

This electronic thesis or dissertation has been downloaded from the King's Research Portal at <https://kclpure.kcl.ac.uk/portal/>



**Primary mathematics teaching reform in a small island developing state
the case of the Mathematics Lesson Structure in the Seychelles**

Valentin, Justin

Awarding institution:
King's College London

The copyright of this thesis rests with the author and no quotation from it or information derived from it may be published without proper acknowledgement.

END USER LICENCE AGREEMENT



Unless another licence is stated on the immediately following page this work is licensed under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International licence. <https://creativecommons.org/licenses/by-nc-nd/4.0/>

You are free to copy, distribute and transmit the work

Under the following conditions:

- Attribution: You must attribute the work in the manner specified by the author (but not in any way that suggests that they endorse you or your use of the work).
- Non Commercial: You may not use this work for commercial purposes.
- No Derivative Works - You may not alter, transform, or build upon this work.

Any of these conditions can be waived if you receive permission from the author. Your fair dealings and other rights are in no way affected by the above.

Take down policy

If you believe that this document breaches copyright please contact librarypure@kcl.ac.uk providing details, and we will remove access to the work immediately and investigate your claim.

This electronic theses or dissertation has been downloaded from the King's Research Portal at <https://kclpure.kcl.ac.uk/portal/>

Title: Primary mathematics teaching reform in a small island developing state: the case of the Mathematics Lesson Structure in the Seychelles

Author: Justin Valentin

The copyright of this thesis rests with the author and no quotation from it or information derived from it may be published without proper acknowledgement.

END USER LICENSE AGREEMENT



This work is licensed under a Creative Commons Attribution-NonCommercial-NoDerivs 3.0 Unported License. <http://creativecommons.org/licenses/by-nc-nd/3.0/>

You are free to:

- Share: to copy, distribute and transmit the work

Under the following conditions:

- Attribution: You must attribute the work in the manner specified by the author (but not in any way that suggests that they endorse you or your use of the work).
- Non Commercial: You may not use this work for commercial purposes.
- No Derivative Works - You may not alter, transform, or build upon this work.

Any of these conditions can be waived if you receive permission from the author. Your fair dealings and other rights are in no way affected by the above.

Take down policy

If you believe that this document breaches copyright please contact librarypure@kcl.ac.uk providing details, and we will remove access to the work immediately and investigate your claim.

**Primary mathematics teaching reform in a small island
developing state: the case of the Mathematics Lesson
Structure in the Seychelles**

Justin Davis Valentin

2013

Thesis submitted in fulfilment of the requirements for the

Doctor of Philosophy degree

School of Social Science and Public Policy

King's College London

Abstract

This thesis investigates the impact of a mandatory primary mathematics teaching reform on teaching and achievement in the context of Seychelles. The reform was implemented in 2006 as a strategy initially to improve mathematics teaching and ultimately the pupils' achievements. The Mathematics Lesson Structure (MLS) reform aimed to encourage a more coherent structure to mathematics lessons, provide variations in pupils' learning experiences, and facilitate school-based teacher learning. The thesis focuses on the outcomes of the reform. Taking this reform as a case study, the thesis explores systemic policy reform in a small developing state.

The research employed a mixed methods design for data collection. A questionnaire was administered to a group of teachers involved in the teaching of mathematics in primary schools ($n = 219$). Four schools were selected for in-depth fieldwork. In each of the four schools, a six-teacher focus group interview was carried out, and samples of lessons, amounting to 22 lessons, were observed. A focus group interview was held with a group of 8 mathematics subject leaders. Additional interviews were conducted with 2 education officers who worked with teachers in schools. Secondary data were drawn from two projects: Improving Pupils' Achievements in Mathematics or IPAM, and Southern African Consortium for Monitoring Educational Quality or SACMEQ. Pupils sample size for the SACMEQ II, III and IPAM data files were $n = 1484$, $n = 1480$, and $n = 1080$ respectively. The IPAM data also consisted of teacher questionnaires and interview responses.

The results indicate that the reform was beneficial to the teachers and the subject leaders in a number of ways. The teachers overwhelmingly liked the reform but lesson observation data show that they were not necessarily complying as they reported. Observation data also show that the lessons deviated from the contemporary vision of what mathematics lessons should look like. Teachers' accounts of their experiences suggest that the primary schools were challenging sites for pedagogical reform. Data about the pupils' achievements show no progress in performance from 2006 to 2007 but an improvement in 2009. The use of MLS reduces variability in pupils' performances. These results have implications for in-service teacher education, pedagogical reform, and policy implementation in small developing states.

Acknowledgment

- I would like to thank my supervisors, Professor Jeremy Hodgen and Professor Mike Askew for their guidance. Prof. Askew helped me to establish the focus of the study until Professor Hodgen took over. I learned so much from Professor Hodgen who taught me how to communicate my ideas and turn this thesis into something useful for the teachers in SIDS.
- I would like to thank my wife, Monica, and my children, Joshua and Caleb for their support, understanding, and for bearing with me. Yes, finally it's over.
- I would like to thank my brothers and sisters: Michel, Bernard, Tianne, and Flossy for their social and financial supports. Thank you to my mother for her morale support.
- Thanks to Jacqueline & Cliff Philoe for being a sister and brother to me. Thank you for lending me their house during the day so that I could study peacefully. They helped me in so many other ways. Jacqueline & Cliff along with Annabelle & Danny Rath, Alice & Ronny Marguerite, and Andrew & Mathilda Banane, made sure that my family and I had a social life in UK. Thanks to Annisha, Annalisa, Hayley, Tiah, Aaron, and Charice, for giving my boys a social network.
- Thanks to my in-laws for supporting my family in so many ways.
- Thanks to the Commonwealth Scholarship Commission, British Council, and the Seychelles Ministry of Education for making this course possible.
- A special thank you to all the teachers and subject leaders who participated in this study and to the management of the primary schools in Seychelles who gave me access to their school.
- Thanks to Donna Assary and Dianne Vidot who helped with the questionnaire data entry and to Jacqueline Kinloch who helped transcribing some interviews.
- Thank you to God for everything. I am blessed in so many ways.

Table of contents

Abstract.....	2
Acknowledgment	3
Table of contents.....	4
Table of tables.....	10
Table of figures.....	13
Terms and Abbreviations.....	14
CHAPTER 1 INTRODUCTION OF THE THESIS	15
1.1 Background of the research.....	16
1.1.1 The international context	16
1.1.2 The local context.....	19
1.2 The Mathematics Lesson Structure (MLS) reform.....	22
1.2.1 Description of MLS	23
1.2.2 Development of MLS.....	24
1.2.3 The context of mathematics teaching in Seychelles	25
1.3 Developing a research agenda	26
1.3.1 A policy agenda	27
1.3.2 Curriculum development agenda	29
1.3.3 Personal motivation.....	30
1.4 Aims of the research	31
1.5 Research questions.....	31
1.6 Significance of the study.....	32
1.7 My position as the researcher	33
1.8 Outline of the other chapters	34
CHAPTER 2 LITERATURE REVIEW	35
2.1 Policy implementation as a domain of research.....	35
2.1.1 Policy implementation: scope for teacher learning	36
2.1.2 Developing a classroom perspective of policy implementation.....	37
2.1.3 Fostering school-based support structure.....	44
2.1.4 The issue of sustainability.....	50
2.2 State of educational reform literature in SIDS	53

2.3	Development of knowledge for local use.....	58
2.3.1	The local context of policy reform.....	58
2.3.2	Research literature in the Seychelles.....	64
2.3.3	Developing knowledge about the reform.....	65
2.4	The NNS: implications for Seychelles	67
2.4.1	Some significant findings about NNS.....	69
2.5	Conceptual framework of the study.....	71
2.6	Summary	74
CHAPTER 3 METHODOLOGY		76
3.1	Operationalizing the study.....	76
3.2	Approach to social inquiry.....	80
3.2.1	The ontological and epistemological issues.....	80
3.2.2	Philosophical assumptions of this research.....	83
3.2.3	Social research in the small states.....	85
3.3	Design of the research	86
3.3.1	Rationale for the design	87
3.4	Mixed methods as an inquiry approach	92
3.4.1	Research methods	93
3.4.2	Rationale for the selection of methods.....	94
3.5	Development of the instruments.....	95
3.5.1	The tests	95
3.5.2	The questionnaire.....	97
3.5.3	The teacher and subject leader focus group interview	99
3.5.4	Classroom observation.....	100
3.5.5	The post lesson interview.....	102
3.5.6	The key informant interview.....	103
3.5.7	Piloting the instruments	103
3.6	Data collection for the main study	105
3.6.1	Access to secondary data	105
3.6.2	The questionnaire survey	106
3.6.3	Selection of the schools for the in-depth study	106
3.6.4	Lesson observation and post lesson interview	108
3.6.5	Teacher focus group interviews	109
3.6.6	Collection of contextual data	110
3.6.7	Subject leader focus group interviews	111
3.6.8	Key informant interviews.....	111

3.7	Validity, reliability, and reflexivity issues	112
3.7.1	Validity and Reliability in the quantitative dimension of this study.....	112
3.7.2	Validity and reliability in the qualitative dimension of this study	113
3.7.3	The Issue of Reflexivity.....	113
3.8	Ethical considerations	114
3.9	Summary	115
CHAPTER 4 DATA AND ANALYSES		118
4.1	Pupils' achievement data	119
4.1.1	The SACMEQ data.....	119
4.1.2	The IPAM Data.....	120
4.2	Teacher questionnaire	121
4.2.1	Validity and reliability of the questionnaire.....	121
4.2.2	Test of normality.....	124
4.2.3	Teacher demographic.....	124
4.2.4	Gender of teacher participants in the questionnaire.....	126
4.2.5	Teaching cycles (grade levels).....	127
4.2.6	Teacher age group and length of teaching mathematics	128
4.2.7	Teacher qualifications.....	129
4.2.8	Distribution of the respondents across geographical region	129
4.2.9	Mathematics teaching loads.....	130
4.2.10	Pupils per mathematics teacher.....	131
4.3	The teacher focus group interviews	131
4.4	The subject leader focus group participants	132
4.5	The classroom teacher participants and data	132
4.6	The key informant data.....	133
4.7	Approach to qualitative data analysis	134
4.8	Approach to analyzing the lesson observation data	138
4.9	Trustworthiness	138
4.10	Summary	139
CHAPTER 5 CONTRIBUTIONS OF MLS FROM THE PERSPECTIVE OF THE MAIN IMPLEMENTERS		140
5.1	Teachers' reporting on MLS	141
5.1.1	Teachers' impression of MLS during the pilot stage.....	141
5.1.2	Teachers' impressions during the early years of the reform.....	143
5.1.3	Teachers' impressions five years into the reform	146

5.2	Teachers and their pedagogy	156
5.2.1	Teachers reporting on their general practices	157
5.2.2	Strategies of engaging the pupils in lessons.....	162
5.3	Determining the impact of the MLS on practices.....	166
5.4	Relationship between teachers' use of MLS and other variables	172
5.5	Outcomes from the key informants' perspective.....	173
5.5.1	Overall impression	173
5.5.2	A lens for viewing lesson.....	175
5.5.3	Indication of what constitute effective mathematics lesson.....	176
5.5.4	Source of teachers' strengths and weaknesses	177
5.5.5	A context for school – level change.....	178
5.6	Summary	180
CHAPTER 6 THE ACTUAL MATHEMATICS LESSONS.....		182
6.1	Framework for analyzing the lessons	182
6.1.1	Structure.....	183
6.1.2	Instructional content.....	188
6.1.3	Summary of the framework	193
6.2	Inquiring about the lesson structure.....	194
6.2.1	Patterns of the lesson.....	195
6.2.2	Content analysis of the lessons	201
6.2.3	The quality of the lessons.....	210
6.2.4	Summary of analysis on lesson structure	213
6.3	Analysis of engagement tasks	214
6.3.1	Classification of tasks	215
6.3.2	The issue of differentiation	223
6.4	Inquiry into classroom discourse	226
6.4.1	Findings in relation to classroom discourse	227
6.4.2	Analysis of Freda's lesson	229
6.4.3	Analysis of Jill's lesson.....	235
6.4.4	Overall analytical remarks of the two lessons.....	240
6.5	Summary	243
CHAPTER 7 PUPILS' MATHEMATICS ACHIEVEMENTS.....		244
7.1	Cross sectional analysis of achievements.....	245
7.2	Longitudinal achievements	250
7.3	Variability in achievement scores.....	263

7.4 Summary	264
CHAPTER 8 THE IMPLEMENTERS' EXPERIENCES	266
8.1 Mediating instructional change	266
8.2 Affordances	268
8.2.1 Teacher collegiality.....	268
8.2.2 Support from the subject leaders.....	273
8.3 Challenges to enacting reform.....	276
8.3.1 The rigidness of the reform.....	276
8.3.2 Instructional demand.....	280
8.3.3 External support.....	285
8.3.4 Programme and availability of resources.....	288
8.3.5 Learners' engagement.....	289
8.4 Summary	290
CHAPTER 9 DISCUSSION	292
9.1 Overview of the findings	292
9.1.1 Impact on teaching.....	293
9.1.2 Impact on achievements.....	294
9.1.3 Implementers' experiences	294
9.2 Impact of MLS on teaching	294
9.2.1 Findings drawn from the self-reported data.....	295
9.2.2 Findings drawn from the classroom observation data.....	302
9.2.3 Response to teaching needs.....	305
9.3 Impact on pupils' achievements	308
9.4 Implementers' description of their experiences.....	313
9.4.1 Teacher-teacher collaboration.....	313
9.4.2 Leadership capacity.....	315
9.4.3 Challenges to policy implementation.....	316
9.5 MLS reform in the context of the change discussion model	321
9.5.1 The culture	322
9.5.2 Collective capacity	324
9.6 Summary	328
CHAPTER 10 CONCLUSION	332
10.1 Successes and failures of the reform.....	333
10.1.1 Successful aspects of the reform.....	333
10.1.2 Less successful aspects of the reform	334

