < .001$).

***Table 6.14** – Mean Age 5 and Age 6 Pupil Outcomes by Mother's Education*

Mother's education	Mean age 5 score	s.d	Mean age 6 score	s.d
No schooling (n = 1)	na	na	na	na
Primary (n = 103)	94.00	14.60	99.00	18.90
Secondary (n = 1035)	99.00	14.40	99.20	14.50
Sixth form (n =329)	103.00	13.60	102.00	14.40
Tertiary (n = 158)	105.00	15.60	104.00	14.90

Pupils with mothers who only attended primary school achieved the lowest scores. Pupils with mothers who achieved a tertiary level qualification achieved the highest scores. The difference in marks between the highest and the lowest achieving pupils amounted to 11 marks at age 5 and five marks at age 6. This implies a narrowing of the achievement gap, between ages 5 and 6, which approximates to half a standard deviation.

6.6.6 Family Status

In Table 6.15, the mean scores achieved by pupils varied significantly at age 5 ($F = 18.327$, $df = 2$, $p < .001$) and at age 6 ($F = 3.823$, $df = 2$, $p < .05$) depending on whether the parents were living together or not.

Table 6.15 *– Mean Age 5 and Age 6 Pupil Outcomes by Marital Status of Parents*

Family status	**Mean age 5 score**	**s.d**	**Mean age 6 score**	**s.d**
Parents together (n = 1445)	101.00	14.20	100.00	14.60
Parents not together (n = 97)	96.20	15.40	103.40	13.50
Children in care (n = 86)	95.30	15.80	97.30	15.30

At age 5, pupils whose parents were living together scored 4.8 marks more than pupils with parents who were not living together. Pupils whose parents were not living together scored 5.7 marks more than pupils in care. By age 6 this has changed. Pupils whose parents were living together achieved on average 3.4 marks less than pupils whose parents were not living together but 3.3 marks more than pupils in care. This implies that pupils with both parents living together start school with higher levels of pupil attainment. However, by their second year in primary school pupils whose parents were not living together have caught up with pupils whose parents were living together.

6.6.7 Home Area/District

In Table 6.16, the mean scores achieved by pupils varied significantly at age 5 ($F = 4.259$, $df = 5$, $p < .001$) and at age 6, ($F = 9.904$, $df = 5$, $p < .001$) depending on the home area of pupils.

***Table 6.16** – Mean Age 5 and Age 6 Pupil Outcomes by District*

Home town region/district	Mean age 5 score	s.d	Mean age 6 score	s.d
Southern Harbour (n = 426)	101.32	15.47	98.43	13.41
Northern Harbour (n = 378)	98.67	13.38	98.17	14.11
South Eastern District (n = 234)	98.82	13.45	99.81	15.52
Western District (n = 158)	99.42	15.63	101.78	14.03
Northern District (n = 310)	103.46	14.33	103.05	15.43
Gozo and Comino (n = 122)	98.73	15.39	100.94	15.93

At age 5, pupils from the Northern District achieved the highest scores whilst pupils from the Northern Harbour achieved the lowest scores. The gap amounts to 4.79 marks or approximatley a quarter of a standard deviation. At age 6, this pattern of achievement is maintained. Pupils from the Northern District achieved the highest scores. Pupils from the Northern Harbour achieved the lowest scores. At 4.88 marks, the gap is similar to that registered the previous year.

6.6.8 Length of Time at Preschool

Table 6.17 describes significant differences in age 5 attainment depending on the length of time pupils spent at preschool ($F = 3.549$, $df = 3$, $p < .01$). By age 6, the significance of preschool had diffused ($F = 0.310$, $df = 3$, $p = .871$).

***Table 6.17** – Mean Age 5 and Age 6 Pupil Outcomes by Length of Time at Preschool*

Preschool	Mean age 5 score	s.d	Mean age 6 score	s.d
No preschool (n = 22)	94.00	17.10	99.10	12.40
One year (n = 76)	95.80	14.40	101.00	14.30
Two years (n = 1441)	100.00	14.20	101.00	14.30
More than two years (n = 88)	100.00	16.20	100.00	13.80

At age 5, pupils who had not attended preschool achieved six marks less than pupils who had spent at least two years in preschool. Similarly, pupils who had only attended one year of preschool achieved 4.40 marks less than pupils with at least two years of preschool. At age 6, the gap between pupils who spent less than two years and pupils who spent at least two years in preschool narrowed considerably, to the extent that differences were no longer significant.

6.6.9 First Language

Table 6.18 describes significant differences in attainment at age 5 ($F = 10.624$, $df = 1$, $p < .001$) and at age 6 ($F = 24.069$, $df = 1$, $p < .001$) depending on first language.

Table 6.18 *– Mean Age 5 and Age 6 Pupil Outcomes by First Language*

First language	**Mean age 5 score**	**s.d**	**Mean age 6 score**	**s.d**
Maltese (n = 1,473)	99.76	14.60	99.65	14.90
English (n = 155)	103.36	14.30	105.68	12.50

At age 5, Maltese-speaking pupils achieved 3.6 marks less than English-speaking pupils. At age 6, the gap in marks widened considerably with Maltese-speaking pupils achieving 6.03 marks less than English-speaking pupils.

6.7 Time to Learn Mathematics

In Maltese primary schools not all pupils experience the same exposure, in time-terms, being taught by their class teacher. On average, all pupils have approximately 179 hours of teacher-managed classroom time available for learning mathematics All pupils in private schools have enjoy on average 68 hours, or 27%, more in such time than pupils in state schools; in spite of a shorter school year and a shorter school day. The quality of classroom time, and by whom they are taught, also differs considerably amongst pupils in the same classroom depending on their ability (Table 6.19).

***Table 6.19** – Time Available for Different Groups of Pupils to Learn Mathematics*

Pupils	**School**	**Average teacher time in hours**
Typically-developing pupils	State	175
	Private	243
Pupils with statements without any form of learning support	State	175
	Private	243
Pupils with statements supported by a learning support assistant	State	160 hours of teacher time is "lost" due to learning support assistants acting as scribe during the explanatory lesson phases.
	Private	Learning support assistants are not allowed to talk during explanatory phases of lessons
Pupils experiencing difficulty with learning mathematics supported by a complementary teacher	State	105
	Private	194

At face value, pupils with statements with support from a learning support assistant in state schools and in private schools appear to be similarly disadvantaged. However, the time-discrepancy is serious for state school pupils with statements supported by a learning support assistant. On average, this group of pupils only obtain around 15 hours of lesson time with their teachers. This critical 91% loss in lesson time is due to a failure of school policy to seriously address the practice adopted by most learning support assistants who choose to explain mathematical concepts/operations to their charges during lessons. Since teachers in state schools are not responsible for learning support assistants in their classroom and many state school teachers feel disempowered, they do not stop or limit this practice, even though they might not agree with it. On the other hand, teachers in private schools are expected to direct the practice of learning support assistants in their class. This implies that pupils in private schools with statements supported by a learning support assistant obtain 83 hours (47%) more in lesson time than their state school counterparts.

Pupils in state schools and pupils in private schools who have difficulty with learning but do not have statements are supported by a more experienced and fully-qualified teacher called a complementary teacher. Since this group of pupils is supported in small groups outside of the classroom during lessons of mathematics, this implies, that on average state school pupils with learning difficulty obtain around 70 hours, or 40%, less in lesson time than their typically-developing state school counterparts. On average, private school pupils with learning difficulty obtain around 49 hours, or 20%, less in teacher managed classroom time than their typically-developing private school counterparts. This implies that pupils in private schools with learning difficulty spend more time learning mathematics in the classroom with their teacher than pupils with learning difficulty in state schools.

6.8 Aggregating Socio-Economic Variables

In the current study, the socio-economic background of pupils is described by four variables: father's occupation, mother's occupation, father's education and mother's education. Percentages in Figure 6.6 are based on aggregated data. Cases were aggregated at the lower and higher ends of the occupational and the educational classification ladders due to the relatively small number of cases. Cases associated with pupils with fathers in professional or in the administrative/managerial occupations were reclassified as high. Cases associated with pupils with fathers in the higher clerical/skilled manual occupations were reclassified as medium. Cases associated with pupils with fathers in the semi-skilled/unskilled workers/home-maker/not gainfully occupied categories were reclassified as low. A similar procedure was conducted for mother's occupation, father's education and mother's education. Figure 6.6 gives percentage figures associated with the aggregated socio-economic data of the parents of pupils in the matched sample.

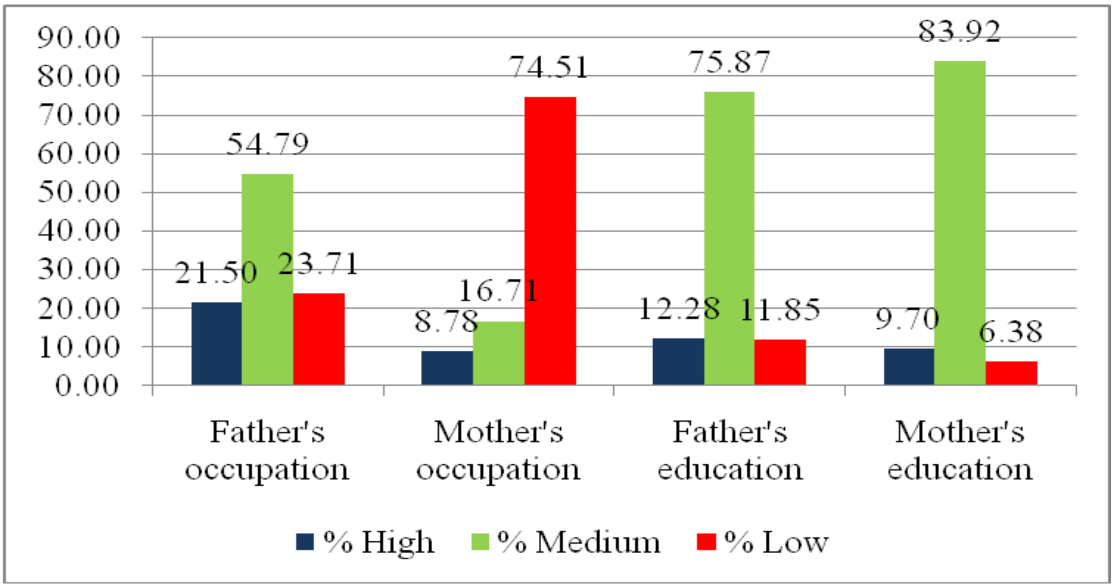

***Figure 6.6** – Percent of Parents in the High, Medium and Low Occupational and Educational Categories*

The relationship between parental occupation and parental education was also examined. A strong positive association between father's occupation and father's education (r = .72, p < .001) and a weak negative association between mother's occupation and mother's education (r = -.178, p < .001) were elicited.

6.9 Summary

This chapter described the characteristics of the matched sample of pupils (n = 1,628) and of their parents. This chapter also ascertained the integrity of the pupil and parent data indicated by: (1) a matched sample that does not differ significantly, in representation, from the achieved sample, (2) age-standardised scores achieved by pupils at age 5 and at age 6 that do not deviate significantly from normality, (3) trends associated with the socio-economic backgrounds of pupils and parents in the matched sample that compare well with trends elicited in the wider Maltese population by Census (2005), (4) low levels of language bias in Maths 6, and by (5) the favourable outcomes achieved by Maltese pupils on the Maths 5 and Maths 6 tests when compared with those of UK pupils as indicated by the percentage of correct responses.

Results from single level analyses show mean differences in pupil outcome at age 5 and at age 6 to depend on pupil ability, parental occupation and parental education. At age 5, but not at age 6, mean differences in pupil outcome are dependent on parental status, first language, the home area or district in which pupils reside in and the length of time they spent at preschool. Discrepancy in the amount of time available for different groups pupils to learn at school was elicited between typically-developing pupils and at risk pupils. Within the at risk group of pupils, discrepancies in the amount of time available for learning were elicited between pupils with statements supported by a learning support assistant and pupils with learning difficulty supported by a complementary teacher. A strong, positive and significant association was elicited between father's occupation and father's education. A weak, negative and significant association was elicited between mother's occupation and mother's education. In spite of differences in pupil ability and pupil background, conditions at the pupil level alone do not determine pupil achievement. In view of this, Chapter 7 describes the characteristics of the school and the classroom level data. Similarly to the approach undertaken in this chapter, the following chapter ascertains the integrity of the data; particularly that for the classroom level.

CHAPTER 7

CHARACTERISTICS OF THE SCHOOL AND THE CLASSROOM DATA

To examine the differential effectiveness of schools and classroom, one must first ascertain the trustworthiness of the data. This chapter, first describes the characteristics of schools and head teachers, classrooms and teachers. The chapter then explores the structure undergirding teacher responses to belief statements from the teacher survey questionnaire and the structure undergirding ratings of teacher behaviours from the classroom observation schedule MECORS (B).

7.1 Margins of Error for the School Level

At end April 2005 there were 100 primary schools in Malta and Gozo. Thirty-seven (37) schools were associated with the matched sample of pupils/parents. In Chapter 5, the difference of 308 pupils between the achieved (n = 1,736) and the matched sample (n = 1,628) was not significant. Therefore, the matched sample remained nationally representative. The difference of 308 pupils, could have implications for the confidence levels at the school and classroom level. Table 7.1 describes an overall school level margin of error that is low at ± 0.55 which indicates the matched sample is robust. In 15 (40.54%) schools no error was registered because all pupils sat for the test at age 5 and at age 6. In 21 (56.76%) schools, the error margin was less than ± 5. In one school, the error margin was high at ± 10. This was due to an outbreak of chicken pox. Since, absenteeism was evenly spread across the four Year 2 classrooms in this school, the test scores of these pupils were included for further analysis.

***Table 7.1** – Margins of Error for the School Level*

School	Achieved Sample	Matched Sample	Margin of error
1	43	43	± 0.00
2	84	44	± 10.26
3	20	20	± 0.00
4	104	99	± 2.17
5	60	58	± 2.37
6	43	42	± 2.33
7	95	91	± 2.12
8	12	12	± 0.00
9	27	26	± 3.77
10	23	22	± 4.45
11	46	45	± 2.18
12	25	24	± 4.08
13	30	28	± 4.86
14	51	46	± 4.57
15	19	19	± 0.00
16	125	112	± 3.00
17	46	46	± 0.00
18	36	36	± 0.00
19	32	32	± 0.00
20	25	25	± 0.00
21	12	12	± 0.00
22	55	54	± 1.81
23	18	18	± 0.00
24	86	80	± 2.91
25	7	7	± 0.00
26	20	20	± 0.00
27	33	32	± 3.06
28	39	38	± 2.58
29	35	35	± 0.00
30	30	30	± 0.00
31	21	21	± 0.00
32	58	55	± 3.03
33	42	41	± 2.39
34	25	24	± 4.08
35	124	114	± 2.62
36	81	73	± 3.63
37	104	104	± 0.00
	1,736	**1,628**	**± 0.55**

7.2 The Mean Age 5 and Age 6 Outcomes of Pupils in Schools

Figure 7.1 plots the mean age 5 (Year 1) and age 6 (Year 2) outcomes of pupils (n = 1,628) in schools (n = 37). The green circle represents a school in which pupils' mean outcomes "increased" considerably from age 5 to age 6. The red circle represents a school in which pupils' mean outcomes "decreased".

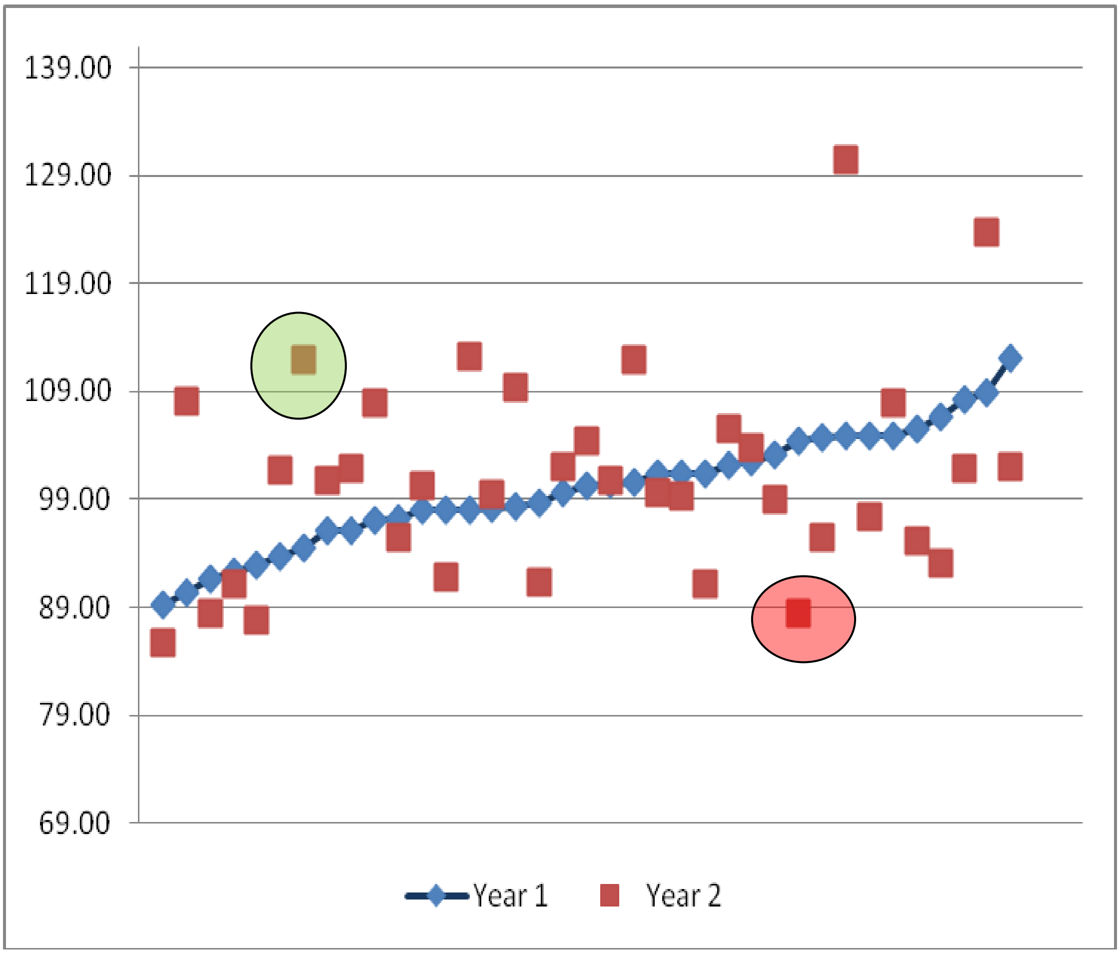

Figure 7.1 *– The Mean Age 5 and Age 6 Outcomes of Pupils in Schools*

Table 7.2 lists the simple gain, or simple loss, in age-standardised scores achieved by pupils in schools from age 5 to age 6.

***Table 7.2** – The Simple Gain in Scores Achieved by Pupils in Schools from Age 5 (Year 1) to Age 6 (Year 2)*

School (number)	Mean age 5 score	s.d	Mean age 6 score	s.d	Simple gain (or loss)
18	104.0	15.5	88.4	11.7	-15.6
21	107.0	17.8	93.0	11.6	-14.0
15	112.0	11.4	102.0	13.2	-10.0
35	105.0	14.2	95.1	11.1	-9.9
37	101.0	13.0	91.2	13.1	-9.8
19	105.0	14.3	95.5	10.6	-9.5
14	105.0	14.3	97.4	16.8	-7.6
20	98.7	11.5	91.3	11.0	-7.4
11	98.0	13.8	91.7	14.0	-6.3
12	108.0	14.2	102.0	8.58	-6.0
26	92.9	13.6	87.7	13.6	-5.2
5	103.0	16.0	99.0	10.4	-4.0
10	89.3	15.2	85.8	9.38	-3.5
13	91.6	15.5	88.4	14.7	-3.2
16	97.2	14.0	95.5	13.1	-1.7
28	101.0	15.2	99.3	11.9	-1.7
29	101.0	12.3	99.7	11.2	-1.3
34	92.3	14.6	91.1	14.6	-0.9
1	103.0	17.9	104.0	13.9	1.0
7	100.0	14.0	101.0	14.0	1.0
30	98.0	11.5	100.0	12.7	2.0
17	98.2	13.3	99.5	14.4	2.3
24	99.6	13.0	102.0	14.6	2.4
4	105.0	13.3	108.0	11.9	3.0
27	96.1	11.60	100.0	12.5	3.9
6	100.0	14.8	104.0	14.7	4.0
32	102.0	13.8	106.0	14.0	4.0
22	96.20	12.2	102.0	10.7	5.8
3	93.7	14.6	102.0	13.9	8.3
36	97.1	14.0	108.0	13.6	10.9
23	101.0	11.5	112.0	12.9	11.0
33	98.4	16.1	109.0	11.7	11.0
9	98.1	13.9	112.0	11.7	13.9
31	109.0	13.4	124.0	11.2	15.0
2	94.5	14.3	112.0	14.0	17.5
8	90.3	18.3	108.0	16.3	18.0
25	105.0	13.4	130.0	5.09	25.0

Eighteen (18), or 48.65%, of schools were associated with pupils who “lost” marks from age 5 to age 6. The remaining 19, or 51.35%, of schools were associated with pupils who “gained” marks. Although figures in Table 7.2 are based on single level analyses, that are unadjusted for the hierarchical nature of the data, important differences in pupil achievement emerge. The difference in marks between the group of pupils gaining the least marks and the group of pupils gaining the most marks amounts to 30.6 marks. At age 6 a difference of 14.57 marks amounts to a standard deviation. Therefore, a difference of 30.6 marks is likely to achieve significance even after adjustment.

7.3 Broader School and Classroom Characteristics

Year 2 teachers were all following ABACUS book 1 during 2005, head teachers had at least 5 years of teaching experience at primary level, most teachers did not conduct a mental warm-up or a plenary and a considerable proportion of Year 2 teachers had not undergone training. Table 7.3 lists other information from the school and classroom collated after the administration of the teacher and head teacher survey questionnaires and MECORS (A).

***Table 7.3** – School and Classroom Characteristics*

School	Categories	(n = 37)	%
Type of school	State	24	64.86
	Private church	9	24.32
	Private independent	4	10.82
Size of school	Small (1 to 2 classes)	22	59.46
	Medium (3 to 4 classes)	11	29.73
	Large (5 to 6 classes)	4	10.81
Average SES	High	1	2.70
	Medium	34	91.89
	Low	2	5.41
Sex	Male	17	45.95
	Female	20	54.05
Age	20 to 24	0	0.00
	25 to 34	0	0.00
	35 to 44	5	13.51
	45 to 54	15	40.54
	55 to 61	17	45.95
First language	Maltese	36	97.30
	English	1	2.70
Teaching	College-trained	19	51.35
	Bachelor of Education	13	35.14
	PGCE	4	10.81
	Not teacher trained	1	2.70
Experience teaching primary	1 to 5 years	6	29.73
	5 to 10 years	11	24.32
	11 to 15 years	9	18.92
	16+ years	11	27.03
Experience head teaching	1 to 5 years	26	70.27
	5 to 10 years	4	10.81
	11+	7	18.91

Table 7.3 *– School and Classroom Characteristics (continued)*

Classroom	Variable Categories	(n = 89)	%
Class size	Small (up to 15 pupils)	2	2.25
	Medium (16 to 25 pupils)	50	56.18
	Large (26 +)	37	41.57
ABACUS topics	Autumn/winter (22	0	0.00
	Spring (19 topics)	68	76.40
	Summer (22 topics)	21	23.59
Average SES	High	4	4.94
	Medium	83	92.82
	Low	2	2.25
Lesson duration	Up to 45 minutes	53	59.55
	More than 45 minutes	36	40.45
Language (of lesson)	Predominantly Maltese	12	13.48
	Maltese and English	57	64.05
	Predominantly English	20	22.47
Mental warm-up	No warm-up	77	86.30
	5 minute warm-up	12	13.70
Explanatory activities	Up to 10 minutes	21	23.60
	Up to 20 minutes	2	2.25
	Up to 30 minutes	66	74.15
Set tasks	Up to 10 minutes	0	0.00
	Up to 20 minutes	57	64.04
	Up to 30 minutes	32	35.96
Plenary	No plenary	56	62.92
	5 minute plenary	33	37.07
Homework	4 times per week	67	75.28
	5 times per week	22	24.72
Sex (of teacher)	Male	2	2.25
	Female	87	97.75
Age (of teacher)	20 to 24	8	8.99
	25 to 34	23	25.84
	35 to 44	14	15.73
	45 to 54	27	30.34
	55 to 61	17	19.11
First language	Maltese	80	89.89
	English	9	10.11
Qualifications	College-trained	21	23.60
	Bachelor of Education	38	42.70
	PGCE	10	11.24
	Not trained	20	22.47
Experience (primary)	1 to 5 years	33	37.08
	5 to 10 years	24	26.97
	11+ years	32	35.95

7.3.1 Socio-Economic Composition

Socio-environmental factors influence pupil outcome (Sammons et al., 2009). The majority of pupils in the matched sample (63.25%) were Table 7.4 describes the mean socio-economic composition of schools and Year 2 classrooms.

***Table 7.4** – Socio-Economic Composition of Schools and Classrooms*

School (type)	School (number)	Class (number)	School SES	s.d	Class SES	s.d
State	1	1	2.21	10.57	2.22	10.56
	1	2			2.03	8.23
	1	3			2.38	12.93
State	2	4	2.04	15.12	2.08	16.80
	2	5			1.88	14.18
	2	6			2.24	15.25
	2	7			1.98	14.25
Church	3	8	2.15	15.85	2.15	15.85
Independent	4	9	2.64	26.32	2.55	23.27
	4	10			2.74	33.43
	4	11			2.67	25.24
	4	12			2.60	23.33
Church	5	13	2.41	17.94	2.52	18.69
	5	14			2.31	15.78
	5	15			2.41	19.34
State	6	16	2.49	16.29	2.21	16.35
	6	17			2.76	16.22
State	7	18	2.04	17.20	2.08	11.58
	7	19			2.12	16.37
	7	20			2.00	19.14
	7	21			2.02	17.10
	7	22			1.96	21.79
State	8	23	1.75	9.79	1.75	9.79
State	9	24	2.08	23.85	2.08	23.85
State	10	25	1.72	15.50	1.72	15.50
State	11	26	1.99	15.98	1.98	13.67
	11	27			2.06	15.42
	11	28			1.93	18.85
State	12	29	2.09	20.68	2.09	20.69
State	13	30	1.89	10.99	1.91	11.91
	13	31			1.87	10.07

Table 7.4 *– Socio-Economic Composition of Schools and Classrooms (continued)*

School (type)	School (number)	Class (number)	School SES	s.d	Class SES	s.d
State	14	32	2.28	14.63	2.34	16.80
	14	33			2.23	12.47
State	15	34	2.05	13.56	2.05	13.56
State	16	35	2.10	16.71	2.04	14.28
	16	36			2.06	17.12
	16	37			2.06	21.52
	16	38			2.18	16.19
	16	39			2.10	17.43
	16	40			2.15	13.71
State	17	41	2.16	15.08	2.17	14.69
	17	42			2.21	15.31
	17	43			2.10	15.24
State	18	44	2.13	12.68	2.14	11.92
	18	45			2.11	13.44
State	19	46	2.06	15.28	2.15	13.09
	19	47			1.97	17.47
State	20	48	2.19	12.52	2.22	11.13
	20	49			2.17	13.91
Church	21	50	2.21	7.86	2.21	7.86
Church	22	51	2.73	18.09	2.28	19.37
	22	52			2.34	16.85
	22	53			3.57	18.05
State	23	54	2.28	13.70	2.28	13.70
State	24	55	2.09	13.23	2.10	13.30
	24	56			2.14	15.56
	24	57			1.86	13.89
	24	58			2.11	12.56
	24	59			2.26	10.86
Church	25	60	2.28	5.95	2.28	5.95
Independent	26	61	2.30	16.48	2.30	16.48
Independent	27	62	2.22	12.11	2.36	13.17
	27	63			2.09	11.06
Independent	28	64	2.69	25.31	2.60	25.68
	28	65			2.79	24.94
Church	29	66	2.18	16.44	2.13	17.44
	29	67			2.23	15.45
Church	30	68	2.59	19.84	2.65	22.18
	30	69			2.54	17.49

Table 7.4 *– Socio-Economic Composition of Schools and Classrooms (continued)*

School (type)	School (number)	Class (number)	School SES	s.d	Class SES	s.d
Church	31	70	2.27	14.60	2.27	14.60
Church	32	71	2.40	16.34	2.43	17.65
	32	72			2.46	18.13
	32	73			2.32	13.24
State	33	74	2.00	14.39	1.96	14.24
	33	75			2.04	14.53
State	34	76	2.18	10.43	2.24	8.73
	34	77			2.13	12.13
State	35	78	2.00	18.88	1.94	20.25
	35	79			2.14	19.53
	35	80			1.94	19.51
	35	81			2.00	16.98
	35	82			2.00	18.14
State	36	83	2.00	22.00	2.04	18.70
	36	84			1.95	22.48
	36	85			2.02	24.80
State	37	86	2.14	16.85	2.12	20.62
	37	87			2.22	14.07
	37	88			2.17	14.85
	37	89			2.06	17.86

Mean figures above were calculated by aggregating data for father's occupation (Appendix 7.1) and mother's education (Appendix 7.2). The range for the aggregated data is 1 (*low*), 2 (*medium*) to 3 (*high*). The total value was divided by two to obtain an average composite score. Participating schools attract a majority of pupils from the medium socio-economic categories. Schools "play in position" when "lower-social-class schools" are associated with pupils who achieve lower scores than pupils associated with "middle-social-class-schools" (Reynolds et al., 2002:277-278). Since most schools attracted the majority of pupils from the medium social category, this implies that socio-economic factors play out differently in Maltese schools. Table 7.5 gives ratios that describe the predominant socio-economic status of pupils in schools alongside with other relevant results.

***Table 7.5** – Pupils' Simple Gain in Scores by Father's Occupation and Mother's Education*

School number (type)	Mean age 5 score	s.d	Mean age 6 score	s.d	Simple gain	Father's occupation high:low	Mother's education high: medium
18 (state)	104.0	15.5	88.4	11.7	-15.6	0.8:1	0.4:1
21 (church)	107.0	17.8	93.0	11.6	-14.0	4.0:1	0.2:1
15 (state)	112.0	11.4	102.0	13.2	-10.0	0.7:1	0.2:1
35 (state)	105.0	14.2	95.1	11.1	-9.9	0.3:1	0.2:1
37 (state)	101.0	13.0	91.2	13.1	-9.8	1.9:1	0.3:1
19 (state)	105.0	14.3	95.5	10.6	-9.5	0.0:1	0.3:1
14 (state)	105.0	14.3	97.4	16.8	-7.6	3.5:1	0.6:1
20 (state)	98.7	11.5	91.3	11.0	-7.4	2.0:1	0.5:1
11 (state)	98.0	13.8	91.7	14.0	-6.3	0.4:1	0.1:1
12 (state)	108.0	14.2	102.0	8.58	-6.0	0.7:1	0.3:1
26 (independent)	92.9	13.6	87.7	13.6	-5.2	2.5:1	0.7:1
5 (church)	103.0	16.0	99.0	10.4	-4.0	5.4:1	0.8:1
10 (state)	89.3	15.2	85.8	9.38	-3.5	0.0:1	0.0:1
13 (state)	91.6	15.5	88.4	14.7	-3.2	0.0:1	0.2:1
16 (state)	97.2	14.0	95.5	13.1	-1.7	0.7:1	0.4:1
28 (independent)	101.0	15.2	99.3	11.9	-1.7	12.0:1	2.3:1
29 (church)	101.0	12.3	99.7	11.2	-1.3	2.3:1	0.4:1
34 (state)	92.3	14.6	91.1	14.6	-0.9	1.1:1	0.5:1
1 (state)	103.0	17.9	104.0	13.9	1.0	1.8:1	0.5:1
7 (state)	100.0	14.0	101.0	14.0	1.0	0.9:1	0.1:1
30 (church)	98.0	11.5	100.0	12.7	2.0	27.1:1	1.8:1
17 (state)	98.2	13.3	99.5	14.4	2.3	0.9:1	0.5:1
24 (state)	99.6	13.0	102.0	14.6	2.4	0.6:1	0.4:1
4 (independent)	105.0	13.3	108.0	11.9	3.0	13.8:1	1.5:1
27 (independent)	96.1	11.60	100.0	12.5	3.9	1.5:1	0.5:1
6 (state)	100.0	14.8	104.0	14.7	4.0	2.5:1	0.3:1
32 (church)	102.0	13.8	106.0	14.0	4.0	8.3:1	0.8:1
22 (church)	96.20	12.2	102.0	10.7	5.8	4.7:1	0.6:1
3 (church)	93.7	14.6	102.0	13.9	8.3	0.5:1	0.2:1
36 (state)	97.1	14.0	108.0	13.6	10.9	0.4:1	0.1:1
23 (state)	101.0	11.5	112.0	12.9	11.0	3.0:1	0.8:1
33 (state)	98.4	16.1	109.0	11.7	11.0	0.5:1	0.2:1
9 (state)	98.1	13.9	112.0	11.7	13.9	2.0:1	0.1:1
31 (church)	109.0	13.4	124.0	11.2	15.0	2.2:1	0.4:1
2 (state)	94.5	14.3	112.0	14.0	17.5	0.2:1	0.2:1
8 (state)	90.3	18.3	108.0	16.3	18.0	0.1:1	0.0:1
25 (church)	105.0	13.4	130.0	5.09	25.0	0.0:1	0.5:1

Twenty-nine (29), or 78.38%, of schools have at least 53.33% of fathers in medium category occupations. Thirty-five (35), or 94.59%, of schools have at least 53.75% of mothers who achieved a medium level qualification. Ratios in Table 7.5 compare the proportion of fathers in high/low category occupations and the proportion of mothers with high/medium level qualifications. Eighteen (18) schools are associated with pupils who "lost" marks. Of these schools, 13 (72.22%) are state schools, 3 (16.67%) are private church schools and 2 (11.11%) are private independent schools. Nineteen (19) schools are associated with pupils who "gained" marks. Of these schools, 11 (68.43%) are state schools, 6 (31.58%) are private church schools and 2 (10.53%) are private independent schools. Of the 18 schools associated with pupils who "lost" marks, eight (44.44%) schools have more than double the proportion of pupils with fathers in high category occupations than pupils with fathers in low category occupations. Of these eight schools, three (37.5%) are state schools, three (37.5%) are private church schools and two (25%) are private independent schools. Of the 19 schools associated with pupils who gained marks, eight (40.79%) schools have more double the proportion of pupils with fathers in high category occupations when compared to the proportion of pupils with fathers in low category occupations, three (37.5%) are state schools, four (50%) are private church schools and one (12.5%) is a private independent school. This confirms that the socio-economic composition of schools in which pupils "lost" marks and in which pupils gained marks are relatively similar. These results strongly suggest that Maltese schools may not "play in position" at all or if they do this is not as in other schools across the world.

7.3.2 Time

In section 6.7, time available for pupil learning was discussed. Global school time averages at 750 hours per year (UNESCO-IBE, 2000) with 150 hours dedicated on average for mathematics worldwide (Benavot & Amadio, 2004). On average, Maltese pupils in state schools dedicate 31.75% time more than pupils worldwide. Maltese pupils dedicate 12.73% time to mathematics whilst pupils worldwide dedicate on average 20%. On the other hand and in spite of a shorter school day, on average Maltese pupils in private schools dedicate 16.29% of their school time to mathematics. Table 7.6 further describes the time dedicated to mathematics at school.

***Table 7.6** – Time Dedicated to Mathematics*

Type of time	**Average time (days)**	**Average time (hours)**
Length of school day		
State	7 hours	
Private Church	6.25 hours	
School time (all subjects)		
State	1,099 hours (157	
Private	896 hours (147 days)	
Average lesson time		
State	40 minutes	
Private	55 minutes	
Annual classroom time (mathematics)		
State	140 hours (5.8 days)	
Typically-developing pupils		175
Pupils with statements without learning support		175
Pupils with statements with a learning support assistant		15
Pupils with difficulty learning mathematics and supported by a complementary teacher		105
Private	218 hours (9.1 days)	
Typically-developing pupils		243
Pupils with statements without learning support		243
Pupils with statements supported by a learning support assistant		243
Pupils with difficulty learning mathematics supported by a complementary teacher		194

7.4 Year 2 Teacher Beliefs

In part B of the teacher survey questionnaire, Year 2 teachers were asked to answer 48 belief statements (Appendix 7.3) which ranged from 1 (*strongly agree*) to 5 (*strongly disagree*). Internal reliability was acceptable at $\alpha = 0.79$. In Table 7.7 below, low mean scores (less than three) indicate teacher agreement. High means (above three) indicate teacher disagreement. Standard deviations that are smaller than one indicate less variation in teacher responses. Standard deviations that are greater than one indicate increased variation in teacher responses.

Table 7.7 *– Mean Scores for Teacher Responses to Belief Statements*

Year 2 teacher beliefs	Mean	s.d
Pupils learn about mathematical concepts before being able to apply them (5)	2.28	1.055
Mathematical concepts, methods and procedures must be introduced one at a time (6)	2.20	0.991
Mathematics is best taught in English (7)	3.15	1.173
Engaging pupils in meaningful talk is the best way to teach mathematics (8)	2.25	1.048
Pupils learn mathematics best through a mixture of Maltese/English (9)	2.16	1.076
Pupils must be shown how to apply appropriate methods and procedures through reasoning (10)	1.62	0.631
Pupils must be taught how to decode a word problem (11)	2.26	0.683
Mathematics is best taught in Maltese (12)	1.52	0.503
Pupils must learn mathematical concepts and how to apply these concepts together (13)	1.99	0.846
Teaching is best based on practical activities so that pupils discover methods for themselves (14)	1.51	0.799
Pupils need to be able to use and apply mathematics using apparatus (15)	3.73	0.780
Teaching is best when based on verbal explanations (16)	3.75	1.003
When teaching, connections across mathematics topics must be made explicit (17)	2.31	0.684
Mathematics routines must be introduced one at a time (18)	2.11	0.910
Pupil misconceptions must be remedied by reinforcing the correct method (19)	2.42	1.136
Pupils' errors need to be remedied in order for them to learn (20)	2.10	1.149
Most pupils are able to become numerate (21)	1.74	0.575

***Table 7.7** – Mean Scores for Teacher Responses to Belief Statements (continued)*

Year 2 teacher beliefs	**Mean**	**s.d**
Pupil methods are important because they understand mathematical concepts, methods and procedures for themselves	1.92	0.801
Pupils must be taught standard methods and procedures (23)	3.78	0.962
Pupils make mistakes because they are not ready to learn mathematics (24)	2.90	1.098
Pupils learn mathematics best mainly through Maltese (25)	3.70	0.910
Pupils learn mathematics by being challenged (26)	2.70	1.219
Pupils learn mathematics by following instructions and working alone (27)	3.31	1.174
Pupils learn mathematics by manipulating concrete materials (28)	1.58	0.540
Pupils learn mathematics through interaction with others (29)	1.70	0.664
Pupils must be ready before they can learn certain mathematics	1.96	0.767
Pupils learn mathematics best through English (31)	3.17	1.090
Pupils vary in their ability to learn mathematics (32)	1.63	0.551
Pupils vary in their rate of mathematical development (33)	1.54	0.501
Pupil misunderstandings need to be made explicit and improved upon (34)	1.52	0.546
Teachers must help pupils refine their problem-solving methods	1.47	0.524
All pupils are able to learn mathematics (36)	2.18	1.173
Most pupils must decode mathematical terms through Maltese	2.99	1.266
Pupils need to be taught how topics link (38)	2.22	0.822
Pupils learn by using any method (39)	1.75	0.743
Pupils learn mathematics when using mathematics apparatus (40)	1.97	0.818
Pupils learn by applying the correct method/procedure (41)	2.60	1.052
Pupils need to be able to read/write/speak English well in order to learn mathematics (43)	2.67	1.232
Pupils learn mathematics by reasoning (44)	1.90	0.622
Pupils need to learn to understand the mathematics context to solve a problem (45)	1.85	0.490
Pupils do not need to be able to read/write/speak English well to learn mathematics (46)	3.42	1.085
Pupils learn to solve problems by using concrete materials (47)	1.94	0.680
Pupils may be taught any method as long as it is efficient (48)	1.69	0.595

The results above show teachers to: (1) agree and vary less in their responses for 24 (55.81%) belief items shaded in blue, (2) agree but vary more in their responses for 11 items (25.58%) shaded in green, (3) disagree and vary less in their responses for three items shaded in yellow, and to (4) disagree and vary more in their responses for five items (11.63%) shaded in orange.

7.4.1 Exploring and Confirming a Structure for Teacher Beliefs

Belief statements in the teacher survey questionnaire were formulated on the basis of findings from the Askew et al. (1997) study. Therefore, the basis for belief statements in the teacher questionnaire was empirical rather than theoretical. Consequently, the validity of instructional constructs relevant to belief statements required exploration. A sample of 89 teachers is rather small for factor analysis (Comrey & Lee, 1992). Yet, the author proceeded because the sample achieved the minimum 1:5 subject to item ratio (Gorsuch, 1983). More recently, Ko and Sammons (2010) found that a small sample of 79 teachers could produce a six-factor model using confirmatory factor analysis with 30 items (from a scale of 45 items). In the current study, alpha factoring techniques with varimax rotation were used to explore the possibility that items would group around three factors (transmission, discovery, connectionist). This solution failed to converge. During the next round, items were not constrained. This resulted in a six-factor solution. Table 7.8 gives factor loadings from this solution for items with a loading of .40 and over.

***Table 7.8** – Exploring a Structure for Teacher Beliefs*

Skills (item)	1	2	3	4	5	6
Pupil misconceptions must be remedied by reinforcing the correct method (19)	.782					
Pupils must be taught standard methods and procedures (23)	.425					
Pupils learn mathematics by working sums out on paper (42)	.845					
Pupils do not need to be able to read/write/speak English well to learn mathematics (46)	-.803					

***Table 7.8** – Exploring a Solution for Teacher Beliefs (continued)*

Routines and Methods	**1**	**2**	**3**	**4**	**5**	**6**
Pupil misunderstandings need to be made explicit and improved upon (34)		.777				
Teachers must help pupils refine their problem-solving methods (35)		.785				
Talk, Readiness and Ability						
Engaging pupils in meaningful talk is the best way to teach mathematics (8)			.600			
Teaching is best based on verbal explanations (16)			.431			*.435*
Pupils make mistakes because they are not ready to learn mathematics (24)			.487			
All pupils are able to learn mathematics (36)			.525			
Understanding						
Pupils learn mathematics by reasoning (44)				.730		
Pupils need to learn to understand the mathematics context to solve a problem				.855		
Connections/Materials and Methods						
Pupils need to be taught how topics link (38)					.648	
Pupils need to learn to solve problems by using concrete materials (47)					.409	
Pupils may be taught any method as long as efficient (48)					.549	
Other Routines/Methods						
Teaching is best based on practical activities so that pupils discover methods for themselves (14)						.871
Pupils must be taught how to decode a word problem (11)						.909

The Kaiser-Meyer-Olkin (KMO) statistic describes the adequacy of the sample (as cited in Dziuban and Shirkey, 1974:359). Kaiser-Meyer-Olkin, refined an index for the interpretation of this statistic. He recommended that anything in the: .90's was "marvelous", .80's "meritorious", .70's "middling", .60's "mediocre" and .50's "miserable". The six factors in this solution have a KMO of .748. Internal reliability, as indicated by the alpha statistic, is acceptable for each of the six factors in the above solution: "Skills" (α = .735), "Routines and Methods" (α = .876), "Talk/Readiness and Ability" (α = .781), "Understanding" (α = .754), "Connections/Materials and Methods" (α = .779) and "Other Routines/Methods" (α = .750). An item with a split loading was included with the factor upon which it next loaded the highest. Names given for each of the six factors describe, as much as possible, the reconfigured nature of items. The correlation matrix in Table 7.9 shows associations as generally weak (*r* is below .40).

***Table 7.9** – Correlation Matrix for Teacher Beliefs*

	B8	**B11**	**B14**	**B16**	**B19**	**B23**	**B24**	**B34**	**B35**	**B36**	**B38**	**B42**	**B44**	**B45**	**B46**	**B47**	**B48**
B8	1.000																
B11	.211	1.000															
B14	.093	.112	1.000														
B16	.416	.177	.002	1.000													
B19	.132	.023	.066	.211	1.000												
B23	.249	.020	.031	.141	.284	1.000											
B24	.334	.116	.318	.095	.025	.258	1.000										
B34	.047	.217	.384	.028	.057	.014	.316	1.000									
B35	.075	.036	.292	.138	.029	.077	.242	.766	1.000								
B36	.167	.186	.084	.135	.080	.266	.242	.200	.195	1.000							
B38	.210	.138	.275	.123	.106	.237	.252	.194	.120	.005	1.000						
B42	.216	.137	.226	.295	.172	.070	.241	.335	.167	.129	.236	1.000					
B44	.196	.276	.104	.032	.149	.133	.098	.122	.009	.006	.023	.048	1.000				
B45	.093	.148	.012	.250	.176	.263	.176	.073	.050	.106	.139	.233	.622	1.000			
B46	-.151	-.101	-.035	-.186	-.547	-.258	.017	.002	-.209	.110	.111	-.322	.088	.051	1.000		
B47	.084	.203	.095	.163	.251	.054	.053	.110	.043	.241	.185	.065	.013	.059	.001	1.000	
B48	.056	.035	.243	.018	.028	.006	.177	.331	.226	.065	.332	.177	.210	.081	.117	.208	1.000

Cells in white mean that the coefficient ***r*** is not significant. Cells in orange mean that the coefficient ***r*** is significant at $p < .001$. Cells in yellow mean that the coefficient ***r*** is significant at $p < .01$. Cells in light blue mean that the coefficient ***r*** is significant $p < .05$

Structural equation modelling is more rigorous than exploratory factor analysis. Confirmatory factor analyses, using the software AMOS, explored the structure associated with constructs underpinning the belief responses of Year 2 teachers. Minimum sample size requirements are vexing in structural equation modelling (Brown, 2006). A sample of 89 teachers is below a critical n of 100 to 150 subjects (Ding, Velicer & Harlow, 1995). However, a ratio of one subject to five variables usually suffices for normal distributions (Bentler & Chou, 1987). Here, the model (for testing) postulates that there are six correlated factors: Skills Needed, Routines and Methods, Talk/Readiness and Ability, Understanding, Connection/Materials and Methods/Other Routines/Methods. The root mean square error of approximation (RMSEA) and the comparative fit index (CFI) describe fit. RMSEA values of less than .05 indicate good fit and values less than .08 represent reasonable errors of approximation (Browne & Cudeck, 1993). MacCallum et al. (1996) extend these cut-off points. Values between .08 and .10 indicate poor but acceptable fit. Browne and Cudeck (1993) and MacCallum et al. (1996) argue that this is more realistic than an exact fit of RMSEA = 0.00. The CFI index ranges from 0 to 1 and is a measure of the complete co-variation in the data (Byrne, 2001) and is not as affected by small sample sizes (Iacobucci, 2010). A CFI value >.90 is indicative of a well-fitting model but this was later revised to <.95 (Hu & Bentler, 1999).

The hypothesized solution did not fit as well with the structure of the local data (RMSEA = .098, CFI = .930, χ^2 = 218.10, df = 152, $p < .001$). Three of the six factors: “skills needed” (RMSEA = .020, CFI = .980, χ^2 = 14.5, df = 5, $p < .05$), “other routines/methods” (RMSEA = .046, CFI = .970, χ^2 = 8.80, df = 3, $p < .05$) and “routines/methods” (RMSEA = .046, CFI = .970, χ^2 = 8.80, df = 3, $p < .05$) separately approached or achieved acceptability. Further attention was given to the items: “pupils must be taught how to decode a word problem” (item 11) and “teaching is best based on practical activities so that pupils discover methods for themselves” (item 14). Fit improved when item 11 was included with the factor “skills needed” (RMSEA = .063, CFI = .973, χ^2 = 22.20, df = 9, $p < .01$). Fit also improved when item 14 was included with the factor “routines/methods”. (RMSEA = .058, CFI = .950, χ^2 = 66.5, df = 34, p

< .05). Figure 7.7 presents a valid model with items 11 and 14 included (RMSEA = .057, CFI = .960, χ^2 = 66.5, df = 34, p < .001) in Figure 7.7.

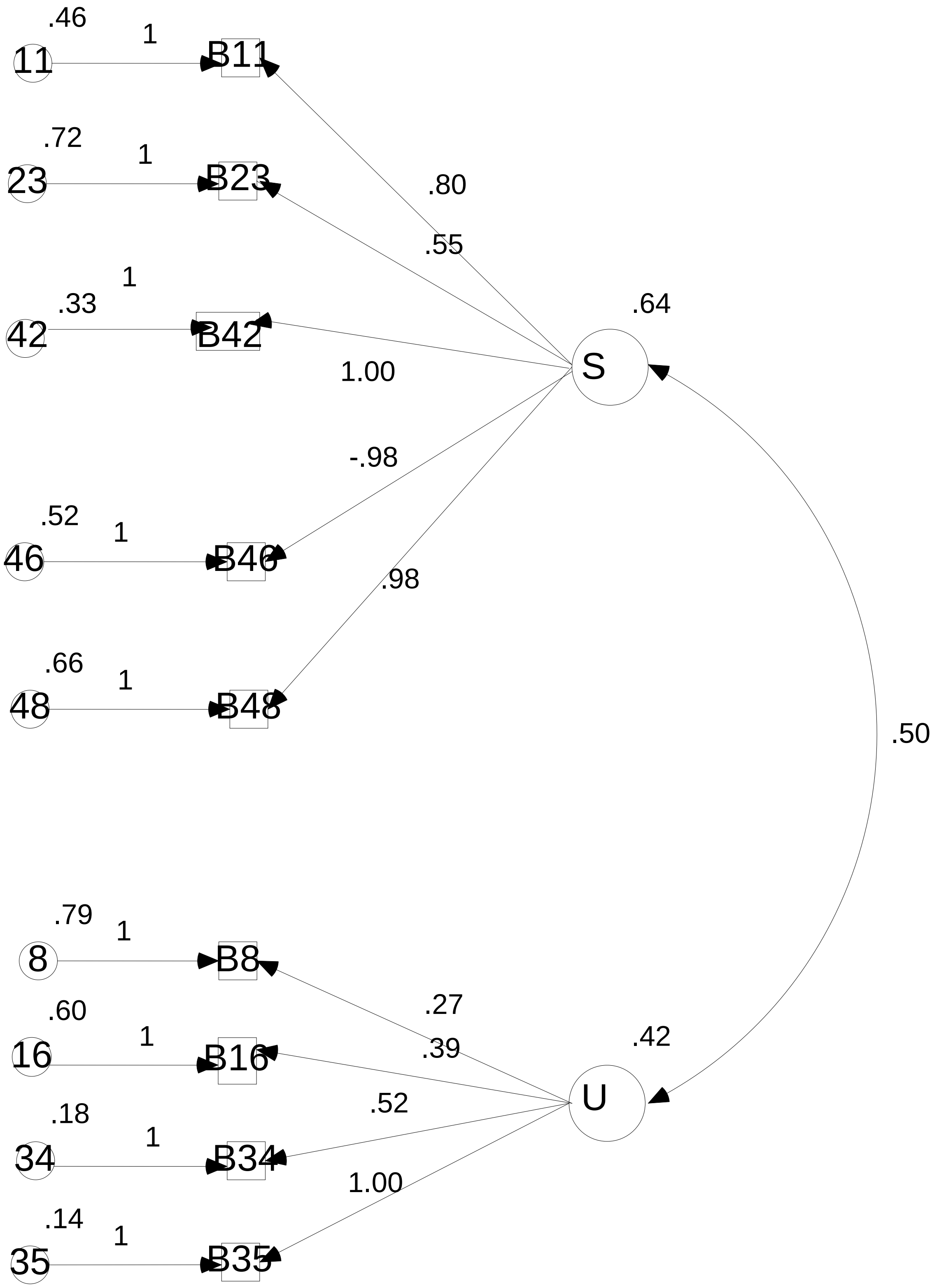

***Figure 7.2** – A Confirmed Structure for Teacher Beliefs*

Key: S = skills and U = understanding.

7.4.1.1 Teacher Responses for Skills and Understanding

Figures 7.3 and 7.4, give percentage figures for teacher responses to belief statements from the validated factors of Skills and Understanding.

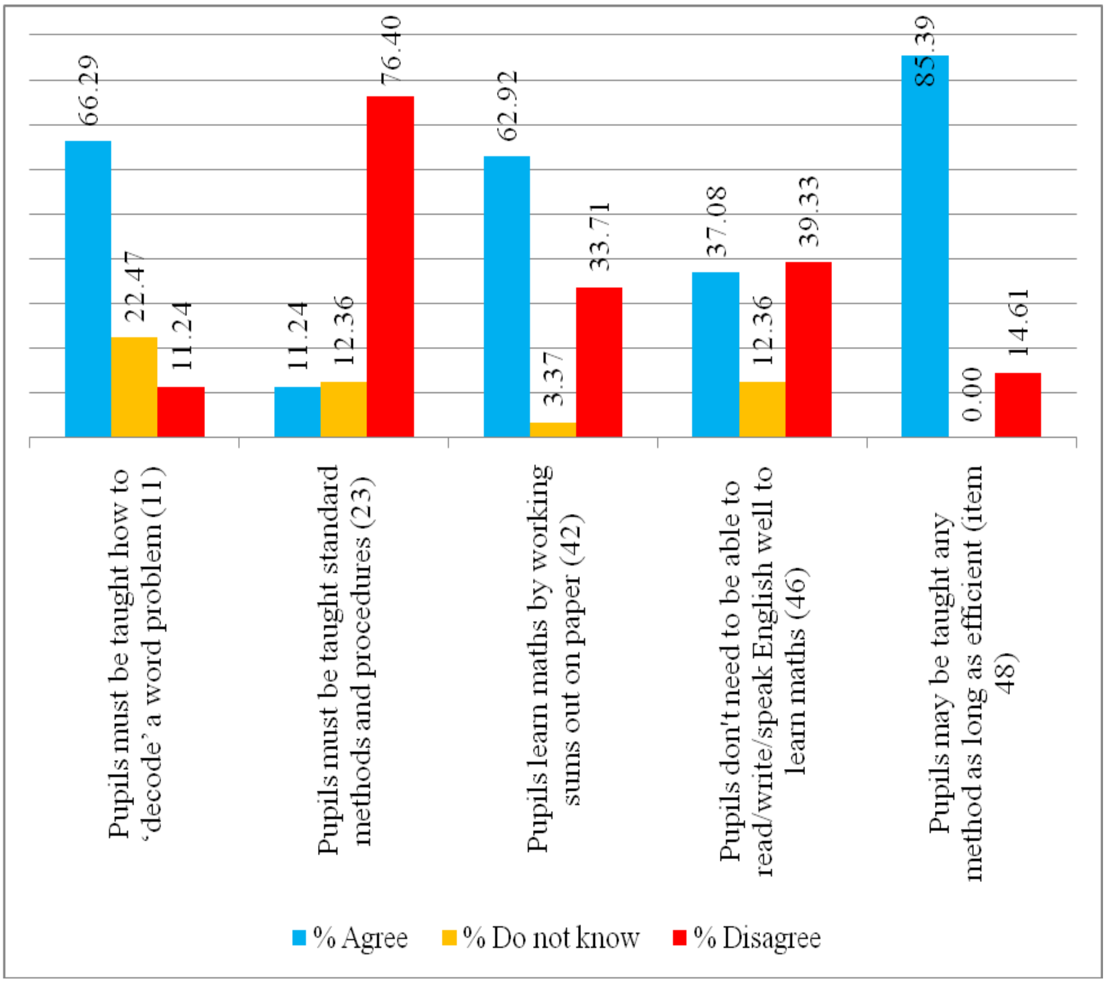

***Figure 7.3** – Percent Responses of Teacher Beliefs from the Factor Skills*

Most teachers agreed that: "pupils must be taught how to decode a word problem" (item 11), "pupil misconceptions must be remedied by reinforcing the correct method" (item 19), "pupils learn mathematics by working sums out on paper" (item 42) and "pupils may be taught any method as long as efficient" (item 48). Teachers tend to disagree that: "pupils must be taught standard methods and procedures" (item 23) and "pupils do not need to be able to read/write/speak English well to learn mathematics" (item 46). No teacher exhibited uncertainty for: "pupils may be taught any method as long as efficient" (item 48).

In Figure 7.4 below, most teachers agreed that: "engaging pupils in meaningful talk is the best way to teach mathematics" (item 8), "pupil misunderstandings need to be made explicit and improved upon" (item 34) and teachers "must help pupils to refine their problem-solving methods" (item 35). Most teachers disagreed that: "teaching is best based on practical activities" (item 14).

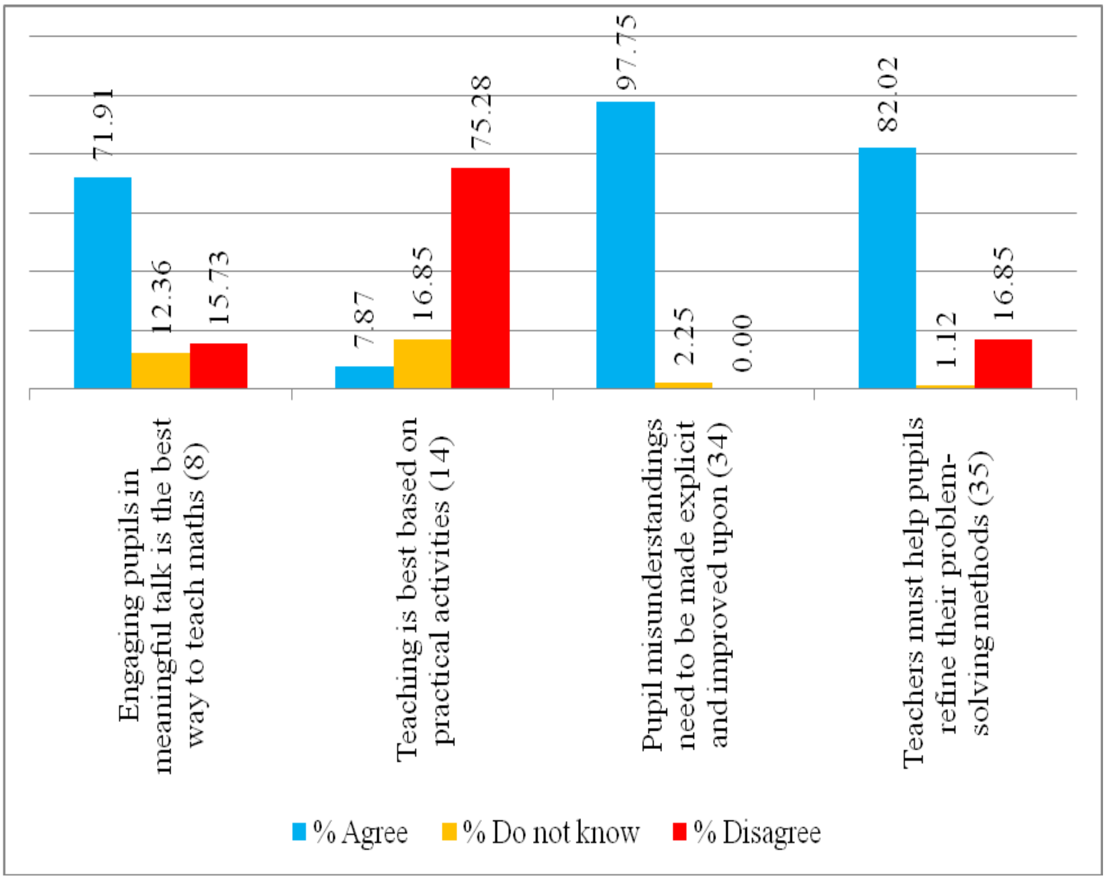

***Figure 7.4** – Percent Responses of Teacher Beliefs from the Factor Understanding*

7.5 Year 2 Teacher Behaviours

Two researchers observed the behaviours of Year 2 teachers at two points in time according to the classroom observation schedule MECORS (B). Each researcher rated the observed teacher behaviours on a scale ranging from 1 (*never observed*) to 5 (*consistently observed*). Internal reliability for was found to be good at $\alpha = 0.76$ (dataset A) and $\alpha = 0.74$ (dataset B). Frequency figures for teacher ratings in datasets A and B (Appendix 7.4), show slight differences in teacher behaviours between the January/February observations (dataset A) and the March/April observations (dataset

B). The relative similarity in teacher behaviours over a 12-week period is indicated by mean scores in Table 7.10. Below, means above three describe the more frequent observation of effective behaviours. Means below three describe the less frequent observation of effective behaviours. Standard deviations smaller than one refer to teachers with increased variation in behaviour. Standard deviations larger than one refer to teachers with decreased variation in behaviour.

***Table 7.10** – Mean Scores for Teacher Behaviours*

Classroom management	**Mean (A)**	**s.d**	**Mean (B)**	**s.d**
Sees that rules and consequences are clearly understood (1)	4.75	0.716	4.78	0.799
Starts lesson on time; within 5 minutes (2)	3.98	0.841	4.10	0.905
Uses time during class transitions effectively (3)	4.02	1.044	4.02	1.044
Tasks/materials are collected/distributed effectively (4)	3.56	1.373	3.75	1.250
Sees that disruptions are limited (5)	1.83	1.256	1.83	1.276
Classroom behaviour				
Uses a reward system to manage pupil behaviour (6)	3.21	1.690	3.21	1.720
Corrects behaviour immediately (7)	4.49	0.759	4.44	0.756
Corrects behaviour accurately (8)	4.26	0.676	4.30	0.659
Corrects behaviour constructively (9)	2.90	0.870	2.99	0.880
Monitors the entire classroom (10)	3.59	1.065	3.65	1.048
Attention on lesson				
Clearly states the objectives/purposes of the lesson (11)	3.28	1.990	3.29	1.990
Checks for prior knowledge (12)	2.87	1.079	2.90	1.040
Presents material accurately (13)	4.42	0.589	4.42	0.590
Presents material clearly (14)	3.83	0.842	3.84	0.825
Gives detailed directions/explanation (15)	3.61	0.963	3.60	0.985
Emphasises key points of the lesson (16)	3.15	1.175	3.23	1.262
Has an academic focus (17)	3.30	1.133	3.30	1.133
Uses a brisk pace (18)	3.53	1.210	3.53	1.200

***Table 7.10** – Mean Scores for Teacher Behaviours (continued)*

Review/practice	**Mean (A)**	**s.d**	**Mean (B)**	**s.d**
Explains tasks clearly (19)	3.33	0.995	3.39	0.994
Offers assistance to pupils (20)	3.03	1.176	3.05	1.158
Summarises the lesson (22)	3.18	1.140	3.19	1.143
Re-teaches if error rate is high (23)	2.98	1.155	2.98	1.155
Is approachable for pupils with problems (24)	2.87	1.070	2.88	1.057
Uses a high frequency of questions (25)	2.55	1.184	2.56	1.187
Skills in questioning				
Asks academic mathematical questions (26)	3.56	1.131	3.56	1.131
Asks open-ended questions (27)	2.58	1.139	2.59	1.141
Probes further when responses are incorrect (28)	2.76	1.248	2.80	1.255
Elaborates on answers (29)	3.02	0.985	3.04	0.953
Asks pupils to explain how they reached solution (30)	1.70	1.176	1.70	1.176
Asks pupils for more than one solution (31)	2.59	1.198	2.60	1.206
Appropriate wait-time between questions/responses (32)	4.02	1.073	3.98	1.044
Notes pupils' mistakes (33)	3.35	1.132	3.35	1.132
Guides pupils through errors (34)	4.33	0.900	4.33	0.900
Clears up misconceptions (35)	3.46	0.989	3.46	0.989
Gives immediate mathematical feedback (36)	3.83	1.111	3.83	1.111
Gives accurate mathematical feedback (37)	4.59	0.621	4.69	0.629
Gives positive academic feedback (38)	3.64	0.916	3.64	0.921

***Table 7.10** – Mean Scores for Teacher Behaviours (continued)*

Mathematics enhancement strategies	**Mean (A)**	**s.d**	**Mean (B)**	**s.d**
Employs realistic problems/examples (39)	4.12	0.856	4.12	0.856
Encourages pupils to use a variety of problem-solving methods (40)	2.86	1.128	2.87	1.152
Uses correct mathematical language (41)	4.60	0.651	4.60	0.651
Encourages pupils to use correct mathematical language (42)	3.24	1.280	3.27	1.320
Allows pupils to use their own problem-solving strategies (43)	3.02	1.146	3.04	1.490
Implements quick-fire mental questions/strategies (44)	2.96	1.449	2.89	1.517
Connects new material to previously learnt material (46)	2.54	0.968	2.45	0.958
Teaching methods				
Uses a variety of explanations that differ in complexity (47)	4.11	0.898	4.17	0.891
Uses a variety of instructional methods (48)	3.41	0.900	3.31	0.800
Uses manipulative materials/instructional aids/resources (49)	3.44	0.914	3.32	0.814
Classroom climate				
Communicates high expectations for pupils (50)	3.06	1.099	2.97	1.109
Exhibits personal enthusiasm (51)	3.68	0.863	3.69	0.861
Displays a positive tone (52)	3.78	0.871	3.79	0.856
Encourages interaction/communication (53)	3.90	0.870	3.90	0.850
Conveys genuine concern for pupils (54)	3.86	0.841	3.36	0.849
Knows and uses pupils' names (55)	4.90	0.577	4.80	0.569
Displays pupils' work in the classroom (56)	3.01	1.115	3.00	1.105
Prepares an inviting/cheerful classroom (57)	3.77	0.897	3.77	0.897

Results for 24 items (42.10%) shaded in blue show teachers to frequently exhibit effective behaviours and to exhibit decreased variation in behaviour. Results for 18 items shaded in green show teachers to frequently exhibit effective behaviours and to exhibit increased variation in behaviour. Results for three items shaded in yellow show teachers to infrequently exhibit effective behaviours and to exhibit decreased variation in behaviour. Results for nine items (15.79%) shaded in orange show teachers to infrequently exhibit effective behaviours and to exhibit increased variation in behaviour.

7.5.1 Exploring and Confirming a Structure for Teacher Behaviours

In the UK, Mujis and Reynolds (2001) organized the 57 items in MECORS (B) that measured the quantity and quality of teachers' observed behaviours during lessons of mathematics under eight instructional categories. Exploratory factor analysis with varimax rotation explored this structure but this solution failed to converge. Teacher ratings from the January/February (2005) and the March/April (2005) observation rounds were included in the analysis. A six-factor solution emerged following the unconstrained analyses. The six factors exhibit a good KMO of .816. Internal reliability is acceptable for each of the six factors. "Practice, Questioning and Methods" has an α of .887, "Orderly Climate" an α of .802, "Management" an α of .898, "Making Time" an α of .876 and "Broader Climate" an α of .873. "Rewards" is only composed of one item and is split in loading. Therefore, the internal reliability for this item was calculated with "Broader Climate". Table 7.11 gives factor loadings at and above the 0.40 cut-off point.

***Table 7.11** – Exploring a Structure for Teacher Behaviours*

Practice, Questioning/Methods (item)	**1**	**2**	**3**	**4**	**5**	**6**
Presents materials clearly (14)	.656					
Offers assistance to pupils (20)	.509					
Summarises the lesson (22)	.568					
Asks academic mathematical questions (26)	.782					
Probes further when responses are incorrect (28)	.843					
Uses appropriate wait-time between questions and answers (32)	.703					
Notes pupils' mistakes (33)	.778					
Gives positive academic feedback (38)	.682					
Uses a variety of explanations that differ in complexity (47)	.771					
Uses a variety of instructional methods (48)	.774					
Orderly Climate						
Conveys genuine concern for pupils (54)		.682				
Displays pupils' work in the classroom (56)		.692				
Sees that rules and consequences are clearly understood (1)		.724				
Management						
Sees that disruptions are limited (5)			.655			
Asks pupils for more than one solution (31)			.755			
Encourages interaction/communication (53)			.648			
Making Time						
Uses time effectively during transitions (3)				.775	*.411*	
Corrects behaviour accurately (8)				.543		
Guides pupils through errors (34)	*.514*			.684	*.523*	
Broader Climate						
Takes care that tasks/materials are distributed/collected (4)					.659	
Prepares an inviting/cheerful classroom (57)					.605	*.450*
Rewards						
Uses a reward system to manage pupils' behaviour (6)	*.503*					.763

Correlations in Table 7.12 below generally show significant relationships between items to range from weak to moderate.

***Table 7.12** – Correlation Matrix for Teacher Behaviours*

	14	**20**	**22**	**26**	**28**	**32**	**33**	**38**	**47**	**48**	**54**	**56**	**1**	**5**	**31**	**53**	**3**	**8**	**34**	**4**	**57**	**6**
14	1.000																					
20	.500	1.000																				
22	.533	.791	1.000																			
26	.294	.599	.630	1.000																		
28	.543	.632	.593	.514	1.000																	
32	.382	.208	.207	.239	.459	1.000																
33	.467	.509	.412	.468	.746	.422	1.000															
38	.454	.607	.432	.335	.541	.233	.526	1.000														
47	.366	.524	.343	.289	.585	.381	.543	.592	1.000													
48	.425	.538	.447	.464	.690	.322	.624	.614	.825	1.000												
54	.308	.548	.582	.528	.414	.191	.217	.279	.468	.516	1.000											
56	.246	.573	.425	.379	.471	.347	.446	.390	.623	.555	.527	1.000										
1	.008	.159	.024	.091	.262	.492	.143	.226	.326	.190	.094	.452	1.000									
5	.214	.143	.011	.056	.314	.336	.233	.242	.315	.332	.028	.284	.541	1.000								
31	.240	.441	.473	.422	.408	.063	.281	.200	.073	.159	.471	.093	.370	.243	1.000							
53	.069	.295	.362	.346	.051	.283	.039	.030	.095	.014	.239	.034	.323	.354	.494	1.000						
3	.140	.595	.459	.457	.392	.113	.329	.450	.334	.471	.348	.240	.036	.121	.294	.130	1.000					
8	.171	.249	.110	.217	.145	.073	.058	.126	.090	.063	.124	.221	.227	.211	.021	.123	.074	1.000				
34	.262	.437	.286	.344	.505	.229	.336	.510	.505	.509	.316	.307	.316	.369	.161	.177	.444	.263	1.000			
4	.141	196	.161	.399	.354	.485	.249	.320	.326	.295	.197	.260	.451	.206	.016	.276	.216	.175	.464	1.000		
57	.340	.596	.404	.510	.604	.387	.520	.585	.708	.695	.615	.705	.359	.272	.314	.011	.301	.126	.490	.439	1.000	
6	.063	.141	.210	.099	.042	.324	.050	.013	.098	.082	.190	.141	.182	.008	.074	.267	.077	.054	.254	.413	.292	1.000

Cells in white mean that the coefficient ***r*** is not significant. Cells in orange mean that the coefficient ***r*** is significant at p < .001. Cells in yellow mean that the coefficient ***r*** is significant at p < .01. Cells in light blue mean that the coefficient ***r*** is significant p < .05

Figure 7.5 confirms a five-factor structure associated with the behaviours observed of Maltese Year 2 teachers (RMSEA = .058, CFI = .968, χ^2 = 308.4, df = 199, p < .001).

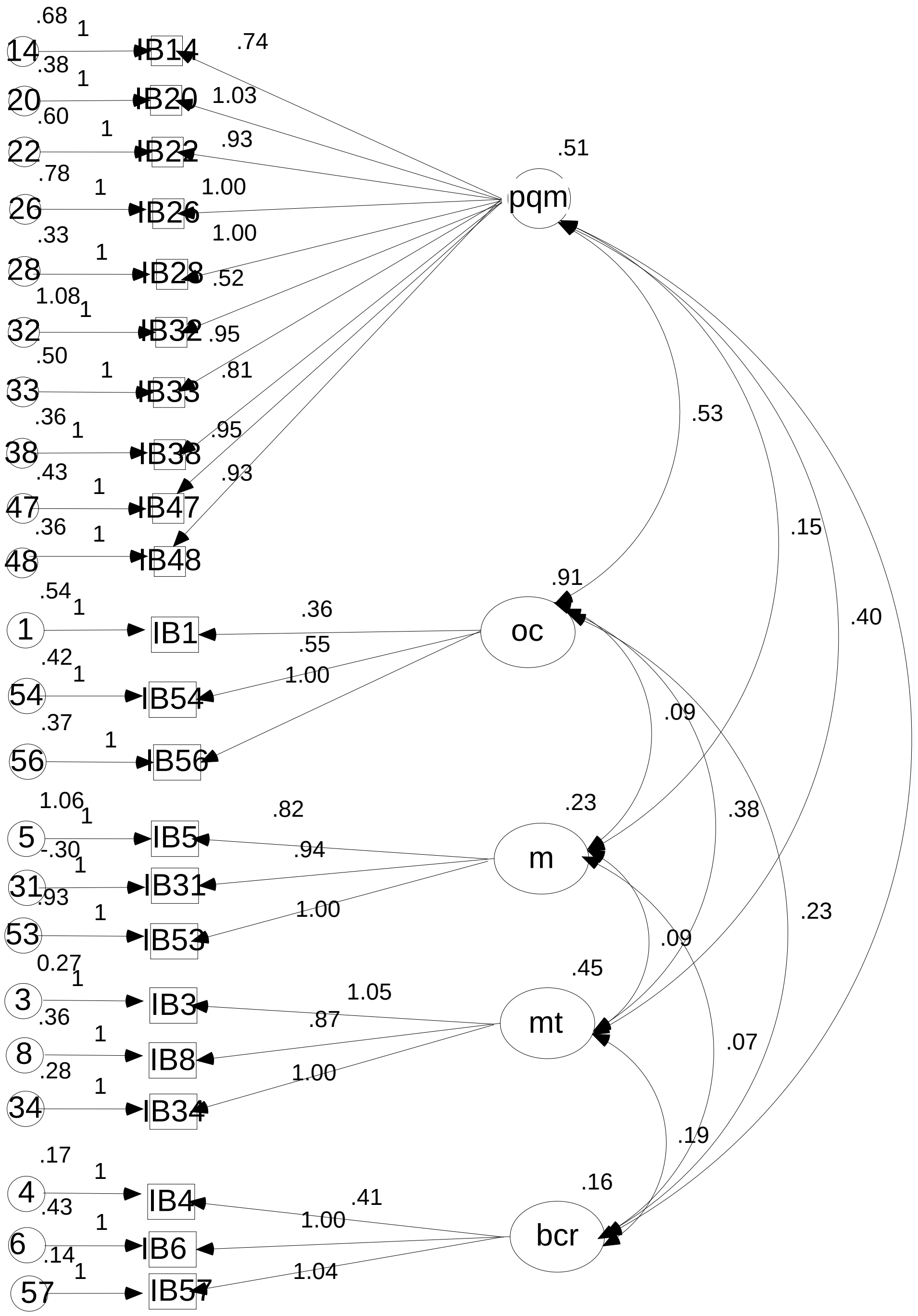

***Figure 7.5** – A Confirmed Structure for Teacher Behaviours.*

Key: pqm = practice, questioning and methods, oc = orderly climate, m = management, mt = making time and bcr = broader climate and rewards.

7.5.1.1 Frequency of Teacher Behaviours

Figures 7.6 to 7.10 describe the frequency of teacher behaviours from the two lessons observed of each teacher and from behaviour items in the confirmed model for Malta (Figure 7.5). The following frequencies are based on data aggregated from a 5-point to a 3-point Likert scale ranging from 1 (*rarely observed*) to 2 (*somewhat observed*) to 3 (*frequently observed*)

Figure 7.6 *– Percent Frequency of Teacher Behaviours for the Factor Practice, Questioning and Methods*

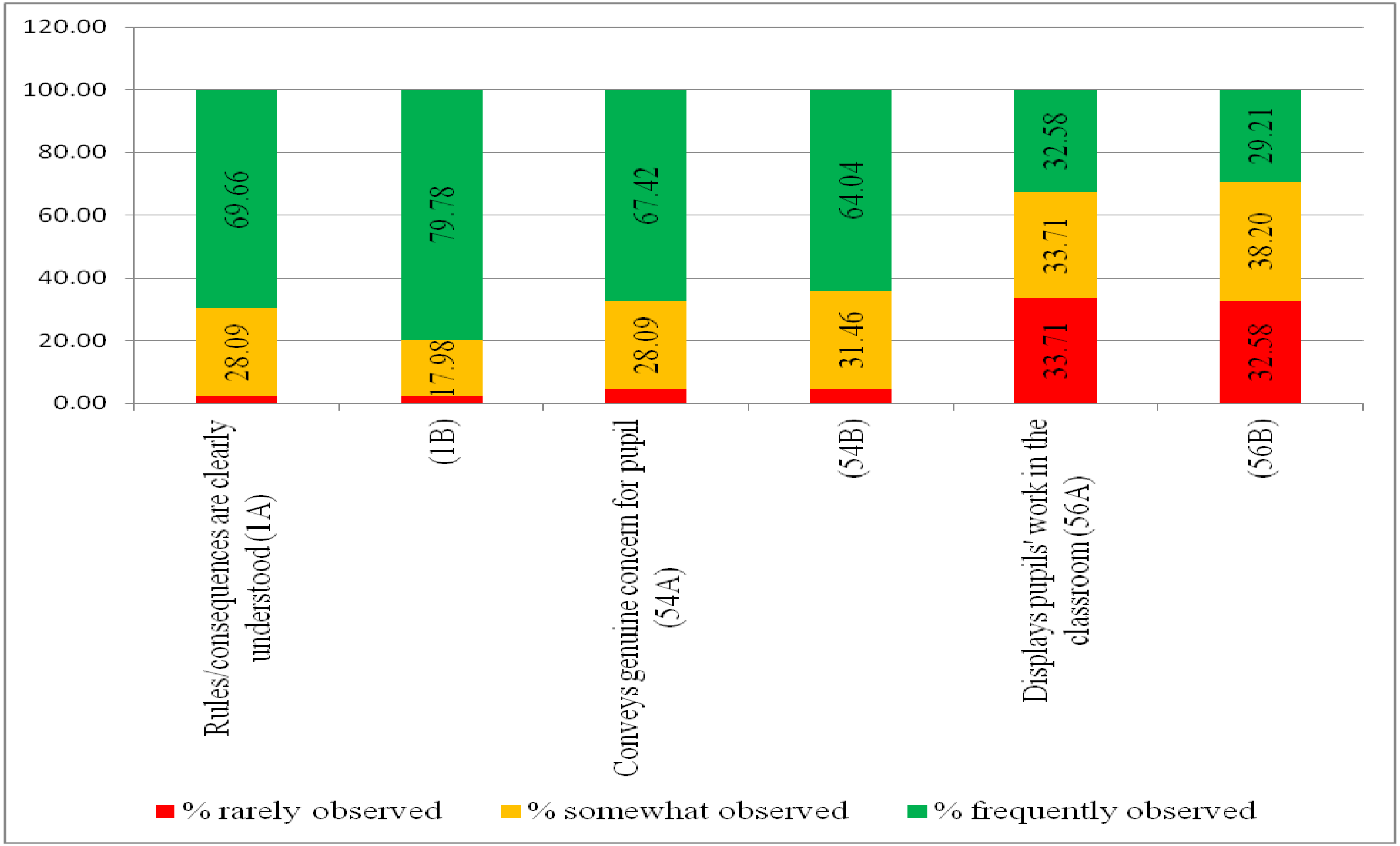

Figure 7.7 *– Percent Frequency of Teacher Behaviours for the Factor Orderly Climate*

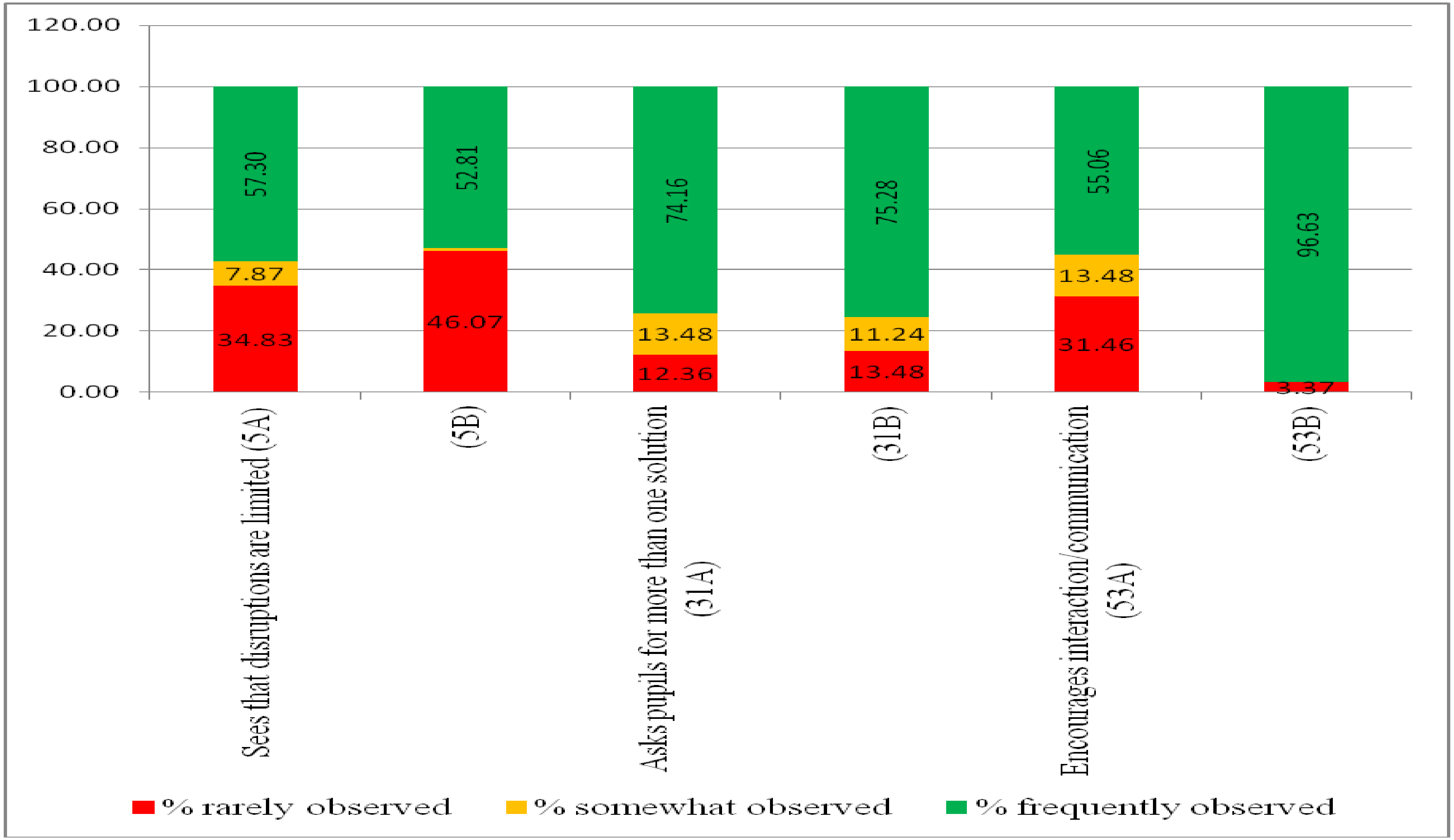

***Figure 7.8** – Percent Frequency of Teacher Behaviours for the Factor Management*

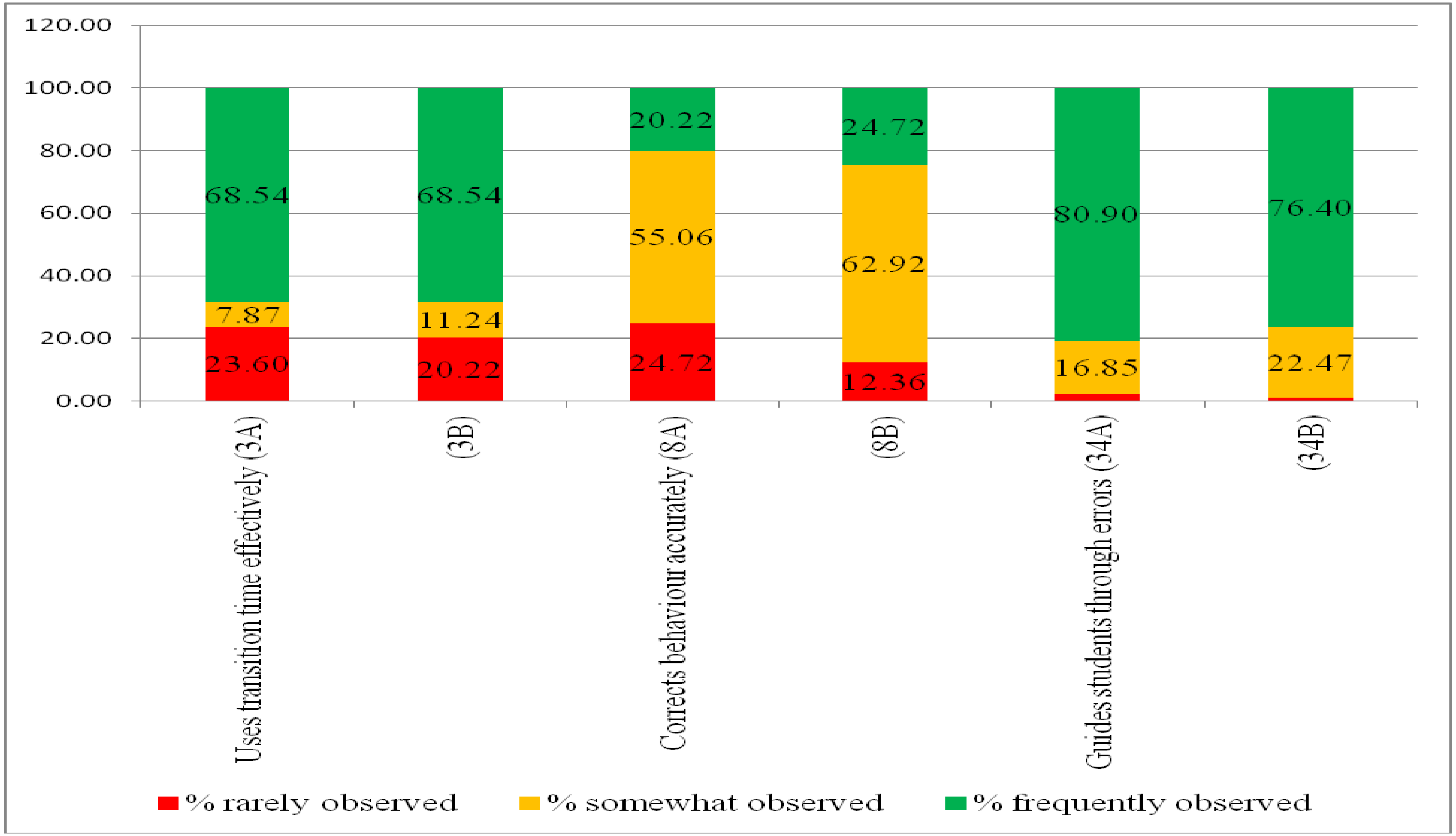

***Figure 7.9** – Percent Frequency of Teacher Behaviours for the Factor Making Time*

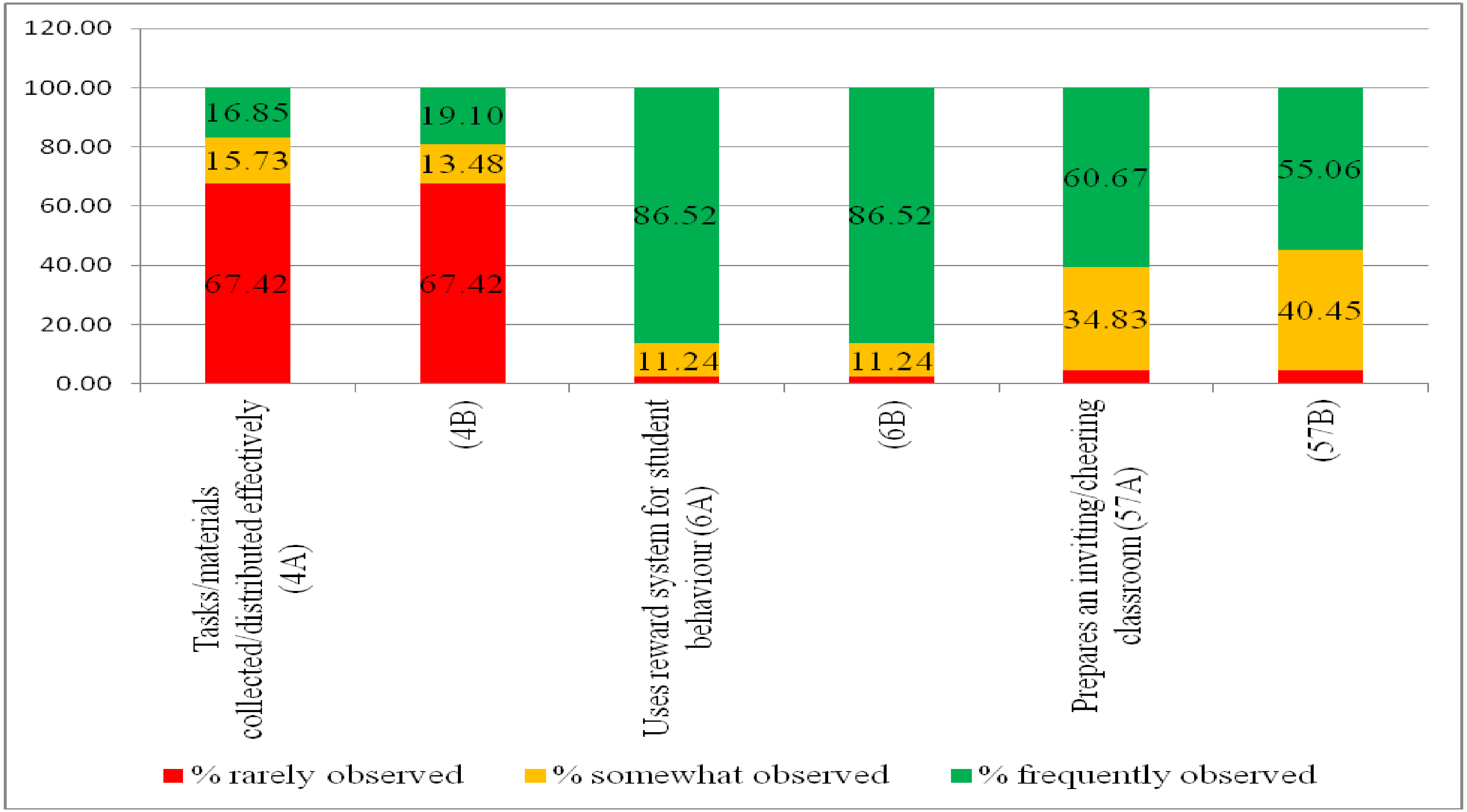

***Figure 7.10** – Percent Frequency of Teacher Behaviours for the Factor Broader Climate and Rewards*

7.6 Summary

This chapter described the characteristics of 37 head teachers and 89 Year 2 teachers associated with 1,628 pupils. Primary schools in Malta attract a mix of pupils that generally reflects the socio-economic mix in the wider population. The current study explored and confirmed two instructional structures associated with the beliefs and the behaviours of teachers. A model for teacher beliefs for Malta was validated. Table 7.13 draws links between the local belief factors of Skills and Understanding with teacher orientations in the UK (Askew et al., 1997) via belief items.