10.1.3	Some failures of the reform	335
10.2	Implications for education in Seychelles.....	336
10.2.1	Development of mathematics education	336
10.2.2	Future policy reform in curriculum areas.....	337
10.2.3	Professional development of teachers.....	337
10.3	Implications for the reform in the small states.....	339
10.3.1	Was the approach appropriate?.....	340
10.3.2	Can the MLS successes be sustained?	342
10.4	Limitations	344
10.5	Further research.....	345
10.6	Reflection	345
10.6.1	Reforming teaching in Seychelles: my perspective	346
10.6.2	Reflection on this study.....	346
10.7	Concluding remarks	347
References	349
APPENDIX 1.	BACKGROUND OF SEYCHELLES	372
APPENDIX 2.	OFFICIAL REQUEST.....	377
APPENDIX 3.	INFORMATION SHEET FOR PARTICIPANTS	379
APPENDIX 4.	CONSENT FORMS.....	381
APPENDIX 5.	INFORMATION SHEET FOR THE PUPILS	382
APPENDIX 6.	MATHEMATICS LESSON STRUCTURE TEMPLATE	383
APPENDIX 7.	SACMEQ LEVEL DESCRIPTORS.....	385
APPENDIX 8.	TEACHER QUESTIONNAIRE	386
APPENDIX 9.	TEACHER FOCUS GROUP INTERVIEW.....	393
APPENDIX 10.	SUBJECT LEADER FOCUS GROUP INTERVIEW	394
APPENDIX 11.	KEY INFORMANT INTERVIEW.....	395
APPENDIX 12.	ITEMS COMMON TO SACMEQ AND IPAM TESTS	396
APPENDIX 13.	MLS EVALUATION LESSON OBSERVATION.....	399
APPENDIX 14.	POST LESSON OBSERVATION INTERVIEW.....	401
APPENDIX 15.	INDICATION OF CODING AND CATEGORIZING	402

Table of tables

Table 1.1	Results of P6 national examination showing the mean (%) by subject by year.....	20
Table 1.2	Distribution of 2000 P6 pupils over each of the competency levels.....	20
Table 1.3	Progression of mathematics lessons as advocated by the MLS	24
Table 3.1	Overview of the methods, sampling and data analyses as related to the research questions.....	90
Table 3.2	Blueprint reflecting the distribution of test items by grade (standards) by competency levels	97
Table 3.3	Strands covered by the questionnaire.....	98
Table 3.4	Summary of data collection processes	116
Table 4.1	Summary of principal component analysis	123
Table 4.2	Distribution of schools by size classification and by geographical locations.....	125
Table 4.3	Demographic information about the teachers	126
Table 4.4	Background of the participants in the focus group interviews.....	132
Table 4.5	Description of the teachers who were observed and interviewed.....	133
Table 5.1	Teachers' motivation to using MLS in their daily practice.....	145
Table 5.2	Mean and standard deviation of items inquiring about the teachers' opinion on MLS: Data presented by teachers' grade levels.....	149
Table 5.3	Computed indices for representing teachers' attitude to MLS.....	150
Table 5.4	Kruskal – Wallis test results for the comparison between various groups of teachers and their self-rating index score on attitudes to MLS	151
Table 5.5	The correlation coefficients between 'Good idea to introduce MLS' with eight descriptive variables	152

Table 5.6	Statistics for items measuring the teachers' reflection of their practices.....	158
Table 5.7	Teachers' pattern of responses for the three most and least popular practices as occurred from the survey.....	160
Table 5.8	Correlation of pattern instructional practices across cycle.....	161
Table 5.9	Item statistics relating to teachers' reported ways of engaging pupils.....	164
Table 5.10	Percentage distributions of teachers within the different quartile groups for the variables, cycles and age group.....	168
Table 5.11	Mean score per quartile for some selected teacher practices and was of engaging pupils in the lessons.....	171
Table 5.12	Comparison of mean for teachers of the different quartile groups on five major variables.....	172
Table 6.1	Evidence of MLS in actual lessons.....	195
Table 6.2	Patterns of lessons that emerged from the 22 lessons.....	199
Table 6.3	Rubric for assessing the cognitive demand of tasks.....	214
Table 6.4	Classification of tasks according to their cognitive demand for the 22 lessons observed.....	216
Table 7.1	Basic statistics for the three tests.....	246
Table 7.2	Comparison of item means: SACMEQ II (y items) and its corresponding SACMEQ III (z items).....	246
Table 7.3	Nature of items at which 2007 cohort performed better.....	248
Table 7.4	Nature of items at which 2000 cohort performed better.....	249
Table 7.5	Comparison of distribution of pupils over the SACMEQ numeracy levels.....	250
Table 7.6	Comparison of item means for the nine items which appears on all the tests from 2006 (P3) through 2009 (P6).....	252
Table 7.7	Comparison of item facility indices for the nine items which appear on all the tests from 2007(P4) through 2009 (P6).....	256
Table 7.8	Alignment of items common to the SACMEQ and the IPAM tests along with their respective means (difficulty indices).....	261
Table 7.9	Comparison of the SACMEQ results against the IPAM results.....	262
Table 7.10	Comparison of variations using the interquartile range.....	264

Table 8.1	Teachers' responses to items measuring the frequency of teacher collaborative activities	269
Table 8.2	Comparison of various teacher groups on their attitudes to school-based collegiality	271
Table 8.3	Kruskal-Wallis test results for the comparison between various groups of teachers and their self rating index score on school based collegiality	272
Table 8.4	Percentages of teachers agreeing and disagreeing to items about school leadership support	274
Table 8.5	Comparison of various teacher groups on their attitudes to school based support structure	275
Table 8.6	Teachers' reported frequency of using each element of the MLS lesson template	284

Table of figures

Figure 4.1	Bar graph showing the number of teachers (only those who indicated the level at which they taught) across the three main cycles.....	128
Figure 5.1	Bar graph showing the teachers' reported frequency of using MLS for organizing and structuring the lessons (n = 211).	147
Figure 6.1	General segments (lesson pattern) of mathematics lessons in USA.....	185
Figure 6.2	Comparison of the observed lessons to the MLS reform requirement.....	197
Figure 6.3	Exercises allocated to two different ability groups in one class [GT12]	224
Figure 6.4	Solution of 2 groups to the question, 18×13	238
Figure 7.1	Growth curves drawn for the items A, B, C.....	253
Figure 7.2	Growth curves drawn for the items D to I.....	254
Figure 7.3	Growth curves drawn for items J, K...and O.....	257
Figure 7.4	Stacked bar chart showing the percentage distribution of P2 to P6 pupils attaining the different mathematics competency levels.....	258
Figure 7.5	Box plot for the score distributions for the P2 to P6 test	263

Terms and Abbreviations

FGD	Focus Group Discussion
IIEP	International Institute of Educational Planning
IPAM	Improving Pupils' Achievements in Mathematics (a national mathematics project in Seychelles which started in 2003)
MLS	Mathematics Lesson Structure – The name of the reform being studied
MWG	Mathematics Working Group (The focal group in the Ministry of Education in Seychelles mandated since 2003 to spearhead activities in relation to improving mathematics education in schools)
NNS	National Numeracy Strategy
North	A term used to describe the industrialized developed countries
SACMEQ	Southern & Eastern African Consortium for Monitoring Educational Quality – It's a regional organization under the auspice of IIEP
Seychellois	Natives (citizens) of the Seychelles
SIDS	Small Island Developing States (used interchangeable with small states) – It's a grouping of islands of the commonwealth states with a population less than 1.5 million and are characterised by their vulnerability in the areas of defence, security, environmental disasters and limited human and economic resources.
SIP	School Improvement Programme
South	A term used to describe the developing countries.

CHAPTER 1 Introduction of the thesis

The research reported in this thesis investigates the impact of a mandatory primary mathematics teaching reform on teaching and achievement in the context of the Seychelles. Implementation of the Mathematics Lesson Structure (MLS) reform started in 2006 as a strategy to improve, initially, mathematics teaching and, ultimately, pupils' achievement. The first wave of the reform was completed in 2009, making this investigation timely and appropriate. The reform aimed to encourage a more coherent structure to mathematics lessons, provide variations in pupils' learning experiences, and facilitate school-based teacher-learning. My main focus in this study is on the outcomes of the reform. Other concerns relate to the development of a school-based support structure for the teachers, and teacher learning in the Seychelles. Taking this reform as a case study, the study explores policy implementation in a small developing state.

The aim of this chapter is to introduce the thesis. First I situate the research in an international and a national context. I argue that different educational movements across many countries led to the development of the reform quest. Hence this study has international and national relevance. I then describe the reform being evaluated followed by a description of the research agenda underpinning this study. Afterward I detail the significance of this study. I also find it relevant to discuss my past involvement with the reform. I close this chapter by outlining the focus of the nine other chapters of this thesis.

1.1 Background of the research

This research reflects the influence of several educational movements on local policy development in the Seychelles. I begin this section by situating the development of mathematics education in Seychelles within an international context. Then I describe the local context which led to the introduction of the reform. This study contributes towards knowledge on policy enactment in small island developing states (SIDS).

1.1.1 The international context

The quest to reform mathematics education across the world has been extensive. The nature and emphasis of reform have been diverse. According to Ross, McDougall, and Hogaboam-Gray (2002) mathematics education reforms have generally been triggered by three major factors: i) the impingement of learning by traditional teaching ii) the endorsement of the idea that mathematics education needs to equip students with sound technological skills and iii) the tendency to shift the goals for mathematics learning towards a social constructivist approach. The latter factor has received most attention. It may be viewed as the approach to improving the first factor. Ross et al. (2002) make two significant observations. They contend that i) the implementation of reform has been a complex activity in education such that even teachers who are considered exemplary in enacting reform ideas have not been consistent over time and ii) the many suggestions to lessen some of the drawbacks to reforming mathematics education, whilst promising, have themselves been complex and at times somewhat contradictory. Nevertheless, scholars have been actively engaged in research to raise the quality of teaching and learning in this area of the curriculum.

On a global level, improving pupils' learning has always been the main target of most of the mathematics reform campaigns (Australian Education Council, 1991; Cockcroft, 1982; NCTM, 2000). Mathematics lessons involving investigative work have been apparent in mathematics reform agendas in several countries. In the Netherlands for example, Gravemeijer (2004) asserts that reforming mathematics education requires instruction that helps students in developing their current ways of reasoning into more sophisticated ways of mathematical reasoning. He points to the proactive role of the teachers in establishing an appropriate classroom culture, in choosing and introducing instructional tasks, organizing group work, framing topics for discussion, and orchestrating discussion. Stacey (2005) argues that teachers should strive to ensure that more students achieve excellence in developing problem solving and investigative skills.

Taking into consideration what the mathematics community is currently advocating, it will be a real shift of vision if a new reform movement is successful in refuting the argument that mathematics teaching should be approached using an investigative framework. The argument about the investigative feature of mathematics lessons is generally well-established amongst scholars and educators in this field.

Reform in mathematics education has been varied in nature and scope. Certainly, there have been special events and occurrences in some countries, which have triggered reforms in their national mathematics education curricular. In England, for example, the publication of the results of international surveys such as the Third International Mathematics and Science Study (TIMSS) (Mullis et al., 1997) caught the attention of the government which, along with other events, in particular media interest, led to the setting up of inquiries into mathematics teaching and,

ultimately, the emergence of the National Numeracy Strategy (NNS) (Brown, Millett, Bibby, & Johnson, 2000; Leithwood, Jantzi, & Mascal, 2002). In Malaysia, in 2002, the government made a call to change the medium of instruction of mathematics in state schools following concerns that Malaysian students were losing out as they were not able to communicate fluently in English and there were insufficient means of translating scientific terms and theorems from English to Malay (Gill, 2005).

Generally however, calls to reform aspects of the mathematics education curriculum are generally a function of factors and events happening on an international level. International context provides encouragement for reform-minded governments to view education as a source of solutions to many of their economic and social constraints (Leithwood et al., 2002). This is especially relevant in the context of small education systems where research and scholarly work are limited: international occurrences set the agenda and directions for reform movements. Small states like Seychelles have benefited from various international contexts to obtain an agenda for reforming mathematics education curriculum. Nevertheless, unique social, political and economic factors within a specific cultural jurisdiction shape, in powerful ways, the nature of the reform strategies and, subsequently, their outcomes (Leithwood et al., 2002).

As noted earlier, one interesting observation in most of the reform initiatives in mathematics education across the world suggests that improving pupils' achievements in the subject has been the overarching goal. Many countries are striving to improve their position in league tables of international education survey results (Takayama, 2008). Publication of league tables of international achievement studies stimulates national debates at the highest level and provides insight into

challenging educational issues (Brown, 1996; Riley & Torrance, 2003), as well as naming and shaming countries. For most countries, their participation in international achievement studies provides a means to evaluate the effectiveness of their education systems or simply to gain a feel for their position in relation to other countries in the same economic state of development (Johnson, 1999).

The debate about international achievement surveys permeates even within developing countries. Currently, the Education For All (EFA) goals are the benchmarks (Buchert, 1995; Goldstein, 2004). Seychelles is attempting to achieve all these goals. The general atmosphere being felt within the country is that its government wants to take a leading role in education amongst the African nations. The introduction of the regional SACMEQ studies (Murimba, 2005) had offered the participating countries opportunity to ascertain the quality of their education system and a means to compare their systems against the other countries within the consortium. In Seychelles, results of the SACMEQ studies have also been used to instigate local curricular projects and formulate policy suggestions (Leste, Valentin, & Hoareau, 2005).

1.1.2 The local context

2003 was especially important for the development of mathematics education in Seychelles. Local examiners began to report that pupils' performance in mathematics was weak. Mathematics featured as the worst performing subject by primary school pupils for the five preceding years, 1998 – 2002, and performance appeared to be declining (See Table 1.1). Although pupils' performance in English was showing a similar decreasing trend, the consensus was to give attention to mathematics. The results indicated that mathematics was the worst performing subject by pupils (average age, 11 yrs old) at Primary Six level. Other small-scale research (e.g.,

Khosa, Kanjee, & Monyooe, 2002; Trencansky, 2002; Valentin, 2003) suggested the same findings.