Table 7.13 *– Links between the Beliefs of the Malta Sample of Year 2 Teachers and Teacher Orientations in the UK*

Factor (Malta)	Belief (item)	Orientation (UK)
Skills	Pupils must be taught how to decode a word problem (11)	Transmission
	Pupil misconceptions must be remedied by reinforcing the correct method (19)	Transmission
	Pupils must be taught standard methods and procedures (23)	Transmission
	Pupils learn maths by working sums out on paper (42)	Transmission
	Pupils do not need to be able to read/write/speak English well to learn maths	Not included in the UK study
	Pupils may be taught any method as long as efficient (48)	Connectionist
Understanding	Engaging pupils in meaningful talk is the best way to teach maths (8)	Connectionist
	Being able to use and apply maths using practical apparatus (15)	Transmission
	Pupil misunderstanding need to be made explicit and improved upon (34)	Connectionist
	Teachers must help pupils refine their problem-solving methods (35)	Connectionist

A model for teacher behaviours was also validated. Table 7.14 draws links between local behaviour factors and instructional categories in MECORS (B) (Mujis & Reynolds, 2001) as indicated in Table 7.14 via behaviour items.

***Table 7.14** – Links between Items in Malta MECORS (B) and UK MECORS (B)*

Factor (Malta)	Behaviour (item)	Category (UK)
Practice/Questioning and Methods	Presents materials clearly (14)	Attention
	Offers assistance to pupils (20)	Review/Practice
	Summarizes the lesson (22)	Review/Practice
	Asks academic questions (26)	Review/Practice
	Probes further when responses are incorrect (28)	Questioning
	Uses appropriate wait-time between questions and answer (32)	Questioning
	Notes pupils' mistakes (33)	Questioning
	Gives positive academic feedback (38)	Questioning
	Uses a variety of explanations that differ in complexity (47)	Teaching Methods
	Uses a variety of instructional methods (48)	Teaching Methods
Orderly Climate	Conveys genuine concern for pupils (54)	Climate
	Displays pupils' work in the classroom (56)	Climate
	Sees that rules/consequences are clearly understood (1)	Management
Management	Sees that disruptions are limited (5)	Management
	Asks pupils for more than one solution	Questioning
	Encourages interaction/communication	Climate
Making Time	Uses time effectively during transitions	Management
	Corrects behaviour accurately (8)	Behaviour
	Guides pupils through errors (34)	Questioning
Broader Climate/Rewards	Takes cares that tasks/materials are distributed/collected (4)	Management
	Knows and uses pupils names (55)	Climate
	Uses a reward system to manage pupils' behaviour (6)	Behaviour

The difference in structures undergirding the beliefs and the behaviours of local Year 2 teachers from those connected with the beliefs and behaviours of UK teachers highlights the importance of confirming the construct validity of instruments when used in different countries.

This chapter also brings to an end the second part of the current study. Following the: presentation of the design and methods in Chapter 5, discussion about the reliability of pupils' age 5 and the age 6 scores on the standardized NFER tests Maths 5 and Maths 6 and the confirmation of structures undergirding teacher processes in this chapter, Chapter 8 following, presents results from multilevel analyses to identify the pupil, classroom and school level predictors of pupil attainment (age 6) and pupil progress in Malta for mathematics.

PART 3

CHAPTER 8

PUPIL, CLASSROOM AND SCHOOL LEVEL PREDICTORS OF PUPIL ATTAINMENT (AGE 6) AND PUPIL PROGRESS FOR MATHEMATICS IN MALTA

What are the predictors of pupil attainment and pupil progress in Malta for mathematics after adjusting for factors at the pupil, classroom and school level? To examine this research question, this chapter presents results from two pupils in classrooms in schools model. The first examines pupil attainment (age 6). The second examines pupil progress from age 5 (Year 1) to age 6 (Year 2).

8.1 Results from the Examination of Pupil Attainment

Multilevel modelling disentangles the contribution of factors and characteristics at the pupil, classroom and school level. Table 8.1 presents two null models for the examination of pupil attainment at age 5 (n = 1,628) and at age 6 (n = 1,628). Intercepts refer to the grand mean achieved by pupils. The small standard error of means (in brackets) indicate the stability of each model.

Table 8.1 *– The Null Models for Attainment (Age 5 & Age 6)*

Variance Components	Age 5	Age 6
Intercept	99.935 (3.461)	100.794 (1.464)
School	15.679	70.771
Class	5.877	6.267
Pupil	195.278	163.103
Unexplained variance		
School	7.23%	29.47%
Class	2.71%	2.61%
Pupil	90.05%	70.00%
Absolute	216.834	240.141
Intraclass correlations		
Level 1	0.07	0.29
Level 2	0.10	0.32
Level 3	0.72	0.90
Likelihood - X^2	15,791.260	13,906.490

Intraclass correlations explain the amount of variance shared between subjects. The level 1 correlation refers to the variance shared between pupils in schools. The level 2 correlation refers to the variance shared between pupils in classrooms across schools. The level 3 correlation refers to the variance shared between pupils in classrooms in the same school. Intraclass correlations were calculated according to the methodology developed by Snijders and Bosker (1999). When the level 3 correlation is above 0.5, as in Table 8.1, this implies that the school level is contributing more to the variability in pupil achievement than the classroom level.

8.1.1 The Pupil/Parent Model (Attainment at Age 5)

The pupil/parent model for the examination of pupil attainment at age 5 was constructed with the addition of ten variables to the null model in Table 8.1. A 3-level model for attainment at age 5 could not be constructed complete with explanatory variables at the classroom and school level due to the limited number of variables included in the The Numeracy Survey (Mifsud et al., 2005). The change in the X^2 from the null model for age 5 in Table 8.1 to the pupil/parent model in Table 8.2 is signficant at p < .001.

Table 8.2 *– Results from the Pupil/Parent Model for Attainment at Age 5*

	Pupil/parent age 5 model
Intercept	97.445 (3.975)
Sex	0.326 (0.292)^{ns}
At risk (pupils with statements only)	-4.601 (0.413)***
Father’s occupation	2.544 (0.255)**
Mother’s occupation	1.568 (0.221)**
Father’s education	1.536 (0.230)**
Mother’s education	2.611 (0.221)***
Parental status	0.702 (0.304)*
Home district	1.116 (0.626)*
First language	0.496 (0.343)^{ns}
Preschool	0.490 (0.329)^{ns}

na = data not available, ns = not significant, * significant at p < .05, ** significant at p < .01, *** significant at p < .001

***Table 8.2** – Results from the Pupil/Parent Model for Attainment at Age 5 (continued)*

Variance Components	**Pupil/parent age 5 model**
School	16.077
Class	3.660
Pupil	184.095
Unexplained variance	
School	7.88%
Class	1.79%
Pupil	90.32%
Absolute (null model)	216.834
Total (pupil/parent model)	203.826
Explained	5.99%
Intraclass correlations	
Level 1	0.08
Level 2	0.10
Level 3	0.81
Likelihood	
X^2(Null Model)	15,791.260
X^2(Model 1)	15,651.160
df	14
Change in X^2	140.100
p level of change in X^2	$p < .001$

na = data not available, ns = not significant, * significant at $p < .05$, ** significant at $p < .01$, *** significant at $p < .001$

Although not directly comparable, results from the pupil/parent model in Table 8.2 above that examine pupil attainment at age 5 in the matched sample (n = 1,628) for the currents study are generally relatively similar to results from The Numeracy Survey from the population of pupils at age 5 (N = 4, 662). In The Numeracy Survey pupils in schools analyses discovered that: special educational needs, father's/mother's occupation, father's/mother's education, family structure and first language were elicited as significant predictors of pupil attainment at age 5. In Table 8.2 pupils in classrooms in schools analyses elicited that: at risk (pupils with special educational needs), father's/mother's occupation, father's/mother's education, parental status (same as family structure) and home district were significant predictors of pupil attainment at age 5. These results imply that prior to the inclusion of explanatory variables at the classroom level, pupil level characteristics elicited as significant predictors of pupil attainment at age 5 in the current study are relatively similar to those elicited by The

Numeracy Survey. In fact, it is after the addition of explanatory variables at the classroom level that: father's education, parental status and home district lose in significance. This implies the compensatory effect of classroom, teacher and/or teaching factors.

8.1.2 The Pupil/Parent Model (Attainment at Age 6 - Model 1)

The model for pupil attainment (age 6) in Table 8.3 was constructed by including 15 variables to the respective null model (Table 8.1). The change in the X^2 from the null model to the pupil/parent model is signficant at p < .001. Variables found to significantly predict pupil attainment (age 6) include: at risk, father's occupation, mother's occupation, mother's education, learning support assistant support and complementary teacher support. Variables not found to significantly predict pupil attainment (age 6) include: sex, father's education, parental status, home district, first language, preschool, private lessons and seating arrangements. Including variables one by one meant that the proportion of variance explained by each variable could be expressed, as a percentage in the reduction of the explained variance, as follows: 2.17% for at risk, 1.37% for father's occupation, 0.8% for mother's occupation, 0.1% for mother's education, 0.1% for learning assistant support and 2% for complementary teacher support.

Effect sizes describe average percentiles for a group in comparison to a reference group. Effect sizes range from 0 (no effect) to ±1. Effect sizes can be small (d = .2), medium (d = 0.5) and large (d = .8) (Cohen, 1988). Effect sizes were calculated by applying the formulae by Tymms, Merrell and Henderson (1997) for continuous and categorical variables (Appendix 8.1). Effect sizes were calculated from coefficients of the head teacher/school model (Model 5) in Table 8.3. Associated parameter estimates and standard errors are in Appendix 8.2.

Differences in pupil ability and socio-economic background can influence pupil outcome. Results from the pupil/parent model for attainment (age 6) show that at risk pupils are disadvantaged in comparison to their typically-developing peers. Effect sizes also indicate differences in attainment between groups of at risk pupils. At risk pupils with learning difficulty with support from a complementary teacher (ES = -.52, $p < .001$) appear to be slightly more disadvantaged than their at risk peers with statements supported by a learning support assistant (ES = -.33, $p < .001$). Pupils with fathers in high category occupations are significantly advantaged in comparison to pupils with fathers in the medium category occupations (ES = .12, $p < .05$). Pupils with fathers in low category occupations are not significantly disadvantaged in comparison to pupils with fathers in the medium category. Pupils with mothers in low category occupations are significantly disadvantaged in comparison to pupils with mothers in medium category occupations (ES = -.16, $p < .05$). This is unexpected because most mothers in the low occupation category are those who opt to stay at home and technically should have more time to dedicate to their children. Pupils with mothers who achieved a high level qualification are significantly advantaged in comparison to pupils with mothers who achieved a medium level qualification (ES = .19, $p < .05$).

8.1.3 The Teacher/Classroom Model (Attainment at Age 6 - Model 2)

In Table 8.3, the teacher/classroom model was constructed by including 15 variables to the pupil/parent model. These variables refer to characteristics broader to the classroom and to the personal/professional characteristics of Year 2 teachers. The change in X^2 from the pupil/parent model to the teacher/classroom model is signficant at $p < .01$. Together, the teacher/classroom and the pupil/parent models account for 11.52% of the total variance. Therefore, the teacher/classroom model accounts for 4.94% of the variance. ABACUS, the variable that refers to the number of topics covered by Year 2 teachers, is the only significant variable in the teacher/classroom model. Effect sizes show the influence of this variable as medium in size (ES = .72, $p < .01$) for Year 2 teachers who covered up to summer in comparison to Year 2 teachers who covered up to spring.

8.1.4 The Teacher Beliefs Model (Attainment at Age 6 - Model 3)

In Table 8.3, the teacher beliefs model was constructed by including ten variables to the teacher/classroom model. These variables refer to a set of validated beliefs held by Maltese Year 2 teachers. The change in X^2 is signficant at $p < .01$. The teacher beliefs model, the teacher/classroom model and the pupil/parent model account for 23.79% of the total variance. Therefore, the teacher beliefs model accounts for 12.27% of the variance. Effect sizes associated with the five beliefs that were elicited as significant predictors of pupil attainment (age 6) exert a small but significant influence. The first belief is: “pupils must be taught how to decode a word problem” (item 11). Year 2 teachers who exhibit uncertainty are associated with a small, positive and significant influence (ES = .19, $p < .05$) in comparison to Year 2 teachers who agree with this belief. The second belief is: “pupils learn mathematics by working sums out on paper” (item 42). Teachers who disagree are associated with a small, negative but highly significant influence (ES = -.24, $p < .001$) in comparison to teachers who agree. The third belief is: “pupils do not need to read/write/speak English well to learn mathematics” (item 46). Teachers who disagree are associated with a small, positive and significant influence (ES = .10, $p < .01$) in comparison to teachers who agree. The fourth belief is: “engaging pupils in meaningful talk is the best way to learn mathematics” (item 8). Teachers who disagree are associated with a very small, positive but significant influence (ES = .10, $p < .01$) in comparison to teachers who agree. The fifth belief is: “teachers must help pupils to refine their problem-solving methods” (item 35). Teachers who disagree are associated with a negative significant effect (ES = -.41, $p < .05$) in comparison to teachers who agree.

8.1.5 The Teacher Behaviour Model (Attainment at Age 6 - Model 4)

In Table 8.3, the teacher behaviour model was constructed with the addition of 21 variables to the teacher beliefs model. Variables refer to a validated set of instructional behaviours observed of Maltese Year 2 teachers. The change in the X^2 is signficant at $p < .001$. The teacher behaviour model with the preceding models accounts for 31.79% of variance. The teacher behaviour model alone accounts for 8% of the variance. Four behaviours were elicited as significant predictors of pupil attainment (age 6). Year 2 teachers who were somewhat observed to: “display pupils’ work in the classroom” (item 56) are associated with a small, positive and significant influence (ES = .24, $p < .05$) in comparison to teachers who were rarely observed. Teachers who were frequently observed are associated with a small, positive and highly significant influence (ES = .38, $p < .001$). Teachers who were frequently observed to: “see that disruptions are limited” (item 5) are associated with a small, positive and significant influence (ES = .28, p < .05) in comparison to teachers who were rarely observed. Teachers who were somewhat observed to: "prepare an inviting/cheerful classroom" (item 57) are associated with a small, negative but highly significant influence (ES = -.27, p < .001) in comparison to teachers who were frequently observed. Teachers who were rarely observed are associated with a small, negative and highly significant influence (ES = -.18, p < .001). Teachers who were somewhat observed to: "use a reward system to manage pupil behavior" (item 6) are associated with a small, negative but highly significant influence (ES = -.10, p < .05) in comparison to teachers who were frequently observed. Teachers who were not frequently observed (ES = -.08, p < .05) are associated with a very small, negative and significant influence.

8.1.6 The Head Teacher/School Model (Attainment at Age 6 - Model 5)

In Table 8.3, the head teacher/school model was constructed with the addition of 11 variables to the teacher behaviour model. These variables refer to the broader characteristics of primary schools in Malta and the personal/professional characteristics of primary school head teachers. The change in X^2 is signficant at p < .001. The head teacher/school model with the preceding models account for 34.37% of the total variance. This implies that the head teacher/school model accounts for 2.58% of the variance. The only variable that is significant in this model refers to the "age" (of the head teacher). Effect sizes show the influence of head teachers between 46 to 55 years as positive, small and significant (ES = .26, p < .01) in comparison to older head teachers aged between 56 to 61 years. The influence of head teachers between 35 to 45 years in age is positive, medium in size and significant (ES = .58, p < .001) in comparison to head teachers in the eldest reference category.

***Table 8.3** – Results from the Model for Pupil Attainment at Age 6*

	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**
Intercept	105.844 (5.735)	95.055 (3.491)	90.325 (3.720)	85.522 (2.807)	80.909 (2.911)
Pupil level					
Sex	-0.675 (0.608)^{ns}	-0.681 (0.619)^{ns}	-0.686 (0.622)^{ns}	-0.686 (0.622)^{ns}	-0.687 (0.622)^{ns}
At risk	-4.510 (1.682)**	-4.769 (1.689)***	-4.493 (1.678)***	-4.673 (1.695)***	-4.676 (1.695)***
Father's occupation	2.284 (1.168)*	1.832 (0.953)*	1.990 (0.724)*	1.725 (0.657)*	1.722 (0.658)*
Mother's occupation	1.159 (0.835)*	1.967 (0.804)*	1.318 (0.504)*	1.423 (0.557)*	1.426 (0.559)*
Father's education	2.819 (1.976)^{ns}	2.877 (1.977)^{ns}	2.911 (1.930)^{ns}	2.844 (1.466)^{ns}	2.847 (1.466)^{ns}
Mother's education	1.970 (0.706)*	1.973 (0.710)*	1.950 (0.699)*	1.773 (0.550)*	1.774 (0.550)*
Parental status	1.287 (1.059)^{ns}	1.290 (0.991)^{ns}	1.319 (1.210)^{ns}	1.296 (1.156)^{ns}	1.296 (1.156)^{ns}
Home district	0.953 (0.893)^{ns}	0.595 (0.554)^{ns}	0.585 (0.555)^{ns}	0.936 (0.759)^{ns}	0.936 (0.759)^{ns}
First language	1.735 (1.531)^{ns}	1.761 (1.277)^{ns}	1.712 (1.395)^{ns}	1.614 (1.374)^{ns}	1.637 (1.381)^{ns}
Preschool	1.443 (1.006)^{ns}	1.335 (1.309)^{ns}	1.335 (1.309)^{ns}	1.850 (1.382)^{ns}	1.909 (1.397)^{ns}
Private lessons	1.554 (1.536)^{ns}	1.576 (1.149)^{ns}	1.497 (1.390)^{ns}	1.588 (1.121)^{ns}	1.591 (1.126)^{ns}
Seating arrangements	1.959 (1.855)^{ns}	1.534 (1.335)^{ns}	1.744 (1.365)^{ns}	1.797 (1.397)^{ns}	1.827 (1.423)^{ns}
Pupils supported by a learning support assistant	-5.184 (1.803)***	-4.914 (1.811)**	-3.421 (1.011)**	-3.963 (1.008)**	-4.015 (1.015)**
Pupils supported by a complementary teacher	-8.275 (0.993)***	-7.421 (1.000)***	-5.361 (1.097)***	-5.229 (1.005)***	-6.340 (1.006)***
Time available for learning in class	2.574 (2.100)^{ns}	2.722 (2.121)^{ns}	2.823 (2.162)^{ns}	2.895 (2.160)^{ns}	2.897 (2.119)^{ns}

ns = not significant, * significant at $p < .05$, ** significant at $p < .01$, *** significant at $p < .001$

***Table 8.3** – Results from the Model for Pupil Attainment at Age 6 (continued)*

Classroom level	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**
Average father's occupation		-1.355 (1.088)^{ns}	-1.911 (1.110)^{ns}	-1.126 (1.069)^{ns}	-1.909 (1.768)^{ns}
Average mother's education		1.742 (1.564)^{ns}	1.624 (1.318)^{ns}	1.656 (1.180)^{ns}	1.954 (1.409)^{ns}
Class size		0.289 (0.247)^{ns}	0.267 (0.245)^{ns}	0.335 (0.291)^{ns}	0.451 (0.321)^{ns}
Homework		3.218 (3.099)^{ns}	3.107 (2.900)^{ns}	3.552 (2.991)^{ns}	3.786 (2.996)^{ns}
ABACUS cover		8.489 (3.389)**	8.400 (3.391)*	8.724 (3.402)*	8.726 (3.403)*
Lesson duration		3.918 (2.986)^{ns}	3.111 (2.814)^{ns}	2.925 (2.906)^{ns}	2.926 (2.908)^{ns}
Language of instruction		2.674 (2.168)^{ns}	2.677 (2.131)^{ns}	2.497 (2.169)^{ns}	2.498 (2.171)^{ns}
Mental warm-up		4.182 (4.147)^{ns}	4.323 (4.029)^{ns}	5.942 (4.248)^{ns}	5.942 (4.248) ^{ns}
Explanatory activities		4.449 (2.405)^{ns}	4.318 (2.233)^{ns}	5.824 (3.302)^{ns}	5.824 (3.302)^{ns}
Set written tasks		4.445 (2.133)^{ns}	4.812 (3.119)^{ns}	4.024 (2.701)^{ns}	4.025 (2.701)^{ns}
Plenary		2.072 (1.837)^{ns}	2.026 (1.707)^{ns}	2.219 (1.608)^{ns}	2.219 (1.608)^{ns}
Teacher Characteristics					
Age		-1.968 (1.439)^{ns}	-2.857 (1.737)^{ns}	-3.255 (2.828)^{ns}	-3.258 (2.830)^{ns}
First language		1.761 (1.277)^{ns}	2.277 (1.931)^{ns}	2.379 (2.004)^{ns}	2.379 (2.004)^{ns}
Teaching qualifications		-4.318 (4.379)^{ns}	5.331 (4.650)^{ns}	4.580 (4.328)^{ns}	4.580 (4.328)^{ns}
Experience teaching at primary school		1.106 (1.086)^{ns}	1.206 (1.089)^{ns}	1.165 (0.977)^{ns}	1.165 (0.977)^{ns}

ns = not significant, * significant at $p < .05$, ** significant at $p < .01$, *** significant at $p < .001$

***Table 8.3** – Results from the Model for Pupil Attainment at Age 6 (continued)*

Instructional beliefs	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**
Skills (item). Pupil/s...					
must be taught how to decode a word problem (11)			3.284 (1.372)*	3.446 (1.359)*	3.447 (1.362)*
misconceptions must be remedied by reinforcing the correct method (19)			5.608 (4.105)^{ns}	5.627 (4.110)^{ns}	5.629 (4.110)^{ns}
must be taught standard methods and procedures (23)			-1.360 (1.047)^{ns}	-1.311(1.008)^{ns}	-1.351(1.118)^{ns}
learn mathematics by working sums out on paper (42)			0.852 (0.121)***	0.995 (0.110)***	1.363 (0.231)***
do not need to be able to read/write/speak English well to learn mathematics (46)			1.016 (0.304)***	1.278 (0.286)***	1.280 (0.287)***
may be taught any method as long as efficient (48)			-1.736 (1.507)^{ns}	-2.383 (2.064)^{ns}	-2.389 (2.066)^{ns}

ns = not significant, * significant at p < .05, ** significant at p < .01, *** significant at p < .001

***Table 8.3** – Results from the Model for Pupil Attainment at Age 6 (continued)*

Understanding (item)	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**
Engaging pupils in meaningful talk is the best way to teach mathematics (8)			-1.880 (0.902)*	-2.084 (0.958)*	-2.139 (0.964)*
Teaching is best based on practical activities so that pupils discover methods for themselves (14)			-3.325 (2.977)^{ns}	-4.326 (3.109)^{ns}	-4.326 (3.109)^{ns}
Pupil misunderstanding need to be made explicit and improved upon (34)			1.505 (1.276)^{ns}	1.364 (1.206)^{ns}	1.414 (1.227)^{ns}
Teachers must help pupils refine their problem-solving methods (35)			5.812 (2.646)*	5.300 (2.369)*	5.304 (2.370)*

ns = not significant, * significant at p < .05, ** significant at p < .01, *** significant at p < .001

Table 8.3 *– Results from the Model for Pupil Attainment at Age 6 (continued)*

Instructional behaviours	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**
Practice, questioning and methods (item)					
Presents materials clearly (14)				-4.404 (2.939)^{ns}	-4.405 (2.940)^{ns}
Offers assistance to pupils (20)				3.528 (1.975)^{ns}	3.528 (1.975)^{ns}
Asks academic mathematical questions (26)				3.261 (2.929)^{ns}	3.261 (2.929)^{ns}
Probes further when responses are incorrect (28)				-1.923 (1.310)^{ns}	-1.923 (1.310)^{ns}
Uses appropriate wait-time between questions/responses (32)				2.440 (2.339)^{ns}	2.440 (2.339)^{ns}
Notes pupils' mistakes (33)				-6.271 (6.248)^{ns}	-6.271 (6.248)^{ns}
Gives positive academic feedback (38)				-4.939 (4.606)^{ns}	-4.939 (4.606)^{ns}
Uses a variety of explanations that differ in complexity (47)				-2.368 (2.272)^{ns}	-2.368 (2.272)^{ns}
Uses a variety of instructional methods (48)				-3.201 (2.279)^{ns}	-3.226 (2.286)^{ns}
Orderly climate					
Sees that rules/consequences are clearly understood (1)				3.299 (2.089)^{ns}	3.299 (2.089)^{ns}

ns = not significant, * significant at p < .05, ** significant at p < .01, *** significant at p < .001

***Table 8.3** – Results from the Model for Pupil Attainment at Age 6 (continued)*

Orderly climate (continued, item)	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**
Conveys genuine concern for pupils (54)				4.454 (3.995)^{ns}	4.454 (3.995)^{ns}
Displays pupils’ work in the classroom (56)				-7.173 (2.607)**	-7.176 (2.608)**
Management					
Sees that disruptions are limited (5)				3.455 (1.554)*	3.456 (1.555)*
Asks pupils for more than one solution (31)				-1.159 (1.057)^{ns}	-1.159 (1.057)^{ns}
Knows and uses pupils’ names (55)				-2.558 (2.266)^{ns}	-2.558 (2.266)^{ns}
Making time					
Uses time effectively during transitions (3)				2.417 (2.328)^{ns}	2.418 (2.330)^{ns}
Corrects behaviour accurately (8)				1.634 (1.279)^{ns}	1.634 (1.279)^{ns}
Guides pupils through errors (34)				1.326 (1.071)^{ns}	1.326 (1.079)^{ns}

ns = not significant, * significant at p < .05, ** significant at p < .01, *** significant at p < .001

***Table 8.3** – Results from the Model for Pupil Attainment at Age 6 (continued)*

Broader climate/rewards (item)	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**
Takes care that tasks/materials are collected/distributed effectively (4)				1.913 (0.989)^{ns}	1.913 (0.989)^{ns}
Prepares an inviting/cheerful classroom (57)				5.575 (1.392)**	5.578 (1.393)**
Uses a rewards system to manage pupil behaviour (6)				1.517 (0.575)*	1.520 (0.577)*
School level					
Type of school					1.377 (1.152)^{ns}
Size of school					0.928 (0.726)^{ns}
Average father's occupation					-2.101 (1.785)^{ns}
Average mother's education					1.975 (1.867)^{ns}
Number of school days					2.071 (1.724)^{ns}
Head teacher					
Sex					-5.111 (4.427)^{ns}
Age					-7.174 (2.217)**
First Language					-2.655 (1.904)^{ns}
Teaching Qualifications					-2.108 (1.987)^{ns}
Experience Teaching Primary					0.687 (0.516)^{ns}
Experience Head Teaching					1.060 (0.752)^{ns}

ns = not significant, * significant at p < .05, ** significant at p < .01, *** significant at p < .001

***Table 8.3** – Results from the Model for Pupil Attainment at Age 6 (continued)*

Variance components	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**
School	69.267	58.658	24.145	7.489	2.747
Class	6.725	5.516	10.524	7.986	6.507
Pupil	148.330	148.372	148.349	148.328	148.351
Unexplained variance					
School	30.87%	27.57%	13.19%	4.57%	1.74%
Class	3.00%	2.60%	5.75%	4.87%	4.13%
Pupil	66.12%	69.84%	81.06%	90.55%	94.13%
Absolute (null model)	240.141				
Total (pupil/parent model)	224.322				
Total (teacher/classroom		212.546			
Total (teacher beliefs model)			183.018		
Total (teacher behaviour				163.803	
Total (head teacher/school					157.605
Explained variance (total)	6.58%	11.52%	23.79%	31.79%	34.37%
Explained (at each stage)		4.94%	12.27%	8.00%	2.58%
Explained – school	0.60%	4.57%	14.37%	6.93%	1.97%
Explained – classroom	0.19%	0.50%	2.08%	1.06%	0.60%
Explained – pupil	6.15%	-0.02%	0.00%	0.00%	-0.00%

ns = not significant, * significant at p < .05, ** significant at p < .01, *** significant at p < .001

***Table 8.3** – Results from the 3-Level Model for Pupil Attainment at Age 6 (continued)*

Intraclass correlations	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**
Level 1	0.31	0.28	0.14	0.05	0.02
Level 2	0.34	0.31	0.19	0.09	0.06
Level 3	0.91	0.91	0.71	0.48	0.30
Likelihood					
X^2- Null model	13,906.490				
X^2 – pupil/parent model	13,713.490				
X^2 – teacher/classroom model		13,677.440			
X^2- teacher beliefs model			13,648.330		
X^2- Teacher behaviour model				13,594.160	
X^2 – Head teacher/school					13,567.560
df	15	15	10	21	11
Change in X^2	193.000	36.05	29.11	63.19	26.60
p level of change in X^2	$p < .001$	$p < .001$	$p < .01$	$p < .001$	$p < .01$

ns = not significant, * significant at $p < .05$, ** significant at $p < .01$, *** significant at $p < .001$

8.2 Results from the Examination of Pupil Progress

The 3-level model in Table 8.4, examines the progress registered by pupils in the matched sample between age 5 (Year 1) and age 6 (Year 2). The construction of this model progress starts with the empty model, which is the same as that for attainment (age 6), in Table 8.1. The inclusion of prior attainment (age 5) to the empty model is what transforms the model for attainment (age 6) to a model for the examination of pupil progress. The considerable amount of variance explained (16.45%) by the model in Table 8.4 highlights the importance of prior attainment (age 5) as a predictor of pupils' later attainment (age 6).

Table 8.4 *– The Prior Attainment Model*

Pupil level	**Null model 0**	**Prior attainment model 1**
Intercept	100.794 (1.464)	57.422 (2.358)
Prior Attainment (age 5)		0.431 (0.021)***
Variance components		
School	70.771	66.304
Class	6.267	5.453
Pupil	163.103	128.882
%		
Unexplained variance		
School	29.47%	33.05%
Class	2.61%	2.72%
Pupil	70.00%	64.23%
Absolute (null model)	240.141	
Total (prior attainment model)		200.639
Explained		16.45%
Intraclass correlations		
Level 1	0.29	0.33
Level 2	0.32	0.35
Level 3	0.90	0.92
Likelihood		
X^2 - null model	13,906.490	
X^2 - prior attainment model		12,669.660
df		1
Change in X^2		1236.83
p level of change in X^2		$p < .001$

*** significant at $p < .001$

The inclusion of prior attainment (age 5), to the null model, also accounts for a small increase in the school level variance (3.58%) and a decrease in the pupil level variance (5.77%). The change in the classroom level variance is minimal at 0.11%. The finding that the school level variances increases after the addition of prior attainment to the null model, suggests that factors at the school level dominate, or operate in ways that suppress the influence of factors at the classroom level.

8.2.1 The Pupil/Parent Model (Pupil Progress - Model 1)

The pupil/parent model for progress (Table 8.5) was constructed with the addition of 15 variables to the prior attainment model (Table 8.4). This model accounts for 22.13% of the total variance. Therefore 5.68% of the variance is attributable to variables other than prior attainment. Variables elicited as significant predictors of pupil progress are: at risk, learning support assistant support and complementary teacher support. Variables that were not elicited as significant predictors of pupil progress are: sex, father's occupation, mother's occupation, father's education, mother's education, parental status, home district, private lessons and seating arrangements. At risk accounts for 1.34% of the variance. Learning support assistant support and complementary teacher support respectively account for a minimal 0.3% and 0.4% of the variance. Together at risk, learning support assistant support and complementary teacher support explain 2.04% of variance. This implies that 4.27% of the explained variance at the pupil level is unaccounted for.

Effect sizes are based on coefficients from the head teacher/school model (Model 5) in Table 8.5. Further information relevant to these effect sizes are in Appendix 8.3. Similarly to that elicited for attainment (age 6), at risk pupils progress at a significantly decreased rate than their typically-developing peers. This disadvantage is small but highly significant (ES = -.40, $p < .001$). Unlike that elicited for pupil attainment (age 6), this disadvantage does not differ considerably between pupils with statements supported by a learning support assistant and (ES = -.31, $p < .001$) and pupils with learning difficulty supported by a complementary teacher (ES = -.48, $p < .001$).

8.2.2 The Teacher/Classroom Model (Pupil Progress - Model 2)

In Table 8.5, the teacher classroom model was constructed with the addition of 15 variables to the pupil/parent model. The teacher/classroom model and the pupil/parent model account for 25.34% of the total variance. Therefore, the teacher/classroom model accounts for 3.21% of the variance. Similarly to that elicited for pupil attainment (age 6), the variable ABACUS is the only significant predictor of pupil progress. Year 2 teachers who covered up to summer in topics exert a positive, medium-sized and significant influence (ES = .51, $p < .001$) in comparison to teachers who only covered up to spring.

8.2.3 The Teacher Beliefs Model (Pupil Progress - Model 3)

In Table 8.5, the teacher beliefs model was constructed with the addition of ten variables to the teacher/classroom model. The teacher/beliefs model with the preceding models accounts for 31.85% of the total variance. Therefore, the teacher beliefs model accounts for 6.51% of the variance. Effect sizes indicate that six instructional beliefs held by Maltese Year 2 teachers exert a weak but significant effect on pupil progress. Teachers who exhibited uncertainty that: “pupils must be taught how to decode a word problem” (item 11) are associated with a small, significant and positive influence (ES = .18, $p < .001$) in comparison to teachers who agreed. Teachers who disagreed that: “pupils learn mathematics by working sums out on paper” (item 42) are associated with a small, positive and highly significant influence for pupil progress (ES = .10, $p < .001$) in comparison to teachers who agreed. Teachers who disagreed that: “pupils do not need to be able to read/write/speak English well to learn mathematics” (item 46) are associated with a small, positive and significant influence (ES = .10, $p < .05$) in comparison to teachers who agreed. Teachers who disagreed that: “pupils may be taught any method as long as efficient” (item 48) are associated with a small, negative and significant influence (ES = -.10, $p < .05$) in comparison to teachers who agreed. Teachers who disagreed that: “engaging pupils in meaningful talk is the best way to teach mathematics” (item 8) are associated with a small, negative and significant influence (ES = -.12, $p < .05$) in comparison to teachers who agreed. Teachers who disagreed that: “teachers must help pupils refine their problem-solving methods” (item

35) are associated with a small, negative and significant influence (ES = -.40, $p < .01$) in comparison to teachers who agreed.

8.2.4 The Teacher Behaviour Model (Pupil Progress - Model 4)

In Table 8.5, the teacher behaviour model was constructed with the addition of 21 variables to the teacher beliefs model. The teacher behaviour model and the preceding models account for 36.03% of the total variance. Therefore, the teacher behaviour model alone accounts for 4.18% of the variance. Effect sizes indicate that when compared to teachers who were frequently observed to implement behaviours that enhance learning, teachers who were somewhat observed (ES = -.10, $p < .05$) and teachers who were rarely observed (ES = -.28, $p < .05$) in: “offering assistance to pupils” (item 20), are significantly associated with a small and negative influence for pupil progress. Teachers who were somewhat observed (ES = -.04, $p < .05$) and teachers who were rarely observed (ES = -.09, $p < .01$) in: “probing further when responses are incorrect” (item 28), are significantly associated with a very small and negative influence. Teachers who were somewhat observed (ES = -.09, $p < .05$) and teachers who were rarely observed (ES = -.21, $p < .05$) in: “allocating appropriate wait-time between questions and responses” (item 32), are significantly associated with a negative influence. Teachers who were somewhat observed (ES = -.12, $p < .05$) and teachers who were rarely observed (ES = -.38, $p < .05$) in: “noting pupils’ mistakes” (item 33), are significantly associated with a negative influence. Teachers who were somewhat observed (ES = -.23, $p < .05$) in: “giving positive academic feedback” (item 38), are significantly associated with a small and negative influence. Teachers who were somewhat observed (ES = -.19, $p < .05$) in: “using a variety of explanations that differ in complexity” (item 47), are significantly associated with a small and negative influence. Effect sizes also indicate that when compared to teachers who were frequently observed to implement behaviours that enhance learning, teachers who were rarely observed (ES = .33, $p < .05$) in: “displaying pupils work in the classroom” (item 56), are significantly associated with a small and negative influence. Teachers who were frequently observed (ES = .31, $p < .05$) in: “taking care that tasks/materials are collected/distributed effectively” (item 4), are significantly associated with a small and positive influence for pupil progress.

8.2.5 The Head Teacher/School Model (Pupil Progress - Model 5)

In Table 8.5, the head teacher/school model was constructed with the addition of 11 variables to the teacher behaviour model. The head teacher/school model and the preceding models account for 43.36% of the total variance. Therefore, the head teacher model alone explains 7.33% of the total variance. Age of the head teacher is the only significant predictor of pupil progress. Effect sizes show the influence of age as greater in its positive influence when head teachers are younger. Head teachers between 35 to 44 years are associated with a medium-sized, significant and positive influence (ES = .64, $p < .01$) in comparison to head teachers between 55 to 61 years. Head teachers between 45 to 54 years in age are associated with a small, significant and positive influence (ES = .28, $p < .01$) in comparison to head teachers between 55 to 61 years in age.

Table 8.5 *– Results from the Model for Pupil Progress*

	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**
Intercept	72.506 (4.791)	63.146 (3.441)	61.063 (3.618)	60.249 (3.025)	48.632 (12.818)
Pupil level					
Prior attainment	0.431 (0.021)***	0.383 (0.022)***	0.383 (0.022)***	0.380 (0.022)***	0.379 (0.022)***
Sex	-0.448 (0.431)^{ns}	-0.477 (0.433)^{ns}	-0.477 (0.435)^{ns}	-0.538 (0.439)^{ns}	-0.538 (0.439)^{ns}
At risk	-4.259 (1.667)*	-4.626 (1.672)**	-4.693 (1.678)**	-4.410 (1.681)***	-4.455 (1.681)***
Father's occupation	1.082 (0.918)^{ns}	1.237 (0.922)^{ns}	1.190 (0.924)^{ns}	1.122 (0.927)^{ns}	1.120 (0.923)^{ns}
Mother's occupation	-0.831 (0.779)^{ns}	-0.823 (0.784)^{ns}	-0.815 (0.785)^{ns}	-0.971 (0.840)^{ns}	-0.971 (0.840)^{ns}
Father's education	-3.572 (3.303)^{ns}	-3.354 (2.924)^{ns}	-3.233 (2.926)^{ns}	-2.877 (1.977)^{ns}	-2.872 (1.976)^{ns}
Mother's education	-3.432 (2.738)^{ns}	-3.038 (2.695)^{ns}	-3.047 (2.698)^{ns}	-2.973 (1.710)^{ns}	-2.973 (1.710)^{ns}
Parental status	4.447 (3.015)^{ns}	4.546 (3.015)^{ns}	4.568 (3.022)^{ns}	4.211 (3.025)^{ns}	4.269 (3.025)^{ns}
Home district	-1.130 (0.971)^{ns}	1.037 (0.932)^{ns}	0.909 (0.832)^{ns}	0.995 (0.584)^{ns}	0.995 (0.584)^{ns}
First language	1.771 (1.489)^{ns}	1.884 (1.311)^{ns}	1.854 (1.749)^{ns}	1.829 (1.727)^{ns}	1.822 (1.178)^{ns}
Preschool	1.467 (1.371)^{ns}	1.709 (1.330)^{ns}	1.712 (1.495)^{ns}	1.548 (1.451)^{ns}	1.554 (1.436)^{ns}
Private lessons	-1.571 (0.233)^{ns}	1.493(1.473)^{ns}	1.497 (1.390)^{ns}	1.505 (1.356)^{ns}	1.508 (1.356)^{ns}
Seating arrangements	3.211 (2.623)^{ns}	3.216 (2.635)^{ns}	1.555 (1.375)^{ns}	1.434 (1.167)^{ns}	1.414 (1.168)^{ns}
Pupils supported by a learning support assistant	-3.700 (1.778)*	-3.386 (1.785)*	-4.914 (1.811)**	-3.467 (1.789)**	-3.512 (1.790)**
Pupils supported by a complementary teacher	-5.387 (0.962)***	-5.404 (0.976)***	-5.361 (0.970)***	-5.261 (0.972)***	-5.344 (0.973)***
Time available for learning in class	2.629 (2.175)^{ns}	2.714 (2.175)^{ns}	2.729 (2.175)^{ns}	2.738 (2.175)^{ns}	2.741 (2.175)^{ns}

ns = not significant, * significant at p < .05, ** significant at p < .01, ** * significant at p < .001

Table 8.5 *– Results from the Model for Pupil Progress (continued)*

Classroom level	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**
Average father's occupation		-1.288 (1.190)^{ns}	-1.316 (1.189)^{ns}	-1.823 (1.767)^{ns}	-2.170 (1.893)^{ns}
Average mother's education		-1.150 (1.019)^{ns}	-2.003 (1.779)^{ns}	-2.160 (1.724)^{ns}	-2.147 (1.713)^{ns}
Class size		-0.217 (0.209)^{ns}	-0.267 (0.185)^{ns}	-0.293 (0.126)^{ns}	-0.268 (0.156)^{ns}
Homework		1.040 (0.802)^{ns}	1.900 (1.107) ^{ns}	1.849 (1.116)^{ns}	2.282 (1.178)^{ns}
ABACUS cover		5.433 (1.389) **	6.047 (1.008)***	5.602 (1.166)**	5.679 (1.618)**
Lesson duration		4.922 (3.133)^{ns}	3.802 (2.012)^{ns}	2.764 (2.311)^{ns}	2.765 (2.311)^{ns}
Language of instruction		2.704 (2.584)^{ns}	2.227 (1.431)^{ns}	2.206 (1.498)^{ns}	2.204 (1.498)^{ns}
Mental warm-up		5.209 (3.612)^{ns}	4.323 (4.029)^{ns}	4.862 (1.173)^{ns}	4.863 (1.173)^{ns}
Explanatory activities		4.127 (3.933)^{ns}	4.318 (4.087)^{ns}	4.319 (4.087)^{ns}	4.317(4.087)^{ns}
Set written tasks		1.555 (1.103)^{ns}	1.233 (1.012)^{ns}	1.238 (1.014)^{ns}	1.238 (1.014)^{ns}
Plenary		1.822 (1.238)^{ns}	2.026 (1.737)^{ns}	2.027 (1.737)^{ns}	2.027 (1.737)^{ns}
Teacher					
Age		3.532 (2.194)^{ns}	3.532 (2.194)^{ns}	3.469 (2.186)^{ns}	3.468 (2.186)^{ns}
First language		1.124 (1.117)^{ns}	1.124 (1.117)^{ns}	1.126 (1.118)^{ns}	1.126 (1.118)^{ns}
Teaching qualifications		-6.500 (6.628)^{ns}	-6.500 (6.628)^{ns}	-6.471 (6.624)^{ns}	-6.471 (6.624)^{ns}
Experience teaching primary		-0.182 (0.092)^{ns}	-0.182 (0.092)^{ns}	-0.398 (0.112)^{ns}	-0.398 (0.112)^{ns}

ns = not significant, * significant at p < .05, ** significant at p < .01, **, significant at p < .001***

***Table 8.5** – Results from the Model for Pupil Progress (continued)*

Teacher beliefs (item)	Model 1	Model 2	Model 3	Model 4	Model 5
Skills. Pupil/s...					
must be taught how to decode a word problem (11)			3.020 (1.293)*	3.021 (1.293)*	3.173 (1.295)*
misconceptions must be remedied by reinforcing the correct method (19)			-0.909 (0.750)^{ns}	-0.911 (0.751)^{ns}	-0.935 (0.758)^{ns}
must be taught standard methods and procedures (23)			-1.360 (1.047)^{ns}	-1.360 (1.047)^{ns}	-1.367 (1.048)^{ns}
learn mathematics by working sums out on paper (42)			0.734 (0.119)***	1.065 (0.130)***	1.140 (0.124)***
do not need to be able to read/write/speak English well to learn mathematics (46)			1.016 (0.304)***	1.134 (0.226)***	1.132 (0.227)***
may be taught any method as long as efficient (48)			-1.568 (0.612)*	-1.572 (0.620)*	-1.573 (0.620)*

ns = not significant, * significant at p < .05, ** significant at p < .01 **, significant at p < .001***

***Table 8.5** – Results from the Model for Pupil Progress (continued)*

Understanding	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**
Engaging pupils in meaningful talk is the best way to teach mathematics (8)			-1.438 (0.764)*	-1.512 (0.340)***	-1.515 (0.349)***
Teaching is best based on practical activities so that pupils discover methods for themselves (14)			-3.075 (2.727)^{ns}	-3.075 (2.727)^{ns}	-3.089 (2.729)^{ns}
Pupil misunderstanding need to be made explicit and improved upon (34)			1.417 (1.102)^{ns}	1.417 (1.102)^{ns}	1.419 (1.103)^{ns}
Teachers must help pupils refine their probem-solving methods (35)			5.632 (2.400)*	4.997 (1.345)**	4.998 (1.345)**

ns = not significant, * significant at $p < .05$, ** significant at $p < .01$, *** significant at $p < .001$

Table 8.5 *– Results from the Model for Pupil Progress (continued)*

Teacher behaviours	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**
Practice, questioning and methods (item)					
Presents materials clearly (14)				2.830 (2.648)^{ns}	2.835 (2.648)^{ns}
Offers assistance to pupils (20)				3.087 (1.815)*	3.077 (1.816)*
Asks academic mathematical questions (26)				-3.257 (2.993)^{ns}	-3.249 (2.990)^{ns}
Probes further when responses are incorrect (28)				1.852 (0.480)**	1.848 (0.480)**
Uses appropriate wait-time between questions/answers (32)				3.472 (1.198)*	3.474 (1.199)*
Notes pupils' mistakes (33)				6.669 (3.061)*	6.641 (3.057)*
Gives positive academic feedback (38)				5.518 (2.822)*	5.527 (2.804)*
Uses a variety of explanations that differ in complexity (47)				2.071 (0.915)**	2.072 (0.915)**

ns = not significant, * significant at p < .05, ** significant at p < .01, *** significant at p < .001

***Table 8.5** – Results from the Model for Pupil Progress (continued)*

	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**
Uses a variety of instructional methods (48)				2.798 (2.564)^{ns}	2.799 (2.564)^{ns}
Orderly climate (item)					
Sees that rules and consequences are clearly				3.117 (2.360)^{ns}	3.118 (2.361)^{ns}
Conveys genuine concern for pupils (54)				2.046 (1.838)^{ns}	2.193 (1.845)^{ns}
Displays pupils' work in the classroom (56)				4.169 (2.032)*	4.231 (2.018)*
Management (item)					
Sees that disruptions are limited (5)				3.455 (1.554)*	3.455 (1.554)*
Asks pupils for more than one solution (31)				-1.159 (1.057)^{ns}	-1.183 (1.038)^{ns}
Knows and uses pupils' names (55)				-2.558 (2.266)^{ns}	-2.558 (2.266)^{ns}

ns = not significant, * significant at $p < .05$, ** significant at $p < .01$, *** significant at $p < .001$

***Table 8.5** – Results from the Model for Pupil Progress (continued)*

Making time	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**
Uses time effectively during transitions (3)				2.829 (2.564)^{ns}	2.418 (2.330)^{ns}
Corrects behaviour accurately (8)				1.738 (1.161)^{ns}	1.738 (1.161)^{ns}
Guides pupils through errors (34)				2.445 (2.288)^{ns}	2.452 (2.276)^{ns}
Broader climate/rewards					
Takes care that tasks/materials are collected/distributed effectively (4)				4.402 (1.509)**	4.418 (1.524)**
Prepares an inviting/cheerful classroom (57)				2.836 (1.031)^{ns}	2.837 (1.031)^{ns}
Uses a rewards system to manage pupil behaviour (6)				2.229 (1.673)^{ns}	2.236 (1.677)^{ns}

ns = not significant, * significant at $p < .05$, ** significant at $p < .01$, *** significant at $p < .001$

Table 8.5 *– Results from the Model for Pupil Progress (continued)*

School level	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**
Type of school					2.184 (1.521)^{ns}
Size of school					3.310 (2.492)^{ns}
Average father's occupation					-1.141 (1.486)^{ns}
Average mother's education					-2.160 (1.627)^{ns}
Head teacher					
Sex					-7.163 (5.966)^{ns}
Age					-5.028 (2.930)*
First Language					3.135 (2.827)^{ns}
Teaching Qualifications					1.121 (0.728)^{ns}
Experience Teaching Primary					1.160 (0.842)^{ns}
Experience Head Teaching					1.998 (1.232)^{ns}
Variance components					
School	67.178	65.242	34.340	22.911	10.812
Class	5.488	2.438	5.403	6.826	3.312
Pupil	123.964	123.917	123.906	123.889	121.879

ns = not significant, * significant at $p < .05$, ** significant at $p < .01$, *** significant at $p < .001$

***Table 8.5** – Results from the Model for Pupil Progress (continued)*

Unexplained variance attributable to each level	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**
School	34.16%	34.05%	20.98%	14.91%	7.95%
Class	2.79%	1.27%	3.30%	4.45%	2.43%
Pupil	63.04%	64.67%	75.71%	80.64%	89.61%
Absolute (null model)	240.141				
Total (pupil/parent model)	196.630				
Total (teacher/classroom		191.597			
Total (teacher beliefs			163.649		
Total (teacher behaviour				153.626	
Total (head teacher/ school					136.003
Explained variance (total)	22.13%	25.34%	31.85%	36.03%	43.36%
Explained (at each stage)		3.21%	6.51%	4.18%	7.33%
Explained – school	1.50%	0.81%	12.87%	4.76%	5.04%
Explained – classroom	0.32%	1.27%	-1.23%	-0.59%	1.46%
Explained – pupil	16.65%	0.00%	0.00%	0.00%	0.80%
Intraclass correlations					
Pupils in schools (level 1)	0.34	0.33	0.21	0.15	0.08
Class and school (level 2)	0.37	0.34	0.24	0.24	0.11
Pupils in classes in same	0.92	0.96	0.86	0.77	0.76

ns = not significant, * significant at $p < .05$, ** significant at $p < .01$, *** significant at $p < .001$

***Table 8.5** – Results from the Model for Pupil Progress (continued)*

Likelihood	Model 1	Model 2	Model 3	Model 4	Model 5
X^2- Null model	13,906.490				
X^2- pupil/parent model	12,574.450				
X^2- Teacher/classroom		12,531.380			
X^2- Teacher beliefs model			12,488.310		
X^2- Teacher behaviour				12,428.004	
X^2- Head teacher/school					12,398.763
df	15	15	10	21	11
Change in X^2	332.040	43.07	53.07	60.30	29.23
p level of change in X^2	$p < .001$	$p < .001$	$p < .001$	$p < .001$	$p < .01$

ns = not significant, * significant at $p < .05$, ** significant at $p < .01$, *** significant at $p < .001$

8.3 Summary

What are the predictors of pupil attainment and pupil progress in Malta for mathematics after adjusting for factors at the pupil, the classroom and the school level? This question led to the multilevel examination of pupil attainment (age 6) and the examination of pupil progress. Characteristics that refer to pupil ability and learning support were elicited as significant predictors of pupil attainment (age 6) and pupil progress. Typically-developing pupils attained and progressed at significantly higher rates than at risk pupils with statements and at risk pupils with learning needs. Interestingly, pupils with statements supported by a learning support assistant were slightly less disadvantaged than pupils supported by a complementary teacher. This strongly suggests that the quality of interaction between learning support assistants and pupils as well as between complementary teachers and pupils influences differentially the attainment and the progress outcomes of at risk pupils.

At the classroom level, curriculum coverage, teacher beliefs and teacher behaviours were elicited as significant predictors of pupil attainment (age 6) and/or pupil progress. The positive influence of increased curriculum coverage is noteworthy for teachers who covered up to summer in comparison to teachers who covered up to spring. Teachers' instructional processes were elicited as significant predictors of pupil attainment (age 6) and/or pupil progress. Six teacher beliefs, four from the factor Skills and two from the factor Understanding were elicited as significant predictors of pupil attainment (age 6) and/or pupil progress. Twelve (12) teacher behaviours, six from the factor Practice, Questioning and Methods, one from the factor Orderly Climate, one from the factor Management and another three from the factor Broader Climate/Rewards were also elicited as significant predictors of pupil attainment and/or pupil progress. At the school level, head teacher age was elicited as a significant predictor of pupil attainment (age 6) and pupil progress. On the basis of residual scores which may be obtained resulting from multilevel analyses conducted in this chapter, it is possible to compare pupils' rates of progress across schools and classrooms. In view of this, the following chapter classifies and characterises the effectiveness of local primary schools for mathematics.

CHAPTER 9
THE CHARACTERISTICS OF DIFFERENTIALLY EFFECTIVE SCHOOLS FOR MATHEMATICS IN MALTA

Do the predictors of pupil progress differ across (and possibly within) differentially effective schools? To examine this second research question, this chapter classifies and characterises school effectiveness in Malta and describes how the pupil, classroom and school level predictors of pupil progress differ across, and whenever possible, within differentially effective schools.

9.1 Classifying School Effectiveness for Mathematics in Malta

School effectiveness is measured by the value-added scores achieved by pupils. Figure 9.1 plots the school level residuals calculated on the basis of the value-added scores achieved by pupils (n = 1,628) in classrooms (n = 89) in schools (n = 37) after adjusting for the contribution of prior attainment (age 5).

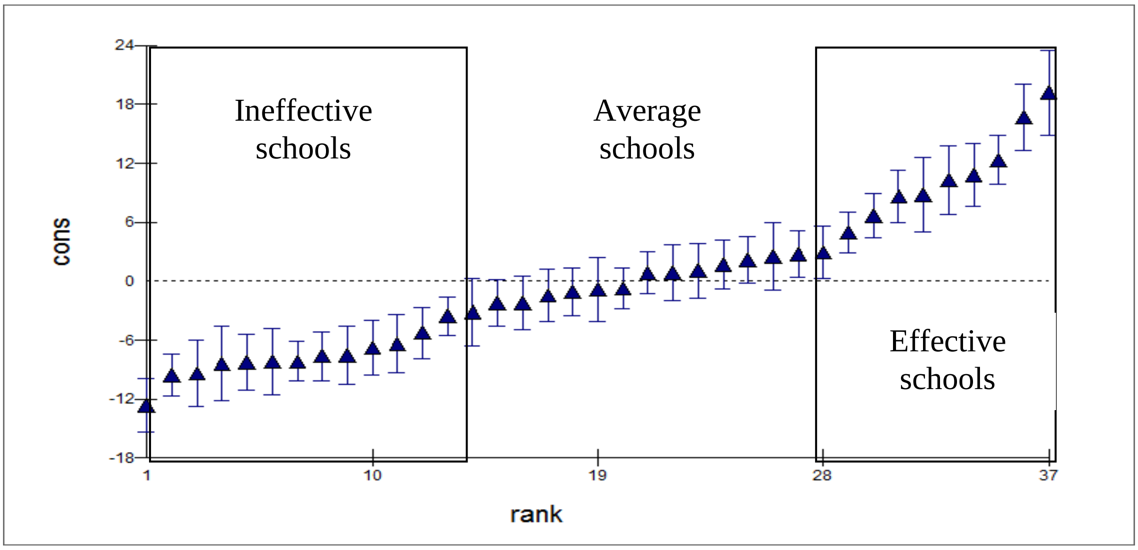

***Figure 9.1**– School Level Residuals for Progress Adjusted for Prior Attainment*

Moving from left to right, 12 ineffective schools are associated with pupils who are progressing at significantly decreased rates of achievement (-1 or -2 standard deviations). Nine effective schools are associated with pupils who are progressing at significantly increased rates (+1 or +2 standard deviations). Sixteen (16) average schools are associated with pupils whose rates of progress do not deviate significantly from expectation. After adjusting for the effects of pupil level characteristics other than prior attainment, residual scores reveal 13 ineffective schools, 14 average schools and ten effective schools (Figure 9.2).

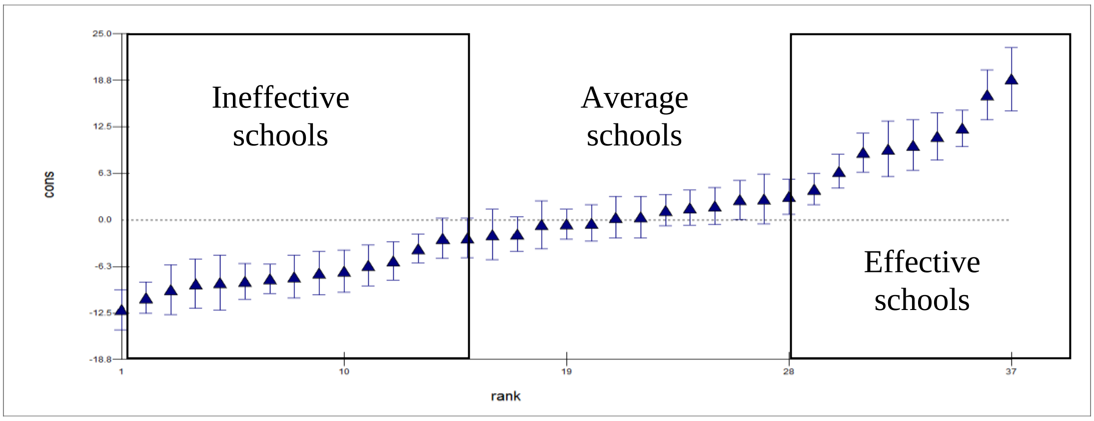

***Figure 9.2** – School Level Residuals for Progress Adjusted for Pupil/Parent Characteristics*

After adjusting for effects at the classroom and school level, Figure 9.3 below reveals seven ineffective schools, 22 average schools and eight effective schools

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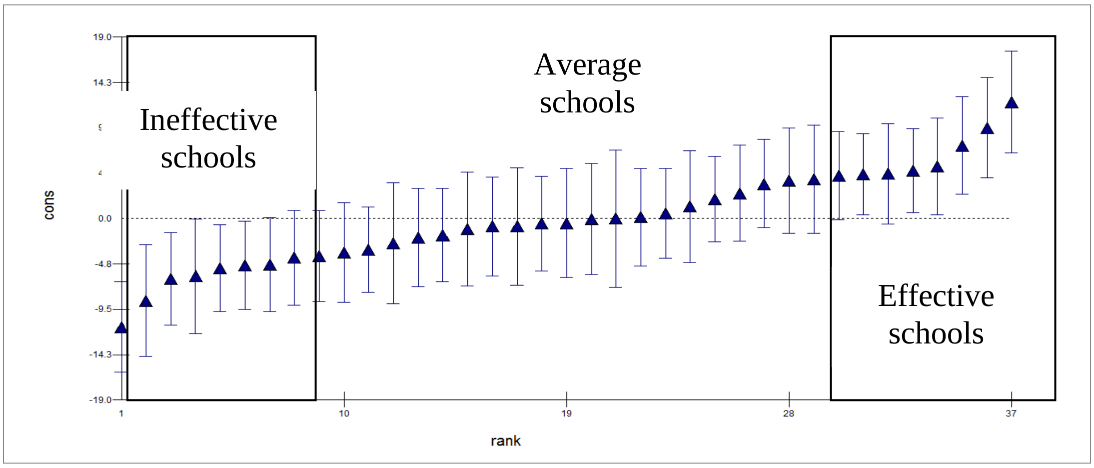

***Figure 9.3** – School Level Residuals Adjusted for Teacher/Classroom, Teacher Beliefs/Behaviours and Head Teacher/School Characteristics*

Local schools do not "play in position" (Reynolds et al. 2002:277) similarly to schools in other countries across the world. Table 9.1 describes the socio-economic composition in differentially effective schools on the basis of father's occupation and mother's education.

Table 9.1 *– Father's Occupation and Mother's Education in Effective, Average and Ineffective Schools*

Father's occupation	**Effective schools n = 8**	**Average schools n = 22**	**Ineffective schools n = 9**
Low	18.01%	14.74%	12.52%
Medium	66.49%	59.28%	72.05%
High	17.03%	25.72%	15.42%
Mother's education	**n = 8**	**n = 22**	**n = 9**
Low	2.18%	1.81%	1.01%
Medium	77.32%	65.29%	75.77%
High	20.50%	32.36%	23.21%

In effective, average and ineffective schools the majority of pupils are from the medium social-class category. Interestingly, effective schools have the highest proportion of pupils with fathers in low occupations. Average schools have the highest proportion of father's in high occupations. Percentage figures for mother's education in effective and ineffective schools are rather similar across the educational categories. The relative similarity in the social background of pupils across differentially effective schools suggests that the influence of social background may come into play, in other perhaps latent ways, in Maltese primary schools.

9.2 Typical and Atypical Differentially Effective Schools

Effective schools are likely to have a majority of effective teachers (Berliner, 1985). In typical schools, the extent of effectiveness at the classroom level is similar to that elicited at the school level. This implies that school effectiveness may be classified along the dimension of extent as follows: “typical effective”, “typical average” and “typical ineffective”. In atypical schools, not all classrooms in the same year group are associated with similarly achieving pupils. This implies that school effectiveness may be classified also along the dimension of spread: “atypical effective”, “atypical average” and “atypical ineffective”. Table 9.2 gives percentage figures for differentially effective schools (and classrooms) in Malta for mathematics. In this table a category, “typical by default”, in Table 9.2, refers to schools with only one “naturally occurring” Year 2 classroom.

Table 9.2 *– Number of Typical and Atypical Differentially Effective Schools*

Schools	**Effective** **n, (%)**	**Average** **n, (%)**	**Ineffective** **n, (%)**	**Total** **n, (%)**
Typical by default	4 (50.00)	7 (31.82)	3 (28.57)	**14 (37.84)**
Typical schools	3 (37.50)	9 (40.91)	3 (57.14)	**15 (40.54)**
Atypical schools	1 (12.50)	6 (27.27)	1 (14.29)	**8 (21.62)**
Total schools	**8**	**22**	**7**	**37**
Teachers in classrooms				
Typical by default	4 (4.49)	7 (7.86)	3 (3.37)	**14 (15.73)**
Typical schools	7 (54.55)	39 (70.91)	6 (77.78)	**52 (58.43)**
Atypical schools	4 (45.45)	13 (29.09)	6 (22.22)	**23 (25.84)**
Total schools	**15**	**59**	**15**	**89**

9.2.1 Prior Attainment (Pupil Level)

Prior attainment is usually the best predictor of later attainment (Duckworth, 2007). In the current study, prior attainment (age 5) was also found to be an important predictor of later attainment (age 6). Table 9.3 presents the mean age 5 and age 6 outcomes of pupils in differentially effective schools. It is important to note that the classification of effective, average and ineffective schools was drawn from an analysis of the effectiveness of schools when pupils were in Year 2 and they were aged 6.

Table 9.3 *– Mean Age 5 and Age 6 Outcomes of Pupils in Differentially Effective, Schools*

All schools	**Effective (s.d)**	**Average (s.d)**	**Ineffective (s.d)**
Age of pupils	**Mean age 5 scores**	**Mean age 5 scores**	**Mean age 5 scores**
Age 5	101.21 (14.53)	101.70 (13.97)	98.50 (14.35)
Age 6	108.17 (15.47)	100.15 (14.03)	93.34 (13.45)
Simple difference in scores	6.96	1.55	-5.16
Typical			
Age 5	102.04 (14.52)	101.47 (14.30)	101.14 (14.87)
Age 6	111.85 (14.80)	97.51 (12.74)	92.63 (13.83)
Simple difference in scores	9.81	3.96	-8.51
Simple difference			
Atypical			
Age 5	100.18 (14.55)	101.60 (13.58)	98.94 (13.81)
Age 6	106.64 (16.14)	102.69 (16.79)	95.64 (17.09)
Simple difference in scores	6.46	1.09	-3.30

From age 5 (Year 1) to age 6 (Year 2), pupils in effective schools gained a mean 6.96 marks, pupils in average schools gained a mean of 1.55 marks and pupils in ineffective schools “lost” 5.16 marks. At age 5 (Year 1), the difference in marks between pupils in effective and ineffective schools was of 2.71 marks was not significant (F = 1.210, df = 1, p = .272) but by age 6 (Year 2) the simple difference in marks had widened by approximately one standard deviation to 14.83 marks. No pupil in the matched sample moved school from age 5 to age 6. However, the classroom groups of pupils in Year 1 were not the same as the classroom groups of pupils in Year 2, even if in the same school. This suggests the differential effectiveness of classrooms across year groups. In turn, this implies that other characteristics besides prior attainment are influential for pupil progress and that the positive, or negative, influence of these other characteristics come to a head sometime during Year 2. At age 6, pupils in typical effective schools achieved an average of 19.22 marks more than pupils in typical ineffective schools. Also at age 6, pupils in atypical effective schools achieved an average of 11 marks more than pupils in atypical ineffective schools. The overall decreased rate in pupil gain, and pupil "loss" associated with pupils in atypical than pupils in typical schools reflects the increased variability in pupils' age 6 attainment outcomes across Year 2 classrooms in atypical schools.

9.2.2 Pupil Ability (Pupil Level)

Typically-developing pupils repeatedly achieved on average approximately ten marks more than their at risk peers at age 5 and at age 6 (Table 9.4).

Table 9.4 *– The Mean Outcomes of Typically-Developing Pupils and At Risk Pupils in Effective, Average and Ineffective Schools*

Pupils	**n pupils (%)**	**Mean score (Age 5)**	**s.d**	**Mean score (Age 6)**	**s.d**
Typically-developing	**n = 1,361**	**101.00**	**14.40**	**101.00**	**14.46**
Effective	196 (14.41)			108.48	15.58
Average	974 (71.56)			100.63	13.79
Ineffective	191 (14.03)			93.81	13.32
At risk	**n = 267**	**91.00**	**15.70**	**90.50**	**15.50**
Effective	39 (14.61)			98.22	10.04
Average	184 (68.91)			89.65	15.16
Ineffective	44 (16.48)			80.90	10.92

At age 6, the difference in marks between typically-developing pupils in effective schools and typically-developing pupils in ineffective schools averaged at 14.67 marks. Similarly at age 6, the difference in marks between at risk pupils in effective schools and at risk pupils in ineffective schools averaged at 17.32 marks. At risk pupils in effective schools progressed more than at risk pupils in average schools. Similarly, at risk pupils in average schools progressed more than pupils in ineffective schools.

Previously in Table 8.5 results from multilevel analyses indicated that pupils with statements supported by a learning support assistant gained on average two standardised marks more than pupils with learning difficulty supported by a complementary teacher. This suggests that differences in the progress outcomes between groups of at risk pupils are associated with the quality of learning support. However, such differences could also be related to other factors such as the allocation of learning support resources in differentially effective schools (Table 9.5).

***Table 9.5** – Learning Support Resources in Differentially Effective Schools*

Schools (n = 37)	**Effective (n = 8) (%)**	**Average (n = 22) (%)**	**Ineffective (n = 7) (%)**
Pupils with statements without any support (n = 26)	0 (0.00)	26 (100.00)	0 (0.00)
Learning support assistants (n = 57)	**14 (24.56)**	**36 (63.16)**	**7 (12.28)**
Pupils with statements supported by a learning support assistant (n = 46)	9 (12.33)	27 (36.99)	10 (13.70)
Complementary teachers (n = 37)	**8 (21.62)**	**22 (59.46)**	**7 (18.92)**
Pupils supported by a complementary teacher (n = 194)	30 (15.46)	127 (65.46)	37 (19.07)
Typical (n = 29)			
Pupils with statements without any support (n = 26)	0 (0.00)	26 (100.00)	0 (0.00)
Learning support assistants (n = 43)	**12**	**26**	**5**
Pupils with statements	7	19	8
Complementary teachers	**7**	**16**	**6**
Pupils supported by a complementary teacher	26	78	26
Atypical (n = 8)			
Learning support assistants	**2**	**10**	**1**
Pupils with statements	2	8	2
Complementary teachers	**1**	**6**	**1**
Pupils supported by a complementary teacher	4	49	11

In effective schools, there are 1.5 learning support assistants for every pupil with a statement. In average schools, there are also more learning support assistants than pupils with statements (1.3 learning support assistants per pupil). In ineffective schools there are fewer learning support assistants (0.7 learning support assistants per pupil). Similarly, there are more complementary teachers in effective schools (0.27 per pupil) than in average (0.17 per pupil) and in ineffective schools (0.19 per pupil). In typical effective schools, there are also more learning support assistants (1.7 per pupil) and complementary teachers (0.26 per pupil) than in typical average schools (learning support assistants 1.4 per pupil; complementary teachers, 0.17 per pupil) or in ineffective schools (learning support assistants, 0.6 per pupil; complementary teachers, 0.19 per pupil). In the one atypical effective school, there is a learning support assistant for every pupil and 0.27 complementary teacher for every pupil. This implies that resources in this one atypical effective school are similar to resources in typical effective schools. In atypical average schools, the proportion of learning support resources is similar to that in typical average schools (1.3 learning support assistants per pupil; complementary teachers, 0.17 per pupil). Learning support resources in the one atypical ineffective school are also similar to those in typical ineffective schools (learning support assistants, 0.7 per pupil; complementary teachers, 0.19 per pupil).

Why do at risk pupils in effective schools progress more than at risk pupils in average and in ineffective schools? Could this be due to the extra learning support assistants in effective schools? Or is it because effective schools utilize such resources in more efficient ways? Is it not contradictory that in effective schools there are more learning support assistants? Especially when learning support assistants are allocated to schools on the basis of the number of pupils with statements? A reason that might partly explain the connection between an increase in the availability of learning support assistants and effective schools could be related to the wider pedagogical role"of learning support assistants in such schools, the type of interaction between the processes of learning support assistant, teacher and teaching processes and/or to broader factors such as the reduction of teacher workload which then leads to the reduction of teacher stress (Blatchford et al., 2011).

9.2.3 Curriculum Coverage (Classroom Level)

Year 2 teachers were required to cover 63 ABACUS topics by the end of the scholastic year (end of June for private schools and by mid-July for state schools). On average, teachers had covered 58 (93.65%) topics by the time of testing in May 2005. Curriculum coverage increased from ineffective to effective schools (Table 9.6).

***Table 9.6** – Mean Number of Topics Covered by Teachers in Differentially Effective Schools*

Typical	**Effective (s.d)** **n = 7 schools, 10**	**Average (s.d)** **n = 16 schools, 46**	**Inffective (s.d)** **n = 6 schools, 10**
	59 (5.12)	49 (5.01)	42 (4.32)
Atypical	**Effective (s.d)** **n = 1 school, 6 teachers**	**Average (s.d)** **n = 6 schools, 16**	**Ineffective (s.d)** **n = 1 school, 2**
	51 (7.13)	50 (5.22)	46 (5.13)

9.2.4 Teacher Beliefs (Classroom Level)

Previously, results from multilevel analyses in Table 8.5 indicated that a set of teacher beliefs were elicited as predictors of pupil progress for mathematics. Percentage figures in Table 9.7 describe teacher agreement, disagreement or uncertainty to these beliefs.

***Table 9.7** – Frequency of Teacher Beliefs*

Belief (item). **Skills.**	**Agree** **n (%)**	**Disagree** **n (%)**	**Do not know** **n (%)**
Pupils must be taught to decode a word problem (11)	59 (66.29)	20 (22.47)	10 (11.23)
Pupils learn mathematics by working sums out on paper (42)	33 (37.08)	45 (50.56)	11 (12.34)
Pupils do not need to read/write/speak English well to learn mathematics (item 46)	27 (30.34)	56 (62.92)	6 (6.74)
Pupils may be taught any method as long as efficient (item 48)	73 (82.02)	13 (14.61)	3 (3.37)
Understanding			
Engaging pupils in meaningful talk is the best way to teach mathematics (8)	64 (71.91)	14 (15.73)	11 (12.36)
Teachers must help pupils refine their problem-solving methods (35)	73 (82.02)	15 (16.85)	1 (1.12)

How similar, or dissimilar, are teacher beliefs? Particularly, across effective and ineffective schools? (Table 9.8).

***Table 9.8** – Teacher Beliefs in Effective, Average and Ineffective Schools*

Belief (item). Pupils…	**Effective** **n = 15**	**Average** **n = 62**	**Ineffective** **n = 12**
must be taught how to decode a word problem (11)	n (%)	n (%)	n (%)
Agree	9 (60.00)	40 (64.52)	10 (83.33)
Disagree	5 (33.33)	14 (22.58)	1 (8.33)
Do not know	1 (6.66)	8 (12.90)	1 (8.33)
learn mathematics by working sums out on paper (42)			
Agree	6 (40.00)	21 (33.87)	6 (50.00)
Disagree	9 (60.00)	30 (48.39)	6 (50.00)
Do not know	0 (0.00)	11 (17.74)	0 (0.00)
Do not need to read/write/speak English well to learn mathematics (46)			
Agree	6 (40.00)	18 (29.03)	3 (25.00)
Disagree	9 (60.00)	38 (61.29)	9 (75.00)
Do not know	0 (0.00)	6 (9.68)	0 (0.00)
may be taught any method as long as efficient (48)			
Agree	15 (100.00)	46 (74.19)	12 (100.00)
Disagree	0 (0.00)	13 (20.97)	0 (0.00)
Do not know	0 (0.00)	3 (4.84)	0 (0.00)
Engaging pupils in meaningful talk is the best way to teach mathematics (8)			
Agree	12 (80.00)	42 (67.74)	10 (83.33)
Disagree	1 (6.66)	13 (20.97)	0 (0.00)
Do not know	2 (13.33)	7 (11.29)	2 (16.67)
Teachers must help pupils refine their problem-solving methods (35)			
Agree	14 (93.33)	47 (75.81)	12 (100.00)
Disagree	0 (0.00)	15 (24.19)	0 (0.00)
Do not know	1 (6.66)	0 (0.00)	0 (0.00)

Most Year 2 teachers agreed that: "pupils must be taught how to decode a word problem" (item 11), "pupils may be taught any method as long as efficient" (item 48), "engaging pupils in meaningful talk is the best way to teach mathematics" (item 8) and that:

"teachers must help pupils refine their problem-solving methods" (item 35). Interestingly, teacher in ineffective schools usually agreed more with these beliefs than teachers in effective schools. Interestingly also, teachers in average schools agreed least with these beliefs. Generally teachers, particularly those in effective and in effective schools, exhibited mixed beliefs about pupil ability to: "learn mathematics by working sums out on paper" (item 42). A noteworthy proportion of teachers in effective schools exhibited uncertainty. Most teachers disagreed that: "pupils do not need to read/write/speak English well to learn mathematics" (item 46). This implies that generally teachers agree that pupils must be fluent in English to be able to learn mathematics.

9.2.5 Teacher Behaviours (Classroom Level)

Teacher behaviours also predict pupil progress in Malta. Table 9.9 describes the frequency of teacher behaviours from the 178 lesson observations.

Table 9.9 *– Frequency of Teacher Behaviours*

Behaviour (item). **Practice, questioning and methods**	**Rarely** **n (%)**	**Somewhat** **n (%)**	**Frequently** **n (%)**
Offers assistance to pupils (20)	76 (42.70)	27 (15.17)	75 (42.14)
Probes further when responses are incorrect (28)	56 (31.46)	69 (38.76)	53 (29.77)
Uses appropriate wait-time between question and answer (32)	41 (23.03)	74 (41.57)	63 (35.39)
Notes pupils' mistakes (33)	28 (15.73)	37 (20.79)	103 (57.86)
Gives positive academic feedback (38)	4 (2.25)	42 (23.60)	132 (74.16)
Uses a variety of explanations that differ in complexity (47)	24 (13.48)	88 (49.44)	66 (37.08)
Orderly climate			
Displays pupils' work in the classroom (56)	59 (33.15)	64 (35.96)	55 (30.90)
Management			
Sees that disruptions are limited (5)	72 (40.45)	8 (4.49)	98 (55.06)
Broader climate/rewards			
Takes care that tasks/materials are collected/distributed effectively (4)	120 67.14)	26 (14.61)	32 (17.98)

More teachers were somewhat observed or frequently observed to engage in effective behaviours. The only exception was for the behaviour: takes care that tasks/materials are collected/distributed effectively. In this case, more teachers were rarely observed. How do the behaviours of teachers in effective and ineffective schools compare? (Table 9.10).

***Table 9.10** – Means for Teacher Behaviours in Effective, Average and Ineffective Schools*

Behaviour (item)	**Effective n = 30 (s.d)**	**Average n = 62 (s.d)**	**Ineffective n = 12 (s.d)**
Offers assistance to pupils (20)	2.22 (0.77)	1.94 (0.47)	1.98 (0.63)
Probes further when responses are incorrect (28)	2.17 (0.57)	2.05 (0.75)	1.92 (0.63)
Uses appropriate wait-time between question and answer (32)	2.15 (0.70)	1.88 (0.62)	2.22 (0.66)
Notes pupils' mistakes (14)	2.40 (0.75)	1.70 (0.50)	2.05 (0.66)
Gives positive academic feedback (38)	3.00 (0.00)	1.83 (0.82)	2.11 (0.61)
Uses a variety of explanations that differ in complexity (47)	2.90 (0.56)	2.10 (0.78)	1.90 (0.55)
Displays pupils' work in the classroom 56)	2.32 (0.71)	1.95 (0.68)	1.90 (0.55)
Sees that disruptions are limited (5)	2.22 (0.74)	1.90 (0.32)	1.99 (0.65)
Takes care that tasks/materials are collected/distributed effectively (4)	2.91 (0.62)	2.03 (0.70)	2.10 (0.84)

Teachers in effective schools were generally observed to engage more frequently in effective behaviours than teachers in ineffective schools. Interestingly, teachers in ineffective schools were observed to engage more frequently in effective behaviours than teachers in average schools. This implies that the increased frequency of effective behaviours alone does not guarantee effective schools.

9.2.6 Age of Head Teachers (School Level)

Head teacher age is a predictor of pupil progress. Table 9.11 describes the age of head teachers in effective, average and ineffective schools.

Table 9.11 *– Age of Head Teachers in Effective, Average and Ineffective Schools*

Age	Effective n = 8 (%)	Average n = 22 (%)	Ineffective n = 7 (%)	Total n = 37 (%)
35 to 44 years	2 (25.00)	1 (4.55)	2 (28.57)	**5 (13.51)**
45 to 54 years	3 (37.50)	9 (40.91)	2 (28.57)	**15 (40.54)**
55 to 61 years	3 (37.50)	11 (50.00)	3 (42.86)	**17 (45.95)**
Total schools	**8 (100.00)**	**22 (100.00)**	**7 (100.00)**	**37 (100.00)**

A quarter of younger head teachers between 35 to 44 years are in effective schools. The proportion of younger head teachers aged between 35 to 44 years are in ineffective schools. More than a third of head teachers in effective schools are older and between 55 to 61 years. Although head teacher age was elicited as a significant predictor of pupil progress, results indicate that head teacher age alone cannot guarantee effective schools.

9.3 Summary

This chapter indicated that the differential effectiveness of schools in Malta occurs along the dimensions of extent (effective, average and ineffective) and spread (typical and atypical). This chapter also highlighted differences in the characteristics that predict pupil progress. At risk pupils were found to attain less marks than their typically-developing peers. Yet, similarly to their typically-developing peers, at risk pupils in effective schools progressed more than their at risk counterparts in average schools. Likewise, at risk pupils in average schools progressed more than their at risk counterparts in ineffective schools. This implies that effective schools exert a positive influence for all pupils and that all pupils can learn, albeit at different rates, when educational conditions are positive for pupil learning.

Curriculum coverage, teachers' instructional beliefs and behaviours and head teacher age varied across differentially effective schools. Teachers in effective schools covered more topics (93.65%) than teachers in average (77.78%) and ineffective schools (66.67%). Generally, the beliefs held by teachers in effective and in effective schools were broadly similar. However, this could be due to the relatively small number of teachers in effective (n = 15) and in ineffective (n = 12) schools in comparison to the number of teachers in average schools (n = 62). Teachers in effective schools engaged in effective behaviours more frequently than teachers in ineffective schools. Interestingly, the relationship between frequency of teacher behaviours and pupil progress is not linear. If this were the case, then teachers in average schools would have engaged in effective behaviours more frequently than teachers in ineffective schools. This suggests that other factors, including those broader to the school, such as the role adopted by the head teacher, also come into play in conditioning effectiveness. In view of the connection between the quality of school-based practice and pupil progress, Chapter 10 following illustrates the practice of head teachers and teachers in six differentially effective schools.