Table 1.1 Results of P6 national examination showing the mean (%) by subject by year

Subjects	Last five years preceding the inception of the IPAM project				
	1998	1999	2000	2001	2002
English	56.8	51.9	50	49.6	41.7
French	62	50.6	58	46.7	53.2
Creole	55.3	54	56	49.9	51.5
Mathematics	43	40.2	41	36.5	29.9
Science	53.2	50.3	49	44.5	53.3
Social Science	54.5	49.7	52	55.8	46.1

Source: (Mathematics Working Group, 2005)

The SACMEQ II interim report (Leste, Valentin, & Hoareau, 2003) gave the issue of weak attainment in mathematics further prominence. It was possible through the SACMEQ Numeracy test to subdivide competency in primary mathematics into eight hierarchical cognitive levels (Ross, Saito, Dolata, Ikeda, & Zuze, 2004) thus allowing pupils' ability in the subject to be measured and compared against a set of benchmarks (See Appendix 7). Educators in Seychelles agreed that pupils should achieve Level 5 by the end of Primary 6. The SACMEQ II data revealed that two thirds of P6 pupils had not reached that level.

Table 1.2 Distribution of 2000 P6 pupils over each of the competency levels

Levels	%	Levels	%
1	2.6	5	13.8
2	20	6	13.3
3	24.2	7	5.0
4	19.7	8	1.4

Source: (Leste et al., 2003)

Following claims that pupils' performance in mathematics was weak, the Minister of Education commissioned a Mathematics Working Group (MWG) to study the situation and propose suggestions. The work of the working group converged into a project – the IPAM (Improving Pupils' Achievements in Mathematics) Project – aimed at working with schools to improve the quality of mathematics education.

In 2004, the MWG carried out research to ascertain what was going on across the education system (Mathematics Working Group, 2005). Some important findings were revealed. For instance, in spite of the fact that primary school teachers were able to push P6 pupils to be among the best in the Southern African region (Leste et al. 2003), it was observed that a high percentage of those teachers dealing with primary mathematics needed training to improve both their subject-matter and pedagogical knowledge. Moreover, there was an overall lack of in-service training and professional development programmes. There were concerns regarding the way mathematics education was supported and coordinated. The teachers felt that because the Curriculum Development Section – the unit within the Ministry of Education which provided curriculum related support to teachers – had closed down, they had been left too much on their own. The teachers said that they were practically unaware whose door they would knock on when they faced pedagogical constraints in relation to mathematics education. Furthermore, serious concerns were raised about the curriculum and the availability of teaching resources. Those concerns and issues suggested that a better coordination and support strategy was necessary.

Subsequently, the MWG produced a National Numeracy Improvement Plan (NNIP) (Ministry of Education, 2005). As a result, improving the quality of mathematics education, and, ultimately, raising standards of achievement in mathematics of all primary schools became one of the Ministry's top priorities

(Ministry of Education, 2005). A target of at least 50% of primary school leavers attaining SACMEQ mathematics Level 5 was suggested.

Teachers, and what they do, were identified as being at the heart of making this priority an attainable one. Hence, the Ministry of Education also endorsed the development of newer sustainable strategies for training primary teachers. The Ministry supported research activities in several aspects of mathematics education based on a cascade training model (Wedell, 2005). The plan had the following aims: a) improve the context of mathematics teaching and learning in Seychelles; b) provide opportunities for in-service teachers to improve on their pedagogical and subject matter knowledge; c) catalyze the process by which the teacher training institution in Seychelles reviews its teacher education programmes; d) develop effective models of curricular coordination and support; and e) improve the quality of learning experiences of primary school pupils (Ministry of Education, 2005).

Despite the scarcity of local research on mathematics education, it was possible to link pupils' weak performance to teaching practices (Mathematics Working Group, 2005). The research carried out by the working group showed that mathematics lessons were disorganised and unstructured. Of concern then, was the need to alter the characteristic pedagogical flow (Schmidt, 1996) which the Mathematics Working Group felt was not effective. I turn now to describe the Mathematics Lesson Structure reform in Seychelles, the main context of the study.

1.2 The Mathematics Lesson Structure (MLS) reform

When an education system has agreed that the quality of teaching is below expectation, a common policy response is to provide its teachers with access to professional development activities (Clarke, 1994). The approach and modality of

these activities vary from system to system. The approach to improving the instructional practices in the teaching of mathematics in Seychelles was inspired by the National Numeracy Strategy (NNS), in particular the three-part lesson structure (DfEE, 1999) which was in place in the English schools. NNS was commended for its three-part structure which provided a framework for teachers to organise the contents of a lesson and was described as effective in improving classroom organization and teaching methods (Brown, Askew, & Millett, 2003) and to some extent, in raising the pupils' confidence and competence in mathematics (Kyriacou, 2005). Since the mathematics lessons in Seychelles generally lacked a coherent structure, the Mathematics Working Group thought that an adapted version of the England model would support a change of culture in the mathematics teaching which was deeply rooted into Seychelles' schools. Based on the principal idea of the three part daily lesson, action research targeting improvement in the teaching of mathematics was initiated and a Mathematics Lesson Structure or MLS reform initiative emerged soon after. It is this MLS reform which forms the main context of the study.

1.2.1 Description of MLS

MLS provided a template for developing any particular mathematics lesson. Table 1.3 shows how teachers were expected to structure and organise a 40-minute mathematics lesson. According to the Mathematics Working Group, MLS constituted a careful and logical lesson design template, uniting lesson components, connecting these components into a coherent structure and hence making daily lessons consistent, focused, integrated and complete.

Table 1.3 Progression of mathematics lessons as advocated by the MLS

Time block (in minutes)	Expectation
00 – 05	Stimulate the mind with a mental activity
06 – 10	Review last lesson for relation to current lesson
11 – 13	Establish focus of the current lesson
14 – 29	Provision to develop conceptual understanding
30 – 37	Engaging pupils' in learning consolidating tasks
38 – 40	Conclude to bring about the gist of the lesson

In addition to this general lesson structure, other features of MLS required the teachers to vary (a) pupils' organization and (b) teaching strategies with the aim of dealing and coping with mixed-ability learners. Teachers were required to plan a lesson each week i) using at least one of the following strategies: investigation, problem solving, exposition, and practical work; ii) organising pupils in pairs, or small groups and iii) presenting learning materials in at least one of the following forms: tabular, pictorial, verbal, written, and simple computations. Lesson planning was a central feature of that new approach to teaching mathematics.

1.2.2 Development of MLS

The development and implementation of MLS was a gradual process. The idea was first discussed in one of the meetings of the Mathematics Working Group towards the end of 2004. A draft of the structure was tested with two primary four teachers over a 4-day period. Strengths and weaknesses were identified and discussed. A second version of the structure emerged thereafter. Volunteered teachers across the country were asked, through their subject leader, to try out the structure over one school term. Concerns about its practical implication were further collected and dealt with. A third revised version of the reform was developed. During its

implementation, subject leaders were trained on various aspects of the structure since they were to lead the school-based implementation of the reform. Joint workshops were organised between the MWG and the education coordinators of the School Division since the coordinators worked with the teachers on a regular basis. MWG organised consultative workshops with the teacher trainers of the National Institute of Education since the trainers were expected to lead further training in relation to the reform.

In January 2006, the implementation of MLS in all Primary Schools was made compulsory. Professional development sessions were conducted in schools by members of the MWG or subject leaders to facilitate the implementation of the structure. The education coordinators and members of the MWG conducted school visits to assist teachers with the implementation of the reform. By May 2006, all primary schools were using MLS as a basis for their planning and teaching of mathematics.

1.2.3 The context of mathematics teaching in Seychelles

At the time of the research MLS was the main lesson planning template in state primary schools in Seychelles, that teachers were expected to use. The timetable was such that primary school children received an average of seven 40-minute lessons per week. This represents 20% of the expected teaching time per week.

All teachers from Primary 1 to Primary 4 were expected to teach mathematics to their classes. These teachers were generalist and they were expected to teach all examinable subjects, notably, mathematics, English, Science, Creole and Social Science. Primary 5 and Primary 6 teachers were semi-specialists and they taught combinations of subjects. One combination was the language subjects while a second combination grouped mathematics and sciences. Generally, in small schools

the teacher teaching mathematics at Primary 5 would also teach mathematics at Primary 6. In some rare instances, some schools had made special arrangements whereby a teacher might, for example, taught mathematics at all levels from P3 to P6.

The mathematics curriculum in the primary school was led by a subject leader, appointed by the main education department. The subject leader also led the science curriculum because maths and science were treated as one strand. All the subject leaders attended training as part of the mathematics reform project. Around 75% of them followed an advanced educational leadership course in 2008. Any subject leader who had been appointed after 2008 had not received any leadership or curricular related training.

1.3 Developing a research agenda

Even though research on Seychelles' education reform activities are seldom carried out, I subscribe to the views espoused by Holmes and Crossley (2004) that innovative activities in the small states should be studied to ascertain how they contribute to the development of education in those jurisdictions. These innovative ideas constitute specific characteristics of the small island states: they are based on local knowledge and development, and they have been crafted to suit a context with unique features. These projects may have what it takes to address and redress defects in education in these challenging systems. Unless they are substantially researched, one will never know how they can be useful in alleviating teaching and learning problems. Too often, local efforts to innovate the education system in the small states are undermined even by local people themselves hence, leaving much of the well intentioned job aiming at improving the teaching and learning environment remains

incomplete. Further, MLS is a borrowed idea which has been adapted to fit the local context. Its contributions to the development of mathematics need to be empirically established. In this section I outline the three main motivations for carrying out a systematic study on the MLS reform in Seychelles.

1.3.1 A policy agenda

IPAM, the project from which the MLS reform was developed, started off as a special initiative supported by the senior management of the Ministry of Education. In line with its policy to improve quality of education, the Ministry of Education had begun to promote participatory action research in schools. The IPAM project had adopted a collaborative – consultative curriculum improvement approach which was gaining recognition by the education management and teachers were satisfied about their involvement (Lespoir, 2009). The education system was seeking a sustainable improvement approach which could stimulate teacher learning as they engaged with new materials integrated in their daily practices. The process of improving mathematics teaching and learning embedded in the MLS reform was attempting to model this requirement. Therefore researching MLS represents a direct move to provide evidence with regard to policy development concerning teacher learning.

A school-based teaching improvement model is necessary in view that many SIDS such as Seychelles face the challenge of recruiting quality teachers at primary school level. Even when suitable candidates are identified and recruited, these systems are not always able to provide the candidates with appropriate and adequate training. As a consequence, primary schools within these countries contain a large proportion of untrained teachers or teachers trained to a minimum level. This puts teaching and learning in these states at risk. Mathematics, being a challenging subject to teach, suffers disproportionately. Subsequently, one big dilemma within SIDS

relates to the way the education system can simultaneously support the development of a subject and the growth of their teachers. The scant literature on pedagogical change in the small states does not provide examples to assist in the development of locally based models within this community of states. Models that are available outside the small state community, in many cases, lack the basics of what smaller states are after: effective, affordable and sustainable programmes that take the characteristics and background of the in-service and pre-service teaching population into account. This leaves many of the instructional challenges in the SIDS community unattended to. Calls for scholars in the small states to take control of their reform agendas and to research reform initiatives are imperative. It is through researching these reform activities that a knowledge base informing practices can be built. In Seychelles, in particular, reliable knowledge based systems grounded in empirical evidence that can inform teaching and learning are yet to be developed. There is a poor culture of research which leaves many of the reform activities undocumented. This study seeks to fill this gap.

It is also essential to note that the issue of mandatory prescribed practices is in contravention with the idea of teacher autonomy often advanced by school reformers. Smyth (1991, p. 325) remarks: “Teachers are supposedly being given more autonomy at the school level at precisely the same time as the parameters within which they are expected to work and against which they will be evaluated, are being tightened and made more constraining”. While it is not my primary intention in this study to research the issue of teacher autonomy per se, my study touches on this issue by examining teachers’ perceptions of the constraints and affordances in the context of a new school reform agenda. My study suggests that a greater focus is necessary on developing teachers’ autonomy and ensuring a plurality of views.

1.3.2 Curriculum development agenda

The MLS reform is a significant development in the teaching of mathematics in primary schools in Seychelles. Being a mandatory reform it implies that the teachers have had to implement the major ideas in their daily practices. As is the case with most instructional reforms in mathematics education it carries with it many challenges. Unfortunately, the development of mathematics education in Seychelles in the context of the MLS reform has not been substantially captured. Lack of systematic research has prevented the accumulation of evidence about the impact or simply the contribution of MLS in the development of mathematics education in the schools. Consequently, little is known about its impact. Most arguments about MLS are not research-based. Claims about its usefulness are limited. It is becoming difficult to continue to persuade in-service teachers and encourage newly qualified teachers to adopt the structure in their lessons. Even if indications from two local studies (Nolan, 2008; Valentin, 2007) and informal communications which I have had with primary school teachers in Seychelles seem to suggest that change has occurred following the reform, several critical issues around the use of the structure in schools remain unknown.

On a second account, evidence is needed to inform the instructional reform process in Seychelles and in other small developing states. Observation as to why MLS prevails amid scepticism and criticism cannot be supported empirically. Reasons as to why MLS has had a longer life span than many previous reform initiatives in Seychelles are unknown. The more fundamental issues such as: what does it take to reform instructional practices in Seychelles and in smaller developing states, and what are the teachers' attitudes to instructional innovation and reform, cannot be discussed. These concerns give impetus to the current study.

1.3.3 Personal motivation

I have a personal interest in developing lessons using the MLS approach. I want to examine MLS and learn in a systematic way what may happen in classrooms when teachers are asked to teach mathematics in this particular way. Furthermore, my personal belief about improving mathematics teaching in Seychelles is strongly based on the role of prescribed instructional practices, something similar to the reform ideas embedded in MLS. Prescribing what teachers should do in class in the form of ready-made lesson plans or teaching guides can be useful in renovating practices and improving the pedagogical knowledge of teachers. I base my argument on the fact that there are too many primary school teachers dealing with mathematics education who are trained to a minimum standard. These teachers need additional pedagogical content knowledge in mathematics. Long traditional models of in-service training are not practical in small education systems. Seychelles' system, as an example, cannot afford to release large numbers of teachers to be trained as there is a scarcity of teachers in the system. As an immediate strategy to alleviate weaknesses, prescribing practices is a realistic option. In this regard, studying MLS in context should provide evidence whether prescribed instructional practices can be the avenue for pedagogical innovation in the Seychelles context.