CHAPTER 10

HEAD TEACHER AND YEAR 2 TEACHER PRACTICE IN SIX SCHOOLS

How does head teacher and teacher practice differ across and within differentially effective schools? In this chapter, the shift from generalisation to illumination leads to the elaboration of six case studies of head teacher and Year 2 teacher practice in a “typical effective”, a “typical average”, a “typical ineffective”, an “atypical effective”, an “atypical average” and an “atypical ineffective” school for mathematics.

10.1 Illustrating the Practice of Head Teachers and Year 2 Teachers in Six Differentially Effective Schools

Value-added measures offer fairer evaluations of effectiveness in schools and classrooms because these describe the longer-in-term patterns of pupil progress. Similarly, illustrations of practice, offer more detailed and fairer evaluations of the contexts and the processes connected with the practice of head teaching and teaching in differentially effective schools. Quality teaching is reflected by the strategies that teachers adopt which in turn reflects their pedagogy, or approach, to teaching. The connection between instruction and pedagogy, as mediated by teacher strategies, is defined by Siraj-Blatchford et al. (2002:10) as follows:

> Instructional techniques and strategies which enable learning to take place. It refers to the interactive process between teacher/practitioner and learner, and it is also applied to include the provision of some aspects of the learning environment (including the concrete learning environment, and the actions of the family and community).

Just as instruction and pedagogy are mediated by the quality of teacher strategies, the organisational approach towards teaching and learning in schools is mediated by the leadership, or the headship, roles that head teachers adopt. Although leadership is not exclusive to head teachers, this chapter focuses in describing the leadership strategies of head teachers.

10.1.1 The Six School Cases

Six case studies illustrate similarities and differences in the quality of organisational and instructional strategies implemented in six differentially effective schools. Pseudonyms for these schools are: Trinidad (typical effective), Ecuador (typical average), Honduras (typical ineffective), Venezuela (atypical effective), Colombia (atypical average) and Mauritius (atypical ineffective). Four of these schools were randomly sampled. Two schools, Venezuela and Mauritius were included straightaway, since these were the only schools in their category. The six case studies were elaborated from the 37 school and the 89 classroom profiles respectively elaborated from the field notes and MECORS (A). Table 10.1 describes the contexts in each of the six case study schools.

***Table 10.1** – The Broader Context in the Six Case Study Schools*

Typical Schools	**Trinidad (effective)**	**Ecuador (average)**	**Honduras (ineffective)**
School Building	Poor fabric	Refurbished	Poor fabric
Indoor assembly areas	Poor facilities	Good facilities	Poor facilities
Outdoor play areas	Spacious, poor quality	Not spacious, well-kept	Spacious, poor quality
School level effectiveness	+1 s.d	0 s.d	-1 s.d
Number of Year 2 classrooms	2	2	3
Classroom level effectiveness	+1 s.d & +2 s.d	0 s.d & 0 s.d	-1 s.d & -1 s.d & -2 s.d
Number of pupils in classrooms	21 & 21	12 & 13	15 & 15 & 16
Head teacher age	35 to 44 years	45 to 54 years	55 to 61 years
Father's occupation			
High	14.58%	33.33%	6.45%
Medium	56.25%	53.33%	77.42%
Low	29.19%	13.33%	16.13%
Mother's occupation			
High	16.67%	40.00%	9.68%
Medium	81.25%	60.00%	87.10%
Low	2.74%	0.00%	3.23%

***Table 10.1** – The Broader Context in the Six Case Study Schools (continued)*

Atypical Schools	Venezuela (effective)	Colombia (average)	Mauritius (ineffective)
School Building	Well maintained	Well maintained	Well maintained
Indoor assembly areas	Poor facilities	Good facilities	Good facilities
Outdoor play areas	Poor facilities	Good facilities	Good facilities
School level	+1 s.d	0 s.d	-1 s.d
Number of Year 2 classrooms	2	5	6
Classroom level effectiveness	0 s.d & +2 s.d	0 s.d, 0 s.d, 0 s.d, +1 s.d & -1 s.d	Three classes at 0 s.d, two classes at -1 s.d, a class at -2 s.d
Number of pupils in classrooms	21 & 21	17, 17, 17, 17 & 18	20, 20, 20, 20, 20, 20 & 21
Head teacher age	45 to 54 years	45 to 54 years	45 to 54 years
Father's occupation			
High	22.22%	10.00%	28.00%
Medium	58.33%	73.00%	64.00%
Low	19.44%	17.00%	8.00%
Mother's occupation			
High	16.67%	27.00%	38.00%
Medium	81.25%	71.00%	62.00%
Low	2.08%	2.00%	0.00%

10.2 Head Teacher Practice

Head teacher leaders exhibit instructional quality by organising the monitoring of lessons, the involvement of staff and the selection/replacement of staff. Head teacher leaders make time available for teaching and learning, hold appropriately high expectations for staff/pupils and set academic goals. Head teacher leaders establish an orderly, positive and collegial school climate sustained by a common academic vision and parental involvement (Mortimore et al., 1988). In the following paragraphs, illustrations of head teacher practice indicate how head teacher strategies in Trinidad (typical effective) and Honduras (typical ineffective) lie at opposite ends of the leadership to headship continuum. By applying the same metaphor, head teacher strategies in Ecuador (typical average) stand along the middle of the leadership to headship continuum. Head teacher strategies in Venezuela (atypical effective), Colombia (atypical average) and Mauritius (atypical ineffective) lie at the headship end.

10.2.1 Monitoring Lessons

Head teachers exhibit leadership through strategies that they adopt to monitor lessons delivered by teachers (Table 10.2).

***Table 10.2** – Head Teachers' Monitoring Strategies*

Trinidad (typical effective)	**Ecuador (typical average)**	**Honduras (typical ineffective)**
Lessons monitored nine times per year per classroom; for most subjects. Clear system in place for observation/teacher feedback. Clear and consistent monitoring strategy.	Lessons monitored three times per year per classroom; in the basic skills. Clear system in place for observation/teacher feedback. Clear and consistent monitoring strategy.	Head teacher does not believe that lessons should not be monitored because teachers are responsible for their teaching. No strategy
Venezuela (atypical effective)	**Colombia (atypical average)**	**Mauritius (atypical ineffective)**
Head teacher believes that teachers must be monitored. Teachers monitored three times per year; for basic skill subjects. Clear system in place.	Head teacher believes that teachers must be monitored. Teachers monitored three times per year; for basic skill subjects. Clear system in place.	Head teacher believes that teachers must be monitored. Teachers monitored irregularly for basic skills No system in place

Head teachers in Trinidad (typical effective), Ecuador (typical average), Venezuela (atypical effective) and Colombia (atypical average) regularly monitored teachers. In Trinidad and Ecuador, head teachers monitored the quality of lessons to provide teachers with constructive feedback to improve their practice. In Venezuela and in Colombia, head teachers also considered it important to monitor teachers. In Venezuela (atypical effective), monitoring frequency was observed to occur less than in Trinidad (typical effective) and was restricted to the basic skills (mathematics, Maltese and English). The head teacher of Honduras (typical ineffective) and the head teacher in Mauritius (atypical ineffective) did not monitor teachers.

The head teacher of Trinidad (typical effective) considered it important to repeatedly monitor lessons so as to provide teachers with support and feedback:

> it is very important to keep in touch with what is happening during lessons in classrooms so that I can support everybody. [...] after a while teachers get caught up in the day-to-day routine, it is up to me to make teachers aware of their strengths and the challenges that they need to deal with...It is my duty to support ourselves (including myself with teachers) in our journey to seek ways to see that our children learn more.

In Trinidad, lesson observations were routinely scheduled every Tuesday, Wednesday and Friday. Over one week, the head teacher observed three teachers in three year groups for lessons delivered between 9:00 a.m and 12:00 noon. Therefore, the head teacher got "to see everyone at their best" on nine occasions during a scholastic year. Six of the lessons observed were for mathematics, Maltese and English (2 visits per subject). Three of the lessons observed were for social studies, art and physical education (1 visit per subject). Feedback given to teachers during a one-to-one follow-up meeting was intended to support the improvement of teacher practice. The head teacher of Ecuador (typical average) monitored lessons regularly, but less frequently than the head teacher of Trinidad (typical effective). The head teacher of Ecuador viewed monitoring as: "necessary in today's time to see what teachers are really doing in the classroom…to see if they (teachers) are on the right track with their lessons…and if not to see that they take my suggestions". Teachers were observed three times during one scholastic year, for mathematics, English and Maltese. Lesson observations were followed by an individual meeting with each teacher. The objective of these meetings was to provide feedback and to encourage teachers to reflect about their practice. In contrast, the head teacher of Honduras (typical ineffective) did not believe in monitoring lessons. This head teacher considered teachers as personally responsible for teaching and therefore they were required to manage their own teaching "without much interference from the head".

Similarly to that elicited in typical schools, lesson observations decreased in frequency from Venezuela (atypical effective), to Colombia (atypical average), to Mauritius (atypical ineffective). The head teachers of Venzuela and Colombia observed teachers three times during one scholastic year, once for mathematics, once for English and once for Maltese. The head teacher of Venezuela followed-up lesson observations with a one-to-one meeting with teachers to discuss their performance. The head teacher of Colombia handed out a written report to teachers immediately after each lesson observation. The head teacher of Mauritius (atypical ineffective) chose to "monitor teachers indirectly" by maintaining "visibility in the corridor".

10.2.2 Involving Staff

Table 10.3 illustrates the ways in which head teachers delegated responsibility to assistant head teachers and Year 2 teachers in the six case study schools.

Table 10.3 – *Head Teachers' Involvement Strategies*

Trinidad (typical effective)	**Ecuador (typical average)**	**Honduras (typical ineffective)**
Delegates organisational duties in respect of staff interests. Organizes teachers to plan/prepare lessons together. Meets regularly with teachers to discuss curricular/instructional issues.	Delegates administrative duties to assistant head teachers. Asks teachers to share examples of better practice Meets regularly with teachers to discuss curricular coverage.	Delegates administrative duties to assistant head teachers. Does not assign teachers duties over and above their responsibilities in the classroom
Venezuela (atypical effective)	**Colombia (atypical average)**	**Mauritius (atypical ineffective)**
Delegates administrative duties to assistant head teachers. Does not assign additional duties.	Delegates administrative duties to assistant head teachers. Does not assign additional duties.	Never took over administrative duties from assistant head teachers. Does not assign additional duties.

Head teachers in Trinidad (typical effective) and Ecuador (typical average) sought to involve staff. The head teacher of Trinidad supported staff involvement through a school repository for schemes of work and lesson plans managed by three teachers. This same head teacher assigned responsibility for displays of pupils' work in the corridor to three learning support assistants:

> after I give them (the staff) space to pursue their educational interests, the majority of them (staff) are then more amenable to complying with a few of my more demanding requests...for example the setting-up of a school-based computer area in which lessons plans and schemes of work are owned by the school implies that all teachers now must write out and/or update their planning and preparation.

Teachers in the same year group were encouraged to plan schemes of work and lessons together. These meetings were scheduled in advance during the two-hourly meetings held every four weeks with each year group of teachers. The head teacher also recommended that teachers meet with their year-group colleagues once every two weeks to share ideas/resources/materials and to keep a log of common issues for further discussion with the head teacher. The head teacher of Ecuador freed time by delegating administrative tasks to two assistant head teachers. The head teacher met teachers once every three months to discuss schemes of work and lesson plans. Unlike the head teacher of Trinidad, the head teacher of Ecuador considered teachers as responsible only for the planning and preparation of materials/resources and did not consider their management by teachers according to a coherent school-wide system as important. Therefore, this head teacher had no means to refer directly to instructional material because there was no school repository. The head teacher of Ecuador involved teachers by asking them to present their ideas/experiences of good practice during school development meetings which take place once a month and lasted for two hours.

In Honduras (typical ineffective), Venezuela (atypical effective), Colombia (atypical average) and Mauritius (atypical ineffective), head teachers delegated administrative duties to assistant head teachers but not to teachers. The head teacher of Honduras (typical ineffective) held two school development meetings during the scholastic year, in fulfilment of the basic requirements for meetings listed by educational authorities. Involving teachers was considered burdensome by this head teacher:

> Teaching children in this school is extremely demanding (due to their problematic and difficult background)...it would be unfair of me to give teachers more work...given the breadth of the curriculum and the low ability (of pupils). Moreover, administrative demands are such that even with the help of the two assistant head teachers there is barely enough time to see that the paperwork is done in time...Imagine having (me) to supervise teachers in connection with

> organisational and educational tasks (assigned to them) that are usually more demanding in nature and to which they are not accustomed to.

Head teachers in atypical schools scheduled three school development meetings during the scholastic year with teachers to discuss schemes of work and lesson planning.

10.2.3 Selecting/Replacing Staff

In most schools head teachers had little, if any, say with regards to the choice of staff. Nonetheless, the head teacher of Trinidad (typical effective) forged good relations with key individuals employed with the former Education Division. Every July, this head teacher checked the status of applications of teachers who requested to leave school and/or of teachers who applied to work in the school. This head teacher then negotiated who was posted to Trinidad. This head teacher has never had to replace teachers and attributed this to the following: "everybody has their own way (of working). I just need to learn about it and work with it." Head teachers in the other five case study schools had no strategy leading to their involvement in the selection/replacement of staff.

10.2.4 Tabling Time

Generally, the tabling of time in schools was placed within the immediate responsibility of the teacher. The head teacher of Trinidad (typical effective) was exceptional in that the head teacher controlled tightly the timetable as well as the topic order to "safeguard and maximise time for teaching and learning". This head teacher scheduled the delivery of mathematics lessons (8:50 to 9:50 a.m) for first thing in the morning to ensure pupils were mentally and physically at their best for "the most cognitively demanding subject". In Maltese schools it is customary for specialist teachers to take over subjects such as art, physical education or science. Usually peripatetic teachers set their timetable for the lessons that they deliver. The head teacher of Trinidad (typical effective) felt that this practice was not beneficial for "the more efficient organisation of teaching" because peripatetic teachers usually occupied "the best time slots" required for more "cognitively demanding subjects" such as Maltese, English and reading besides mathematics. The head teacher was unwilling to negotiate timetable matters with peripatetic teachers. The head teacher of Ecuador (typical average) controlled time by asking teachers to note any changes in the timetable, as set by the head teacher, in their planning file. Head teachers in the other case study schools allowed teachers total control of the timetable.

10.2.5 High Expectations

The head teacher of Trinidad (typical effective) believed that every pupil had the potential to succeed. This head teacher believed that the balancing of expectations was challenging but believed that the climate in schools developed more positively when the head teacher held appropriately high expectations: “usually the more you expect of individuals (pupils and teachers) the more they try to live up to your expectations of them; if they perceive these expectations to be positive and worthwhile...the same also applies for parents.” The expectations held by the other head teachers were generally positive even in comparison to those held by the head teacher of Trinidad (typical effective). However, the head teacher of Honduras (typical ineffective) was reluctant to involve teachers in the broader management of the school and generally held low expectations for parents.

10.2.6 Academic Goals

The head teacher of Trinidad (typical effective) focused attention on academic goals during planning meetings. This was achieved this by placing “teaching for learning objectives” first on the agenda and for shorter (3 month) and longer (6 to 9 month) planning periods. This head teacher monitored goals in action during lessons and believed that a school repository for planning material was essential to keep better track of the planned teaching and learning objectives. In the other five schools, head teachers were aware that teachers included learning objectives in their lesson planning. However, these five head teachers did not discuss these objectives specifically and were not as organized in keeping track of these objectives during lesson observations.

10.2.7 An Orderly and Positive School Environment

The climate in each of the six case study schools was orderly. Typical schools clearly displayed the rules that pupils were expected to observe. The head teacher of Trinidad (typical effective) adopted a positive whole-school approach, spearheaded by the assistant head teacher who personally developed: "a four step-plan towards the establishing of a system that encourages everybody to teach and to learn, to enjoy teaching and learning and to want to teach and to learn even more." This system was constituted by the four golden rules for the school. First, be gentle, kind, helpful and not hurt others. Second, work hard, do not waste time and look after property. Third, be honest. Fourth, listen. The assistant head teacher and the head teacher encouraged teachers to display rules in corridors and classrooms. The assistant head teacher complemented this with a school-wide reward system. When pupils flouted any one of the rules they were assigned a sad face. When pupils respected these rules they were assigned a smiley face. Pupils with more than 30 sad faces forfeited going on school outings. Six similar rules were also promoted in Ecuador (typical average). These rules were consistently reinforced in a positive manner by the head teacher during assembly time and by teachers in the classroom. Once weekly, during assembly the head teacher of Ecuador named pupils who invested effort in observing these rules.

Honduras (typical ineffective) set and displayed the following rules in classrooms: say please and thank-you, do not run in corridors/classrooms, do not speak unless spoken to, attend school in uniform, do not wear jewellery, do not answer back to teachers, you must work hard and not waste time. Rules in Honduras were not as positive as the rules in Trinidad (typical effective) and Ecuador (typical average) and not complemented by a reward system. Pupils who did not observe these rules were admonished by the head teacher during assembly. In Venezuela (atypical effective), Colombia (atypical average) and Mauritius (atypical ineffective) no rules were observed on display. However, teachers in these atypical schools did make reference to similar rules during lessons.

10.2.8 Common Vision

The head teacher of Trinidad (typical effective) “inherited” a well developed school development plan from the preceding head teacher. The head teacher of Trinidad desired to: “find time...and whenever possible make time.” “Finding time” means that the timetable is organized in ways that safeguard time for teaching. “Making time” means that lessons are timed and ordered to harness the “cognitive energy” of pupils and to support pupil learning. The head teachers’ personal daily routine also helped to safeguard time. The head teacher of Trinidad started the day at 7:00 a.m. First, e-mail was attended to, “to get administrative issues out of the way”. In this way, this head teacher maximised time for important academic matters. At twenty to eight the head teacher welcomed teachers. At half-past eight the head teacher welcomed pupils and led the assembly during which a pupil was invited to read out a motto for the day. At 2:15 p.m the head teacher said goodbye to pupils. This head teacher was usually last to leave the school towards 5:00 p.m.

With the exception of the head teacher in Honduras (typical ineffective), head teachers in the other five case study schools were all involved in the writing-up of the school development plan. Four head teachers considered this as burdensome and additional to their “real work”. With the exception of the head teacher of Trinidad (typical effective) and the head teacher of Ecuador (typical average), head teachers did not consider their contribution to the school development plan as relevant to their role. This reticence was connected a reluctance to work beyond the stipulated school hours. In fact, only the head teacher of Trinidad and the head teacher of Ecuador started their school day earlier than required and were generally last to leave the school and it was during these “extra hours” that they contributed towards the school development plan.

10.2.9 Collegiality

The head teacher of Trinidad (typical effective), forged good relations amongst staff to: “facilitate…a climate of collegiality”. This head teacher considered it important to greet staff: “to obtain a sense of what is going on with teachers”. This head teacher considered this useful to promote new ideas and to obtain reactions to ideas before pursuing these further during school meetings. This head teacher described the positive spin-offs of these strategies as follows:

> If I am available to them when they (teachers) need support they will not see me only as the head teacher but more importantly as a colleague who offers support...Also I find that if I am there for them (teachers) they are also more likely to be there for their colleagues, their children and the parents of children in their class.

This head teacher also recognised limitations concerning relations amongst some teachers:

> Peripatetic staff…experience their…belonging to the school in a way that is less intense than that experienced by more permanent members of staff...it would be great if specialist teachers were to be assigned to one school...this would help me to dictate less (with such teachers), negotiate more and generally communicate better.

This head teacher also believed that to cultivate collegiality, misunderstandings had to be dealt with, with expediency and in a non-judgemental manner. A main source of misunderstanding in this school concerned the supervision of playground time. This constituted an extra source of remuneration for teachers and most teachers wanted to supervise. The preceding head teacher allowed teachers to manage this for themselves. However, because of this situation the same three teachers got to supervise pupils whilst other teachers got side-lined. At first, the head teacher of Trinidad imposed a more equitable distribution of the playground supervision but later came to the conclusion that communication is better:

> Ultimately the teachers still arrived at the decision that I would have imposed...yes it did take a week of talk (and disagreement)...but in the end the solution (equitable) was negotiated amongst us.

The head teacher of Ecuador School (typical average) also invested time and effort in nurturing good relations with and amongst staff.

> Many of our teachers are now reading for a Masters or attending the Diploma Programme in Educational Administration so that they eventually qualify to

> become assistant head teachers and later on head teachers...Many of our teachers make suggestions for improvement based on what they have learnt or heard...It is up to me to provide them with opportunities to try these and provide them with resources whenever possible...When teachers see that I value their ideas and their input this helps to establish a positive bond between me and them (teachers)...When other teachers realise the space I offer they themselves come up with other ideas for us to try...after a series of trial and error phases...the majority of teachers usually succeed in their ventures.

This head teacher adopted strategies that supported collegiality but was not as adept in establishing good relations and fostering collegiality as the head teacher of Trinidad (typical effective). The head teacher of Ecuador believed it important to be available to staff and meetings with staff were held thrice-weekly between 2:30 p.m till 3:30 p.m without appointment in fulfilment of this organisational objective. This head teacher also thought that the golden rules were also suitable for staff:

> Everybody enjoys being treated with kindness and with respect. Many recognise the value of being honest with them, even if they don't like what they hear, and most of our teachers just need to be listened to...I choose to treat my staff the way I expect to be treated by them.

The head teacher of Ecuador considered it important to clear misunderstandings but held back in dealing with them unless:

> it escalates to the point of explosion...and then the way I do it is to take a decision for myself...apply it to the parties involved...and try to make sure that this offers a solution which nobody thought of...when I cannot think of another solution I choose the best available solution and give reasons for the why I took this on board...at times this leaves some teachers feeling aggrieved but after all I am the head teacher and there are times when I need to take responsibility.

The head teacher of Honduras (typical ineffective) adopted an authoritarian approach and thought that teachers were required to respect the authority that comes with the job of head teaching, even if teachers are "not that happy with decisions taken."

The three head teachers in Venezuela (atypical effective), Colombia (atypical average) and Mauritius (atypical ineffective) were also not as adept in fostering collegiality. Although they thought well of staff, pupils and parents, they failed to establish routines to involve stakeholders. A reason for this "weaker" approach is that they believed collegiality to be high amongst staff. However, all Year 2 teachers in atypical schools felt that relations amongst staff were mixed. As one teacher said: “the head teacher knows about it (good relations)...but thinks that this will happen by itself.” The two Year 2 teachers in Venezuela got on very well together, shared ideas and resources but stopped short from planning together. The five Year 2 teachers in Colombia and the six Year 2 teachers in Mauritius felt that Year 2 teachers did not get on well together:

> The head teacher likes some teachers more than others…these preferred teachers share resources together and plan lessons together (with the head teacher)…other Year 2 teachers who are less liked (by the head teacher) and who get on less well with one another are then left to teach and plan by themselves.

A Year 2 teacher in Colombia highlighted that this “watered down sense of collegiality” was due to “over-familiarity” since head teacher and all Year 2 teachers had served in the school for at least seven years:

> ...the head teacher knows that teachers are there, the teachers know about other teachers but we all choose to get on with our work and do what we are used to doing.

Strategies adopted by head teachers in atypical schools were “weaker” in comparison to the “stronger” strategies of head teachers in typical schools. The strategies of head teachers in atypical schools do not appear to facilitate the alignment of school and classroom conditions as “tightly” particularly when compared to the strategies adopted by the head teachers of Trinidad (typical effective) and Ecuador (typical average).

10.2.10 Parental Involvement

The head teacher of Trinidad (typical effective), initiated ventures to “get parents into schools” because “schools are not organized in ways that make parents feel welcome”. The head teacher of Ecuador (typical average) involved parents by making it easier for them to obtain feedback about their children by making it easier for parents. On the other hand, the head teacher of Honduras (typical ineffective) maintained the status quo by not involving parents. The head teacher of Trinidad considered it important to hold open hours, every Wednesday and every Friday, for parents to be able to meet with the head teacher without appointment. This head teacher encouraged mothers to hold after school classes for reading and held bi-annual meetings for parents during the evening (between 6:00 to 8:00 p.m) instead of during school hours. The head teacher of Ecuador (typical average) also made it easier for parents to meet with staff. Every Friday between 4:00 p.m to 6:00 p.m, parents could also meet with this head teacher without appointment. Similarly to Trinidad, the two parents' days were held twice-yearly after school hours:

> it is easier for parents to meet with us after school hours because they find it easier to find someone to mind their children than to take time off work...For many working mothers and fathers taking time off with only a week notice is not always an option...Moreover why lose two days from teaching and from learning when these meetings with parents are so much more convenient when held after school hours?

In contrast, the head teacher of Honduras did not consider it prudent for parents to be involved in school life and academic matters and stated that:

> parents need to understand that us professionals know best when it comes to seeing that children learn...many parents really want to complain or stir trouble or simply spoil their children instead of wanting to help their children learn by accepting our direction and trusting completely in us...do I tell a doctor or a lawyer what to do? Would they tolerate us doing so? Then parents should not be telling me what to do nor should I encourage parents to do so.

Head teachers in Venezuela (atypical effective), Colombia (atypical average) and Mauritius (atypical ineffective) were generally available to teachers and parents. The head teacher of Venezuela considered parental involvement as an opportunity to "lower barriers" between teachers and parents:

> In Maltese Schools it is customary for head teachers to keep parents at a very healthy distance. I don't think that this is always in the best interest of the child. Parents need to be made to feel welcome if this distance is to narrow...and teachers need to be shown this.

Head teachers in atypical schools were aware that holding parents' days during school hours was inconvenient for many parents. However, they did not take the required steps necessary to hold these events at a more convenient time. A reason that was generally offered for this inaction was that school days would be too long for teachers. As noted by the head teacher of Mauritius: “the choice is not easy…but I face teachers on a daily basis and I must accommodate them.”

10.3 The Practice of Year 2 Teachers

There are 20 teachers in the Year 2 classrooms associated with the six case study schools. Two teachers are in two effective classrooms in Trinidad (typical effective), two teachers are in two average classrooms in Ecuador (typical average) and three teachers are in three ineffective classrooms in Honduras (typical ineffective). In Venezuela (atypical effective), one teacher is in an effective classroom and another teacher is in an average classroom. In Colombia (atypical average), one teacher is in an effective classroom, three teachers are in average classrooms and one teacher is in an ineffective classroom. In Mauritius (atypical ineffective), three teachers are in average classrooms and another three teachers are in ineffective classrooms.

10.3.1 Classroom Displays, Seating Arrangments and Lesson Structure

The strategies that teachers adopted to organize classroom displays, seating arrangments and lessons reflected the quality of their teaching. In Trinidad (typical effective), Year 2 teachers established classroom environments conducive to learning. Displys were visually attractive, informative, organized around a teaching for learning theme and rich in print and in number. Pupils were usually seated in pairs. Two pupils in one Year 2 classroom and a pupil in the other Year 2 classroom were seated alone. This decision was taken by the Year 2 teachers together with the head teacher during a planning meeting due to the higher academic ability of these pupils. Year 2 teachers in Trinidad started lessons with a five-minute mental warm-up. They both followed this with a five-minute introductory explanatory activity. During this phase, key-words/key-symbols were introduced and/or revised. This was followed by two explanatory activities that lasted between five to seven minutes. The first activity was intended for low ability pupils. The second activity was intended for high ability pupils. Differentiated written seat-work was then assigned to pupils. Pupils were allowed 15 to 20 minutes to finish their written work. Pupils who finished early had additional tasks prepared for them. A five minute plenary session was conducted by both teachers in order to revise the key points covered during the lesson.

In Ecuador (typical average), displays were attractive and informative and charts were organised according to a theme. Both Year 2 teachers started lessons with an introductory activity that lasted for five minutes. This activity was followed by another two ten-minute activities; which were not graded according to difficulty. All pupils were assigned the same written task and allowed 20 minutes to complete the set task. No extra tasks were prepared for pupils who finished early. No plenary was conducted.

In Honduras (typical ineffective) displays were not rich in print and/or number. Visual material on display was not attractive and charts were not organized according to a theme. Pupils across the five Year 2 classrooms were generally seated in groups of four. Two pupils with statements in each classroom were seated individually. This was conducted to provide ease of access to learning support assistants. The three Year 2 teachers in Honduras structured lessons identically. They did not conduct a mental warm-up, introduced the lesson very briefly, conducted a 15 minute activity, assigned 30 minutes for seat work that was not differentiated by ability and did not hold a plenary session. These teachers also chose to bunch topics consecutively over shorter periods in time, rather than revisiting the same topics over longer time-periods to consolidate and extend pupils' mathematical concepts.

The quality of classroom displays, seating arrangments and the lesson strategies adopted by teachers in Venezuela (atypical effective), Colombia (atypical average) and Mauritius (atypical ineffective) differed widely amongst Year 2 teachers in these atypical schools. In Venezuela, displays associated with the teacher in the effective classroom were rich in print and number and well-organized around a theme. The strategies of this teacher are similar to the strategies of the two Year 2 teachers in Trinidad (typical effective). In Venezuela, the displays of the teacher in the average classroom were not clearly organised according to a theme, lacked in visual attraction and in their reference to number, when compared to displays associated with the other Year 2 teacher in the effective classroom in Venezuela. Pupils in both Year 2 classrooms in Venezuela were seated similarly in groups of four/five. Each teacher covered 59 ABACUS topics, began lessons with a five-minute mental warm-up, followed by a five-minute introductory activity, then followed by one or two explanatory activities of ten to 15 minutes each, followed by seat-work for 15 minutes and concluded by a 5 minute plenary session.

Classroom displays and seating arrangements did not vary considerably amongst teachers in five Year 2 classrooms in Colombia (atypical average) and Mauritius (atypical ineffective). Displays were organized around a theme but were poor in print and number and pupils were seated in groups of four/five. Year 2 teachers in average classrooms in Colombia and in average classrooms in Mauritius structured lessons similarly. Teachers introduced the lesson briefly, conducted a 15 minute explanatory activity, followed by half-an-hour of written seat-work. A teacher in an ineffective classroom in Colombia structured lessons similarly to the three teachers in ineffective classrooms in Mauritius. Teachers in average classrooms in Colombia and Mauritius started their lessons with a five-minute introductory activity, followed by two ten-minute explanatory activities, followed by 15 to 20 minutes of seat-work and ended with a plenary. Teachers in average classrooms in Colombia structured lessons similarly to teachers in average classrooms in Mauritius and similarly to teachers in average classrooms in Ecuador (typical average).

10.3.2 Better Teacher Practice

Teachers in effective classrooms presented material, offered assistance, probed further, varied wait-time depending on pupil ability, gave positive academic feedback, employed a variety of explanations graded by difficulty, displayed pupils work in the classroom, limited disruption, took care that tasks/materials were managed effectively and used rewards to manage pupil behaviours more frequently and more strategically than teachers in ineffective classrooms (Table 10.4). Interestingly and as discussed earlier in section 9.2.5 and in Table 9.10, teachers in ineffective classrooms were observed to engage in the above mentioned behaviours more frequently than teachers in average classrooms. However, Table 10.4 shows that whilst teachers in average classrooms generally exhibited a much narrower repertoire of behaviours than effective teachers these behaviours, though limited, were generally positive. On the other hand, although teachers in ineffective classrooms usually exhibited a similar repertoire of behaviours than teachers in average classrooms, these behaviours were generally more negative than those employed by teachers in average classrooms. This suggests that the quantity and the quality of teacher behaviours come into play in conditioning and directing the differential influences of teaching. For ease of reference the strategies observed of teachers in Year 2 classrooms are compared in Table 10.4.

***Table 10.4** – Teacher Practice in Six Differentially Effective Schools*

Effective classrooms (n) - Trinidad (n = 2), Venezuela (n = 1), Colombia (n = 1). Teacher…	**Average classrooms (n) -** Ecuador (n = 2), Venezuela (n = 1), Colombia (n = 3) and Mauritius (n = 3). Teacher...	**Ineffective classrooms (n) -** Honduras (n = 3), Colombia (n = 1) and Mauritius (n = 3). Teacher...
Presents materials clearly (item 14). introduces lesson topic. signals to pupils changes in lesson phases. connects with pupils' prior knowledge and/or with previously covered topics. introduces key-words and refers to key-words on display (Trinidad only).	introduces lesson topic. signals pupils changes in lesson phases.	does not introduce lesson topic. does not signal changes in lesson phases. expects pupils to memorise routines. For example pupils write out dates for mathematics from memory not copy/refer to these from board or display.
Offers assistance to pupils (item 20). answers quickly when pupils ask for assistance. offers assistance even when pupil is reluctant to get help (Trinidad only).	answers quickly when pupils ask for assistance. sometimes offers assistance even when pupil is reluctant to get help (Ecuador & Colombia only)	is slow to help pupils. sometimes ignores pupils who ask for help.

Table 10.4 *– Teacher Practice in Six Differentially Effective Schools (continued)*

Effective classrooms (n) - Trinidad (n = 2), Venezuela (n = 1), Colombia (n = 1). Teacher…	**Average classrooms (n) -** Ecuador (n = 2), Venezuela (n = 1), Colombia (n = 3) and Mauritius (n = 3). Teacher...	**Ineffective classrooms (n) -** Honduras (n = 3), Colombia (n = 1) and Mauritius (n = 3). Teacher...
Probes further when responses are incorrect (item 28). guides pupils to process misunderstandings; usually through higher-order questioning. probes even when answer is correct.	sometimes guides pupils to process misunderstandings; usually through lower-order questioning.	does not probe. tells pupils that the answer is right/wrong.
Uses appropriate wait-time between questions and answers (item 32). allows enough wait-time (20 seconds). differentiates wait-time by pupil ability.	allows some wait-time (10 seconds). does not differentiate wait-time by pupil ability.	allows little wait-time (up to 5 seconds). does not differentiate wait-time by pupil ability.

Table 10.4 *– Teacher Practice in Six Differentially Effective Schools (continued)*

Effective classrooms (n) - Trinidad (n = 2), Venezuela (n = 1), Colombia (n = 1). Teacher…	**Average classrooms (n) -** Ecuador (n = 2), Venezuela (n = 1), Colombia (n = 3) and Mauritius (n = 3). Teacher...	**Ineffective classrooms (n) -** Honduras (n = 3), Colombia (n = 1) and Mauritius (n = 3). Teacher...
Gives positive academic feedback (item 38).		
praises for academic effort and/or when pupils explain mathematical processes.	praises but offers little feedback to help pupils understand.	gives lots of praise, usually to the same select group of pupils, but offers little feedback to help pupils understand.
gives feedback to pupils when required but does not slow lesson.	is not always clear why praise is given.	offers no indication as to why praise is given.
Uses a variety of explanations that differ in complexity (item 47).		
delivers differentiated explanatory activities (low/high ability). differentiating strategy also used during feedback; e.g. through lower/higher-order questions (Trinidad only).	delivers two explanatory activities that are slightly graded in difficulty.	delivers one explanatory activity.

Table 10.4 *- Teacher Practice in Six Differentially Effective Schools (continued)*

Effective classrooms (n) - Trinidad (n = 2), Venezuela (n = 1), Colombia (n = 1). Teacher…	**Average classrooms (n) -** Ecuador (n = 2), Venezuela (n = 1), Colombia (n = 3) and Mauritius (n = 3). Teacher...	**Ineffective classrooms (n) -** Honduras (n = 3), Colombia (n = 1) and Mauritius (n = 3). Teacher...
Displays pupils work in the classroom (item 56). delivers theme-driven lessons for mathematics. displays are print/number rich and organized by headings/titles. displays pupils' work according to effort and outcome.	displays are picture rich with clear subject headings. displays pupils' work only when correct.	has little material on display. does not display pupils' work.
Sees that disruptions are limited (item 5). closes classroom door. adopts a traffic-light system. displays/refers rules of conduct. limits interaction between support staff and pupils during explanations.	closes classroom door. displays/refers rules of conduct.	closes classroom door.

Table 10.4 **–** *Teacher Practice in Six Differentially Effective Schools (continued)*

Effective classrooms (n) - Trinidad (n = 2), Venezuela (n = 1), Colombia (n = 1). Teacher…	**Average classrooms (n) -** Ecuador (n = 2), Venezuela (n = 1), Colombia (n = 3) and Mauritius (n = 3). Teacher...	**Ineffective classrooms (n) -** Honduras (n = 3), Colombia (n = 1) and Mauritius (n = 3). Teacher...
Takes care that tasks/materials are collected and distributed effectively (item 4).		
sees that task-work and homework copybooks/textbooks are handed in/out by pupil leaders first thing in the morning.	hands out copybooks/textbooks herself.	hands out copybooks/textbooks.
sets table for copybooks/textbooks that is accessible to pupils.	sets table for copybooks/textbooks that is accessible to pupils.	keeps copybooks/textbooks on table.
Uses a reward system to manage pupil behaviour (item 6)**.**		
rewards good behaviour and academic effort.	rewards good behaviour.	does not reward good behaviour.
rewards correct outcomes connected with written seat-work	rewards correct outcomes connected with written seat-work	

10.3.2.1 Limiting Disruption

Teachers in effective classrooms were adept in limiting disruptions. They established a clear system for this and attended only to urgent incidents; such as when pupils felt sick or for fire drills. Teachers closed the classroom door during lessons to discourage individuals not to disturb and to reduce noise from outside. The two teachers in Trindad (typical effective) and one teacher in an effective classroom in Venezuela (atypical effective) adopted a traffic light system and placed the traffic-lights on the classroom door facing the corridor. Red indicated "do not disturb unless absolutely urgent". Orange indicated "disturb when important". Teachers in ineffective classrooms did not handle disruptions as efficiently and had no clear system in place. The teacher in the effective classroom in Venezuela limited disruption as follows:

It is 9.00 a.m: The lesson has just started and the head teacher knocks on the door in spite of the red light outside

Teacher: "Is it urgent?"

Head teacher: "No but..."

Teacher: "I realise it could be inconvenient, but I will handle it during the first lunch break by coming to your office."

It is 9:20 a.m, the teacher is engaging pupils in an explanatory activity the care-taker knocks on the door. She rolls her arms and hands signalling to the care-taker to try later.

A teacher in an ineffective classroom in Mauritius (atypical ineffective) dealt with disruption as follows. It is 11.00 am. The lesson has been underway for 15 minutes underway. The head teacher knocks:

Teacher: Smiles and head teacher enters

Head teacher: "I need to speak to pupils and give them this circular to take home and give to their parents."

Teacher: "Fine."

Head teacher enters the classroom and stays for five minutes.

10.3.2.2 Feedback

Teachers in effective classrooms probed further when pupils were unsure about their answer and questioned to probe further to guide pupils towards a solution. This is illustrated for a teacher in Trinidad (typical effective). It is 9:45 a.m. The teacher is helping a girl to work out an addition sum. She has drawn the attention of a pupils having difficulty working out this sum.

Teacher:	"What answer do you get if you add 16 with 12?" (Waits for nearly a minute).
Girl:	"28" (said in a hesitant tone).
Teacher:	"Do you think her answer is correct?" (Teacher addresses the class and waits a while).
Boy:	"Yes she is."
Teacher:	"Good the answer is correct. How did you get that answer?" (To girl)
Girl:	"First I did 10 + 10." "Then I..."(voice trails off).
Teacher:	"Did you plus any other numbers?" (Waits five seconds). "After you added the tens did you add the units?"
Girl:	"Yes" (still hesitantly).
Teacher:	"Please come out and show us on the board".
Girl:	Adds 10 from the number 16 and 10 from the number 12. Together these equal to 20. Then she adds the 6 from the number 16 and the 2 from the number 12. Together these numbers equal to 8. Then she adds the 20 together with the 8 to get 28.
Teacher:	"Isn't this the same answer like the one you gave me earlier?"
Girl:	Looks at whiteboard and says "yes" (in a more convinced tone of voice).

This teacher created opportunities for interaction, included other pupils by asking if the supplied answer was correct and checked how the pupil arrived to the correct solution. When the pupil hesitated, the teacher asked two further questions to prompt the pupil to answer. Finally, the teacher confirmed that the solution given by the pupil was correct.

On the other hand, teachers in ineffective classrooms lost opportunities to interact meaningfully with pupils through probing and to support pupil understanding. An example of this is offered by a lesson event in Honduras (typical ineffective). It is 9:50 a.m. The teacher is explaining addition with double digits.

Teacher:	"What answer do you get if you add 18 with 12?" (Teacher waits for nearly a minute)
Boy:	"30"
Teacher:	"Ok" (surprised).
Boy	"I did 10 + 10 + 8 + 2" (writing it out on board)

Teacher is happy with answer.

Boy:	"Let me show you."
Teacher:	"No, go back to your place please?"

The teacher in an effective classroom in Trinidad (typical effective) and the teacher in an ineffective classroom in Honduras (typical ineffective) offered feedback to pupils. The main difference was that the teacher in the ineffective classroom accepted the correct answer straight away. In contrast, the teacher in the effective classroom checked further for pupil understanding. This suggests that teachers in ineffective classrooms may not be as receptive to opportunities that present themselves during lessons to provide pupils with feedback.

10.3.2.3 Wait-Time

Teachers in effective classrooms differentiated the amount of wait-time they allocated to pupils depending on ability. The following illustrates how a teacher in Venezuela (atypical effective) differentiated wait-time by pupil ability. It is 9:25 a.m. Teacher is in the first explanatory activity.

Teacher:	"How many tens and how many ones in eleven?" (to low ability boy).
Boy:	(hesitates)
Teacher:	"Is there one or are there two packets of ten in eleven?"
Boy:	"There is one packet of ten" (answers hesitantly).
Teacher:	"So?"

Boy: “There is one ten and a one.”

It is 9:28 a.m.

It is 9.30 a.m. Teacher is in the second explanatory activity.

Teacher “How many packets of tens and units are there in 46?” (to medium ability boy)

Boy “There are 6 units and...”(voice trails off)

Teacher “Why not start with the tens?” (In a firm voice)

Boy “Let me start again...”(thinks)”...there are four packets of ten and six units.”

It is 9:30 a.m.

10.3.2.4 Probing

Teachers in effective and teachers in ineffective classrooms both used probing strategies during lesson explanations. Teachers in effective classrooms probed in ways that engaged pupils cognitively more than teachers in ineffective classrooms. Teachers in effective classrooms usually intended the first explanatory activity for low ability pupils, the second explanatory activity for medium ability pupils and the third explanatory activity for high ability pupils. The first activity was usually delivered by the teacher towards the front of the classroom. In this way, the teacher could better engage with low ability pupils. Teachers in effective classrooms usually left medium and high ability pupils seated when interacting with them. This was conducted to encourage these pupils to engage in more abstract ways with their learning. The following illustrates this point for a teacher in an effective classroom in Colombia (atypical average). The first explanatory activity follows the mental warm-up. The lesson is about estimating weight (light/heavy). It is 9:15 a.m.