Secondly, since I wish in future to carry on working with primary teachers in the Seychelles; gaining insight into this specific reform approach will allow me to comprehend better how teachers relate to reform calls. Knowledge about the effectiveness of the outcomes of MLS will inform my decision regarding the strategies I may adopt in future to support the work of the less competent teachers in the system.

1.4 Aims of the research

The ultimate goal of this study is to assess how worthwhile the MLS reform has been hence arguing the extent to which it has generated potential solutions to the Seychelles' problem of weak mathematics teaching in primary schools. To this end, I seek evidence as to whether after five years of implementation, mathematics teaching in schools evokes the ambiance which the reformers anticipated: teaching creating opportunities to learn, pupils attaining better results than prior to 2006, and schools promotion of teacher learning and development. As a secondary purpose, using outcomes of the MLS reform in Seychelles as a critical case, I seek to discuss the implications of pedagogical reform in SIDS.

1.5 Research questions

All reform initiatives will in one way or another have outcomes. Outcomes can be positive and/or negative, and intended and/or unintended. No reform quest envisages negative outcomes. Yet, negative outcomes are possible products of reform activities. Pedagogical reform activity such as the MLS reform is expected to impact on both the context and processes within schools. Identifying all possible outcomes of the reform may be difficult to achieve in small scale research such as this PhD research. However, it is possible to frame a research study so that the pertinent outcomes are identified.

The research questions of the study are:

- 1) How has the teaching of mathematics in primary schools changed with the implementation of the MLS reform?

- 2) How do primary pupils' achievements in major examinations in Seychelles before and after the MLS reform compare?
- 3) How do primary school teachers and the mathematics subject leaders describe and evaluate their experience of teaching mathematics using the MLS approach?

1.6 Significance of the study

Outcomes of this research are useful in a number of ways and to a number of people. Firstly, it forms a basis for evaluating the ideas which the MLS reform seeks to advocate and propagate. This includes: a) the efficiency of teaching mathematics using the specific structure; and b) the advantage of some pedagogical approaches to teaching primary mathematics such as i) attempting mental activities at the start of lessons, ii) sharing lesson expectations to the pupils, summarizing the gist of each lesson, and iii) varying teaching strategies. Individual teachers who lack strategies and pedagogical knowledge may use the findings from this study to decide whether or not MLS is a suitable structure for mathematics lessons in their classes.

Secondly, the study will provide mathematics educators and policy makers with empirical data to support or otherwise refute the campaign of teaching mathematics using a prescribed structure. Thirdly, any education system, big or small, that faces the issue of poor quality mathematics lessons, or unskilled mathematics teachers, may use the outcomes of this study to determine whether a lesson structure such as the MLS or equivalent can be an alternative to assisting teachers.

As I argued earlier, this research does not only examine how effective the MLS reform has or has not been, but it also addresses the processes of reform and pedagogical innovation more generally. Hence, a fourth outcome of this research

may be its role in planning further pedagogical innovations in mathematics or in other pedagogical arenas.

Lastly, this study seeks to contribute to the limited literature on systemic instructional reforms in small developing states. Hence the Seychelles' experience of the MLS reform contributes to the building literature on the roles of this specific approach in improving the effectiveness of mathematics lessons, strategies for improving teaching, and the enactment of systemic reform.

1.7 My position as the researcher

The MLS reform was led by a Mathematics Working Group (MWG) appointed by the Minister of Education, in 2003, to spearhead developmental activities in this part of the primary school curriculum. I have chaired the activities of MWG from its inception to 2009 when I left for this PhD degree. Hence, I played a leading role in the development and implementation of the reform. The thesis, therefore, is informed by both empirical data and by my direct involvement in the project. I bring to this thesis some personal experiences over the years while I was participating in the reform process. It is imperative that I establish well in advance that my involvement with the MLS reform does not invalidate the outcomes of this current research. Instead it enriches the discussion. It is a common occurrence in small states (Crossley & Holmes, 2001), especially in Seychelles, for education officials to play multiple roles – developing, implementing and evaluating – when it comes to reform processes. I believe that as long as the evaluation process is critical, reflective, and subjectivity minimised, the reformer becomes a valuable contributor to the evaluation exercise. Specific to this study, the issue of reflexivity and validity is discussed elsewhere in this thesis.

1.8 Outline of the other chapters

This thesis has nine other chapters. Chapter 2 presents the outcomes of my literature review which in itself is a rationale for my study. Chapter 3 covers extensively the methodological issues of this research. Chapter 4 onwards begins the second part of the thesis: analyses and results. In Chapter 4, I present a detailed account of the analyses I carried out on the various datasets. In Chapters 5 and 6 I present results in relation to the first research question which attempts to find the impact of the reform on teaching. Chapter 5 looks at the implementers' self-reported data while Chapter 6 deals with lesson observation data. Chapter 7 deals with results relating to the second research question which seeks to inquire about the impact of the reform on pupils' achievements. In chapter 8, I present results in relation to the third research question: the implementers' description of their experiences with the reform. In Chapter 9, I develop an extensive discussion of the findings from the four results chapters. In Chapter 10, the conclusion chapter, I explore the implications of the findings, I address the contributions and limitations of this study, I outline possible areas for further research, and I provide an account of my reflection on this PhD study.

CHAPTER 2 Literature review

This study is guided by the assumption that it is imperative to draw benefits from policy reforms and ascertain the ways in which reforms provoke change, be it positive or negative. This literature review provides a discussion which justifies the need for this study. In developing this review, I take the stance advocated by Maxwell (2006, p. 28) in which literature review for a dissertation may be regarded as review “for research” rather than review of research only. Nevertheless, I do not intend to be comprehensive. Instead, I seek, in the first instance, to develop a warrant for the study. At a different level I seek to develop a conceptual framework for the study. I discuss other contributions of the literature throughout the thesis.

2.1 Policy implementation as a domain of research

It is the vision of most education systems to ensure that all of their students have “real opportunity to learn” (Spillane & Jennings, 1997, p.449) and achieve more learning goals. To this end, education systems across the world are in constant renovation. Policy reform and implementation have become common features of educational processes. Braun, Maguire, and Ball (2010, p. 547) comment, “education policy-making has been appropriated by the central state in its determination to control, manage and transform society and, in particular, reform and ‘modernise’ education provision and raise standards”. Unarguably, drastic changes in classroom practices are needed to achieve this world vision of quality education. Paramount to this quest is a thorough understanding of policy reform and implementation. In this

study, in particular, the policy in question is one about teaching improvement which calls for significant changes in teachers' practices. Therefore, developing understanding around policy implementation along with developing methods of aligning policies for coherent practices form the basic requirements of the discourse. This ultimately positions policy implementation as an invaluable research domain.

2.1.1 Policy implementation: scope for teacher learning

Braun et al. (2010, p. 547) state that, "schools and teachers are expected to be familiar with, and be able to implement, multiple (and sometimes contradictory) policies that are planned for them by others, while they are held accountable for this task". Spillane and Jennings (1997) offer an interesting avenue to look at how teachers can be stimulated to effect changes in their rooted practices through the idea of policy alignment. Their study looked at how policies at district level could be better aligned to instigate changes. Their main finding was that even if policies are carefully aligned to support ambitious pupils' learning goals, "what teachers learn about practice is shaped by much more than the occasions for learning provided by policymakers and others" (p. 451). Furthermore, the authors contend that even if the alignment strategy may seem to have provoked some changes towards "ambitious pedagogical practices" (p.475) it may still be insufficient in changing other essential dimensions of classroom practices such as task development and classroom discourse.

The study reported in Spillane and Jennings (1997) has one important implication to what is being done in Seychelles, in particular. The education system is seeking a model that can at one level, improve teachers' practices while at another level, improve pupils' achievements. Hence, viewing policy implementation as an

opportunity to facilitate teacher learning has significance to what the education system is trying to achieve.

To appreciate teacher learning in the context of policy implementation, understanding how teachers enact reform ideas (Braun et al., 2010; Millett & Bibby, 2004; Spillane, 1999) is essential. Braun et al. (2010) provide three reasons why studying specific contexts is important in making sense of outcomes of policy reform. According to them:

It is important to consider, firstly, that policies are processes, even when mandated, and policy texts can be differently worked on and with. Secondly, policy practices are specific and contextualised. They are framed by the ethos and history of each school and by the positioning and personalities of the key policy actors involved. And thirdly, and related to the contextualised aspect of practice, policies are mediated by positioned relationships: between government and each local authority, the local authority and each of its schools, and within, as well as between schools. (Braun, et al., 2010, p.558)

This argument suggests that because of the specificity in the way policies are enacted in different contexts, the enactment of MLS in Seychelles has to be studied so as to reveal its unique impact. However, this does not denigrate how knowledge of what occurred in Seychelles can be used elsewhere. Instead it provides contributions for future international comparative studies. The field of policy reform needs more inputs from the SIDS community. Specific to the Seychelles context it is important to access alternatives to teacher learning.

2.1.2 Developing a classroom perspective of policy implementation

Van den Berg and Ros (1999, p. 881) argue that although the objective characteristics of an innovation (e.g. policies, cooperative networks and financial arrangements) are important for the successful realization of the innovation, the core of the process strongly depends on the experiences, concerns, and skills of the

individuals and groups involved in the process. This is what Fullan et al. (2006) label as an “expert instructional system” within the classroom context. In view of the fact that the impact of reform is likely to be felt in the classroom processes, it is imperative to make the classroom the ultimate target of reform effort and the teachers, being the main implementing agents, should hold the major role. Even if teachers are sometimes criticized for lacking the commitment, will and capacity (Spillane, 1999) they are nevertheless the major partners in the realization of reform (Macnab, 2003) and the key to the success of curriculum reform (Bezzina & Camilleri, 2001; Spillane & Callahan, 2000). In understanding how policy is enacted in schools, it is important to consider the roles that teachers play.

In her argument to characterize the process of instructional change, Smith (2000) argues that the process of change in the classroom is one of the dilemmas or conflicts that all teachers have to endure in their professional life as a response to reform calls. Smith notes:

As a consequence of calls for reform [...] teachers are likely to take on roles and responsibilities in mathematics teaching that may not match their current teaching practices, their professional educational experiences, or their own experiences as students. As a result, as teachers make changes in the way mathematics is taught and learned, dilemmas are likely to arise when old practices and new pedagogy suggest different, sometimes conflicting, courses of action. (Smith, 2000, p. 352)

The above quote illustrates the world of teaching as dynamic and unstable. To some teachers the world of teaching presents unexpected experiences and to others, teaching is de-motivating. To some, teaching occurs in conflicting settings when the teachers’ personal agenda differs from that of the school or the system as a whole.

Many of the curriculum reform ideas that are introduced in schools as a means to improve pupils’ learning target the teachers (Ling, 2002; Nielsen, Barry, &

Staab, 2008; Tabulawa, 1998). In many instances when teachers are presented with reform intents, they are generally being asked to make significant changes in the core business of their practices (Spillane, 1999). Some of these reforms require them to deconstruct practices which have been rooted over a long period of time, and other reforms challenge the teachers' beliefs and values. However, as Bowe, Ball, and Gold (1992) claim,

“[teachers] do not [just] confront policy texts as naïve readers, they come with histories, with experience, with values and purposes of their own, they have vested interests in the meaning of policy ...” (p. 22).

Teachers have their personal beliefs, values and conceptions which they bring to the profession which certainly affect the way they internalize the demand of the reform. Furthermore, the teachers bring to the profession their perception of their self efficacy (Stein & Wang, 1988). This is a self evaluation of the extent to which they can handle the demand of the reform. Fullan (1982) argues that other than self efficacy, teachers' motivation to fully implement the reform ideas depends on the extent to which their own beliefs are in line with those of the reform. Belief dominates the teachers' decisions and the teachers' ways of enacting reform intents. Hence, most moves to reform instructional practices, in particular, moving from traditional approaches to more constructivist – problem solving approaches necessitate a substantial set of knowledge of pedagogy as advanced by Ball (1991), and some considerable amendments to the belief system and mindset with regard to the reform and the context into which the moves are taking place (Sztajn, 2003).

One common perspective in the teacher change literature is that teachers' beliefs impact on a) the teachers' experiences (Stipek, Givvin, Salmon, & MacGyvers, 2001) and b) the teachers' decision to enact the reform intention

(Spillane, 1999). Stipek et al. (2001) report on a survey of a group of twenty one primary teachers and observe that the teachers' belief of mathematics was consistently associated with the teachers' observed practices. Three beliefs namely: a) mathematics is based on algorithm, b) the teachers should be in total control, and c) extrinsic reinforcement motivates learning were positively associated with an emphasis on performance. These three beliefs were, however, negatively associated with an emphasis on learning for understanding, student autonomy, low risk environments, and teacher enthusiasm.

Nathan and Knuth (2003) add a new perspective to the issue of belief and practices. On following the process of change of one particular teacher over a two year period, they observe that "teacher change may not necessitate change in beliefs" (p.202). They argue that changes in the way teachers enact reform may happen within a consistent belief system when the reform, which may differ considerably to the old practice, is attuned with her old belief. The claim made by Nathan and Knuth is based on weeks of video-taped classroom observation, interviews, and interaction with the teacher in question. It may not be generalized extensively given that it is based on the experience of only one teacher. However, it points to the fact that teachers' decisions to change practices may not always require a change in belief.

Most of the time, teachers do not have the freedom to choose whether they attend to or ignore calls to reform their instructional practices. Whilst teachers may claim that the decision to change their practice is a function of the responsibilities they hold about their pupils' learning, pressures from policy makers or school management may dictate what and how they change.

Teachers' willingness to change their practices introduces the issue of receptivity (Waugh & Godfrey, 1993). Teachers' receptivity plays a crucial role in

determining the success or failure of curriculum change (Waugh & Godfrey, 1993) such that teachers will be more likely to commit themselves to the change if they have a positive attitude to it. In a study to investigate teachers' receptivity to a system wide curriculum reform in China, Ma, Yin, Tang, & Liu (2009) note that although the reform seemed difficult to achieve the teachers could manage because of high receptivity.

Senger (1998) provides a critical case for examining teachers' process of change. The school in question was relatively small (population 706 students). It was characterized by a wide range of abilities and its pupils came from varying home environments and socio-economic status. Over a one year period the researcher collected data which included interviews, classroom visits, and field-notes which were analyzed qualitatively. Senger's analysis demonstrates that the process of teacher change varies from teacher to teacher and that change is a recursive process. This in my view is a warning call for including diversity in teachers' needs and support mechanism when it comes to change. It points to the need to make the element of "need satisfaction" a focus area when collecting data about teacher change.

The recursive nature of thought processes and sense making of the meaning of reform intentions also suggests some levels of inconsistencies in the teachers' teaching approaches. Teachers are in a state of learning new material or new approaches. In such process their classroom is seen as a laboratory and their children as guinea pigs. Their "recursiveness" may cause disequilibrium in the pupils' learning processes. Very often researchers do not consider these consequences that impinge on learners as their teachers go through a change process as described in Senger (1998). Studies of this nature have implications for policy makers and teacher

education programmes. Despite the fact that Senger has not talked about any adverse effects on learners, it cannot be assumed that these did not occur. The implication therefore, is that both in-service and pre-service teacher education programmes should equip teachers with skills to manage pupils' learning as they engage in efforts to change their practices and beliefs.

Understanding teachers' enactment of policy reform in terms of beliefs, efficacy or pedagogical knowledge is an "individualist perspective" (Ryder & Banner, 2012, p. 2) and gives little attention to the role of context in interpreting this aspect of educational processes. Goodson (2001) discusses three types of context which bear directly on curriculum reform in particular: the internal, the external and the personal context. According to Goodson:

Internal change agents work within school settings to initiate and promote change within an external framework of support and sponsorship; external change is mandated in top-down manner, as with the introduction of national curriculum guidelines or new state testing regimes; personal change refers to the personal beliefs and missions that individuals bring to the change process (Goodson, 2001, p. 45).

Goodson argues that for curriculum reform to be successful there needs to be harmonization and integration of the three contexts of reform. Using a major reform of the science curriculum for the 14 -16 yrs old in England as the main field of inquiry, Ryder and Banner (2012) explore the ways in which the external and internal structures within which teachers work, and the personal characteristics of teachers, feature in the teachers' reflections on their experiences of the reform. Besides personal contexts such as subject knowledge and beliefs about teaching, this study reveals the wide range of additional factors that also impact teachers' experiences. Within the internal setting of the school, Ryder and Banner identify factors specific to the subject department, and also broader in-school factors such as

the nature of the student intake. In turn, these personal and internal school factors sit within still broader external contexts – local and/or national education policies. The study serves to highlight that comprehending teachers' response to curriculum reform involves consideration of these three nested contexts of their work. Ryder and Banner observe that change is better afforded and reform better embraced when these contexts are aligned. Evidently, when these contexts do not align, there are barriers to change. An example is reported in Ryder and Banner (2012), illustrating one possible repercussion when contexts are not aligned:

... [one teacher] demonstrates a personal teaching goal of preparation for post-compulsory science study. This goal aligns with the internal school context of a high attaining school with a large number of students continuing into post-compulsory science study. This alignment of personal and internal contexts clashes with the external context of reform which emphasises the goal of scientific literacy for all students. Thus, [that teacher] is resistant to teaching about socio-scientific issues and the nature of science (p.19).

The ideas presented in the extract above can be transferred to the mathematics curriculum context. For instance, a teacher may be committed to work with children on an individual basis. This goal may be aligned with the school context which requires the teachers to foster individualized instruction. However, both goals may clash with the external context of reform which places emphasis on a reform towards whole class interactive teaching. A teacher in such a situation may resist whole class teaching. The issue of context in understanding how reform is enacted clearly justifies why studying reform in its locality is important. It is worth noting that in Seychelles, the teachers rarely express critical opinion on national policies. The prime reason may be because there is no proper structure which encourages such practice. It may also be due to the past political context of the country which disfavoured open criticisms. Many teachers may still be feeling afraid or insecure in

expressing their views. But in order for the alignment that Ryder and Banner (2012) talk about to take place teachers need to be better supported in articulating aspects of internal and personal change, and the system needs to encourage a plurality of views, some of which will – and should be – critical.

Furthermore, Fullan, Hill and Crévola (2006) argue about the coherence between the multiple levels of schooling – the classroom, the school, and the larger system (in Seychelles' case, the Ministry of Education) – as important preconditions for reform in the educational context. The authors too are of the opinion that the flow of schooling is disrupted when there is a lack of alignment and coherence. Such deficiency may result in instances where members of the system receive mixed messages about the requirement of the reform idea. From a cognitive perspective, the implementation of a reform idea or policy proposal is a product of the kind of understanding or meaning that the implementers construct from the reform message or from their experiences while enacting the reform requirements (Spillane, 2000). Studying MLS should contribute in understanding how reforms are enacted and its intents realised in the context of schools in SIDS.

2.1.3 Fostering school-based support structure

The current research and policy discourses on the approach to teaching mathematics, seek to do away with the traditional perspective that learning mathematics should be a mastery of facts, memorization of rules and procedures and moving towards one which is centred on teaching using an inquiry approach (Cockcroft, 1982; NCTM, 2000). This change in teaching perspective calls for a substantial alteration in the approaches to teaching mathematics (Wood, Cobb, & Yackel, 1991). Subsequently, teachers are challenged in a number of ways (Spillane & Zeuli, 1999). Unfortunately, what is being asked from the teachers is the stimulation of learning experiences

which they have hardly experienced or seen (Pereira, 2011). Reform visions of mathematics teaching are based on learning theories that teachers find difficult to align with their current experience and the realities of the context within which they operate (Ross, McDougall, Hogaboam-Gray, & LeSage, 2003; Wood et al., 1991). This situation has many implications for policy makers and in-service teacher education programmes. In education systems where teachers are not necessarily mathematics specialists, efforts to reform practices face great difficulties. This problem is even greater in developing systems like Seychelles where professional and systemic expertise, and teacher education, are necessarily more limited than in developed countries like the UK. What is required in those jurisdictions, is a system that continuously supports the teachers to review their practice and attempt deep worthwhile change (Millett, Brown, & Askew, 2004a).

In developing countries, professional development is currently the centrepiece of many school effectiveness programmes in that it is an effective approach towards improving teacher quality and instructional practices (Johnson, 2006). Where a sustained professional development programme cannot be achieved, action research projects involving researchers and teachers working in a collaborative environment (Haggarty & Postlethwaite, 2003) such as the IPAM project in Seychelles (Ministry of Education, 2005) provide a means to improving teaching. Through similar projects the reformers develop close working relationship with the implementers, and teacher learning is believed to happen in the reality of classroom context (O'Sullivan, 2002) – a factor which gives these types of reform activities high credentials. In other jurisdictions, the lesson study model (Lewis, Perry, & Murata, 2006) is gaining prominence.

Due to lack of empirical work on reform activities in the small states, their education systems are not learning much about those reform efforts designed to renovate the teaching of mathematics. Here I point to one specific context in which I have worked for the past fifteen years. Seychelles has embarked on the international agenda to improve the teaching and learning experience in mathematics education. Yet, the education system has not adequately researched on the efforts and outcomes of its work. At the moment the system lacks empirical evidence to lead its work and future decisions with regard to the reform moves.

Much has been said about what constitutes effective teaching of mathematics (Askew, Brown, Rhodes, Wiliam, & Johnson, 1997). However, little has been said about ways to develop the teaching of those teachers who have very weak mathematics backgrounds or poor attitudes to the subject, yet are faced with the challenge to teach generations after generations. What impact do prescribed classroom practices such as the MLS approach have on them? These are important issues which justify this study.

The discourses on policy reform in schools revolve around the conversion of schools into a community of learners (Hoban, 2002) or community of practice (Sergiovanni, 1998; Wenger, 2000). The assumption underlining these discourses is that engagement in social practice is the fundamental process by which people learn. According to Wenger (2000, p. 229), members of a community of practice “are bound together by their collectively developed understanding of what their community is all about, ... build their community through mutual understanding, ... and have produced a shared repertoire of communal resources”. In the process of instructional reform, schools are viewed as communities of practice, sites in which learning is likely to take place due to the high occurrences of social interactions.

Some research studies have shown that to effect change, curricula need to support student learning, and also directly address teacher learning and teaching needs (Ball & Cohen, 1996; Davis & Krajcik, 2005).

The study reported in Jarzabkowski (2003) is highly relevant to this review in that the school site referred to in her study is situated in a very remote area of Australia with limited advantages. It has many of the characteristics of schools in Seychelles. Jarzabkowski's study sought to ascertain what collegiality looks like in a remote school setting and the benefit that the teachers can draw from it. The study reveals that those teachers developed a special connection with their colleagues which helped them to achieve their goals, even if it occurred under some quite adverse conditions. Examples of collegiality at the school were in instances when the teachers worked collaboratively or when they socially and emotionally supported one another.

Hoban (2002) further argues that efforts for teacher change, in particular, instructional change, should be supported in a framework for long-term teacher learning. This is because most of the time attempts to bring about educational change involve learning how to go about doing something new in the classroom. The argument is that if teachers understand what to learn and how they learn in their workplace, they would probably begin to manage their own change. Such occurrence may also lead teachers to better appreciate their job.

Increasingly, professional development for the purpose of capacity building is becoming a condition for successful education improvement activities (Bantwini, 2009; Guskey, 2002). Capacity building is concerned with creating the conditions, opportunities and experiences for collaboration and mutual learning. This perspective embraces the notion of a professional community where teachers participate in

decision making, have a shared sense of purpose, engage in collaborative work and accept joint responsibility for the outcomes of their work (Harris, 2003). Building school capacity implies the notion that schools promote collaboration, empowerment and inclusion. It also implies that individuals feel confident in their own capacity, in the capacity of their colleagues, and in the capacity of the school to promote professional development (Mitchell & Sackney, 2001).

One consistent finding of school improvement research is that in view of the fundamental role teachers play in effective implementation of school change programmes, there is a need to provide training to those teachers who are involved in this change process. Stein and Wang (1988) argue that with adequate training, teachers are able to implement a variety of innovative programmes. Unfortunately, as Guskey (2002) argues, in practice, many professional development initiatives for teachers lack two fundamental requirements: a) an appreciation of factors that motivate the teachers to be engaged in professional development programmes, and b) the process by which change in teachers typically occurs. O'Sullivan (2002) provides a case in which an INSET programme for the Namibian teachers failed simply because researchers did not take into consideration, the 'classroom realities' that the teachers worked within.

To gain benefit from professional development programmes they must necessarily be designed to help teachers. School-based and context-specific professional development sessions are gaining precedence as the principle model that is likely to link training and classroom realities more closely. Clarke (1994) has offered ten key principles of what he argues are invaluable in determining the success of professional development of the teachers. Among the list, requirements include: a) address teachers' needs, concerns, and interest; b) recognise and address

the many impediments to teachers' growth; and c) enable participating teachers to gain a substantial degree of ownership by their involvement in decision-making, clearly emphasize the need to place the teachers at the centre of efforts to improving their teaching.

With regard to change and improvement some studies (Leithwood & Jantzi, 2006; Millett & Johnson, 2004) have endorsed the role of an effective school-based support structure in both mediating and catalyzing the process. This model of school-based support consists of the leading roles of subject leaders and the collaborative roles of other professional colleagues such as other teachers. In the context of teacher change, subject leaders are viewed as the immediate sources of professional development for the teachers (Millett & Johnson, 2004) hence the prime aspect of school which needs to be developed for effective instructional reform capacity.

To add to the understanding of coordination and collegiality in this model of school-based support structure, Millett and Johnson (2004) address the role of subject coordinators in supporting teachers within their *zone of enactment* to the extent such sources of support can lead the teachers to change. Subject coordinators in primary schools in England assume the roles of leading and overseeing the curriculum. Millett and Johnson's analysis of data of a four-year project in six primary schools reveals that the majority of classroom teachers believed that a key influence on their mathematics teaching is interactions with the subject coordinator. Furthermore, they observe that the subject coordinators played the mediating roles but not all were catalyst of change. A variety of skills were observed among the subject coordinators. However, some were more confident leaders than others. In spite of the fact that this argument suggests that the coordinators' work is influenced by the situation in which they work (McNamara & Corbin, 2001; Millett & Johnson,

2004) it may be argued that effective coordinators do have the capacity to shape the situation into a change-oriented site. This observation further supports the point I am making with respect to the use of local experts and the importance of context in undergoing systemic reform.

Millett and Johnson argue that subject-coordinators possess the capacity to develop rich zones of enactment for their teachers. While some subject coordinators were claiming competency, for example in making decisions about whether to approach teachers individually or collectively, creating interactive and lively discussion at meetings, and leading classroom practices, there were others who were reporting weaknesses in: a) bringing all teachers on board with the reform idea, b) dealing with the professional development of teachers, c) relating to students of various characteristics and ability, and d) demonstrating an ability to break some teachers' individualistic ways of working toward a more collaborative mode.

The discussion presented in this subsection illustrates the influence of teachers' colleagues and subject leaders in supporting other teachers in their quest to reform practices. The development of a school-based support structure is critical if reform is to be taken up in schools. Getting teachers to evaluate the quality of support they have had in order to realise the intents of the reform is an objective of my study.