Teacher: “In this activity we are going to play a game with heavy objects and also with light objects.” (Teacher calls out two boys to the front of the classroom and they come to the front of the class).

Teacher: “Could you please choose an object each from the basket?” (Each boy chooses an object).

Teacher: “Place the lunch-box and the tissue-roll on the balancing scales.”

Teacher: (To one boy). "Which is heavier the lunch-box or the tissue-roll?"

Boy 1: "The lunch-box."

Teacher: "Why?" (To the boy).

Boy 1: "Because the scales are down on the side of the lunch-box."

Teacher: "Is his answer correct?" (To the whole-class).

Class: "Yes" (together).

Teacher: Picks out three boys and asks them to explain why (a couple of minutes pass)...

Teacher ...(to the other boy). "Why is the tissue-roll lighter?"

Boy 2: "Because the scales are down."

Teacher: "Correct...and remember" (addressing also the rest of the class) "...when an object is heavy the scales are down but when an object is light the scales are up."

Teacher asks the two boys to go back in their seat.

At the start of the second whole-class activity, the teacher hands out common everyday objects to each pupil and delivers instructions. Thus, the teacher signals the start of another activity. The teacher tells pupils that they are required to estimate (by hand) heavier/lighter objects.

Teacher: "Remember that each boy in each pair has to check the answer by using the scales." (Pupils hold objects in their hands as shown by the teacher during the mental warm-up.)

Teacher: "Did you all compare the weight of each of your objects? Did you hold each object together in each of your hands?"

Teacher: "Which object is heavier and which object is lighter?" (To a pair of pupils).

Boy 1: "This is heavier" (shows her a torch).

Boy 2: "This is lighter" (shows her a book).

Teacher: "Are there any of you who did not take a turn on the scales? What is the reading for each object?"

Boy 1: "800 grams."

Boy 2: “600 grams.”

Teacher: “By how many grams is the book lighter?”

Teacher goes round pupils who have just started working on their tasks on tables arranged in a U-shaped layout.

During the third whole-class activity, the teacher hands out another set of everyday objects to each pupil. Pupils are told to estimate the weight of each object, check their estimation and then write out answers in the worksheet.

Teacher: “Let us start with the first item on the worksheet.”

Teacher: “Which items do we need to compare?” (To first boy).

Boy 1: “We need to compare the weight of the six pencils with the weight of the three copybooks” (boy looks at worksheet and thinks aloud).

Teacher: “Without using your hands, which set of objects do you think will be heavier the pencils or the copybooks?”

Boy 1: “I’m not sure.”

Boy 2: “I think that the copybooks will be heavier.”

Teacher: (to first boy) “Could you please weigh the copybooks?” (points to digitial scales). “How much do they weigh?”

Boy 1: “200 grams.”

Boy 2: “The pencils weigh 30 grams.”

Teacher: “Please write down the weight of each object under each object.” (Teacher points, whilst facing the class to show where pupils have to write down answers). “Then write down the heavier or the lighter object.” (Teacher goes round pupils who have just started working on their tasks on tables arranged in a U-shaped layout.)

It is 9:32 a.m.

The use of probing by teachers in ineffective classrooms was brief. This is indicated by the following lesson event at Honduras (typical ineffective). The topic is shapes. It is 11:45 a.m.

Teacher: "A cube is this... (shows large cube to pupils) "...and a cuboid is this." (Shows large cuboid to pupils)

"On that chart you will also see a cube and a cuboid."

"They are all like a box but they are different because their size is different."

"The cube and the cuboid have something in common because their opposite sides are equal."

"What happens if you cut a cylinder? How about using your imagination?"

"What happens if you cut a ball?" (Tells pupils to start their seat-work).

10.4 Summary

This penultimate chapter illustrated the practice of head teachers and Year 2 teachers in six differentially effective schools. In Trinidad (typical effective), the head teacher leads. In Honduras (typical ineffective) the head teacher heads. The strategies of the head teacher of Ecuador (typical average) were similar to the strategies of the head teacher in Trindad (typical effective). Insights gained from this chapter illustrate that head teachers are key to effective and ineffective schools. In Trinidad (typical effective) the head teacher established an orderly climate that focused teachers to better organise their instructional practice. The head teacher in Ecuador did not implement strategies as frequently and in as skilful a manner as the head teacher in Trinidad. This implies that both the quality and the quantity of head teacher strategies influence the extent, spread and direction of effectiveness. This also suggests that in typical schools, conditions at the school and at the classroom level come together in ways that supports a more even spread of effectiveness; which may be positive or negative in effect for pupil progress. On the other hand, head teacher practice did not differ as noticeably across the three atypical schools. The head teachers of Venezuela (atypical effective), Colombia (atypical average) and Mauritius (atypical ineffective) exhibited strategies consistent with head teachers fulfilling a headship role. This suggests that in atypical schools, conditions at the school and at the classroom level do not come together, or align, in ways that promote the even spread of effectiveness.

Quality of teacher practice also differed considerably in the six differentially effective schools. Teachers in effective classrooms possessed a richer repertoire of strategies than teachers in ineffective classrooms. In effective classrooms, teachers adopted strategies that were effective in: limiting of disruption, providing feedback to pupils, differentiating the amount of wait-time dedicated to different pupils and in probing pupils so that teachers gained a window into their learning. On the other hand, teachers in ineffective classrooms possessed a narrower and limited repertoire of strategies than teachers in effective classrooms. Teachers in ineffective classrooms were not as adept in limiting disruption, providing feedback, differentiating wait-time and probing pupils. In typical schools, the strategies adopted by teachers did not vary considerably across Year 2 classrooms in the same school. Understandably, in atypical schools the strategies adopted by teachers varied considerably across Year 2 classrooms in the same school.

CHAPTER 11
CONCLUSIONS AND RECOMMENDATIONS

This final chapter synthesizes the findings and insights following: the identification of the predictors of pupil attainment (age 6) and pupil progress from age 5 (Year 1) to age 6 (Year 2), the classification and characterisation of differentially effective primary schools in Malta for mathematics, and illustrations about the practice of head teachers and Year 2 teachers in six differentially effective schools. This chapter concludes the current study by recommending pathways for future research and the development of educational policy within the Maltese Islands.

11.1 Back to the Research Questions

Increasingly, larger-in-scale studies adopt both quantitative and qualitative approaches. Mixed methods increase the possibility of identifying trends and patterns associated and connected with educational phenomena (Sammons, Day & Ko, 2011). The current study is the first local pupils in classrooms in schools study to examine the school and classroom factors and characteristics associated with pupil attainment and pupil progress for mathematics and to combine a multilevel and a case study approach in connection with the collation and the analysis of the data. The main quantitative approach adopted by the current study was driven by the following research questions:

1. what are the predictors of pupil attainment and pupil progress in Malta for mathematics after adjusting for factors at the pupil, the classroom and the school level?
2. do the predictors of pupil progress differ across differentially effective schools? Within this research question lie the following research questions: how do the broader school and classroom characteristics and teaching/teacher/instructional characteristics (beliefs and behaviours) differ across (and possibly within) differentially effective schools?

The minor qualitative approach adopted by the current study was driven by the following research question:

3. how does the practice of head teachers and Year 2 teachers differ across and within differentially effective schools?

By mixing approaches the current study avoided the pitfalls of adopting an either/or approach (Teddlie & Sammons, 2010) and a one-size-fits-all approach to research (Thrupp, 2001) based on an over-reliance on quantitative methodologies (Coe & Fitz-Gibbon; Goldstein & Woodhouse; Scheerens & Bosker, 1997). The complementary analysis of the numerical and the textual data generated and illuminated diverse forms of local-specific and more synergistic understandings (Sammons, 2010) about the attainment and progress outcomes of young pupils in classrooms in schools for mathematics. The mix in approach also shed light as to the differential effectiveness of schools and about " 'what works' " (Reynolds et al., 2012:15), and what does not work as well, with regards to head teacher and Year 2 teacher practice in differentially effective primary schools in Malta for mathematics.

11.2 The Main Findings and Conclusions

The findings and insights from the current study led to three conclusions. First, Maltese pupils are able to learn mathematics when school and classroom conditions enhance learning (Duncan et al., 2007). The current study also discovered that pupil progress is an accomplishment of factors at the classroom and the school level (Kyriakides, Campbell & Gagatsis, 2000). Second, local schools and classrooms are differentially effective due to variations in the quantity and quality of instructional and organisational processes in schools. Interestingly, primary schools in Malta do not "play in position" (Reynolds et al., 2002:277-278) similarly to schools in other countries across the world. Third, the practice of head teachers and Year 2 teachers is differentially effective. In six differentially effective schools, the practice connected with head teachers and Year 2 teachers differed with regards to the type of strategies that they employed. The over-arching conclusion for the current study, is that the differential effectiveness of local primary schools and Year 2 classrooms, for mathematics in Malta, is operated by a complex arrangement of factors. Factors such as the leadership role, as opposed to the headship role of head teachers and factors related to teacher and teaching. This overarching conclusion is consistent with more comprehensive (Creemers, 1994), dynamic (Kyriakides, Creemers & Antoniou) and with more dynamic understandings (Mujis & Reynolds, 2011) about teacher, school and educational effectiveness.

11.2.1 All Pupils are Able to Learn

All Maltese pupils are able to attain and progress mathematically, albeit at their own pace, if educational conditions are supportive of pupil attainment and pupil progress. This conclusion was drawn on the basis of results from multilevel analyses in Chapter 8 which examined the predictors of pupil attainment at age 6 (Table 8.3) and the predictors of pupil progress (Table 8.5). The model for attainment (age 6) explained 34.37% and the model for progress explained 43.36% of the variance. The pupil level accounts for the greatest proportion of the variance for pupil attainment (age 6) and pupil progress as respectively indicated in Table 11.1 and Table 11.2.

Table 11.1 *– Unexplained and Explained Variance for Attainment (Age 6)*

Unexplained variance	**Model 1 (pupil/ parent)**	**Model 2 (teacher/ classroom**	**Model 3 (teacher beliefs)**	**Model 4 (teacher behaviours)**	**Model 5 (head teacher/ school)**
School	30.87%	27.57%	13.19%	4.57%	1.74%
Class	3.00%	2.60%	5.75%	4.87%	4.13%
Pupil	66.12%	69.84%	81.06%	90.55%	94.13%
Explained	6.58%	11.52%	23.79%	31.79%	34.37%
School	+0.60%	+4.57%	+14.37%	+6.93%	+1.97%
Classroom	-0.19%	+0.50%	+2.08%	+1.06%	+0.60%
Pupil	+6.15%	-0.02%	+0.00%	+0.00%	-0.00%

Table 11.2 *– Unexplained and Explained Variance for Progress*

Unexplained variance	**Model 1 (pupil/ parent)**	**Model 2 (teacher/ classroom**	**Model 3 (teacher beliefs)**	**Model 4 (teacher behaviours)**	**Model 5 (head teacher/ school)**
School	34.16%	34.05%	20.98%	14.91%	7.95%
Class	2.79%	1.27%	3.30%	4.45%	2.43%
Pupil	63.04%	64.67%	75.71%	80.64%	89.61%
Explained	22.13%	25.34%	31.85%	36.03%	43.36%
School	+1.49%	+0.81%	+12.86%	+4.76%	+5.04%
Classroom	+0.32%	+2.30%	-1.23%	-0.59%	+1.46%
Pupil	+16.30%	+0.02%	+0.00%	+0.00%	+0.00%

The finding that the pupil level accounts for a greater proportion of the variance than the school or classroom level is generally in keeping with findings from similar studies (Campbell et al., 2004; de Jong, Westerhof & Kruiter, 2004; Mujis & Reynolds, 2003; Reezigt, Guldemond & Creemers, 1999). Results from the head teacher/school model in Model 5 of Table 11.1 show, that after adjusting for the contribution of factors at the pupil, classroom and school level, the classroom level contributes slightly more (2.34%) than the school level for pupil attainment (age 6). On the other hand, results from the head teacher/school model in Model 5 of Table 11.2 show the classroom level to contribute less than the school level for pupil progress.

Generally, the classroom level variance is greater than the school level variance after adjusting for factors at the pupil, classroom and school level (Kyriakides, 2005; Reezigt, Guldemond & Creemers, 1999). The possibility that in the model for progress the school level contributes more to the variance in pupil achievement than the classroom level is a consequence of technical issues such as the relatively small sample size, rather than systemic factors, cannot be ruled out. This unexpected finding may also be connected to the increased homogeneity, for example in pupil background, within Maltese primary schools. The current study did in fact elicit a predominance of pupils with parents from the middle occupational and educational categories. The effect of homogeneity may also be heightened because Malta is a small-island state. The possibility that societal, cultural and technical issues aggregate at the higher level of the school and mop-up effects at the lower level of the classroom is a real possibility. Further studies are required to examine whether the greater contribution of the school level over the classroom level is restricted only to the subject of mathematics, or whether, this is a regular feature of schooling in Malta.

11.2.1.1 Pupil Level Predictors of Pupil Attainment (Age 6) and Pupil Progress

Which pupil level characteristics predict pupil attainment (age 6) and pupil progress (in Malta)? Prior attainment (age 5) and pupil ability were identified as predictors of pupil attainment (age 6) and/or pupil progress. Father’s occupation and mother’s education were elicited as predictors of pupil attainment (age 6) but were not elicited as predictors of pupil progress. Sex, father’s/mother’s occupation, father’s/mother’s education, parental status, home district, first language, preschool, private lessons and the seating arrangement of individual children in class were not elicited as predictors of pupil progress. The importance of prior attainment (age 5) as a predictor of later attainment (age 6) is indicated by the considerable variance (16.45%) accounted for by this variable. Table 11.3, compares the pupil level predictors identified by the The Numeracy Survey (Mifsud et al., 2005) with counterpart characteristics in the current study

Table 11.3 *– Comparing Local Predictors of Pupil Attainment and Pupil Progress for Mathematics*

Pupil level (age-adjusted)	**The Numeracy Survey (Mifsud et al. 2005) – attainment at age 5**	**The current study – attainment at age 6**	**The current study – progress (age 5 to age 6)**
Prior attainment	na	na	***
Sex	ns	ns	ns
First language	**	ns	ns
Preschool	ns	ns	ns
Special needs/at risk	***	**	*
Father's occupation	***	*	ns
Father's education	***	ns	ns
Mother's occupation	ns	*	ns
Mother's education	*	*	ns
Family structure/parental status	***	ns	ns

na = not applicable, ns = not significant,

* significant at p < .05, ** significant at p < .01, *** significant at p < .001

In Table 11.3 above, the predictors identified by The Numeracy Survey as significant for pupil attainment (age 5) are not always keeping with the predictors identified by the current study as significant for pupil attainment (age 6) and pupil progress. This inconsistency may be partly due to differences in the design of The Numeracy Survey (which was a pupils in schools study) and the design of the current study (which is a pupils in classrooms in schools study).

In the current study, differences in pupil outcome depending on pupil ability are not only significant between typically-developing and at risk pupils but also between groups of at risk pupils. At risk pupils with statements supported by a learning support assistant and at risk pupils without statements supported by a complementary teacher progress significantly less than their typically-developing peers. On average, pupils with statements supported by a learning support assistant achieve three age-standardised marks less than typically-developing pupils (-3.700, s.e = 1.778, p <. 05). Pupils with learning difficulty supported by a complementary teacher achieve on average five age-standardised marks less than their typically-developing peers (-5.387, s.e = 0.962, p < .001).

Father's occupation as well as father's/mother's education were elicited as predictors of pupil attainment (age 6) but not of pupil progress. This indicates differences in the stability of effects associated with the pupil level predictors of pupil attainment and pupil progress (Table 11.4).

Table 11.4 *– Stability of Effect for Pupil Level Predictors*

Pupil level (variable/reference category)	**Attainment**	**Progress**	**Stability**
At risk (typically-developing pupils)			
Learning support assistant support	-.33***	-.31***	stable
Complementary teacher support	-.52***	-.48***	stable
Father's occupation (medium)			
High	.12*	ns	unstable
Low	ns	ns	stable
Mother's education (medium)			
High	.19*	ns	unstable
Low	-.16*	ns	unstable

[ns] means not significant, *p < .05, ***p < .001

Effect sizes in Table 11.4 confirm the negative and stable contribution associated with the educational vulnerability of at risk pupils. Differences in the size of effects between at risk pupils supported by a learning support assistant and at risk pupils supported by a complementary teacher suggest differences in the quality of learning support. Effect sizes in Table 11.4 also depict a mixed picture as to the stability in the influence of socio-economic characteristics. The effect of paternal occupation and maternal education is not stable across pupil attainment (age 6) and pupil progress. This strongly suggests that educational factors at the classroom and school level compensate for effects associated with differences in parental occupation and maternal education.

11.2.1.2 Classroom and School Level Predictors for Pupil Attainment (Age 6) and Pupil Progress

Which classroom and school level characteristics are predictors of pupil attainment (age 6) and pupil progress? Classroom and school level predictors of pupil attainment (age 6) and/or pupil progress include: curriculum coverage, teacher beliefs and teacher behaviours. The teacher/classroom, the teacher beliefs and the teacher behaviour models together in Tables 8.3 and 8.5 respectively account for 25.21% of the variance for pupil attainment (age 6) and 13.90% of the variance for pupil progress. This highlights the important contribution of teachers and teaching for pupil achievement. Curriculum coverage accounts for 4.84% of the variance for attainment (age 6) and 3.21% of the variance for progress. Teacher beliefs account for 12.27% of the variance for attainment (age 6) and 6.51% of the variance for progress. Teacher behaviours account for 8% of the variance for attainment (age 6) and 4.18% nce for progress. At the school level, the variable age of the head teacher accounts for 2.58% of the variance for attainment (age 6) and 7.33% of the variance for progress. As indicated in Table 11.5, the influence of characteristics at the classroom and school level were generally small and not necessarily positive or stable across attainment (age 6) and progress.

Table 11.5 *– Stability of Effect for Classroom and School Level Predictors*

Classroom level (characteristic/ item, reference category)	**Attainment**	**Progress**	**Stability**
Curriculum coverage (up to spring)			
Up to summer	.72***	.51***	stable
Teacher beliefs			
Pupils must be taught how to decode a word problem (11, agree)			
Disagree	ns	ns	stable
Do not know	.19*	.18*	stable
Pupils learn mathematics by working sums out on paper (42, agree)			
Disagree	-.24***	.10***	unstable
Do not know	ns	ns	unstable
Pupils do not need to be able to read/write/speak English well to learn mathematics (46, agree)			
Disagree	.10***	.10***	stable
Do not know	ns	ns	stable
Pupils may be taught any method as long as efficient (48, agree)			
Disagree	ns	-.10*	unstable
Do not know	ns	ns	stable
Teacher behaviours			
Engaging pupils in meaningful talk is the best way to teach mathematics (8, agree)			
Disagree	.10***	-.12***	unstable
Do not know	ns	ns	stable
Teachers must help pupils refine their problem-solving methods (35, agree)			
Disagree	-.41**	-.40**	stable
Do not know	ns	ns	stable
Offers assistance to pupils (20, frequently observed)			
Somewhat observed	ns	-.10*	unstable
Rarely observed	ns	-.28*	unstable

ns = not significant, *p < .05, **p < .01, ***p < .001

***Table 11.5** – Stability of Effect for Classroom and School Level Predictors (continued)*

Teacher behaviours (characteristic/ item, reference category)	**Attainment**	**Progress**	**Stability**
Probes further when responses are incorrect (28, frequently observed)			
Somewhat observed	ns	-.04**	unstable
Rarely observed	ns	-.09**	unstable
Uses appropriate wait-time between question/answer (32, frequently observed)			
Somewhat observed	ns	-.09*	unstable
Rarely observed	ns	-.21*	unstable
Notes pupils' mistakes (33, frequently observed)			
Somewhat observed	ns	-.12*	unstable
Rarely observed	ns	-.38*	unstable
Gives positive academic feedback (38, frequently observed)			
Somewhat observed	ns	-.23*	unstable
Rarely observed	ns	ns	stable
Uses a variety of explanations that differ in complexity (47, frequently observed)			
Somewhat observed	ns	-.19**	unstable
Rarely observed	ns	ns	stable
Displays pupils' work in the classroom (56, rarely observed)			
Somewhat observed	.24**	ns	unstable
Frequently observed	.38**	.33**	stable
Sees that disruptions are limited (5, rarely observed)			
Somewhat observed	ns	ns	stable
Frequently observed	.28**	.29**	stable

ns = not significant, *p < .05, **p < .01, ***p < .001

***Table 11.5** – Stability of Effect for Classroom and School Level Predictors (continued)*

Teacher behaviours (characteristic/ item, reference category)	**Attainment**	**Progress**	**Stability**
Takes care that tasks/materials are collected/distributed effectively (4, rarely observed)			
Somewhat observed	ns	ns	stable
Frequently observed	ns	.31**	unstable
Prepares an inviting and cheerful classroom (57, frequently observed)			
Somewhat observed	-.27**	ns	unstable
Rarely observed	-.18**	ns	unstable
Uses a reward system to manage pupil behaviour (6, frequently observed)			
Somewhat observed	-.10*	ns	unstable
Rarely observed	-.08*	ns	unstable
School level			
Age of head teacher (55 to 61 years)			
35 to 44 years	.58**	.64**	stable
45 to 54 years	.26**	.28**	stable

ns = not significant, *p < .05, **p < .01, ***p < .001

The positive effect associated with younger head teachers was found to be stable for pupil attainment (age 6) and for pupil progress. The significant and positive influence of increased curricular coverage was medium-sized and stable in influence for attainment (age 6) and for progress. This implies that in Malta, Year 2 teachers who cover an increased number of ABACUS topics are associated with increased rates of pupil progress. This indicates that “a guaranteed and viable curriculum” (Marzano, 2003:15) is also important, as elsewhere, for effective schools in Malta for mathematics.

The effects of teacher beliefs and teacher behaviours are generally small and not necessarily stable in direction. For example, the effect of teachers disagreeing with the belief that: “pupils learn mathematics by working sums out on paper” (item 42) exerted a negative influence for pupil attainment (age 6). However, this same belief exerted a positive influence for pupil progress. Therefore, beliefs influential for attainment are not necessarily the same as beliefs influential for progress. The finding that teacher beliefs are directly influential for pupil attainment (age 6) and pupil progress goes counter to the findings by Mujis and Reynolds (2002). The finding by the current study implies that whilst teacher beliefs might appear as less proximal to pupils, because these are mediated by other teaching processes such as teacher behaviours, the influence of some beliefs can effect pupil achievement in non-latent ways. The direct association elicited between pupil achievement and teacher beliefs in the current study is in line with the argument held by Campbell et al. (2004) that quality of teacher practice also depends on less observable processes such as teacher beliefs. The mix in the stability of effects associated with the influence of curriculum coverage, teacher beliefs and teacher behaviours indicates that the implementation of frequent effective teaching characteristics alone in a regular and consistent manner does not guarantee effectiveness. For example, even if teachers adopt and implement teaching behaviours that are likely to enhance pupil learning, regularly in and over time, this may not have the desired effects over time for progress as they do in time for attainment. This suggests that educational effectiveness in Malta is operated by a complex and dynamic mix of organisational and instructional influences (Kyriakides, Creemers & Antoniou, 2009) that extend beyond the behavioural (Campbell et al., 2004).

11.2.2 Schools are Differentially Effective

The Chapter 9 findings revealed considerable differences associated with characteristics such as curriculum coverage, teacher beliefs and teacher behaviours across differentially effective schools. In effective schools, pupils (typically-developing and at risk) progressed more than they normally would on the basis of their prior attainment outcomes. Conversely, in ineffective primary schools in Malta pupils progressed at significantly decreased rates. Average schools did not significantly influence pupil learning for mathematics to an extent that pupils exceeded their “normal” rate of development. Table 11.6 describes how head teacher and Year 2 teacher characteristics play together in slightly diverse configurations in effective, average and ineffective schools.

***Table 11.6** – Characteristics of Effective, Average and Ineffective Schools*

Head teacher/school (item)	**Effective**	**Average**	**Ineffective**
Age of head teacher	Younger	Older	Older
Learning support resources	More available	More available	Less available
Teacher/classroom			
Curriculum - teachers cover an average of…	58 (93.65%) topics.	49 (77.77%) topics	42 (66.67%) topics
Teacher beliefs			
Pupils must be taught how to decode a word problem	Most (60%) teachers agree.	Most (64.52%) teachers agree.	Most (83.33%) teachers agree.
Pupils learn mathematics by working sums out on paper (42)	Less (40%) teachers agree.	Less (33.87%) teachers agree.	Half of teachers agree.
Pupils do not need to: be able to read, write, speak English well to learn mathematics (46).	Less (40%) teachers agree.	More teachers agree (61.29%)	More (75%) of teachers agree.
Engaging pupils in meaningful talk is the best way to teach mathematics (8)	Most (80%) teachers agree.	Most (67.74%) teachers agree.	Most (83.33%) teachers agree.
Teachers must help pupils refine their problem-solving methods (35).	Most (93.33%) teachers agree.	Most (75.81%) teachers agree.	All teachers agree.
Offers assistance to pupils (20)	Most frequently	Less frequently	More frequently
Probes further when responses are incorrect (28)	More frequently	Most frequently	Less frequently
Uses appropriate wait-time between question and answer (32).	Most frequently	Less frequently	More frequently
Notes pupils' mistakes (14).	Most frequently	Less frequently	More frequently

Table 11.6 **–** *Characteristics of Effective, Average and Ineffective Schools (continued)*

Teacher behaviours (item)	**Effective**	**Average**	**Ineffective**
Gives positive academic feedback (38)	Most frequently	Less frequently	More frequently
Displays pupils' work in the classroom (56).	Most frequently	Less frequently	More frequently
Sees that disruptions are limited (5).	Most frequently	Less frequently	More frequently
Takes care that tasks and materials are collected and distributed effectively (4).	Most frequently	Less frequently	More frequently

11.2.3 Practice is Differentially Effective

The insights gained by the current study indicate that head teachers are central to the quality of organisational conditions at school which support, or mitigate, against effectiveness. Chapter 10 elaborated six case studies that illustrated the strategies connected with head teacher and Year 2 teacher practice in three typical schools (effective, average and ineffective) and in three atypical schools (effective, average and ineffective). Just as teacher practice and associated teacher activity is central to quality teaching in classrooms, head teacher practice is central in directing and influencing the quality of school conditions for the organisation of teaching and learning (Leithwood, 2003). To highlight the key role that head teachers play in schools, Table 11.6 compares head teacher strategies in the six differentially effective case study schools.

***Table 11.7** – Head Teacher Strategies in Six Differentially Effective Schools*

Head teacher monitors teachers	**Trinidad**	**Ecuador**	**Honduras**	**Venezuela**	**Colombia**	**Mauritius**
frequently	x					
regularly		x		x	x	
not at all			x			x
Head teacher delgates duties						
to assistant head teacher/s	x	x	x	x	x	x
according to staff interest	x					
Head teacher involves staff						
organizes teachers to plan/prepare together	x					
asks teachers to plan/prepare together		x		x	x	
does not expect teachers to plan/prepare together			x			x
Head teacher selects/replaces staff						
involved	x					
not involved		x	x	x	x	x
Head teacher tables time						
controls timetable	x					
aware of timetable but allows teachers to manage it		x		x	x	
gives teachers complete control over the timetable			x			x
Head teacher expectations						
has high expectations for parents/pupils	x					
has appropriate expectations for parents/pupils		x		x	x	x
has low expectations for parents/pupils			x			
Head teacher goals						
works with teachers towards academic goals	x					
aware that teachers need academic goals		x	x	x	x	x
Head teacher and an orderly environment						
implements rules positively	x	x		x	x	x
implements rules negatively			x			
Head teacher vision						
establishes common vision	x					
is not focused in establishing common vision		x	x	x	x	x
Head teacher and collegiality						
leads for collegiality	x					
models good relations		x				
maintains status quo amongst staff			x	x	x	x
Head teacher and parental involvement						
available to parents	x	x	x	x	x	x
facilitates parents meeting with educational staff	x	x				
Does not make parents feel welcome			x			

Key: Trinidad (typical effective), Ecuador (typical average), Honduras (typical ineffective), Venezuela (atypical effective), Colombia (atypical average) Mauritius (atypical ineffective).

The strategies of the head teacher of Trinidad (typical effective) are more consistent with the practice of head teacher leaders. In line with Hallinger's (2005) description of head teacher leaders, the head teacher of Trinidad is as an instructional leader who shapes a common academic vision and a positive school climate that is focused on teaching for pupil learning. On the other hand, the strategies implemented by head teachers in Honduras (typical ineffective), Venezuela (atypical effective), Colombia (atypical average) and Mauritius (atypical ineffective) are more consistent with the practice of head teachers who are fulfilling a headship role. Interestingly, the strategies implemented by the head teacher in Ecuador (typical average) are more consistent with the strategies implemented by the head teacher of Trinidad (typical effective). However, the head teacher in Ecuador is not as successful as the head teacher in Trinidad in securing conditions supportive of an effective school. This is possibly due to the decreased frequency in leadership strategies implemented by the head teacher of Ecuador.

Head teacher practice influences schools in ways that are positive, or negative, for quality teaching via the school structures and cultures (Hallinger, 2005). Similarly, teacher practice influences classrooms in ways that are positive, or negative, for pupil progress via the a positive and academic classroom climate. Generally, Year 2 teachers in effective classrooms exhibited a wider repertoire of strategies than Year 2 teachers in ineffective classrooms. Teachers in effective classrooms implemented strategies in qualitatively diverse ways than teachers in ineffective classrooms. For example, they were more successful in: limiting disruption (even from senior members of staff), probing pupils through questioning (for the purpose of providing feedback), varying the amount of wait-time (allocated to pupils in respect of individual learning differences) and in using richer language during probing.

11.2.4 The Alignment of School and Classroom Practice Influences the Character of Educational Effectiveness

Multilevel analyses in Chapter 8 revealed that no one characteristic at the pupil, classroom and school level determines pupil progress. The Chapter 9 findings also revealed that a complex mix of relatively small differences in curriculum coverage, teacher beliefs, teacher behaviours and age of head teachers come together in slightly diverse ways in differentially effective schools. Therefore, even within the Maltese context, educational effectiveness is not determined by factors limited to the classroom or the school level alone, which is consistent with the argument forwarded by Kyriakides, Campbell and Gagatsis (2000:504):

> pupil achievement should not be considered as either an accomplishment of classroom factors only (as in many studies on teacher behaviour) or of school factors only (as in many studies of school policies) but it should be considered as an outcome of both levels.

Insights emerging from Chapter 10 trace a plausible mechanism as to how the character of effectiveness in six differentially effective schools may be shaped by the alignment of strategies connected with head teacher and Year 2 teacher practice. For example, conditions in typically effective schools exhibit a greater degree of positively-oriented organisational and instructional cohesion than conditions in typically ineffective schools. This cohesion is reflected by head teacher strategies that are influential and positive for pupil outcome (Leithwood, 2003), school conditions that are positive for the improved co-ordination of the curriculum (Marzano, 2003) and conditions that are positive for teaching quality (Townsend, 2007). The quantity and the quality of head teacher strategies also appear to be connected with the character of effectiveness in schools. For example, the head teacher in Trinidad (typical effective) monitors teachers, delegates duties, involves staff, gets involved in the selection and the replacement of staff, controls the timetable, holds appropriately high expectations for teachers and pupils, sets academic goals, sustains and shares a common positive school vision, encourages collegiality and parental involvement more frequently than other head teachers.

In sharp contrast, the head teacher in Honduras (typical ineffective) does not: monitor teachers, delegate duties, involve staff, select/replace staff, control the timetable, hold high expectations, set academic goals, share a positive school vision, encourage collegiality and parental involvement. The main difference in the strategies associated with the three head teachers in Venezuela (atypical effective), Colombia (atypical average) and Mauritius (atypical ineffective) (effective, average and ineffective) is a mis-match between what head teachers believe and what head teachers implement. For example, each of the three head teachers thought collegiality to be high amongst teaching staff. However, this view was not shared amongst Year 2 teachers. This suggests that the occurrence, or absence, of certain aspects of head teacher practice is influential for school and educational effectiveness. This also suggests that the quantity and quality of head teacher strategies coupled with the quantity and quality of teacher strategies serve to shape the more even, or the uneven spread, of effectiveness in schools. This implies that just as pupil achievement is an accomplishment of factors at the school and at the classroom level (Kyriakides, Creemers & Gagatsis, 2000), educational effectiveness is an accomplishment of factors affiliated with head teacher and teacher practice and connected with the systemic arrangement of education, leadership, teaching and instruction in schools. Differences in the extent and spread of effectiveness across and within schools also suggests that in Malta educational effectiveness is operated by a more complex and dynamic interplay of school and classroom level factors (Kyriakides, Creemers & Antoniou, 2009).

11.2.5 Do Maltese Schools Play in Position?

In Chapter 7, it was discussed how Maltese schools do not appear to: “play in position...with lower-social-class schools getting lower initial mathematics’ achievement scores than middle-social-class schools, and less effective schools getting lower scores than typical or more effective schools” (Reynolds et al., 2002:277-278). However, this assertion was made with regards to the simple gain in scores achieved by pupils in schools between age 5 and age 6. Following results from multilevel analyses, the Chapter 9 findings continued to show that Maltese primary schools do not “play in position” similarly to schools in other westernised educational systems. Although local primary schools are differentially effective, the prior attainment (age 5) outcomes of pupils in effective and in ineffective schools only varied by 2.71 marks. Keeping in mind that one standard deviation, for pupil progress, approximates 14 marks, this implies that differences between the prior attainment (age 5) outcomes of Maltese pupils are rather narrow. However, by age 6 the attainment gap between pupils in effective schools and pupils in ineffective schools had widened to 14.83 marks. The narrow gap in the age 5 attainment outcomes, of 2.71 marks, between pupils in effective schools and in ineffective schools may suggest that schools begin to make a difference at Year 2. However, whilst the findings of the current study are suggestive of this, clearly further research is required to examine whether this is a one-off occurrence or whether this is a “real” outcome of the local educational situation.

In view of the importance of socio-economic factors (Dumay & Dupres, 2008; Sammons et al., 2009; Strand, 2007) and socio-compositional factors (Gorard, 2006; Thrupp, 2008) for pupil achievement, the lack of a significant direct association between socio-economic factors and pupil progress does not exclude the possibility that such factors are still important for pupil progress and therefore “play in position” in yet undiscovered and/or in more complex and indirect ways. At face value, a difference of 2.71 marks between the prior attainment (age 5) outcomes of Year 2 pupils in effective and in ineffective schools suggests the “equalisation of the family resource…so reducing the link between origin and opportunity for all individuals” (Gorard, 2010:1). The narrowing of the effects of the “socio-economic gap” appears to be at play in Maltese primary schools. Earlier percentage figures in Table 9.1 revealed that generally the proportion of fathers in the low, medium and high occupational categories and the proportion of mothers in the low, medium and high educational categories are relatively similar in effective, average and ineffective schools. .

Gorard, See and Shaheen (2009) argue that schools are not immune to patterning by family origin. In Malta, pupils from the middle social category predominate in most schools. Therefore, few schools are predominantly composed of children from the low or the high social categories. This implies that socio-compositional factors in schools “pull” classroom and school environments towards the local social middle. Therefore, differences in socio-economic background may not be sufficient enough to achieve significance. However, by the end of their second year in primary school, pupils in effective schools had progressed significantly more than pupils in average schools. Similarly, pupils in average schools had progressed significantly more than pupils in ineffective schools. Yet, the socio-economic composition of pupils in effective schools was generally similar to the socio-economic composition of pupils in average schools and to the socio-economic composition of pupils in ineffective schools. This too implies that socio-economic patterning in Malta may not be as accentuated as in other European countries (perhaps due to a variety of political and socio-cultural reasons). It is also possible, that socio-compositional effects become more evident across schools, depending on their effectiveness, over time. Reasons for the apparent invisible influence of the effects of socio-compositional factors in Malta may also be attributable to the finding that in more homogenous systems or in societies in which parents have little real options such effects may go undetected (Harker, 2004; Teddlie & Reynolds, 2000). It is also understandable that in a small-island state such as Malta, with an economy that is not considered to be of scale, socio-economic effects become manifest in diverse ways than what usually occurs in larger Westernised countries. The less visible effects of socio-economic factors are possibly spin-offs of government policy adopted between 1971 and 1982 by the then Labour prime-minister Dom Mintoff. Even today, differences in declared income between minimum and maximum wage earners do not generally exceed a 1,000 euros per month. A strong black market economy and the role of the extended Maltese family are also considered to cushion the effects of socio-economic disadvantage (Boissevain & Selwyn, 2009).

11.2.6 Is Head Teacher Age a Stand-In Variable?

In the school level models for pupil attainment at age 6 (Table 8.3) and for pupil progress (Table 8.5), age of the head teacher was elicited as a predictor of pupil attainment (age 6) and pupil progress. Research generally shows that teacher attributes do not usually influence pupil achievement directly (Borich, 1996) and one would have expected that the age of the head teacher would exert a similar effect. A plausible reason affiliated with this unexpected occurrence is possibly related to the fact that the examination of the association between pupil achievement and head teacher activity/practice is usually concerned with the effect of the leadership roles that head teachers adopt rather than on the influence of head teacher attributes. The relationship between the age of the head teacher and effectiveness is linear and this pattern is particularly noticeable in the three typical case study schools. In Trinidad (typical effective), the head teacher was between 35 to 44 years. In Ecuador (typical average), the head teacher was between 45 to 54 years. In Honduras (typical ineffective), the head teacher was between 55 to 61 years.

Earlier in section 11.2.3, the positive effect of head teacher practice in Trinidad (typical effective) was connected with the increased frequency of strategies positive for teaching and learning. On the other hand, the head teacher of Honduras (typical ineffective) frequently implemented strategies but not in ways that were generally positive for teaching and learning. For example, the head teacher of Honduras did not consider it appropriate to: monitor teachers, delegate duties to teachers, see that teachers meet to plan/prepare together, control the timetable, hold high expectations of pupils and parents, highlight academic goals, implement rules using positive ,rather than, negative approaches, establish a common vision for the school and did not consider it appropriate to involve parents. This introduces the possibility that age might be a stand-in variable, or a mediating characteristic, for other head teacher factors such as attitudes, values, beliefs and/or leadership skills.

11.2.7 Why Does Time Not Make a Difference?

Pupils have individual learning needs and require different amounts of time for learning (Carroll, 1963). Opportunity for pupils to learn may be improved, or hindered, by conditions in classrooms and schools (Creemers, 1994). Rather surprisingly, classroom and school time dedicated to the teaching (and learning) of mathematics was not elicited as a predictor of pupil attainment (age 6) or pupil progress. Earlier in Tables 6.20 and 7.6 two important points that referred to the amount of time and to the type of time were discussed. First and in spite of a longer school day for both typically-developing and at risk pupils in state schools, pupils in state schools have less time available to learn mathematics than their private school counterparts. Second and with the exception of pupils experiencing difficulty with learning mathematics, at risk pupils in private schools get to spend more time in the classroom than typically-developing and at risk pupils with statements in private schools. Also and due to a school policy that does not allow learning support assistants to speak during lesson explanations the quality of time obtained by at risk pupils in private schools appears as more similar to the quality of time obtained by typically-developing pupils in private schools. In spite of these noteworthy differences, time does not appear to directly effect pupil progress. This does not however rule out the possibility that time influences the effectiveness of schools and classrooms in other ways. This highlights the need for local research to further examine the nature of influences that refer to the quantity and quality of time made available for teaching as well as for learning within schools and classrooms across the private and the state school sectors and for different groups of pupils. In particular, local research should consider the quality of interaction that occurs in a direct pedagogical role between learning support staff and at risk pupils (Blatchford et al., 2009).

11.3 Limitations of the Current Study and Pathways for Future Research

Earlier in section 2.5 which discussed criticism levied towards school and educational effectiveness research by critics such as Gorard (2010a & b, 2011), the author of the current study concluded, on the basis of responses such as that offered by Reynolds at al. (2012) to critics, that acknowledging the limitations of school and educational effectiveness research serves as a spring-board for the conducting of future studies. Any act of research is not without its limitations and the current study is no exception. Therefore, acknowledging the limitations of the current study serves as a "launching-pad" for ideas regarding the conducting of future research studies in Malta. At the pupil level of the current study, the examination of pupils' attainment and pupils' progress outcomes was restricted to one year and for the subject of mathematics; which is associated with pupils' cognitive domain. In the current study, pupil motivation and aptitude were not considered as predictors of pupil attainment or pupil progress. At the classroom level, the examination of predictors and their effects was mainly focused on the instructional aspect of teaching. Moreover, only one instrument MECORS was used to collate data about Year 2 teachers' behaviours Also at the classroom level, teacher beliefs about teaching and learning were surveyed once during one scholastic year At the school level, variables hypothesised to predict pupil attainment and pupil progress were limited to the examination of contextual characteristics such as the size of the school and the age of the head teacher.

The above mentioned limitations of the current study point the way for a number of research improvements regarding future studies that might be conducted in Malta following the current study. At the pupil level, local research needs to focus on examining the longer-in-term patterns of pupil attainment and pupil progress over far longer periods in time than what was conducted by the current study. Local research also needs to focus on conducting studies that evaluate the affective (Cefai et al., 2011), psychomotor (Kyriakides & Tsangaridou, 2008) and new learning outcomes (Kyriakides, Creemers & Antoniou, 2009) that are becoming increasingly associated with diverse concepts as to what constitutes learning.

At the classroom level, local research needs to focus on examining the longer-in-term patterns of teacher performance, teaching quality and the operators of effectiveness at the classroom level such as those relating to the frequency, stability and consistency of teacher beliefs and teacher behaviours. Local research also needs to focus on evaluating teacher performance beyond teachers' cognitive domain. For example, with regards to teachers' affective domain (Cheng & Tsui, 1996). Local researchers also need to validate classroom observation instruments other than MECORS, such as QAIT (Schaffer et al., 1998) and more recent instruments for the observation of teachers such as the Quality of Teaching (QoT) by van de Grift et al., 2004) and the International System for Teacher Observation and Feedback (ISTOF) scale (Teddlie et al., 2006). This would allow local academics to increase the classroom observation instruments available to local researchers and to compare the construct validity of international instruments as this applies abroad and in Malta.

At the school level, local research needs to focus on examining the longer-in-term patterns of head teacher performance and head teachers' leadership activity and practice (Sammons, Day & Ko, 2010) and to quantify and qualify the direct and latent effects of school leadership and changes in leadership conditions in relation to pupils' attainment and pupils' progress outcomes (Day et al., 2009). Future studies also need to monitor and track the direct and the latent effects of socio-economic and socio-compositional factors for pupil attainment and pupil progress, at the individual level of the pupil and at the group level of the classroom and of the school, so as to better measure and evaluate whether the effects of schooling and education in Malta are sufficiently influential to compensate for differences in pupils' socio-economic backgrounds across different subject areas and over longer periods in time.