2.1.4 The issue of sustainability

The issue of sustainability has become an important element in the implementation of reform and innovative ideas. According to Datnow (2005, p. 123) "when one speaks of the sustainability of a reform, one is typically interested in knowing whether the reform lasts over time and becomes an institutionalized feature of a school". It is the wish of all reformers to see their reform initiative succeed, long

term, with maximum impact. This is the reason why reformers are not only taking measures to ensure that their innovative ideas are successful but are also intensifying the use of all available resources to guarantee the sustainability of their ideas. To claim success over a reform idea there must be sufficient evidence that the idea is attaining its principal goal, plus evidence that it can survive within the confinement and constraints of its residing settings. Hence, the issue of sustainability is a good measure of success of reform or innovative ideas.

In the context of educational reform, sustainability is often used alongside institutionalization. The two are related. Sustainability encompasses the longevity of the reform initiatives while institutionalization infers the sense that the innovative idea has become an established practice (Datnow, 2005). Essentially, to justify an argument for institutionalization of a reform idea, there must be strong evidence that the idea has sustained over time. However, reforms are often criticized for their short life span.

Sustaining reforms, especially reforms that place demands on the system and its resources, is generally problematic. Even in Seychelles where one would have expected scaling up to be less of a problem given the size of the country, many brilliant education reform ideas have survived just a short time. The tendency for teachers to revert to previous practices appears to be almost insurmountable. Giles and Hargreaves (2006), while discussing specifically why innovative schools often revert to common practices, claim that there are three factors which appear to contribute to the weak record of sustainability of the reform. Firstly, they claim that innovative ideas reveal an unrealistic nature of school activities, distort the image of what could be possible in schools and subsequently create hostility in other schools. Secondly, they associate this tendency to the dynamic nature of school occurrences:

a) changing leadership and staff members, and students' composition, b) eruption of new vision or shift in original intents, and c) parental and other institutions' influences, and d) teachers' traditional inclination. Thirdly, they associate the phenomenon to changes in external condition of the school such as reduction of resources and power relation between school and local authorities. Giles and Hargreaves' arguments, in particular, the issue of leadership instability, may be extended to the Seychelles' context. Recently, Seychelles went through an extensive project to train school heads to an MBA level. Wherever a headteacher was released to participate in the training, a new one was appointed to fill the vacant post in school. The situation has resulted in an unstable state of headships. I suspect that the situation has consequently prevented ideas being followed through. This is consistent with the argument advanced in Datnow (2005) that context affects the sustainability of reform.

On the other hand, one effective model of reform implementation which teachers are claiming to be effective in increasing the sustainability of reform is the consultative - participatory approach to reforming schools (Lespoir, 2009). The education system in Seychelles has adopted an approach whereby working groups are nominated by the Minister of Education to spearhead the implementation of reform ideas in schools. These working groups catalyze the implementation process, spearhead all related activities and act as a focal point for concerns regarding the reforms. The drawback with such a strategy however, is that if teachers are not prepared to take control, the reform ceases with the phasing out of the working group. There have been some cases which have suffered this occurrence. It may be argued that instructional reform is difficult to achieve irrespective of the size of the education system.

The recent push across the world to achieve improvement in teaching and learning has been the “standards-based reform through the imposition of prescribed curricular and accountability framework” (Harris, 2003, p. 370). Through such an approach, the responsibility of pupils’ learning is placed on those who work with the pupils in schools in such a way that they are held accountable for it. According to Harris (2003), to make improvement possible under this new vision a salient condition would be the creation of opportunities for the teachers to work with and learn from each other. This would stimulate a community of practice (Sergiovanni, 1998; Wenger, 2000) as discussed earlier in this section.

The issue of sustainability has other implications in the context of SIDS. As discussed in Ghina (2003) the geographic and economic vulnerability make education for sustainable development an important theme among SIDS. While enacting reforms, the implementers and reformers should maximize the use of resources and aim to gain maximum benefits from the reform ideas. Ideally, it is hoped that reform ideas get diffused through the system. Analyzing MLS along this line is a way of ascertaining whether or not the values around sustainable development have resounded across populations in SIDS.

2.2 State of educational reform literature in SIDS

One approach which has been commonly used to define SIDS and determine whether a particular country belongs to this classification has been the population and territorial size, gross domestic product, and the term of trade (Atchoaréna, Da Graca, & Marquez, 2008; Brock & Smawfield, 1988). While a common definition is yet to be adopted, the population size has been the benchmark by which a small state is defined – one of a population less than 1.5 million. Since this is the case, Seychelles

best fits the definition of a “micro-state” (Armstrong, De Kervenoael, Li, & Read, 1998) with its population hardly exceeding 90,000. Nevertheless, Seychelles belongs to the SIDS community and benefits from grants or projects allocated to both the small states and the developing countries (Atchoaréna et al., 2008)

According to Atchoaréna et al. (2008, p. 168) “the following criteria limit the development of SIDS in general and Seychelles particularly: a) geographical isolation, b) vulnerability to natural disasters such as cyclone, tsunami, or sea level rise (climate change), c) lack of human and physical capacity, d) limited economic and employment diversification, e) high external dependency, and f) high risk of poverty. Being a microstate, Seychelles faces even greater challenges. As Campling and Rosalie (2006) note, Seychelles has achieved impressive social provision since its independence in 1976 but in the face of the range of political and economical challenges, the question of whether these developments are sustainable arises.

In an ever more globalized international environment, SIDS face unprecedented challenges. The fact that these states are, geographically isolated, exposed to economic vulnerability, and bear the direct repercussion of natural disasters, UNESCO and the Commonwealth organizations have described them as states in need of specific help. In terms of education development, SIDS lag behind several other countries. It is little wonder therefore that SIDS feature in improvement agendas of the commonwealth and UNESCO. The focus of improvement has principally been on the development of tertiary education. The tertiary education sector is fundamentally important since it provides the human resources that allow countries to connect to and develop a knowledge society. Subsequently, much of the current discourse about education in SIDS focuses on tertiary education (Ait Si Mhamed, 2012; Baldacchino, 2011). Other educational reform issues deal mainly

with the vision of education for all (Goldstein, 2004) along with Millennium Development Goals (MDG) (Crossley, 2008). School improvement also preoccupies the educational literature in SIDS (Morrison, 2009; Purvis, 2007). However, in the current literature, curriculum reform in the primary sector does not have a major focus. Curriculum reform as a domain of research appeared in the literature of the late seventies (Wilson, 1978) and does not appear to be on the current priority list for SIDS.

A review of the literature reveals that a profound interest in the development of education in SIDS is quite recent. The late 1980s saw the beginning of work to spearhead development in education in these states. Among the pioneer works were those reported during the mid 1980s and all focused on the impact of size on the development of education (Bray, 1985; Brock & Smawfield, 1988). For example, in discussing factors that may have an impact on the size of a particular state, Brock and Smawfield (1988) observe that some educational problems experienced by the small states are similar to those of the large states, but possibly bigger in scale.

... in all countries there is a problem of matching the output of the education system with the manpower needs of the economy. In large diversified national economies with substantial and ongoing structural change, selecting and targeting a particular occupation is becoming increasingly difficult. A curriculum, broadly based in knowledge and skills is desirable. In a small concentrated economy it is obviously not suitable to focus the school curriculum towards just one or two areas of occupation (Brock and Smawfield 1988, pp. 228 -229).

However, Bray (1990) argues that small states are not simply scaled down versions of bigger states which suggests that what is applied or can be done in bigger states may not simply be applied to the smaller states in reduced volumes. Small states have their own simplicity and specificity which render them unique in a number of

ways. It could be argued that these discourses, with smallness as the central theme, have helped in describing the implications for educational development.

Later on with the introduction of school improvement within the SIDS educational agenda, the research focus changed to deal with issues of decentralization of education administration; a vision gearing at giving schools more autonomy. Many of the issues of reform and policy implementation addressed school leadership and management (Jennings, 1994; McGrath, 2010; Scott, 2001). However, for the past few years as pointed out by Baldacchino (2011, p. 459) “the vulnerability to climate change and sea level rise has become the most visibly pressing agenda of small, especially in island and low lying states”.

A relevant work in relation to policy reform and implementation in SIDS is reported in George, Mohammed, and Quamina-Aiyejina (2003) and addresses the issue of giving teachers a prominent role in educational reform. The intent is such that:

the qualities and capabilities demanded of teachers in the new reform climate are a willingness to participate fully in their own development and that of their students; an understanding that the school is the focus of a thrust to include the community in enhancing the development potential of all participants; and an appreciation of a culture of collaboration with school and non-school personnel in building the vision and mission of the school (ibid 2003, p. 194).

Essentially, to achieve such intent, it will require that the education system in SIDS develop good teacher-participatory models, and research on how policies are implemented and enacted by the teachers in the first instance. George et al. (2003) examine teachers’ identity in the context of systemic reform in Trinidad and Tobago. Identity in this context refers to the kind of images, experiences and expectations that teachers have had, and continue to have, about teaching. With the changing vision

about the roles of schools – one which holds a more rooted place in the local community – teachers should be able to understand and appreciate their roles in current reform movement. The study presented in George et al. (2003) offers a way for policy makers in the small states to better understand the role of key stakeholders in policy implementation quests. However, their study is related to beginning teachers. Evidently, studying MLS would enable policymakers to view the same phenomenon but among teachers with more teaching experiences, possibly with more established identities.

To summarise the state of literature on education in SIDS, it may be argued that even at the moment, the literature resembles the state that Van der Eyken, Goulden, and Crossley (1995, p.33) contended: “... theory and practice [in particular, with regard to] formal evaluation, draws [too] heavily upon western academic traditions”. The tendency for the literature to ignore the perspectives of smaller and less developed nations prevails. Views and experiences about educational reform remain one-sided in this respect. More recently, Crossley (2010) has argued for the importance of context to be given serious consideration if the world is to benefit from comparative international study and learn in a systematic way the challenges of developing education in others’ jurisdictions.

From a review of literature in the small states, two interesting points emerge as rationales for the current study. The first relates to the need to fill the gap and contribute to the literature on mathematics improvement in small settings. The second relates to the issue of context. In the same way that the evaluation of the project to improve primary education in Belize (Van der Eyken, et al. 1995) has served to understand the idea of context in evaluating educational reforms, studying

MLS may serve the same purpose in the case of mathematics education in Seychelles, but specific to areas where prescribed practices are concerned.

2.3 Development of knowledge for local use

In this part of the review I argue that MLS needs investigating in order to develop local knowledge about the reform. Currently, very little is known about the reform. Lack of knowledge about the reform limits the types of claims and decisions that can be done in relation to it.

2.3.1 The local context of policy reform

Seychelles' education system, like that of many other SIDS, tends to look towards the developed nations, particularly the UK, as the basis for its curriculum reforms. Through intellectual exchanges and technical assistance that are often provided by the experts from the Anglo-Saxon countries, knowledge of educational change has been widely exported to transition countries and increasingly to the developing parts of the world (Sahlberg, 2006). This is partly because, due to constraints of size and finances, the developing states generally lack both professional capacity and resources to initiate and manage the implementation of reform activities. Reforming educational processes is a complex endeavour requiring specialized skills. In particular, educational reform, such as changing teachers' instructional practices, requires a good research capacity, adequate physical and financial resources, and a receptive environment (Harris, 2001), most of which are limited in SIDS.

Relevant to this discussion, I can report that at the time of this research, in Seychelles, there were only two officers within the entire education system holding a PhD degree, while three others were engaged in doctoral studies. Most education

planning officers within the main headquarters were educated to Masters level. Even the National Institute of Education lacked the capacity to do research. A few studies have been carried out as individual studies, usually on small scales. Others have been carried out by outsiders.

The research capacity and the research culture are yet to be developed in Seychelles. Most projects are not linked to research programmes. Decisions in relation to educational improvement are seldom research-based. They are motivated by political concerns or based on philosophical assumptions of people with power or influence.

The attempts of the education system to develop a research section have been restricted by a number of factors. Recruiting staff has been problematic. The budget allocated is rather thin. However, there were some major efforts during 2007 – 2009 to implement action research as part of the school processes. There again, even if the intention was good, the availability of suitable people to lead the projects was a major challenge. Most of the efforts to develop a good research capacity crumbled almost instantaneously. Consequently, education systems in SIDS have been relying heavily on advancements and research findings from larger developed systems when they strive to induce changes in their educational processes. The MLS reform for instance, which is the subject of this thesis, was stimulated by the National Numeracy Strategy (NNS) in UK (DfEE, 1999). Lack of research movements within SIDS limits what Seychelles can do and the possibility of borrowing ideas from contexts with similar backgrounds.

The conduct of research is costly. Policy makers hardly bring research into their agenda. As a result, people whose job it is to work in schools with teachers are often confined to just one alternative: adopt and adapt a ready-made approach from

the north. This act of transporting reform ideas from the north to the south is a focus of heated debate within the SIDS movement (Crossley & Holmes, 2001). The tendency for developing states to import reform initiatives from their developed counterparts is being challenged. Crossley and Holmes (2001) argue that priorities and agendas of international educational development over-emphasize the large states perspectives and pay little consideration to the specific contexts of small states. Hence the tendency to borrow reform outcomes is losing popularity.

When importing reforms, in many instances, the ideas may become inappropriate and unusable unless they undergo a high level of adaptation (Datnow, 2002). Such adaptations on the other hand may alter the essence of the reform and may lead the local initiative to be ineffective. Woodbury and Gess-Newsome (2002) argue that changes in education are often almost unrecognisable because of the extent of the adaptations. They discuss two distinct approaches to change: a) the *ameliorative innovation* which seeks to make improvement on existing elements of the system and b) the second order change or *transformative innovation* which seeks to drastically revamp the malfunctioning elements of the system and considerably alter the fundamental ways by which elements of a system are organised. Whilst in general education systems seek to achieve transformative innovation, in practice their attempts fall short of this, at best achieving an ameliorative innovation. Indeed, they argue that often the reform is so changed it becomes unrecognisable and ineffective.

A second problem relates to the relevance of the idea. When the developed countries undergo reform in their educational processes they do so in response to their national (and developed) context and conditions. These conditions do not necessarily apply to developing nations. Ideas that work well in the developed countries may not be relevant to the developing countries or vice versa. Furthermore,

education systems from the developed nations, may be reforming aspects which they feel necessitate a reform and usually these reforms succeed several rounds of research or in-depth inquiries. Relying solely on what occurs in the north may leave much of the problems in the south untouched. This however does not imply that all reform initiatives originated in the developed states are carefully researched. Slavin (2008, p. 124) describes the process of making decisions about certain educational programmes as “slick marketing” ultimately failing to provide the best deeds to vulnerable children and removes incentives for developers to create programmes and technology that actually work better than current practices. Slavin’s argument suggests that some educational programmes or even policy initiatives lack the evidence base hence limiting their scope in advancing educational agendas. However, the problem is more serious in SIDS as there is practically no evidence-base to take account of and no independent research infrastructure to carry out proper evaluation.

A third reason relates to the interpretation of the results. Some authors (Holmes & Crossley, 2004) have spoken about uncritical intercultural transfer of a research agenda – a phenomenon which sees research consumers making direct translation of research outcomes without taking cultural factors into consideration. For example, there is disappointing evidence that, after many years of reform in mathematics education in the United Kingdom, the effects are limited (Brown, 2010). This claim suggests that reforms in mathematics education have not been as effective given the finance and energy invested in the process. This claim is also misleading. It suggests that conducting reform is worthless. It may also prevent small islands from borrowing wonderful ideas from developed countries. I argue however, that the very same reform ideas that may appear to have failed in the developed

countries can be successful in the developing states. My argument is based on the fact that the goals for teaching and learning – the basic goals of education – in small developing states are different to that of the developed states. Hence, professionals within these two contexts may enact reform calls with different audacity and different levels of compliance. Braun, Maguire, and Ball (2010) have argued that at a national level, officials sometimes have to re-interpret and perhaps reinvent policy to make it fit the local context. In Seychelles, for instance, given the local nature of the system as a whole, the teachers may be more committed to the reform objectives. Evidence of Seychellois teachers' participation in school improvement projects (Purvis, 2007) testifies to this claim. Moreover, teachers' involvement in reform initiatives can be a motivating factor. Due to its small size and the geographic location, many of the research activities that happen in Seychelles especially those that are done in conjunction with overseas institutions, often end up in exchange programmes outside the country (Geisler & Pardiwalla, 2010; Purvis, 2007). These international exposures are motivating factors to the teachers and strongly influence their commitment to research activities. My experience working with Seychellois teachers reveals that they enjoy participating in external exchanges. Research projects under these schemes have been highly successful. On the other hand success is far from guaranteed if the programmes do not take into account the realities of the developing nations (Guskey, 2002).

Calls for the education systems of developing states to lessen their dependence on outcomes of reform carried out in developed states is gaining prominence. Given that educational needs and priorities are contextualized, localized, and specific, education systems of SIDS should work towards building their local reform and research capacity. Capacity building is a critical and timely

strategy for improving the relevance of national policies especially in the small states (Crossley & Holmes, 2001) like Seychelles. An association such as SACMEQ joining fifteen Ministries of Education, of which Seychelles is a member, has been established to fulfil this mission of building reform and research capacity within the developing countries of Africa (Murimba, 2005). Seychelles in particular, has a school improvement model which is well respected within the small states community (Purvis, 2007). The system should use structures like these to facilitate and foster school-based educational reform that fits the local context.

On the other hand, even the conduct of reform within context may be problematic. There are many fundamental issues that need to be taken into consideration. Harris (2001) remarks that, although the drive to initiate educational change begins with strong intentions only rarely is attention paid to the need to build the capacity to implement those ideas. Very often schools begin reform with limited resources and commitment which consequently lead many well intentioned school-based reform initiatives and programmes to fail. The nature of some instructional reforms and particularly the context of some schools, necessitate in-depth changes to school structure and culture. The capacity of small developing states to undertake systemic instructional reform should become an area for research and development – an area where money should be invested (Crossley, 2008). There should be no fear in attempting transformative innovation as opposed to lingering on ameliorative innovation (Woodbury & Gess-Newsome, 2002) year in, year out. This represents one major challenge for educational reform in SIDS and situates my thesis within this current educational reform discourse in SIDS. This thesis looks at the capacity of a small developing state to effect reform in a specific area of its primary school curriculum.

2.3.2 Research literature in the Seychelles

Research studies about education processes in Seychelles are mainly those conducted by postgraduate students within their studies. To date, these are all unpublished, although some research has been presented at regional and international conferences (Barallon, 2011; Purvis, 2007). Although the education system has undergone major structural reforms over the past 10 years, those reforms have not been accompanied by scholarly papers in peer reviewed journals. What tends to happen is that the schools or education officers working on the various projects write progress reports along the way to capture the reform process. Usually these are confidential documents and are seldom disclosed to the public at large unless they are requested by someone. Alternatively, many of the documents tend to remain the property of the person working on the project and are generally inaccessible.

During the last ten years, formal research studies in Seychelles have centered on the SACMEQ studies (Leste et al., 2005), the IPAM project (Ministry of Education 2005), socialization of boys – a gender related study (Geisler & Pardiwalla, 2010), the development of school-based action research (Action Research Committee, 2009), and the Child development study (Myers et al., 2003; Myers et al., 2009). The latter is a 25-year old longitudinal study which seeks to establish links between exposure to mercury intake through consumption of fish and cognitive ability. More recently, there has been a focus on a project in early childhood education focussed on developing children's phonics skills in Creole. There is no publication on the latter project so far.

What the local literature suggests is that studies done locally are not properly documented. It is for this reason that little is found about the MLS reform. In the section which follows, I argue that there is a need to develop knowledge about

the MLS reform in order to advance the development of mathematics education in Seychelles.

2.3.3 Developing knowledge about the reform

As is the case with reform-oriented instruction initiatives, the implementation of MLS in schools was monitored for administrative and supportive purposes. School reports were analyzed to ascertain teachers' perception and impression of using the template. Lessons were frequently observed and monitored to support teachers with the various aspects of the process. Informal discussions with teachers were conducted to gauge the effectiveness of the structure. Unfortunately up to now only three empirical studies (Lespoir, 2009; Nolan, 2008; Valentin, 2007) have been conducted around this reform initiative in the Seychelles. Hence, very little is known about the outcomes of this reform initiative. There are other data which have been collected on MLS implementation and are yet to be analyzed.

In a small scale study Valentin (2007) reviews a sample of ten school reports produced by the schools as part of their end of term report which they have to submit to the school authority. The review provided some practical thoughts on the way the reform was developing and areas of the school life and mathematics lesson cultures which were being affected. The results indicate that, as may be the fact with most changes in education, the introduction of MLS was welcomed with some concerns challenging mainly its nature and its rigid time scale. Teachers complained that it required them to plan too much; an activity which added more demands to their existing workload. There were initial fears that MLS would kill teachers' creativity and restrict them from attending to unforeseen occurrences in class. There were also some claims that the requirements of MLS interfered with what pre-service teachers were getting in their initial teacher training programme. The findings also

indicate that a large majority of teachers within the different schools showed eagerness to try out planning and conducting their lessons using the MLS requirements and parameters and the overall conduct of maths lessons had improved in that the teachers were more focused, little time was wasted on unplanned activities, the pupils' conceptual understanding was better facilitated and teachers generally enjoyed teaching mathematics (Valentin, 2007).

The method of reviewing those school reports employed in Valentin (2007) had some limitations. The fact that the reports were produced by the schools for submission to an authority may suggest that the reported occurrences might not fully reflect the reality of what was going on in the schools. Moreover, schools might have reported on things which seemed most significant to their situations only. There was no specific area for reporting. Hence, the fact that the teachers did not report on a particular point does not mean that the point was insignificant. A more systematic inquiry was necessary.

In a second study on education processes commissioned by the government of Seychelles, Nolan (2008) questions some school officers and teachers on the use of MLS and links some of his findings to the pupils' achievement data. In his consultancy report to the president of the republic, Nolan explains how mathematics achievement in the national examination had improved. He attributes these changes to the reform in mathematics, namely, the MLS reform. Nolan's analysis supports the use of MLS in the classroom:

... "the [Primary Six] results for 2007, ... show a significant improvement across all grades (and groups of grades) ... especially in the percentage of top grades and the Grade C or higher category. This is also reflected in a 'mean statistic of 49.64, which compares with that of approximately 41 in 2006, and below 30 in previous years.

It would seem that this welcome improvement is attributable, to a significant extent, to the work of the Mathematics Working Group, under the aegis of the Ministry of Education which, in collaboration

with teachers, developed a Model Mathematics Lesson Structure. This Lesson Model, which is applicable to all mathematics lessons, has been readily accepted by the teachers, and is backed up by a support service from the Ministry. It would now seem appropriate that this Model Lesson Structure would become an integral part of the course in the 'methodology of teaching mathematics' at the NIE. Moreover, the apparent success of this initiative should act as a 'best practice', and provide a prototype for the teaching of other subjects in Primary Schools, modified as deemed appropriate (Nolan, 2008, p.57).

Evidently, more research is needed to understand the aspects of the structure which account for variations in pupils' achievements and other aspects of their learning outcomes. More importantly, it would be useful to know the extent to which MLS is contributing to the gain in achievement reported in Nolan's synthesis.

As part of her Master's thesis, Lespoir (2009) inquires about teachers' perceptions of the reform through a survey about the impact of IPAM. Consistent with what Valentin (2007) reports, the teachers had endorsed the introduction of MLS, and were trying to incorporate the major ideas of the reform in their teaching although they were finding some components of the reform challenging to try.

In spite of these three studies, very little is known about the reform in schools. Five years into the reform, questions such as a) what are some potential outcomes of MLS; b) how has it impacted on teaching and learning; and on top of all c) how worthwhile has the reform been, are key questions that deserve answering. Evidence is needed to spearhead development of mathematics education in the country.

2.4 The NNS: implications for Seychelles

In this part of the review I look at the implications of the NNS which I believe are relevant to the Seychelles' context. I discussed elsewhere that the MLS reform in Seychelles was motivated by the three-part lesson structure in place in England.

There should be some relations between the two. Unfortunately, I do not have adequate evidence from the Seychelles project to compare with the England NNS. As Kyriacou (2005, p. 169) specifies, “one of the key features of the NNS, was the introduction of a daily mathematics lessons in primary schools based on a three-part lesson format, and making substantial use of interactive whole-class teaching”. Hence, I will limit my discussion to those reported outcomes of the NNS which are associated with the daily lesson. These outcomes would be more relevant to the Seychelles’ case.

The NNS introduced in England in 1999 (DfEE, 1999) and the MLS introduced in Seychelles in 2006 (Mathematics Working Group, 2006) should offer a wonderful opportunity to compare mandated policy implementation between a developed and a developing state. In view that the development of MLS was stimulated by England’s three-part lesson structure, future comparison could be geared towards understanding the process of transferring reform ideas between the developing and the developed countries. Already one clear distinction on the process of policy development, implementation and evaluation between the England case and the Seychelles case relates to the nature of research into which the policy is grounded. Brown et al. (1998) describe how the NNS is grounded in research and bring multiple evidence to support the decisions which led to the development of the reform. However, the authors acknowledge that there was, at times, weak and equivocal evidence to support some of the decisions. The authors also acknowledge that “there are always many practical constraints on policy which are likely to override empirical evidence” (p. 378). This suggests that policy cannot be solely guided by research. In a small state like Seychelles where a research culture is yet to be developed, empirical evidence seldom influences policy. The Seychelles’ process of

developing MLS was based primarily on policy makers' intuition of those teaching practices which they [the policy makers] believed would work. Development of the structure was not research-informed per se but some aspects of it, for example the requirement to vary teaching and learning strategies and incorporate prior knowledge or concrete examples in developing mathematical concepts, were grounded in research discourses (Barry & King, 1989; Carpenter, Fennema, & Franke, 1996; Good & Brophy, 1987). Due to the nature and extent of research carried out on the UK National Numeracy Strategy, implications can be drawn for the development and advancement of the MLS reform in Seychelles.

2.4.1 Some significant findings about NNS

The first evidence evaluating the NNS gives support to large scale systemic reform (Earl, Watson, & Torrance, 2002) and mandatory prescribed practices (McNamara & Corbin, 2001). Earl et al. (2002) describe the NNS as the most ambitious large-scale reform initiative which has claimed success in a number of ways. McNamara and Corbin (2001) contend that the NNS itself was largely well received in schools, especially for its clear guidance, and its perceived emphases on mental strategies and pupils' understanding. These two pieces of evidence suggest that carefully designed improvement interventions implemented on a large-scale can be an effective way to deal with educational issues at national level.

The review reported in Kyriacou (2005) show that the NNS was successful to some extent in raising the pupils' knowledge and understanding and their confidence as learners of mathematics. The benefit on pupils' achievements was relatively small but positive (Brown, Askew, Millett, & Rhodes, 2003; Tymms, 2004). Even if little is known about the link between teachers' attitudes and pupils' learning in the context of the NNS, it may be possible that the rise in pupils'

competence and confidence could well be a consequence of the teachers' positive attitude towards the initiative. Although the strategy was not legally compulsory, most teachers used the opportunity to try the suggested ideas. Millett, Askew, and Brown (2004) remark that within just the early years into the reform most teachers were incorporating the strategy into their practices. Unfortunately not all of the teachers' direct instructional practices were associated with improvement in the way pupils' learn mathematics. Anghileri, Beishuizen, and van Putten (2002) contend that standard algorithms such as those for division, do not build on children's intuitive understanding of the operation. The evidence is such that the early teaching of these algorithms led to learning strategies that inhibited thinking and conceptual understanding of numbers and processes (ibid, 2002). Hence, to enable pupils to learn to use standard algorithms in a less mechanistic way, it would seem appropriate to build on intuitive understanding.