The above mentioned recommendations for future research studies in Malta call for larger-in-scale and more complex studies that utilise mixed methods as a third pragmatic approach (Greene & Garacelli, 1997) and which allow the analysis of data in multiple, embedded, linear and non-linear ways to enable richer and more synergistic (Day, Sammons & Gu, 2009) and meta-inferential (Tashakkori & Creswell, 2007) forms of understanding about educational effectiveness. The above recommendations for future studies also requires a shift away from a simpler concept of effectiveness in terms of school improvement towards a more complex concept of effectiveness in terms of educational improvement (Armstrong et al., 2012).

11.4 Tracking the Achievement Outcomes of Maltese Pupils and the Effectiveness of Primary Schools and Classrooms

Educational conditions at the school and at the classroom level are dependent on conditions at the policy level (Kyriakides, Creemers & Antoniou, 2009). The current study recommends that the effect of policy decisions taken at the supra level of the educational hierarchy are monitored, evaluated and reviewed in terms of the associated effects for pupil attainment and pupil progress. Local policy-makers also need to be more clear as to their intentions connected with the policies that they put into place For example, the removal of streaming from secondary schools which led to the introduction of a benchmarking system regarding the outcomes achieved by pupils in different schools at age 11 (Year 6) in September of 2011 was not framed by a broader discussion regarding the values and the introduction of a standards-based approach.

The current study considers it important to compare the achievement outcomes of pupils across schools. The current study also considers it vital that this is conducted in ways that are respectful towards head teachers and teachers. The tracking of pupils' attainment outcomes should be conducted with the aim of monitoring the longer-in-term patterns of pupil progress. Moreover, records of pupil achievement in and over time should not be primarily intended to compare the performance of educational professionals across and within schools but to provide educational professionals with the feedback and training to help them improve their practice. Not all educational activity and practice in schools and in classrooms is equally effective because not all head teachers and teachers have the potential to adopt and implement similarly effective strategies as part of their practice. Therefore, the current study recommends that detailed records relating to head teacher and teacher strategies are kept to offer head teachers and teachers constructive feedback for their professional improvement. Educational professionals should then utilize feedback given to themselves and to their colleagues to collectively get together and improve the community of practice within schools. Therefore, the current study recommends the creation of a national system to monitor, evaluate and review the policy, leadership, organisational, instructional and pedagogical ways in which the different tiers of educational professionals and associated support staff promote quality in the adoption and implementation of diverse educational processes.

11.4.1 Summative and Formative Modes of Ongoing Pupil Assessment

All pupils have the potential to learn but not much is known about the "what", "why" and "how" of the educational factors and characteristics associated with the attainment and progress outcomes of young Maltese pupils. During the last five years primary schools have had to keep logs regarding the average attainment outcomes of pupils as records of school performance. However, the longer-in-terms patterns of pupils' progress outcomes are not monitored in a rigorous, systematic and an age-standardised manner. Therefore, the current study recommends that pupils are tested annually to measure pupil progress and that records of pupils' work are regularly maintained to qualify pupil progress. The testing of pupils is premised on a standards driven concept of accountability. Test-based accountability is highly contentious in Westernised educational systems (Sahlberg, 2010) and promises to be just as controversial in Malta. The position adopted by the current study is that the tracking of pupil attainment and pupil progress, across subjects and learning domains, is necessary, but not as the sole measure of pupil achievement. Hence, it is essential that summative and formative modes of assessment monitor pupils' achievement outcomes in and over time.

In line with the findings of The Numeracy Survey (Mifsud et al., 2005), the current study elicited significant differences in pupil attainment at age 5 and at age 6. Similarly to the findings of the Literacy for School Improvement study (Mifsud et al., 2004) the current study also elicited significant differences in pupils' progress outcomes for mathematics from age 5 (Year 1) to age 6 (Year 2). Younger pupils were also found to be significantly disadvantaged in comparison with older pupils. In the UK, Crawford, Dearden and Meghir (2007) had recommended that education authorities age-standardise test results. Close to 20 years ago Borg and Falzon (1995) had recommended that Maltese children enter school on their birthday rather than during their year of birth. Therefore, the current study recommends that Maltese children enter school and then advance from one year group to the next on their birthday. In line with the recommendations by Crawford, Dearden and Meghir (2007) the current study also recommends that outcomes achieved by pupils on examinations are age-standardised from very early on at primary school and that progression during primary, secondary and sixth form/vocational college is conducted on the basis of pupils'/students' age-standardised scores.

In Malta, the introduction of baseline assessment has gone far beyond its sell-by date. Baseline assessment tracks the attainment outcomes at the start of pupils' school careers. Baseline assessment supports the identification and the monitoring of pupils likely to be at risk of experiencing learning delay. Annual national age-standardised assessments are required to monitor the attainment and progress outcomes of different groups of pupils. The systemic implementation of baseline assessment would also complement the benchmark system of assessing the attainment of pupils aged 11 (Year 6) that has been in place since 2011. Baseline assessment should also facilitate the development of "multiple at risk indices of disadvantage" as in The Effective Provision of Preschool Education Project (Sylva et al. 2004) by examining and indentifying the local-specific educational factors and characteristics that place some young children at risk of experiencing delay in learning.

Whilst summative assessment monitors pupil attainment and tracks subsequent pupil progress, formative assessment illustrates pupil achievement. Insights gained from formative modes of assessment illuminate the practice of teachers particularly with regards to the individual curricular and instructional adjustments that teachers need to conduct. Formative assessment also clarifies the connection between implicit and explicit forms of knowledge about teaching and learning (Nonaka & Takeuchi, 1995) and therefore serves to improve collaboration amongst teachers. Formative assessment implies that teachers are familiar with approaches likely to improve their practice and advance pupil learning. Wiliam (2009:11) argues that the shortest cycles of hourly and daily assessments, that are formative in nature, bear the greatest impact on pupil achievement:

> if students leave the classroom before teachers have used information about their students' achievements to adjust to their teaching, the teachers are already playing catch-up. If the teachers have not made adjustments by the time the students arrive the next day, it is probably too late.

Informal modes of minute-by-minute assessment require teachers to establish a reflective self-feedback loop fuelled through constant questioning and planning/preparation but are not easy to record. These are nonetheless required so that Maltese teachers are empowered through their own practice to engage more meaningfully with the learning potential of individual pupils in classrooms.

11.4.2 Finding Time for Teaching and Learning

Time spent on task was not identified as a predictor of pupil attainment (age 6) or pupil progress. Perhaps because there may not be enough school and classroom time for time to exert a significant effect. In view of this, the current study recommends that the school day and the school year are lengthened so that teachers have sufficient time to deliver "a numeracy hour", rather than the average 45 minutes, and to purposefully engage pupils in processes that are beneficial for learning. Should the school day be lengthened, the effects of such policy, need to be monitored in an ongoing and systematic fashion particularly in relation to its impact on educational areas such as curriculum coverage in terms of topic breadth and more importantly topic depth. The lengthening of the school day and year is probably currently unacceptable to unions, which implies that additional time needs to be organised for in diverse ways such as by alternating between morning and afternoon teams of teachers. The lengthening of the school day should also serve to promote subjects that are currently neglected such as physical education, history, geography, art and music and should encourage primary school teachers to redirect focus onto the basic skills of reading, writing and number.

More time for learning and better quality time also needs to be made available for at risk pupils. The recommendation here is that such pupils are allowed, as much as possible, to follow lessons as delivered by the class teacher. In this way, the class teacher should have increased opportunity to engage different groups of pupils in differentiated, direct and interactive ways during lessons. Some pupils with statements will require classroom-based support from a learning support assistant. However, this support should be preferably given when this is needed more by pupils such as during seat-work. During this stage in the lesson, learning support assistants should have more time to interact with their charges in more meaningful ways. Pupils with learning difficulty also require additional amounts of time to learn the same skills and knowledge than typically-developing pupils. The current system of out-of-classroom support decreases the amount of time for learning mathematics in the classroom. In view of this, the current recommends that pupils with learning difficulty should be supported when they are not attending to lessons delivered by the class teacher. Head teachers and teachers need to reassess the deployment of support staff and the impact and influence that support staff exert on teaching conditions and pupil achievement (Blatchford, Russell & Webster, 2012) with the aim of maximising the contribution of learning support staff (Russell, Webster & Blatchford, 2013) and their effectiveness.

11.4.3 Investing in Leadership

All head teachers and teachers have the potential to lead, yet not all are empowered to do so. Given that leadership is a key characteristic of effective schools, the current study recommends that local policy needs to invest in cultivating a culture that fosters head teacher as well as teacher leadership based on the value of professional accountability. Professional accountability largely depends on an internalized obligation, reinforced by intrinsic factors such a personal sense of remorse as to the meeting of a social obligation. Therefore, the current study recommends that the policy level as represented by the Minister for Education and the Directors of Education hold themselves, college principals, head teachers and teachers accountable for pupil learning as indicated by the shorter-in-term and the longer-in-term patterns of pupil achievement.

Reynolds et al. (2002) discovered that differences between effective and ineffective schools across different educational systems are either associated with the quality of the head teachers and/or to relational factors, as in the UK, or with the implementation of curricula and organizational structures as in the Pacific Rim. Therefore, the current study recommends the establishing of policy that empowers head teachers and teachers to lead in ways that focus on developing and improving the organisational and the instructional structures within their school. The current study also recommends that any effects of any implemented policy need to be monitored with regards to the associated positive, inconsequential or negative effects for pupil attainment and for pupil progress. In tandem to this, head teachers and teachers need to be supported to review their own activity/practice and that of their colleagues. For examples as reflected by head teachers' leadership or headship strategies or by the teaching orientations prevalent their school.

In Malta, the core tasks for head teachers and teachers to develop as leaders are not defined. Therefore, policies to define the roles, responsibilities and tasks required of head teacher and teacher leaders need to be put in place so that smoother and tighter links between educational policy and educational practice foster conditions that facilitate the development of effective educational environments and the ongoing improvement of education. Policies that devolve power to head teachers are required so that head teachers are empowered to embrace further their professional autonomy. Policies that expect head teachers to: regularly monitor teachers and the quality of teachers' delivered lessons, regularly involve head teachers in the selection and replacement of staff, establish and maintain control on the amount of time dedicated to teaching and learning and in respect of the curriculum, hold appropriately high expectations for pupils and teachers, set academic goals and to establish an orderly and collegial school environment that is welcoming to parents are required. This should go some way in supporting head teachers to develop increased awareness as to the leadership tasks required of them. The processes involved should also guide the establishing and sustaining of a collegial and a collaborative goal-oriented environment within local schools. Emphasis should also be placed on the instilling of an educational culture whereby head teachers guide teachers to adopt roles that extend beyond their instructional role within the classroom.

An important characteristic of teacher leaders is their willingness to take on board responsibilities that go beyond their immediate classroom duties. Teacher leadership is important because "teachers tend to replicate the culture and pedagogy of their personal experiences at school when they themselves were students" (Stigler & Hiebert, 1999:83). In this way, teacher leaders counter-act the potentially negative effect of their experiences rooted in a past time when they themselves were pupils at school. The current study also recommends that policies need to instill a school culture that empowers teachers to act as leaders and that encourages teachers to: achieve curricular goals, coordinate the planning/preparation of academic material, establish a school repository for materials and resources, model examples of better practice to colleagues, and to encourage other teachers to adopt the role of mentor.

Conclusion

The current study is the first local pupils in classrooms in school study to adopt mixed methods to: identify the predictors of pupil progress, classify the differential effectiveness of schools and illustrate the practice of head teachers and Year 2 teachers in six differentially effective schools for mathematics. Generally, the overall findings and conclusions of the current study are consistent with the findings by Reynolds et al. (2002:279) that show that:

> ...many factors that make for good schools are conceptually quite similar in countries that have widely different, cultural, social and economic contexts. The factors hold true at school level, but the detail of how school level concepts play out within countries is different between countries. At the classroom level, the powerful elements of expectation, management, clarity and instructional quality transcend culture.

In spite of the many similarities regarding the broader factors elicited by the current study to those elicited by international research, there remain many blind-spots as to the "what", "why" and "how" the factors and characteristics of educational effectiveness play out in local schools. Hopefully, this study offers local academics and researchers a template to stimulate local-specific research in this key area of educational inquiry.

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APPENDICES TO CHAPTER 5

Appendix 5.1 – Guidelines for Researcher Conduct

Dear ___________________,

Please take note of the following guidelines when visiting schools for the purposes of conducting MIPS research:

General Guidelines

1. Always go to school smartly dressed;
2. Always be courteous to all members of staff, and pupils. Please remember that schools and teachers are hosting **us** within the school premises;
3. Do not park your cars within the school premises. There are times when you may not be able to leave immediately. Also remember that these places are usually reserved for members of staff; and,
4. At the end of your visit say goodbye to the pupils, teacher and the head teacher.

Specific Guidelines for Researchers Administering MECORS

1. Please give the head-teachers broad guidelines of when you will be visiting the school but **do not** give a specific date (this only applies for classroom observation visits);
2. Get information about the school timetable and when lessons of mathematics are scheduled for delivery. Also of any activities happening inside and outside the school for the period you intend to conduct your visit;
3. Always be at school by 8:15 a.m, latest, unless otherwise indicated by the head teacher or the person in charge;
4. Always introduce yourself first to the head teacher and then to the Year 2 teachers;
5. When you are visiting the class always introduce yourself personally to the teacher and to the pupils. Ask the teacher where you may be seated. Remind the teacher that s/he will be provided with a copy of the notes taken during the observation and that a copy will be supplied, only to him/her, at the end of the data collation exercise.

Appendix 5.1 – Guidelines for Researcher Conduct (continued)

Specific Guidelines for Researchers Administering Maths 6, The Survey Questionnaires and the Parental Consent Forms

1. Take the survey questionnaires and the parental consent forms a week to ten days before the date set for the administration of the Maths 6 test;
2. Give these to the head teacher or the person in charge. At this point take the opportunity to confirm with the head teacher the specific dates of when you will be administering the test to the Year 2 pupils;
3. Inform the head teacher or the person in charge that you will collect these yourself on the first day of Maths 6 testing;
4. Get information about any activities happening inside and outside the school for the days scheduled for the test administration;
5. Always be at school towards 8:00 a.m unless otherwise indicated by the head teacher or the person in charge;
6. Always notify the head teacher or the person in charge of your presence in the school;
7. Collect the parental consent forms and the head teacher and the teacher questionnaires; and,
8. Go and pick up the pupils yourself from their class (5 at a time), check their parental consent forms and escort them to the room where the testing is going to take place. Take the pupils yourself when the test is over. It is important that pupils are attended by yourself at all times.

Should you require any clarification please do not hesitate to contact me on **2340 2090** or on **7944 2919**. You may also e-mail me on **lara.said@um.edu.mt.**

With thanks
(Signature of the author included here)

Lara Said

Appendix 5.2 – Testing Protocol: Instructions to Maths 6 Test Administrators (taken from Maths 6 instruction pamphlet, page 2)

Dear___________________,

It is **very important** that you familiarize yourself with these instructions before testing. These guidelines are to be with you during testing should you need to refer to them.

General Information (from Maths 6, Pages 4 to 6)

All the questions in this test are to be read aloud by you. There is no time limit, and it is expected that the test will last between 30 and 50 minutes. It is recommended that a break of at least 20 minutes is taken near the middle of the test (to minimize pupil fatigue), but schools with pupils who work quickly can complete the test in one session if they wish. You should ensure that the room used is well lit and ventilated, and, that the pupils are as comfortable as conditions permit. It is important that the pupils are seated at separate desks. If it is necessary to use a different classroom for the test, you should explain the reason for the move, and possibly use this classroom for a lesson before the test. Make sure that you remove any distracting or helpful wall charts.

Pupils with Special Requirements

You may adapt the administration of the pupils who are not fully fluent in the English language. For example, you may give the meaning of individual words or even read the questions to these pupils in their first language. However, it is important to ensure that you do not explain any mathematical terms, for example the word ‘tallest’ in question 23, or give any additional interpretation of mathematics in doing this.

Appendix 5.2 – Testing Protocol: Instructions to Maths 6 Test Administrators (continued)

Dealing with Unexpected Incidents

If, on any occasion, there is an incident that interrupts the test session, you should carefully record this so that it can be considered when interpreting the test scores. It may, for example, explain unexpectedly low scores. On the back cover of the Pupil Booklet, and on the Group Record Sheet, is a box for any comments by the administrator, and it could be useful to note the type of disturbance, its duration and the pupils affected. This is particularly important if another teacher will be marking the tests and/or interpreting the results.

Equipment

Each pupil will need:

- A Mathematics 6 Pupil Booklet;
- A pencil or pen.

Rubbers may be provided if it is your practice of the school to use them. Calculators, or any displays of numbers or shapes, should not be available.

Administering the Test

Tell the pupils that they are going to take a Maths test and explain in your own words the purpose of the test. You should give any reassurance that you think is necessary to put pupils at ease. Hand out the Pupil Booklets and ask pupils not to open them before being told to do so. The pupil information, in the panel on the front cover, should be completed before the start of the test. You may illustrate what is required by writing an example on a board. It is essential that the date of birth and date of testing are recorded accurately, so that the pupil's age may be determined exactly. Therefore, you may choose to fill them in for the pupils before handing out the booklets. You must ensure that the pupils understand exactly what they are to do. You must cover all points below using your own words. The following wording is suggested:

Appendix 5.2 – Testing Protocol: Instructions to Maths 6 Test Administrators (continued)

1. I will read all the questions to you.
2. You will have plenty of time to do the questions.
3. Do any rough working in the white space around each question.
4. Write clearly and, if you make a mistake, cross (or rub) it out neatly and write the correct answer clearly.
5. If you are not clear what to do, put up your hand. (Questions of procedure cannot be answered, but otherwise pupils should be told to 'do the best you can' or 'do what you think is best').
6. When you have finished answering each question, look up and put your pencil down quietly so that I can see you have finished it.

You should answer all questions concerning procedure/conduct of the test. However, you should not help pupils with the mathematical content of individual questions. The questions should be read exactly as set out overleaf. You may read a question more than

once, if you feel this is necessary, or if requested. You should move forward from one question to another, when, all of the pupils have attempted as much as they reasonably can.

Appendix 5.3 – Yamane's Formula for Calculating Sample Sizes

Yamane (1967) gives the following formula for estimating sample sizes according to different error margins and confidence intervals:

$$\mathbf{n_o = \frac{z^2p(1\text{-}p)N}{z^2p(1\text{-}p) + Ne^2}}$$

where:

n = sample size

z = confidence interval corresponding to a level of confidence

p = population proportion

N = population size

e = error limit

Appendix 5.4 – Maltese/English Versions of Maths 6 with First and Last Changes Showing

MALTESE	ENGLISH
Mistoqsija 1	**Item 1**
Ghaxar t-tfal ma jhobbux it-tadam (1). Xi hadd staqsa lill-ghaxar t-tfal jekk ihobbux it-tadam (2).	**Ten children were asked whether they liked tomatoes.**
It-tfal li jhobbu t-tadam qeghdin fic-cirku (1). **It tfal li jhobbu t-tadam qeghdin** fis-'circle' (2).	**The number of children who like tomatoes is shown inside the circle.**
Kemm hemm tfal li ma jhobbux it-tadam? (1). **Kemm tfal ma jhobbux it-tadam? (2).**	**How many children do NOT like tomatoes?**
Ikteb ir-risposta tieghek fuq l-ispazju (1). **Ikteb** 'l-answer' **tieghek fuq** il-'line' **(2).**	**Write your answer in the space.**
Mistoqsija 2	**Item 2**
Immarka il-forma ta' taht il-kaxxa (1). Aghmel sinjal fuq ix-'shape' ta' taht lis-'square' (2).	**Tick the shape which is below the square.**
Mistoqsija 3	**Item 3**
Hemm tmien bicciet flus fil-portmoni (1) **Hemm tmien** muniti **fil-portmoni** tieghek **(2).**	**There are eight coins in your purse.**
Ghandek tlitt ihbieb.	**You have three friends.**
Taghti kull habib bicca flus (1). Inti **taghti kull habib** munita wahda **(2).**	**You give each friend one coin.**
Kemm flus jibqalhek fil-portmoni? (1). **Kemm jibghalqek** muniti **fil-portmoni? (2).**	**How many coins will be left in your purse?**
Ikteb ir-risposta tieghek fl-ispazju. (1) **Ikteb** l-'answer' **tieghek fuq** il-'line' (2).	**Write your answer in the space.**
Mistoqsija 4	**Item 4**
Wiehed min dawn ix-'shapes' ghandu erba nahat li huma l-istess	**One of these shapes has four corners that are the same.**
Immarka dan ix-'shape' (1) Aghmel sinjal fuq dan ix-'shape' **(2)**	**Put a tick on this shape.**

Appendix 5.4 – Maltese/English Versions of Maths 6 with First and Last Changes Showing (continued)

Mistoqsija 5	**Item 5**
Aghti d-doppju ta' kul numru. Ikteb ir-risposta fil-kaxxex (1). **Aghti** d-'double' **ta' kul numru. Ikteb** l-'answer' **fil-kaxxex (2).**	**Double each of the numbers and write your answers in the boxes**
Mistoqsija 6	**Item 6**
Ghandhek ghaxar bicciet ta' helu fil-borza (1). Inti ghandek ghaxar hlewwiet gewwa borza (2).	**There are ten sweets in the bag**
Inti taghti tnejn lil-habib tieghek.	**You give two sweets to your friend**
Kemm jibqaghlek?	**How many do you have left?**
Ikteb ir-risposta tieghek fuq il-linja (1). **Ikteb** l-'answer' **tieghek fuq** il-'line' (2).	**Write your answer in the space**
Mistoqsija 7	**Item 7**
Kemm trid iz-zid lil-numru tlieta biex taghmel sebgha? (1). Kemm trid iz-zid lill-'three' biex taghmel 'seven'? (2)	**This question says 'What must be added to 3 to make 7?'**
Immarka r-risposta tieghek fuq il-linja (1). **Ikteb** l-'answer' **tieghek fuq** il-'line' (2).	**Write your answer in the space**
Mistoqsija 8	**Item 8**
Hawn 'squares' u 'circles'.	**Squares and circles are drawn in a pattern**
L-ewwel hemm 'group' ta' 'squares' mbaghad hemm 'group' ta' 'circles'	**A group of squares is followed by a group of circles**
Kemm hemm squares f'kull grupp?	**How many squares are there in each group?**
Ikteb in-numru fl-ispazju (1). **Ikteb in numru fuq** il-'line' (2).	**Write the number in the space**
Mistoqsija 9	**Item 9**
Wiehed min dawn ix-'shapes' ma ghandux tlitt nahat.	**One of these shapes does not have three sides**
Immarka dan ix-'shape' (1). Aghmel salib fuq dan ix-'shape' (2).	**Put a tick on this shape**
Mistoqsija 10	**Item 10**
Dawn l-istampi juru kif hmistax il-familja marru fuq gita	**This shows how fifteen families travelled on holiday**

Appendix 5.4 – Maltese/English Versions of Maths 6 with First and Last Changes Showing (continued)

Il-kliem ifissru 'dghajsa', 'ajruplan', 'ferrovija' u 'karozza'	**The words say 'boat', 'plane', 'train' and 'car'.**
'Add together' il-familji li marru bit-'train' u dawk li marru bil-'karrozza'.	**Add together the number of families who went by train and by car.**
Ikteb r-risposta fil-kaxxa (1). **Ikteb** l-'answer' **fil-kaxxa (2).**	**Write your answer in the box.**
Mistoqsija 11	**Item 11**
Erbgha persuni qeghdin fil-'queue' biex ihallsu x-'shopping' taghhom	**Four people are standing in a queue to pay for their shopping**
It-tifel huwa l-ewwel fil-queue. (Jekk hemm bzonn uri t-tifel	**The boy is first in the queue. (Point to the boy if necessary).**
Min hu t-tielet fil-'queue' ?	**Who is third in the queue?**
Immarka il-kaxxa ta taht it-tielet persuna (1). Aghmel sinjal gol-kaxxa taht il-persuna li jigi 'third' (2).	**Put a tick in the box below the person who is third**
Mistoqsija 12	**Item 12**
Liema numru huwa 'ghaxra' aktar min 'sebgha' (1). **Liema numru huwa** 'ten' **aktar min** 'seven' **(2).**	**What number is ten more than seven?**
Ikteb ir-risposta fil-kaxxa (1). **Ikteb** l-'answer' **fil-kaxxa (2).**	**Write your answer in the box**
Mistoqsija 13	**Item 13**
Hawn il-prezzijiet ta' tlitt hlewwiet (1). Hawn tlitt hlewwiet. Dan huwa il-prezz ta' kull wiehed min dawn il-hlewwiet (2).	**Here are the prices of three types of sweets: a mouse, a bootlace and a chew.**
Inti tixtri tlitt hlewwiet. Wiehed min kul-tip ta' helu.	**You buy three sweets – one of each type**
B'kollox kemm infaqt?	**How much do they cost altogether?**
Ikteb ir-risposta tieghek fuq il-linja (1). **Ikteb** 'l-answer' **fuq** 'il-line' **(2).**	**Write your answer in the space**
Mistoqsija 14	**Item 14**
Hemm tliet tuffieh fil-basket.	**There are three apples in the basket**
Hemm sitt tuffieh fuq is-sigra.	**There are six apples in the tree**

Appendix 5.4 – Maltese/English Versions of Maths 6 with First and Last Changes Showing (continued)

B'kollox kemm hemm tuffieh?	**How many apples are there altogether?**
Ikteb ir-risposta tieghek fuq il-linja (1). **Ikteb** 'l-answer' **fuq** 'il-line'**(2).**	**Write your answer in the space**
Mistoqsija 15	**Item 15**
Fil-kaxxa, ikteb numru ikbar minn tlieta imma inqas minn tnax (1). Fil-kaxxa, ikteb numru ikbar minn 'three' imma inqas minn 'twelve' (2).	**In the box, write any number that is greater than three but less than twelve**
Mistoqsija 16	**Item 16**
Kemm hemm pari kalzetti?	**How many pairs of socks are there?**
Ikteb ir-risposta fil-kaxxa (1). **Ikteb** 'l-answer' **fil-kaxxa (2).**	**Write your answer in the box**
Mistoqsija 17	**Item 17**
Din hija stampa ta' kappell tal-karnival (1). Dan huwa kappell tal-karnival (2).	**This is a picture of a party hat**
Liema 'shape' ghandu l-kappell	**What shape is the hat?**
Immarka ir-risposta (1). Aghmel sinjal fuq 'l-answer' (2).	**Put a tick on the answer**
Mistoqsija 18	**Item 18**
Aghti r-risposta u iktibha fil-kaxxa (1). Aghti l-answer fil-kaxxa (2).	**Work out the answer and write it in the box**
Mistoqsija 19	**Item 19**
B'kollox dawn il-flus kemm jaghmlu?	**How much do all these coins add up to?**
Ikteb ir-risposta tieghek fuq il-linja (1). **Ikteb** 'l-answer' **fuq** 'il-line' **(2).**	**Write your answer in the space**
Mistoqsija 20	**Item 20**
Iktbu dawn in-numri fil-kaxex	**Write these numbers in the boxes**
Ibdew bl-icken u spiccaw bl-akbar	**Start with the smallest and end with the largest**
Mistoqsija 21	**Item 21**
Wiehed min dawn is-'circles' ghandha nofsa mimlija	**One of these circles has one half coloured**

Appendix 5.4 – Maltese/English Versions of Maths 6 with First and Last Changes Showing (continued)

Poggi salib fuq is-'circle' li ghandha nofsa mimlija (1). Aghmel sinjal **fuq is-'circle' li ghandha nofsa mimlija (2).**	**Put a tick on the circle that has one half coloured**
Mistoqsija 22	**Item 22**
Aghtu zewg numri li fliemkien jaghmlu disgha (1). Aghti zewg numri li fliemkien jaqghdu 'nine' (2).	**Find two numbers that add up to nine**
Ikteb iz-zewg numri fil-kaxex	**Write these two numbers in the boxes**
Mistoqsija 23	**Item 23**
Liema hija l-itwal sigra	**Which is the tallest tree?**
Poggi salib fil-kaxxa ta' tahta	**Put a tick in the box below it**
Liema hija l-isqar sigra?	**Which is the shortest tree?**
Poggi salib fil-kaxxa ta' tahta.	**Put a cross in the box below it**
Mistoqsija 24	**Item 24**
Wiehed min dawn ix-'shapes' ghandu n-nahat mawga u n-nahat dritti	**One of these shapes has curved sides and straight sides**
Poggi salib fuq dan ix-'shape' (1). Aghmel sinjal **fuq dan ix-'shape' (2).**	**Put a tick on it**
Mistoqsija 25	**Item 25**
It-twegiba tghid, 'Il-helu jiswa 4 cents kull wiehed'	**The question says, 'Sweets cost 4 pence each.'**
Katie tixtri zewg hlewwiet	**Katie buys 2 sweets**
Kemm tonfoq Katie?	**How much does she spend?**
Ikteb ir-risposta tieghek fuq il-linja (1). **Ikteb** 'l-answer' **fuq** 'il-line' **(2).**	**Write your answer in the space**
Mistoqsija 26	**Item 26**
X'hin juri l-arlogg?	**What time does this clock show?**
Ikteb ir-risposta tieghek fuq il-linja (1). **Ikteb** 'l-answer' **fuq** 'il-line' **(2).**	**Write your answer in the space**

Appendix 5.5 – Parents'/Guardians' Consent Form and Questionnaire (English Version)

PERMISSION TO CONDUCT RESEARCH

Dear Parent(s)/Guardian(s),

My name is Lara Said and I am currently reading for a Ph.D in Education. I am currently employed as lecturer with the University of Malta. My studies entail that I test those children, currently in Year 2, in mathematics. This will allow me to (1) adapt this test for use with Maltese schoolchildren, and, (2) provide feedback to schools as to how Maltese children progress in mathematics. Currently this information does not exist for Year 2 children.

In order to achieve this I would like to test your child in mathematics. The test should not take longer than half an hour. The results obtained will be kept in the strictest confidence and no personal details will be divulged to third parties. **Should you wish your child to participate in this study kindly sign this form and return it with your child by the _________________.**

I give permission for ______________________________(name and surname of your child).

(Signature/s of parent/s)

____

If you gave your consent please give the date of birth

☐☐/☐☐/☐☐☐☐

day month year

and your child's identification number (I.D ____

Also, please answer the following questions.

1) Does the child have any special educational needs?

☐No ☐Yes

2) Does the child have a facilitator in class?

☐Yes ☐No

Appendix 5.5 – Parents'/Guardians' Consent Form and Questionnaire (English version, continued)

3) Does the child have a complementary or support teacher

☐Yes ☐No

4) Does the child get private lessons in mathematics?

☐Yes ☐No

5) What is the occupation of the child's father?______________________________

6) What is the occupation of the child's mother?_____________________________

7) What is the educational level of the child's father?_________________________

8) What is the educational level of the child's mother?_________________________

Should you wish for further clarification please do not hesitate to contact me on 7944 2919 or
2340 2090.

Thank you very much for your assistance.

Lara Said; B.Ed (Hons), MA (London)

Appendix 5.6 – Parents'/Guardians' Consent Form and Questionnaire (Maltese Version)

TALBA GHALL-PERMESS TA' RICERKA

Gheziez Ġenituri,

Jiena Lara Said u qieghdha nsegwi ricerka biex ngib Ph.D fil-qasam ta' l-Edukazzjoni. Bhalissa jiena mpjegata bhala 'lecturer' ma' l-Universita ta' Malta. Ir-ricerka tieghi titlob li naghti 'test' tal-matematika lil dawk it-tfal li qeghdin fil-Year 2. Din ir-ricerka toffri l-opportunita' li

(1) nizviluppa 'test' fil-matematika biex jintuza mat-tfal Maltin, u

(2) naghti informazzjoni, lill-iskejjel, dwar kif it-tfal Maltin jitghallmu l-ahjar il-matematika.

Biex nilhaq dan il-ghan nixtieq li t-tifel/tifla tieghek j/toqghod ghall dan it-test li m' ghandux idum aktar minn nofs siegha. Ir-rizultati ji[u mizmuma minni biss u l-ebda informazzjoni personali ma tinghata lil terzi persuni. Jekk inti trid li t-tifel/tifla tippartecipa f'dan l-istudju jekk jghogbok ibghat lura din it-talba, iffirmata, mat-tifel/tifla tieghek fi zmien gimgha.

Jiena naghti permess li ____________________________ (isem u kunjom ibnek/bintek) j/tiehu sehem f'dan l-istudju.

____

(Firma/firem tal-genitur/i)

Jekk tajt l-kunsens tieghek biex it-tifel/tifla j/tippartecipa fl-istudju ghati d-data tat-twelid ☐☐/☐☐/☐☐☐☐

jum xahar sena,

aghti l-I.D card number tat tifel/tifla tieghek________________________________

Jekk jghogbok wiegeb dawn id-domandi:

1) It tifel/tifla ghandu/ghanda bzonnijiet specjali?

☐ iva ☐ le

Appendix 5.6 – Parents'/Guardians' Consent Form and Questionnaire (Maltese Version, continued)

2) It-tifel/tifla ghandu/ha 'facilitator'?

☐ iva ☐ le

3) It-tifel/tifla jmur ghandu/a 'complementary' teacher'?

☐ iva ☐ le

4) It-tifel/tifla jmur ghal-privat fil-'Maths'?

☐ iva ☐ le

5) Ix-xoghol ta' missier it-tifel/tifla?____

6) Ix-xoghol ta' omm it-tifel/tifla?____

7) Il-livell ta' edukazzjoni ta' missier it-tifel/tifla ?____________________________

8) Il-livell ta' edukazzjoni ta' omm it-tifel/tifla ?______________________________

F'kaz ta' diffikulta cempel fuq 79442919 jew 2340 2090.

Grazzi ta' l-ghajnuna.

Appendix 5.7 – Mathematics Enhancement Classroom Observation Record

PART A

Time	Activity Code	Notes	Time on Task – Pupil Activity (every 5 mins)
			Time On Task Off Task Waiting Out of class
			Time On Task Off Task Waiting Out of class
			Time On Task Off Task Waiting Out of class
			Time On Task Off Task Waiting Out of class

Please write detailed notes about observations for the following on the attached sheets of paper

01 = Whole-class interactive
02 = Whole-class direct
03 = Individual/pairwork/group work
04 = Seating arrangement
05 = Testing/assessment
06 = Language of mathematics instruction
07 = Classroom management
08 = Maintaining behaviour
09 = Maintaining attention on lesson
10 = Review and practice
11 = Skills in questioning
12 = Mathematics enhancement strategies
13 = Teaching methods
14 = Establishing a positive classroom climate

Appendix 5.7 – Mathematics Enhancement Classroom Observation Record (continued). Key: 1 (*never)*, 2 (*occasionally*), 3 (*sometimes*), 4 (*frequently*), 5 (*consistently*).

PART B	**Classroom Management Techniques.** Teacher...	**1**	**2**	**3**	**4**	**5**
1	Sees that rules and consequences are clearly					
2	Starts lesson on time (within 5 minutes)					
	Uses time during class transitions effectively					
4	Takes care that tasks/materials are					
5	Sees that disruptions are limited					
	Classroom Behaviour	**1**	**2**	**3**	**4**	**5**
6	Uses a reward system to manage pupil behaviour					
7	Corrects behaviour immediately					
8	Corrects behaviour accurately					
9	Corrects behaviour constructively					
10	Monitors the entire classroom					
	Focus/Maintain Attention on Lesson	**1**	**2**	**3**	**4**	**5**
11	Clearly states the objectives/purposes of the lesson					
12	Checks for prior knowledge					
13	Presents material accurately					
14	Presents material clearly					
15	Gives detailed directions and explanation					
16	Emphasises key points of the lesson					
17	Has an academic focus					
18	Uses a brisk pace					
	Review and Practice	**1**	**2**	**3**	**4**	**5**
19	Explains tasks clearly					
20	Offers assistance to pupils					
21	Checks for understanding					
22	Summarises the lesson					
23	Reteaches if error rate is high					
24	Is approachable for pupils with problems					
25	Uses a high frequency of questions					
26	Asks academic mathematical questions					
27	Asks open-ended questions					
	Skills in Questioning	**1**	**2**	**3**	**4**	**5**
28	Probes further when responses are incorrect					
29	Elaborates on answers					
30	Asks pupils to explain how they reached their					
31	Asks pupils for more than one solution					
32	Uses appropriate wait-time between					
33	Notes pupils' mistakes					
34	Guides pupils through errors					
35	Clears up misconceptions					
36	Gives immediate mathematical feedback					
37	Gives accurate mathematical feedback					

Appendix 5.7 – Mathematics Enhancement Classroom Observation Record (continued). Key: 1 (*never)*, 2 (*occasionally*), 3 (*sometimes*), 4 (*frequently*), 5 (*consistently*).

	Skills in Questioning (continued)	**1**	**2**	**3**	**4**	**5**
38	Gives positive academic feedback					
	Enhancement Strategies	**1**	**2**	**3**	**4**	**5**
39	Employs realistic problems/ examples					
40	Encourages/teaches the pupils to use a variety of					
41	Uses correct mathematical language					
42	Encourages pupils to use correct mathematical					
43	Allows pupils to use their own problem-solving					
44	Implements quick-fire mental questions strategy					
45	Connects new material to previously learnt material					
46	Connects new material/ previously learnt material to					
	Variety of Teaching Methods					
47	Uses a variety of explanations that differ in complexity					
48	Uses a variety of instructional methods					
49	Uses manipulative materials/instructional					
	Positive Classroom Climate					
50	Communicates high expectations for pupils					
51	Exhibits personal enthusiasm					
52	Displays a positive tone					
53	Encourages interaction/communication					
54	Conveys genuine concern for pupils					
55	Knows and uses pupils' names					
56	Displays pupils' work in the classroom					
57	Prepares an inviting/cheering classroom					

Appendix 5.8 – Sample of Coded Text from MECORS (A)

Key to colour coding

No coding	Classroom management		Classroom behaviour	Focus attention
Review & practice	Questioning	Enhancement Strategies	Teaching methods	Positive climate

<u>Teacher 74A, 2/3</u>
<u>Tuesday 18th January</u>

Lesson Topic:	Estimating weight with a focus on heavier and lighter
Textbook in Use:	ABACUS
In keeping with ABACUS:	yes
Lesson Duration:	8:55 – 10:00
Adherence to timetable:	flexible
Classroom layout:	U-shaped
Predominant teacher position in class:	Up-front
Predominant delivery of lesson (as observed):	Direct teaching
Predominant pupil stance (as observed):	Individualistic with some collaborative
Seatwork:	Appears collaborative but ends up being individualistic
Resources used during lesson:	Common everyday objects such as purse, socks, detergents, dominoes…
Classroom mood:	Quiet yet purposeful, pupils engaged on task most of the time. Work mostly individualistic.
No. of pupils in class:	20 present, 0 absent

<u>8:55, E, whole-class lecture</u>

- Comparison and estimation of weight as in ABACUS
- Teacher: 'What does lighter mean? And heavier
- Light goes up, heavy goes down

<u>9:00, E, whole-class lecture</u>

- Girl 1 and Boy 2 given two objects which are then exchanged
- Teacher to girl 1: 'Put the lunchbox and the tissue-roll on the balancing scales. Which is heavier the lunchbox or the tissue-roll?' (asks the whole-class)
- Pupils together: 'The lunchbox.'
- Teacher: 'Correct, heavy down, light up. Say after me, heavy down, light up.'
- Teacher gives small bottle of water and a copybook to girl 3.

Appendix 5.8 – Sample of Coded Text from MECORS (A) (continued)

- Teacher: heavier down, lighter up.
- Girl 4: (given bottle of liquid soap and purse). 'The liquid soap is heavier.'
- Teacher: 'Correct, why?'
- Girl 4: 'Heavy down (pointing to liquid soap), light up (pointing to purse)

<u>9:05, E, whole-class interactive</u>

- Teacher hands out common everyday objects, to pupils, and clearly states that this is the start of another activity. Also explains that the aim of this game is to (1) check which object is heavier and which object is lighter; and, (2) to check their answer using the balance.
- Teacher assigns pupils to pairs starting from the end of the U-shaped layout.
- Teacher: 'Both of you have to check on the scales.'
- Pupils estimate objects by holding them in their hands as told and shown by teacher (modelling).
- Teacher: 'Did you compare the weight? By keeping both things in your hands.'
- Teacher to the 1st pair (boy/girl): 'Which side will go down and which will go up?' (boy points to one side going down and girl says that the other side will go up). Pupils check by placing their objects on the balancing scales. The answer is correct.
- Teacher to the 2nd pair (boy/girl): 'Which side will go down and which will go up?' (boy points to one side going down and girl says that the other side will go up). Pupils check by placing their objects on the balancing scales. The answer is correct.
- Teacher to the 3rd pair (boy/girl): 'Which side will go down and which will go up?' (boy points to one side going down and girl points that the other side will go up but they don't appear too convinced and must be prompted by the teacher).
- Teacher: 'So you think that this is heavier and this is lighter?'
- Pupils check by placing their objects on the balancing scales. The answer is correct.
- Teacher asks a 4th pair (girl/girl). This pair also appears hesitant. Teacher needs to help with the terms 'heavier' and 'lighter' by prompting them. Teacher also draws the attention of an inattentive boy.
- Teacher goes through the same routine with another 4 pairs. The teacher stresses the terms 'lighter/heavier' and on the rhyme 'Light up, heavy down or heavy down, light up'. Pupils are shown how to mime it.

<u>9:15, Em, whole-class interactive</u>

- Teacher: 'Choose something from your bag (school bag) or your pocket (pencil case). Two objects, one heavier, one lighter.
- Boy 1: This is heavier, this is lighter (stressed)
- Girl 2: This is heavier, this is lighter
- Girl 3: This is lighter, this is heavier (teacher checked this with another girl from those seated).

Appendix 5.8 – Sample of Coded Text from MECORS (A) (continued)

- Girl 4: Din hafifa u din tqila (teacher switching to Maltese and girl responding in support of girl and some pupils in class). Similar routine with Boy 5, Girl 6 and Girl 7.
- gewx hawn barra?' (three pupils put up their hands)
- Girl 8: Makes correct estimation (teacher is at first doubtful but then accepts the girl's response)
- Girl 9: Correct estimation (teacher checks on scales and confirms that girl is right)
- Girl 10: Correct estimation (appears to be clear to both girl and teacher)
- Throughout this activity children are purposefully engaged with the task and working in pairs collaboratively.

<u>9:20, Me, direct and instruction</u>

- Teacher: 'When something is lighter it will go up. When something s heavier it will go down.'
- Pupils are asked to stand up by teacher and mime the following together: 'Light up, heavy down. Teacher up-front during this activity.
- Workbooks (ABACUS Space and Measure Book 2) handed out by girl/boy pair.
- Teacher asks pupils to work page 5. Teacher gives clear instructions that the first two examples will be worked out together with her. Drawing attention to inattentive boy: 'Is that page 5?'

<u>9:25, Me, direct and individual instruction</u>

- Teacher explains clearly how to work out the exercise. She shows them how to work out the first two problems. She makes sure that the pupils work them with her. She stresses that the pupils must estimate first which object is 'lighter' and which object is 'heavier'. (Many of the objects require fine discrimination, *please refer to handwritten notes for drawing relating to the connected explanation*). 'Let me check. Ha niccekja, ha nerga nahdem l-ewwel wahda. Ara, liema naha nizlet…u l-ohra telghet, liema 'heavier'? u liema 'lighter'. (Teacher draws attention constantly to keep the pupils focused on the task. 'No, don't (work out the task implied to a boy) you tell us, then I will correct it. The cork and the dice, dawna kwazi ndaqs

<u>9:35, E, interactive whole-class</u>

- Teacher: 'I'm going to give you a handout but we are going to do only the 1st exercise…then we are going to explain what we are going to do. What is the title? Remember, heavier down, lighter up. Ghandha 'banana' u ghandha 'apple'…which is heavier…than (explaining the language of mathematics in the exercise and with reference to photocopy master 13 in ABACUS). Ha nerga 'heavier' down jew up?

<u>9:45, Me, direct instruction on an individual basis</u>

- Pupils engaged on individual work. Teacher going around pupils.

<u>9:50, Me, direct instruction on an individual basis</u>

- Teacher asking pupils who finished to do extra work from the 'extra work cards'. Teacher helping pupils still working on the mathematics writing task.

<u>10:00, Me, lesson ends for lunchbreak</u>

Appendix 5.9 – Pilot Study Version of Part B of the Teacher Survey Questionnaire

School Code ____________________

Head Teacher/Teacher ___________*(for office use only)*

Thank you for participating, kindly note that there are no right or wrong answers to any of the items in Part A and in Part B

PART A

01	**Sex** (please circle accordingly)	
	Male	1
	Female	2
02	**Age** (please circle accordingly)	
	20 to 25	1
	26 to 35	2
	36 to 45	3
	46 to 55	4
	55 to 65	5
	65+	6
03	**What is your first language?** (please circle one)	
	Maltese	1
	English	2
04	**What are your teacher qualifications?** (please circle as many apply)	
	Mater Admirabilis	1
	St. Michael's Training College	2
	Bachelor in Education	3
	Post-Graduate Certificate in Education	4
	Diploma in Educational Mangement and Administration	5
	Master in Education	6
	Doctorate in Education	7
	Other (please specify)___________________________________	

Appendix 5.9 – Pilot Study Version of Part B of the Teacher Survey Questionnaire (continued)

05 **Were you trained?** (please circle accordingly)

As a primary teacher	1
As a secondary teacher	2
Trained as both a secondary and primary teacher	3

06 **What is your teaching and/or administrative experience?**
(please specify in YEARS as many apply)

As a primary school teacher (Years 1 to 3)	☐ years
As a primary school teacher (Years 4 to 6)	☐ years
As a secondary school teacher (Forms 1 to 5)	☐ years
As an assistant head teacher (Years 1 to 3)	☐ years
As an assistant head teacher (Years 4 to 6)	☐ years
As a head teacher (Years 1 to 3)	☐ years
As a head teacher (Years 4 to 6)	☐ years
Other (please specify)________________________________	☐ years

07 **How long have you been working in this school?** ☐ years

08 **Which scheme for mathematics have you used during this scholastic year?**
(please circle as many apply)

ABACUS 'R'	1
ABACUS '1'	2
ABACUS '2'	3

Appendix 5.9 – Pilot Study Version of Part B of the Teacher Survey Questionnaire (continued). Key: 1 (*strongly agree*), 2 (*agree*), 3 (*do not know*), 4 (*disagree*), 5 (*strongly disagree*).

PART B

	Beliefs about what it is to be a numerate pupil. Being numerate involves:	**1**	**2**	**3**	**4**	**5**
1	use of methods of calculation that are both efficient and effective					
2	confidence and ability in the use of mental methods					
3	selecting a method of calculation on the basis of both the operation and the numbers involved					
4	pupils engaged in meaningful mathematical talk					
5	awareness of the links between different aspects of the curriculum for mathematics					
6	reasoning, justifying and eventually proving results about number					
7	the ability to perform standard procedures or routines					
8	heavy reliance on paper and pencil methods					
9	selecting a method of calculation primarily on the basis of the operation involved					
10	confidence in separate aspects of the curriculum					
11	being able to decode context problems to identify the particular routine or technique required					
12	finding the answer to a calculation by any method					
13	a heavy reliance on practical methods					
14	understanding separate aspects of the curriculum for mathematics					
15	Pupils being able to use and apply mathematics using practical apparatus					
	Beliefs about how pupils learn to become numerate.					
16	Pupils become numerate through purposeful interpersonal activity based on interactions with others					
17	Pupils learn through being challenged and struggling to overcome difficulties					
18	Most pupils are able to become numerate					
19	Pupils have strategies for calculating but the teacher has the responsibility for helping them to refine their methods					

Appendix 5.9 – Pilot Study Version of Part B of the Teacher Survey Questionnaire (continued). Key: 1 (*strongly agree*), 2 (*agree*), 3 (*do not know*), 4 (*disagree*), 5 (*strongly disagree*).

	Beliefs about how pupils learn to become numerate.	**1**	**2**	**3**	**4**	**5**
20	Pupil misunderstandings need to be recognised, made explicit and worked on					
21	Pupils become numerate through individual activity based on the following of instructions					
22	Pupils learn through being introduced to one mathematical routine at a time and remembering it					
23	Pupils vary in their ability to become numerate					
24	Pupil strategies for calculating are of little importance; they need to be taught standard procedures					
25	Pupil misunderstandings are the result of failure to 'grasp' what was being taught and needs to be remedied by further reinforcement of the 'correct' method					
26	Pupils become numerate through individual activity based on actions on objects					
27	Pupils need to be ready before they can learn mathematical ideas					
28	Pupils vary in the rate at which their numeracy develops					
29	Pupil strategies are important because understanding is based on working things out for oneself					
30	Pupil misunderstandings are the result of pupils not being ready to learn the ideas					
31	Beliefs about how best it is to teach pupils to become numerate.					
32	Teaching and learning are complementary					
33	Numeracy teaching is based on dialogue between teacher and pupils to explore understandings					
34	Learning about mathematical concepts and the ability to apply these concepts are learned alongside each other					
35	The connections between mathematical ideas need to be acknowledged in teaching					
36	Application is best approached through challenges that need to be reasoned about					
37	Teaching is seen as separate from and having priority over learning					

Appendix 5.9 – Pilot Study Version of Part B of the Teacher Survey Questionnaire (continued). Key: 1 (*strongly agree*), 2 (*agree*), 3 (*do not know*), 4 (*disagree*), 5 (*strongly disagree*).

	Beliefs about how pupils learn to become numerate (continued)	**1**	**2**	**3**	**4**	**5**
38	Numeracy teaching is based on verbal explanations so that pupils understand teachers' methods					
39	Learning about mathematical concepts precedes the ability to apply these concepts					
40	Mathematical ideas need to be introduced in discrete packages					
41	Application is best approached through word problems: contexts for calculating routines					
42	Learning is seen as separate from and having priority over teaching					
43	Numeracy teaching is based on practical activities so that pupils discover methods for themselves					
44	Application is best approached through using practical equipment					

Appendix 5.10 – Final Version of Part B of the Teacher Survey Questionnaire

Teaching/Learning Beliefs (item code)	**1 Strongly agree**	**2 Agree**	**3 Do not know**	**4 Disagree**	**5 Strongly disagree**
Effective teachers attach equal importance to teaching and learning (1)					
Mathematics is best taught using a mixture of Maltese and English (2)					
Effective teachers attach more importance to learning than teaching (3)					
Effective teachers attach more importance to teaching than learning (4)					
Pupils learn about mathematical concepts before being able to apply them (5)					
Mathematical concepts, methods and procedures must be introduced one at a time (6)					
mathematics is best taught in English (7)					
Engaging in meaningful talk is the best way to teach mathematics (8)					
Pupils learn mathematics best through a mixture of Maltese/English (9)					
Pupils must be shown how to apply appropriate methods and procedures through reasoning (10)					
Pupils must be shown how to decode a word problem (11)					
mathematics is best taught in Maltese (12)					
Pupils must learn how to apply mathematical concepts (13)					
Teaching is best based on practical activities (14)					
Pupils being able to use and apply mathematics' apparatus (15)					
Teaching is best based on verbal explanations (16)					

Appendix 5.10 – Final Version of Part B of the Teacher Survey Questionnaire (continued)

Teaching/Learning Beliefs (item code)	**1 Strongly agree**	**2 Agree**	**3 Do not know**	**4 Disagree**	**5 Strongly disagree**
When teaching connections across mathematics topics must be made explicit (17)					
Mathematics routines must be introduced one at a time (18)					
Pupil misconceptions must be remedied by reinforcing the correct method (19)					
Pupils' errors need to be remedied in order for them to learn (20)					
Most pupils are able to become numerate (21)					
Pupil methods are important because they help pupils to understand concepts (22)					
Pupils must be taught standard methods and procedures (23)					
Pupils make mistakes because they are not ready to learn mathematics (24)					
Pupils learn mathematics best mainly through Maltese (25)					
Pupils learn mathematics best by being challenged (26)					
Pupils learn mathematics by following instructions and working alone (27)					
Pupils learn mathematics by manipulating concrete materials (28)					
Pupils learn mathematics through interaction with others (29)					
Pupils must be ready before they can learn mathematics concepts, methods and procedures (30)					
Pupils learn mathematics best through English (31)					
Pupils vary in their ability to learn mathematics (32)					

Appendix 5.10 – Final Version of Part B of the Teacher Survey Questionnaire (continued)

Teaching/Learning Beliefs (item code)	**1 Strongly agree**	**2 Agree**	**3 Do not know**	**4 Disagree**	**5 Strongly disagree**
Pupils vary in their rate of mathematical development (33)					
Pupil misunderstandings need to be made explicit (34)					
Teachers must help pupils to refine their problem-solving methods (35)					
All pupils are able to learn mathematics (36)					
Most pupils must learn to decode mathematical terms through Maltese (37)					
Pupils learn by using any method (39)					
Pupils learn mathematics when using mathematics apparatus (40)					
Pupils learn by applying the correct method/procedure (41)					
Pupils learn mathematics by working sums out on paper (42)					
Pupils need to be able to read/write/speak English well in order to learn mathematics (43)					
Pupils learn mathematics by reasoning (44)					
Pupils need to learn to understand the mathematics context to solve a problem (45)					
Pupils do not need to be able to read/write/speak English well in order to learn mathematics (46)					
Pupils learn to solve problems by using concrete materials (47)					
Pupils need to be taught any method as long as efficient (48)					

Appendix 5.11 – The Head Teacher Survey Questionnaire for the Pilot (November 2004) and the Main Study (April 2005)

HEAD TEACHER QUESTIONNAIRE

(It is important to note that there are no right or wrong answers to any of the items)

01	**Sex of head teacher** (please circle accordingly)	
	Male	1
	Female	2
02	**Age** (please circle accordingly)	
	20 to 25	1
	26 to 35	2
	36 to 45	3
	46 to 55	4
	55 to 65	5
	65+	6
03	**What is your first language?** (please circle one)	
	Maltese	1
	English	2
04	**What are your teacher qualifications?** (please circle as many apply)	
	Mater Admirabilis	1
	St. Michael 's Training College	2
	Bachelor in Education	3
	Post-Graduate Certificate in Education	4
	Diploma in Educational Management & Administration	5
	Master in Education	6
	Doctorate in Education	7
	Other (please specify)________________________	
05	**Were you trained?** (please circle accordingly)	
	As a primary teacher	1
	As a secondary teacher	2
	Trained as both a secondary and primary teacher	3

Appendix 5.11 – The Head Teacher Survey Questionnaire for the Pilot (November 2004) and the Main Study (April 2005) (continued)

06 What is your teaching/administrative experience? (please specify accordingly)

As a primary school teacher (Years 1 to 3) ☐ years
As a primary school teacher (Years 4 to 6) ☐ years
As a secondary school teacher (Forms 1 to 5) ☐ years
As an assistant head teacher (Years 1 to 3) ☐ years
As an assistant head teacher (Years 4 to 6) ☐ years
As a head teacher (Years 1 to 3) ☐ years
As a head teacher (Years 4 to 6) ☐ years
Other (please specify)____________________________ ☐ years

07 How long have you been working in this school? (please specify accordingly)

____

Appendix 5.12 – Field Note Sheet

Please take detailed notes about:

Notes about the School	Notes about the Classroom
Type of school	Size of classroom
Size of school	ABACUS topics covered
Socio-economic composition of school	ABACUS topics not covered
Sex of head teacher	Socio-economic composition of classroom
Age range of head teacher	Sex of teacher
Experience teaching primary	Age range of teacher
Head teacher involvement of teachers	Teaching qualifications
Head teacher monitoring of staff	Duration in minutes
Staff turnover	Disruptions to lessons in minutes
Availability of school development	Duration of mental warm-up
Implementation of school curriculum	Number of explanatory activities
Climate and order	Duration of each explanatory activity
Time scheduled for mathematics	Duration of plenary
Head teacher formed relationships with teachers	Number of times per week mathematics homework is assigned
Parental involvement	Nature of mathematics homework
Head teacher discusses instructional quality with staff	Year 2 teachers' observed behaviours according to the eight instructional categories in MECORS (B)
Head teacher discusses curricular issues with staff	

Focus on the head teacher. Please ask head teacher questions about above criteria whenever possible and/or note observations

Please ask teacher questions about the above criteria whenever possible and/or note any observations not covered by MECORS (A & B).

Appendix 5.13 – Sample of Coded Text from the Field Notes (Head Teacher Questions, Case 32)

Key to colour coding

Leadership/Headship	Vision	Practice	Relationships

Questions asked of this head teacher and answers obtained

What do you think about head teaching?

I think that head teaching is a vocation. Not everyone is cut-out to do it. Even though we are now specifically trained and must have the qualifications to do this job. You also have to be able to have to manage a lot of tasks together. Nowadays head teaching is very stressful. There is a lot of paperwork that one (the head teacher) must do which is required by the education authorities. Moreover, it is becoming very hard nowadays to manage a school. Teachers are forever questioning and making demands. Unfortunately they no longer look-up to the head teacher and respect the head teacher as they used to before. Pupils too are quite disrespectful of both teachers and the head teacher. This comes from their parents. This is because parents expect the school to be completely responsible for what pupils learn. Parents also need to teach their pupils, we cannot do all the work for them. This is why so many families and children have so many problems nowadays.

Is there a school-wide timetable?

This school does not have a school-wide timetable. Teachers are free to set their own and they do so. **So at what time in the day do teachers (Year 2) teach Maths?** Most of the teachers do so during the morning but they are free to teach this subject whenever they like…as long as they have a timetable on display in the classroom and they stick to it. **How come you don't have a school-wide timetable?** We are a primary-school. Teachers and children need to be and feel freer.

Do you monitor staff? I do monitor staff but I do so quite informally. I walk through corridors. Peek into classroom and sometimes walk in unannounced. If I find disruption or if the teacher is not pleased to see me I then will keep a close check on

Appendix 5.13 – Sample of Coded Text from the Field Notes (Head Teacher Questions, Case 32, continued)

Key to colour coding

Leadership/Headship	Vision	Practice	Relationships

teachers. **Do you watch any lessons given by teachers?** On rare occasions I do. Usually this is after complaints from a number of parents…you know I cannot do so after a couple of complaints…most parents will complain just for the sake of it**. So the school does not have a systematic programme for monitoring teachers?** No**. Don't you or the assist head teachers think that staff should be monitored?** No, we believe that head teachers

Appendix 5.13 – Sample of Coded Text from the Field Notes (Head Teacher Question Section, Case 32) (continued)

are professionals and can do the work well on their own. We select our teachers carefully and if they do not conform to the ethos of this school we talk to them about it. In a few extreme cases we have replaced staff who did not manage to fit it and/or who were not teaching children well.

Are you writing-up or improving the school development plan? The school does not have a plan.

Do you do administrative tasks? The role of the head teacher and the assistant head teachers is mainly administrative. Nowadays the administrative demands are so great that it requires more than one person (the head teacher) to do these. **Do you delegate administrative tasks to teachers?** This school asks a lot from its teachers so they are not given any administrative tasks? **What are your curricular responsibilities?** My job is to see that the objectives set by the primary syllabi are implemented. It is up to the teachers to agree amongst themselves (on a year group basis) as to how they implement ABACUS. **When do you discuss curricular and instructional issues with staff?** In a year, we hold two staff development meetings. I usually raise anything required of us by the education authorities during these meetings…(long

Appendix 5.13 – Sample of Coded Text from the Field Notes (Head Teacher Questions, Case 32, continued)

Key to colour coding

Leadership/Headship	Vision	Practice	Relationships

pause)…(change in direction of answer) teachers usually come up with ideas and sometimes when most of them agree…(long pause) they put their ideas in practice…(long pause) such as their wish for a Maths coordinator. One for the lower juniors and another for the upper juniors. Up to now I have resisted this…it would be like a ship with too many captains.

How do you maintain order? This is primary school. It is quite easy for our teachers to maintain order. Remember we know our teachers quite well. I also tell children to behave well during assembly…each teacher also displays their rules for good behaviour in the classroom. This is usually enough…it is after all a primary school.

What do you think about parental involvement? If parents send their children to this school it is because they trust us. Teachers (and the head teacher) do know what is best in order for children to learn. Many parents nowadays think that they know best…you know there is the mentality in this country that everyone can teacher…if the school were to actively involve parents we would be simply reinforcing this mistaken mentality. **How many Parents Days do you hold throughout the school year?** The school reserves six days, two per term, for Parents' Meeting; held during school hours. **How do you establish good relations with your staff?** Staff gets on very well with one another. Bad relations have never been an issue. People who don't fit in tend to realize this and go and teach elsewhere…besides I am freely available to my staff and they know that they can discuss any burning issues with me. **What do you do when staff disagree amongst themselves?** I have been working here for the past ten years and I cannot think of any serious disagreement amongst staff… they usually do as they are told…so good direction minimizes differences.

APPENDIX TO CHAPTER 6

Appendix 6.1 – Age-Standardisation Table for Maths 6

Age in Years and Completed Months													
Score	**6.04**	**6.05**	**6.06**	**6.07**	**6.08**	**6.09**	**6.10**	**6.11**	**7.00**	**7.01**	**7.02**	**7.03**	**7.04**
0	69	69	69	69	69	69	69	69	69	69	69	69	69
1	69	69	69	69	69	69	69	69	69	69	69	69	69
2	69	69	69	69	69	69	69	69	69	69	69	69	69
3	69	69	69	69	69	69	69	69	69	69	69	69	69
4	69	69	69	69	69	69	69	69	69	69	69	69	69
5	69	69	69	69	69	69	69	69	69	69	69	69	69
6	69	69	69	69	69	69	69	69	69	69	69	69	69
7	69	69	69	69	69	69	69	69	69	69	69	69	69
8	72	71	70	69	69	69	69	69	69	69	69	69	69
9	74	73	70	72	71	70	69	69	69	69	69	69	69
10	77	76	70	74	71	72	71	70	70	69	69	69	69
11	79	78	77	76	76	75	74	73	72	71	70	70	69
12	81	80	80	79	78	77	76	75	74	73	72	71	69
13	83	82	82	81	80	79	78	77	75	74	73	72	72
14	85	84	84	83	82	81	78	77	76	75	74	73	72
15	88	87	86	85	84	83	82	82	81	80	79	78	77
16	90	89	88	87	86	85	84	84	83	82	81	81	80
17	93	92	91	90	89	88	87	86	85	84	83	83	82
18	95	95	94	93	92	91	90	89	88	87	86	85	84
19	99	98	97	96	95	94	93	92	91	90	89	88	87
20	102	101	100	99	98	97	96	95	94	93	92	91	90
21	105	104	103	103	102	101	100	99	98	97	96	95	94
22	109	108	107	106	106	105	104	103	102	101	100	99	98
23	113	112	111	111	110	109	108	108	107	106	105	104	103
24	117	117	116	115	115	114	114	113	112	112	111	110	109
25	122	122	121	121	121	121	120	120	119	119	118	118	117
26	134	134	134	133	133	133	133	132	132	132	132	132	131

APPENDICES TO CHAPTER 7

Appendix 7.1 – Proportion of Fathers in the Low, Medium and High Occupational Categories

Type	School	% Low	% Medium	% High
State	1	14.81	59.26	25.93
State	2	20.93	74.42	4.65
Church	3	38.89	41.67	19.44
Independent	4	5.41	19.82	74.77
Church	5	8.75	43.75	47.50
State	6	4.44	84.44	11.11
State	7	13.91	73.04	13.04
State	8	50.00	42.86	7.14
State	9	6.67	80.00	13.33
State	10	52.17	47.83	0.00
State	11	16.13	77.42	6.45
State	12	10.71	82.14	7.14
State	13	25.81	74.19	0.00
State	14	8.00	64.00	28.00
State	15	15.79	73.68	10.53
State	16	12.33	78.77	8.90
State	17	15.07	71.23	13.70
State	18	20.45	63.64	15.91
State	19	8.33	91.67	0.00
State	20	7.69	76.92	15.38
Church	21	8.33	58.33	33.33
Church	22	6.82	61.36	31.82
State	23	5.00	80.00	15.00
State	24	17.00	73.00	10.00
Church	25	0.00	77.78	22.22
Independent	26	13.33	53.33	33.33
Independent	27	25.58	37.21	37.21
Independent	28	6.00	22.00	72.00
Church	29	8.00	74.00	18.00
Church	30	2.08	41.67	56.25
Church	31	19.23	38.46	42.31
Church	32	5.06	53.16	41.77
State	33	29.17	56.25	14.58
State	34	19.44	58.33	22.22
State	35	19.55	73.68	6.77
State	36	13.10	82.14	4.76
State	37	7.22	79.38	13.40

Appendix 7.2 – Proportion of Mothers in the Low, Medium and High Educational Categories

Type	School	% Low	% Medium	% High
State	1	0.00	64.81	35.19
State	2	4.65	79.07	16.28
Church	3	0.00	80.77	19.23
Independent	4	0.00	40.54	59.46
Church	5	1.25	53.75	45.00
State	6	4.44	71.11	24.44
State	7	2.61	86.96	10.43
State	8	7.14	92.86	0.00
State	9	0.00	90.00	10.00
State	10	8.70	86.96	4.35
State	11	3.23	87.10	9.68
State	12	0.00	78.57	21.43
State	13	9.68	77.42	12.90
State	14	0.00	62.00	38.00
State	15	0.00	84.21	15.79
State	16	2.74	71.92	25.34
State	17	0.00	67.12	32.88
State	18	0.00	70.45	29.55
State	19	2.78	75.00	22.22
State	20	2.56	64.10	33.33
Church	21	0.00	83.33	16.67
Church	22	0.00	61.36	38.64
State	23	0.00	55.00	45.00
State	24	2.00	71.00	27.00
Church	25	0.00	66.67	33.33
Independent	26	0.00	60.00	40.00
Independent	27	0.00	67.44	32.56
Independent	28	0.00	30.00	70.00
Church	29	0.00	74.00	26.00
Church	30	0.00	35.42	64.58
Church	31	0.00	69.23	30.77
Church	32	2.60	53.25	44.16
State	33	2.08	81.25	16.67
State	34	0.00	66.67	33.33
State	35	2.26	81.20	16.54
State	36	3.57	84.52	11.90
State	37	2.06	74.23	23.71

Appendix 7.3 – Frequency of Teacher Responses to Belief Statements

Key: 1 (*strongly agree*), 2 (*agree*), 3 (*do not know*), 4 (*disagree*), 5 (*strongly disagree*).

Instructional Beliefs (item)	**1**	**2**	**3**	**4**	**5**
Mathematical concepts, methods and procedures must be introduced one at a time (6)	21	43	12	12	1
Mathematics is best taught in English (7)	8	24	11	39	7
Engaging pupils in meaningful talk is the best way to teach mathematics (8)	20	44	11	11	3
Pupils must be shown how to apply appropriate methods and procedures through reasoning (10)	41	41	7	0	0
Pupils must be taught how to decode a word problem (11)	6	54	20	10	0
Pupils must be shown how to apply appropriate methods /procedures by using practical equipment (12)	43	46	0	0	0
Pupils must learn mathematical concepts and how to apply these concepts together (13)	21	58	1	8	1
Teaching is best based on practical activities so that pupils discover methods for themselves (14)	57	23	5	4	0
Pupils being able to use and apply mathematics using mathematics' apparatus (15)	2	5	15	60	7
Teaching is best based on verbal explanations (16)	3	10	10	49	17
When teaching, connections across mathematics topics must be made explicit (17)	9	45	33	2	0
Mathematics routines must be introduced one at a time (18)	20	51	6	12	0
Pupil misconceptions must be remedied by reinforcing the correct method (19)	17	44	5	20	3
Pupils' errors need to be remedied in order for them to learn (20)	28	44	3	8	6
Pupils must be taught standard methods and procedures (23)	4	6	11	53	15
Pupil misunderstandings need to be made explicit and improved upon (34)	45	42	2	0	0
Teachers must help pupils refine their problem-solving methods (35)	33	40	1	10	5

Appendix 7.3 – Frequency of Teacher Responses to Belief Statements (continued)

Key: 1 (*strongly agree*), 2 (*agree*), 3 (*do not know*), 4 (*disagree*), 5 (*strongly disagree*).

Instructional Beliefs (item)	**1**	**2**	**3**	**4**	**5**
All pupils are able to learn mathematics (36)	23	49	4	4	9
Pupils may be taught any method as long as efficient (48)	33	52	3	1	0
Pupils learn about mathematical concepts before being able to apply them (5)	21	40	11	16	1
Pupils learn mathematics best through a mixture of Maltese/English (9)	23	47	5	10	4
Most pupils are able to become numerate (21)	27	60	0	2	0
Pupil methods are important because they understand mathematical concepts, methods and procedures for themselves (22)	25	53	4	7	0
Pupils make mistakes because they are not ready to learn mathematics (24)	12	22	18	37	0
Pupils learn mathematics best mainly through Maltese (25)	2	11	9	57	10
Pupils learn mathematics by being challenged (26)	13	38	7	25	6
Pupils learn mathematics by following instructions and working alone (27)	7	19	13	39	11
Pupils learn mathematics by manipulating concrete materials (28)	39	48	2	0	0
Pupils learn mathematics through interaction with others (29)	36	45	7	1	0
Pupils must be ready before they can learn certain mathematics concepts, methods and procedures (30)	24	49	12	4	0
Pupils learn mathematics best through English (31)	9	19	9	52	0
Pupils vary in their ability to learn mathematics (32)	36	50	3	0	0
Pupils vary in their rate of mathematical development (33)	41	48	0	0	0
Most pupils must decode mathematical terms through Maltese (37)	5	40	3	4	5
Pupils learn by using any method (39)	34	47	4	4	0
Pupils learn mathematics when using mathematics apparatus (40)	22	55	4	6	1

Appendix 7.3 – Frequency of Teacher Responses to Belief Statements (continued)

Key: 1 (*strongly agree*), 2 (*agree*), 3 (*do not know*), 4 (*disagree*), 5 (*strongly disagree*).

Instructional Beliefs (item)	**1**	**2**	**3**	**4**	**5**
Pupils learn by applying the correct method/procedure (41)	6	52	7	20	4
Pupils learn mathematics by working sums out on paper (42)	1	32	11	39	6
Pupils need to be able to read/write/speak English well to learn mathematics (43)	11	45	3	22	8
Pupils learn mathematics by reasoning (44)	19	63	4	3	0
Pupils need to learn to understand the mathematics context to solve a problem (45)	17	69	2	1	0
Pupils don't need to be able to read/write/speak English well to learn mathematics (46)	2	25	6	46	10
Pupils learn to solve problems by using concrete materials (47)	20	57	5	3	0
Pupils may be taught any method as long as efficient (item 48)	33	40	0	12	1

Appendix 7.4 – Frequency of Teachers Behaviours from Datasets A and B.

Key: 1 (*never*), 2 (*occasionally*), 3 (*sometimes*), 4 (*frequently*), 5 (*consistently*).

Classroom Management (item)	**1**	**2**	**3**	**4**	**5**
Sees that rules and consequences are clearly understood	0	2	25	34	28
(1B)	2	0	16	0	71
Starts lesson on time; within 5 minutes (2A)	0	8	19	23	39
(2B)	2	1	24	24	38
Uses time during class transitions effectively (3A)	12	9	7	36	25
(3B)	9	9	10	22	39
Tasks/materials are collected/distributed effectively	0	60	14	14	1
(4B)	2	58	12	12	5
Sees that disruptions are limited (5A)	31	0	7	24	27
(5B)	40	1	1	25	22
Maintain Appropriate Classroom Behaviour					
Uses a reward system to manage pupil behaviour (6A)	2	0	10	24	53
(6B)	2	0	10	26	51
Corrects behaviour immediately (7A)	1	1	4	53	30
(7B)	2	0	5	58	24
Corrects behaviour accurately (8A)	6	16	49	16	2
(8B)	1	10	56	22	0
Corrects behaviour constructively (9A)	2	14	26	29	18
(9B)	7	15	23	24	20
Monitors the entire classroom (10A)	37	0	0	0	52
(10B)	27	0	0	0	62
Focus/Maintain Attention on Lesson (item)					
Clearly states the objectives/purposes of the lesson	5	35	27	14	8
(11A)	4	32	37	10	6
Checks for prior knowledge (12B)	0	1	2	43	43
(12B)	2	0	1	43	43
Presents material accurately (13A)	1	2	29	38	19
(13B)	1	2	25	35	26
Presents materials clearly (14A)	2	15	14	46	12
(14B)	1	10	23	34	21
Gives detailed directions and explanation (15A)	2	32	21	18	16
(15B)	3	46	16	14	13
Emphasises key points of the lesson (16A)	2	23	27	19	18
(16B)	3	28	21	13	24
Has an academic focus (17A)	2	19	24	17	27
(17B)	2	9	30	21	27
Uses a brisk pace (18A)	2	15	34	26	12
(18B)	2	10	36	23	18

Appendix 7.4 – Frequency of Teacher Behaviours from Datasets A and B (continued). Key: 1 (*never*), 2 (*occasionally*), 3 (*sometimes*), 4 (*frequently*), 5 (*consistently*).

Provides Pupils with Review and Practice (item)	**1**	**2**	**3**	**4**	**5**
Explains tasks clearly (19A)	3	37	14	23	12
(19B)	2	32	18	25	10
Offers assistance to pupils (20A)	2	31	18	25	13
(20B)	2	34	15	22	14
Summarises the lesson (22A)	4	37	13	26	9
(22B)	2	39	15	25	8
Reteaches if error rate is high (23A)	3	37	26	13	10
(23B)	4	34	27	11	13
Is approachable for pupils with problems (24A)	15	35	20	12	7
(24A)	10	38	27	11	3
Uses a high frequency of questions (25A)	0	24	13	30	22
(25B)	0	18	9	39	23
Asks academic mathematical questions (26A)	9	50	4	20	6
(26B)	4	35	8	25	17
Asks open-ended questions (27A)	14	30	17	20	8
(27B)	11	35	14	23	6
Skills in Questioning					
Probes further when responses are incorrect (28A)	5	23	36	19	6
(28B)	6	22	33	18	10
Elaborates on answers (29A)	59	9	9	8	4
(29B)	63	6	8	9	3
Asks pupils to explain how they reached solution (30A)	20	19	27	18	5
(30B)	24	10	34	17	4
Asks pupils for more than one solution (31A)	2	9	12	31	35
(31B)	1	11	10	30	37
Appropriate wait-time between questions/responses	1	19	39	7	23
(32B)	2	19	35	6	27
Notes pupils' mistakes (33A)	1	19	19	39	11
(33B)	1	20	22	42	4
Guides pupils through errors (34A)	1	10	28	13	37
(34B)	1	12	17	13	46
Clears up misconceptions (35A)	1	1	15	21	51
(35B)	1	0	20	24	44
Gives immediate mathematical feedback (36A)	0	1	3	27	58
(36B)	1	0	8	24	54
Gives accurate mathematical feedback (37A)	2	1	43	21	22
(37B)	1	0	40	16	32
Gives positive academic feedback (38A)	1	0	21	31	36
(38B)	2	1	21	31	34

Appendix 7.4 – Frequency of Teacher Behaviours from Datasets A and B (continued). Key: 1 (*never*), 2 (*occasionally*), 3 (*sometimes*), 4 (*frequently*), 5 (*consistently*).

Mathematics Enhancement Strategies (item)	**1**	**2**	**3**	**4**	**5**
Employs realistic problems/ examples (39A)	3	38	23	9	16
(39B)	1	34	25	16	13
Encourages/teaches the pupils to use a variety of	1	0	3	26	59
(40B)	4	0	5	24	56
Uses correct mathematical language (41A)	2	33	21	7	26
(41B)	1	30	20	4	34
Encourages pupils to use correct mathematical language	3	34	25	10	17
(42B)	2	37	25	7	29
Mathematics Enhancement Strategies	**1**	**2**	**3**	**4**	**5**
Allows pupils to use their own problem-solving	19	14	26	10	20
(43B)	10	28	30	12	9
Implements quick-fire mental questions/strategies (44A)	4	52	17	8	8
(44B)	7	42	18	10	12
Connects new material to previously learnt material	0	0	31	16	42
(46B)	2	3	23	19	42
Variety of Teaching Methods					
Uses a variety of explanations that differ in complexity	0	12	43	18	16
(47B)	0	12	45	19	13
Uses a variety of instructional methods (48A)	0	16	31	28	14
(48B)	1	12	21	30	25
Uses manipulative materials/instructional aids/resources	0	40	15	20	14
(49B)	2	36	16	22	13
Positive Classroom Climate					
Communicates high expectations for pupils (50A)	1	3	38	30	17
(50B)	1	1	44	24	19
Exhibits personal enthusiasm (51A)	1	3	31	34	20
(51B)	1	3	34	42	19
Displays a positive tone (52A)	1	3	24	37	24
(52B)	1	2	26	37	23
Encourages interaction/communication (53A)	0	28	12	36	13
(53B)	3	28	10	41	7
Conveys genuine concern for pupils (54A)	1	3	25	40	20
(54B)	1	3	28	34	23
Knows and uses pupils' names (55A)	1	2	0	0	86
(55B)	1	2	0	0	87
Displays pupils' work in the classroom (56A)	8	22	30	18	11
(56B)	5	24	34	21	5
Prepares an inviting/cheerful classroom (57A)	2	2	31	34	20
(57B)	2	2	36	26	23

APPENDICES TO CHAPTER 8

Appendix 8.1 – Effect Sizes for Categorical and Continuous Variables. (Tymms, Merrell & Henderson, 1997).

Categorical Variables

Effect sizes are calculated by dividing the coefficient for the categorical predictor variable by the square root of the pupil level variance.

$\Delta = \beta_1 / \sigma_e$

Continuous Variables

Effect sizes for are calculated by dividing the coefficient for the categorical predictor variable being multiplied by the standard deviation of the continuous predictor variable with the resultant product divided by the square root of the pupil level variance.

$\Delta = \beta_1 * \text{ sd x } 1 / \sigma_e$

Appendix 8.2 – Effect Sizes from the Head Teacher/School Model (Model 5) for Attainment at Age 6

Pupil level (reference category)	**Estimate**	**SE**	**Z**	**Effect size**
At risk (typically-developing)	-4.673***	1.695	-0.754	-0.38
Father's occupation (medium**)**				
High	1.508*	0.407	0.302	0.12
Low	-2.540^{ns}	1.180	-0.238	-0.20
Mother's occupation (medium**)**				
High	1.424^{ns}	0.742	0.457	0.15
Low	-1.935*	0.442	-0.069	-0.16
Mother's education (medium**)**				
High	2.268*	0.887	0.147	0.19
Low	-1.291^{ns}	1.126	-0.039	0.10
Learning support assistant support (typically-developing)	-4.015**	1.015	-0.759	-0.33
Complementary teacher support (typically-developing)	-6.340***	1.006	-0.643	-0.52
Classroom level (reference category)				
ABACUS topics covered (up to spring)				
Up to summer	8.726*	3.403	0.101	0.72
Teachers' instructional beliefs (item and reference category)				
Pupils must be taught how to decode a word problem (11, agree)				
Do not know	2.218*	0.823	0.147	0.26
Disagree	1.172^{ns}	0.628	0.007	0.10
Pupils learn mathematics by working sums out on paper (42, agree)				
Do not know	na	na	na	na
Disagree	-2.974***	0.411	-0.070	- 0.24

na = not applicable since cases amounted to 5 or less, ns = not significant,

*p < 0.05, **p < 0.01, ***p < 0.001

Appendix 8.2 – Effect Sizes from the Head Teacher/School Model (Model 5) for Attainment at Age 6 (continued)

Classroom level (item and reference category)	**Estimate**	**SE**	**Z**	**Effect size**
Pupils do not need to be able to read/write/speak English to learn mathematics (46, agree)				
Do not know	na	na	na	na
Disagree	1.153**	0.362	0.225	0.10
Engaging pupils in meaningful talk is the best way to teach mathematics (8, agree)				
Do not know	0.902^{ns}	0.524	0.155	0.07
Disagree	1.013*	0.426	0.224	0.08
Teachers must help pupils refine their problem-solving methods (35, agree)				
Do not know	na	na	na	na
Disagree	-4.986*	2.178	-0.023	0.41
Teachers' instructional behaviours				
Displays pupils work in the classroom (56, rarely observed)				
Somewhat observed	2.871*	0.806	0.008	0.24
Frequently observed	4.682***	1.407	0.102	0.38
Sees that disruptions are limited (5, rarely observed)				
Somewhat observed	na	na	na	na
Frequently observed	3.427*	1.152	0.015	0.28
Prepares an inviting/cheerful classroom (57, rarely observed)				
Somewhat observed	-5.326***	1.201	-0.287	-0.27
Frequently observed	-2.218***	0.187	-0.147	-0.18
Uses a reward system to manage pupil behaviour (6, rarely observed)				
Somewhat observed	-1.235*	0.526	-0.302	-0.10
Frequently observed	-0.927*	0.318	-0.148	-0.08

na = not applicable since cases amounted to 5 or less, ns = not significant,

*p < 0.05, **p < 0.01, ***p < 0.001

Appendix 8.2 – Effect Sizes from the Head Teacher/School Model (Model 5) for Attainment at Age 6 (continued)

School level (reference category)	**Estimate**	**SE**	**Z**	**Effect size**
Age of head teacher (55 to 61 years)				
45 to 54 years	3.174**	0.817	0.103	0.26
35 to 44 years	7.100**	1.427	0.130	0.58

na = not applicable since cases amounted to 5 or less, ns = not significant, *p < 0.05, **p < 0.01, ***p < 0.001

Appendix 8.3 – Effect Sizes from the Head Teacher/School Model (Model 5) for Progress

Pupil level (reference category)	**Estimate**	**SE**	**Z**	**Effect size**
Prior attainment	0.379***	0.030	-0.001	0.01
At risk (typically-developing)	-4.455***	1.681	-0.660	-0.40
Learning assistant support (typically-developing)	-3.467**	1.789	-0.560	-0.31
Complementary teacher support (typically developing)	-5.261***	0.972	-0.571	-0.48
Classroom level (reference category)				
ABACUS topics covered (up to spring)				
Up to summer	5.679***	1.618	0.278	0.51
Teacher beliefs (item, reference category)				
Pupils must be taught how to decode a word problem (11, agree)				
Do not know	2.021*	0.875	0.038	0.18
Disagree	1.142^{ns}	0.608	0.177	0.10
Pupils learn mathematics by working sums out on paper (42, agree)				
Do not know	na	na	na	na
Disagree	1.084***	0.126	0.118	0.10
Pupils do not need to be able to read/write/speak English to learn mathematics (46, agree)				
Do not know	na	na	na	na
Disagree	1.124***	0.126	0.109	0.10
Pupils may be taught any method as long as efficient (48, agree)				
Do not know	na	na	na	na
Disagree	-1.113*	0.526	-0.416	-0.10

na = not applicable since cases amounted to 5 or less, *p < 0.05,**p < 0.01,***p < 0.001.

Appendix 8.3 – Effect Sizes from the Head Teacher/School Model (Model 5) for Progress (continued)

Engaging pupils in meaningful talk is the best way to teach mathematics (8, agree)	**Estimate**	**SE**	**Z**	**Effect size**
Do not know	0.688ns	0.584	0.251	0.06
Disagree	-1.335*	0.550	-0.481	-0.12
Teachers must help pupils refine their problem-solving methods (35, agree)				
Do not know	na	na	na	na
Disagree	-4.300**	1.269	0.158	-0.40
Teachers' Instructional Behaviours				
Offers assistance to pupils (20, frequently observed)				
Somewhat observed	-1.128*	0.486	-0.104	-0.10
Rarely observed	-3.077*	1.816	-0.409	-0.28
Probes further when responses are incorrect (28, frequently observed)				
Somewhat observed	-0.482*	0.109	-0.029	-0.04
Rarely observed	-1.048**	0.380	-0.096	-0.09
Uses appropriate wait-time between questions/responses (32, frequently observed)				
Somewhat observed	-1.001*	0.382	-0.118	-0.09
Rarely observed	-2.304*	1.009	-0.199	-0.21
Notes pupils' mistakes (33, frequently observed)				
Somewhat observed	-1.311*	0.378	-0.142	-0.12
Rarely observed	-4.231*	1.757	-0.254	-0.38
Gives positive academic feedback (38, frequently observed)				
Somewhat observed	-2.527*	0.604	-0.234	-0.23
Rarely observed	na	na	na	na

na = not applicable since cases amounted to 5 or less, *p < 0.05,**p < 0.01,***p < 0.001.

Appendix 8.3 – Effect Sizes from the Head Teacher/School Model (Model 5) for Progress (continued)

Uses a variety of explanations that differ in complexity (47, frequently observed)	**Estimate**	**SE**	**Z**	**Effect size**
Somewhat observed	2.072**	0.915	0.175	0.19
Rarely observed	na	na	na	na
Displays pupils work in the classroom (56, frequently observed)				
Somewhat observed	-0.871^{ns}	0.806	-0.042	-0.08
Rarely observed	-3.682**	1.407	-0.254	-0.33
Sees that disruptions are limited (5, frequently observed)				
Somewhat observed	na	na	na	na
Rarely observed	3.455*	1.154	0.015	0.29
Takes care that tasks/materials are collected/distributed effectively (4, rarely observed)				
Somewhat observed	na	na	na	na
Frequently observed	3.427*	1.152	0.149	-0.31
School level				
Age of head teacher (55 to 61 years)				
45 to 54 years	3.174**	0.817	0.172	0.28
35 to 44 years	7.100**	1.427	0.379	0.64

na = not applicable since cases amounted to 5 or less, *p < 0.05,**p < 0.01,***p < 0.001.