The impact of the NNS on achievement is further discussed in Millett, Brown, and Askew (2004b). The researchers followed two cohorts of approximately 2000 children from a representative sample of schools during the period 1997 to 2002. This project was part of the Leverhulme project which began before the introduction of the NNS and extended to some years after its implementation which hence allowed pre and post reform effect to be measured. In a second study, Anghileri (2006) reports on how pupils' solution of division problems changed between 1998 and 2003. Anghileri replicated a study done in 1998 with a different group of Year 5 pupils in 2003, using the same items and 9 of the 10 schools in the initial sample. The two studies (Anghileri 2006; Millett et al. 2004) differed in scope in that Anghileri's study was more focused on solutions to division while the other study considered tests with a wider scope. Even if there seems to be an improvement

in the pupils' performance as a result of the NNS, it could be argued that such system-wide effect was relatively small (Anghileri 2006; Millett et al. 2004). Furthermore, the spread of pupils' achievements widened. The low attainers lost out at the expense of the high attainers. Claim that NNS was having a negative impact on the performance of low achievers is also reported in Gross (2007) who indicates that while the percentage of the students at the end of Key Stage 2 scoring high marks was increasing over the years, the percentage of students achieving below the minimum acceptable level was not reducing consistently. In the first interim evaluation report of the NNS, Earl et al. (2000) have observed that the strategy by itself might not be the most effective approach to fostering higher order thinking.

2.5 Conceptual framework of the study

The change discussion model serves as the main lens through which evaluation of reform initiatives can be studied. I use the term 'change discussion model' to label the model formed by the fusion of the six Ps model (Spillane 1999) and the model for discussing change suggested in Millett and Bibby (2004). The fused model is appropriate for studying the implementation and outcomes of MLS in that it focuses mainly on the teachers making decisions for instructional change within their community of practice (Wenger, 2000) and the wider context. Spillane's model is used to explain why some teachers can change their practices while others cannot. He proposes a six **Ps**' model to describe instructional reform. Millett and Bibby added to this model in order to conceptualize instructional change processes in the context of primary mathematics teaching reform in England. In this section, I describe the fused model resulting from the work of Millett and Bibby, and I indicate its relevance to my study.

Spillane posits that teachers, the central people in the process of instructional change, are influenced by a number of factors when they attempt to revise their practices. Spillane (1999, p.144) uses the concept “*zone of enactment*” to hypothetically describe the location where the teachers operate and face the reality of their practices, eventually, the zone where reform ideas are met and interacted with, and professional development possible. The Ps represent the teacher (the **p**erson at the midst of change) and a set of five major sectors external to the *zone of enactment* namely, **p**olicy, **p**rofessional community, **p**upils, **p**ublic, **p**riate, that have direct influences on the teachers’ working environment. All these sectors may support or discourage teacher learning, hence influencing the teachers’ decisions to change. In the paragraph which follows, I discuss how the Ps may be related to the MLS reform.

One of the Ps refers to policy. The policy sector refers to the government and institutional policies. Reforming mathematics teaching preoccupies many governments. MLS reform has become a policy reform specific to Seychelles, and depending on its outcomes it might influence teaching in other small states. It is likely that MLS reform ideas along with other policies in schools in Seychelles have influenced the teachers’ decision to change. Another of the Ps refers to professional community which describes the formal and informal contact among teachers within the working environment. Due to Seychelles being small with everybody knowing everybody else, the influence of the professional community can be powerful. The next factor relates to the pupils who unarguably exert a lot of influence on the teachers’ decisions. In view of the proximity of the teachers and the pupils to the *zone of enactment*, I would have considered both to be at the centre of the reform. Another of the Ps relates to the public sector – the parent and the community within which the school is located. Since mathematics education is a core subject, and is

believed to be the gateway to many opportunities, influences that the public can have on teachers' decision to change might be quite substantial. Private sector represents another P in the model. It encompasses private sectors such as publishers, learning aids manufacturers, private businesses, etc..., which in their own way influence how teachers address the issue of change. For example, if teachers have access to supportive and effective resources such as textbooks or teaching materials, and are supported financially by national businesses to try out new classroom project, it is likely that these supports will influence their decision to change. The last P, essentially the most significant in my opinion, is the teachers as the people making change. In such a context, Spillane talks about personal resources – the teachers' characteristics and background. Spillane argues that some teachers are more responsive to change than others. Teachers see and construe reform calls differently. As learners, teachers have different potential to effect change. As individuals, they have different attitudes vis-à-vis change. Hence, personal resources can play a significant role in the way change is addressed by the teachers regardless of any other factors.

Spillane (1999) assumes that ultimately the teachers' decision to revise practice depends on the characteristics of the teachers' *zone of enactment*. He argues that the nature and quality of interactions among teachers and other individuals in the professional community determine how change is embraced.

Millett and Bibby (2004) drew on Spillane's work along with the work of Leithwood, Jantzi and Mascall (1999) and introduce the concept "situation" (p.2) to provide a more appropriate reflection of what goes on in the *zone of enactment*. All the day-to-day influences from colleagues and pupils that impinge on the teachers' way of work are labelled as the situation and it is those interactions within the

situation that gives the school its unique culture, and consequently shape the nature and intensity of working relationship (Millett & Bibby, 2004). Within the situation Millett and Bibby include the pupils and the professional community of colleagues. They argue that the external influences could also be regarded as part of the situation as they are part of the learning environment of the teacher even if it is not necessarily encountered on a day-to-day basis.

To narrow the focus of my study, data for the evaluation were collected about aspects of the “situation” which have an influence on teachers’ *zone of enactment*. It was not practical to collect data from other sectors. Specifically, I looked at how the teachers engaged with the reform and I mainly discussed change from their perspectives. I did not research on the influence of the pupils per se, but I inquired into how teachers’ practices brought about changes in pupils’ achievements.

2.6 Summary

This chapter has addressed the issue of policy implementation in the context of an education system in SIDS attempting to improve the quality of learning experience of its pupils. The study is justified on the grounds that policy implementation in education remains a major dilemma, mainly because the process requires changes in practices at various levels of the system. Small states, in spite of their small sizes, are challenged by a number of factors in their quest to reform education. A second important justification of the study lies in the fact that small states like Seychelles are unable to learn from one another on the issue of policy/pedagogical reform as relevant literature in this community of states is practically inexistent. My study seeks to fill the gap and stimulate a new conversation on sustainable pedagogical reform. The local benefit of this study is to uncover the pros and cons of this new

approach to teaching mathematics and its potential to provoke deep, worthwhile change in the teachers' practices.

In view that MLS was developed from a theme embedded in England's National Numeracy Strategy – the development of lessons using a specific template – I paid a major interest on the outcomes of the NNS in this review and drew implications for the Seychelles reform. This literature review establishes a rationale for this present study. The chapter ends with the overall conceptual framework based on the work of Spillane (1999) and Millett and Bibby (2004).

CHAPTER 3 Methodology

The research reported in this thesis employed a mixed methods design within an interpretivist paradigm. The overall aim of this chapter is to describe the approaches I used and the rationale behind the choice of each step. In Section 3.1, I describe how I operationalise this study. In Section 3.2, I discuss my current ontological and epistemological stance of social inquiry. In Section 3.3, I outline the design of my research. In Section 3.4, I discuss mixed methods as the principal paradigm of this research. In Section 3.5, I outline the development of the instruments while in Section 3.6, I report on the data collection processes. In Section 3.7, I take up the validity, reliability and reflexivity issues. In Section 3.8, I discuss the ethical considerations of this study. In Section 3.9, I summarize the chapter.

3.1 Operationalizing the study

This study is an investigation into the impact of a mandatory teaching reform. It is about determining the outcomes of the reform, identifying how effective it has been to date in terms of improving the teaching and learning of mathematics in state primary schools in Seychelles. The study is situated in the context of a small island developing state. The questions that arise are: what is impact, what is outcome, what is effectiveness, and how can they be determined? The definition of these terms does not come up as a single statement. Instead, it is embedded in my conception of outcomes of instructional reform activities in schools which I discuss below.

In this study, my conception of ‘outcomes of reforms’, specifically the arguments I use to identify and discuss indicators of reforms’ successes or failures, are influenced by the work of Cuban (1998) who posits that policy-makers and practitioners use different standards to evaluate the outcomes of reforms. Judging the success or failure of school reforms is a difficult task. Essentially, when the evaluation is in place, Cuban (1998) asserts that it is crucial to identify what criteria are being used to make judgments, whose criteria they are, and how schools change reforms as they are implemented. This argument suggests that passing judgements on the worth of school-based reform is a critical task. Central to Cuban’s argument is his claim that implementers bring to the reform sites service values and moral that differ considerably from the technical and scientific values that reformers would normally suggest. Implementers accumulate expert knowledge about students and how to teach skills and subject matter that few researchers or policymakers would hold. Hence, teachers’ judgements of the outcomes of reforms may be more value-laden. Teachers might suggest or adapt reform initiatives, a phenomenon which Cuban describes as putting their signature on mandated reform so that the reforms can work to the betterment of their students. When policy makers may be judging an outcome such as adaptation of reform ideas as lack of fidelity or a sign that the reform is decaying, teachers could be evaluating the same outcome as a precondition for effectiveness.

Another criterion for judging the outcomes of reforms which Cuban discusses as standards for policy-makers relates to the durability of the reform. Usually an initiative would be deemed successful if it lasts. My experience working with primary school teachers has shown that teachers may draw useful insight from some aspects of the reform and then discard the bulk of the ideas altogether. At face level, it could be seen that the reform has decayed but in reality it might not.

Moreover, schools as organizations evolve rapidly. School in Seychelles are very unstable: teachers move from school to school regularly; others get promoted; leaders take on new positions or move away for further training. All these ultimately may obscure the durability or the diffusion of reform ideas. Schools evolve to take account of these changes while at the same time teachers adjust themselves to survive the evolution (Cuban, 1998). Cuban argues that, unfortunately, due to power relations, the reform entrepreneurs rarely invoke the teachers' adaption of reform ideas which teachers have undertaken to survive the schools' changing context.

According to Cuban, reform is a journey of adaptation that can be seen as effective or ineffective depending on one's criteria of success. Such equivocal definition suggests the need to "move away from the usual thumbs-up or thumbs-down verdict on a reform, and point to improvements in practice" (Cuban, 1998, p. 471). My study takes Cuban's words into consideration in that I focus the inquiry on the implementers' experiences of the reform mainly, and to a lesser extent, on some objective evidence, in particular, pupils' tests scores. Both the implementers' and policy-makers' perspectives are important in understanding what went on with regard to the reform. At the same time I acknowledge that reforms take time to have impact (Hall & Loucks, 1978; Johnson, Hodges, & Monk, 2000), and that five years might be too short to notice impact such as sustainability. This is why much of the focuses are given to the implementers' evaluation of the reform.

I take the views of Perry and Lewis (2009, p. 367), who in their attempt to understand the success of lesson study in one district in US, suggest to us the need to describe the impact of reforms "on teachers' self-reported instructional practices, their professional capacity, and their ability to work together to improve their knowledge for teaching". Furthermore, the practitioners' judgments are useful in my

study for two reasons: firstly, MLS is in its infancy and its true impact is yet to be seen, and secondly, the reform has not been systematically researched before, nor properly documented which makes fidelity and spread standard (the policy-makers' standards) problematic to assess.

Enactment of teaching reform calls becomes meaningful to the implementers if the anticipated reform is consistent with classroom realities (O'Sullivan, 2002). "Classroom realities" encompass the daily occurrences within the classroom along with the socialization patterns of its members, the climate, ethos, constraints, limits and affordances. In such case the teachers would critically engage with the reform artefact and carry out tasks that are in line with what the reform advocates. Teachers' compliance can be intrinsically stimulated. However, compliance would be more than rote practice. If the latter occurs it could be justified in the context of classroom reality. Similarly, defiance should not necessarily be viewed as rebellious. It could also be contextually justified. Matured systems advocate the need for conflicting ideas in order to foster new insights.

In line with my search for outcomes and impact of the MLS reform I have made three other fundamental assumptions: (1) I assume that all teachers in the primary schools have made MLS the basis of their lesson planning and conduct, hence all lessons I observed were influenced by the MLS regime. This assumption is important as it enables me to discuss the status of mathematics teaching in Seychelles in the context of the reform. (2) I assume that MLS reform is the dominant reform influencing primary mathematics education in Seychelles and, thus, whatever outcomes I will identify are largely due to MLS. Over the past five years there have been other initiatives and reform ideas brought to schools. The occurrence of the various initiatives suggests that teachers might have been involved in other

improvement activities. This point undermines my approach to investigate impact at school level, hence presents a limitation to my study. However, the conduct of MLS was more systematic and systemic. The reform has preoccupied entire school activities, and has been visible as one major aim on all school development plans. It has been the predominant instructional reform during the past five years. (3) I assumed that the views of the participants, especially those who have had pre and post experience of teaching mathematics under the MLS regime, reflected an accurate approximation of reality. Nevertheless, I acknowledge that not all teachers will communicate (intentionally or unintentionally) a true picture of what has been going on. For example, some teachers might feel they were using MLS when in fact they were not. Also, some teachers might have felt that this research is still connected to my previous work with the Ministry of Education. They might have not said what they should have said.

3.2 Approach to social inquiry

In this section I discuss three things. First, I present a brief discussion of my current ontological and epistemological stance on social inquiry. Second, I discuss the selected philosophical assumption specific to this study, and third I outline a new perspective to doing research in the context of small island states. This section forms the premise of other sections in that it gives an overall rationale for the choice of the design and methods.

3.2.1 The ontological and epistemological issues

Ontological assumption of a research relates to what the researcher believes to constitute the reality of the phenomenon in the research (Cohen & Manion, 2000). In

other words one's ontological position provides answers to the nature of the reality to be investigated in the research. Put simply, ontology answers the question of what one may know. Epistemological positioning deals with the issue of how the researcher comes to know what he believes may exist or what is known (Cohen & Manion, 2000). As Grix (2002) observes, ontology is a prime concern of all research activities. It forms the basis onto which the epistemological and the methodological concerns of the research are established.

Two epistemological frameworks to conducting social inquiry feature prominently in the literature. These are the positivist and the interpretivist frameworks (Candy, 1989; Cohen & Manion, 2000). Expressed in simplistic terms, the positivist – interpretivist debate posits that creation of knowledge is either through aims and methods of science (positivism) or through sense-making of the world through experience (interpretivism). The positivist view of inquiry dominated the research field for a long time until critiques emerged that better sense-making could be made about phenomena in social science if they are given interpretive explanations. Opponents of positivism converge on their beliefs that human behaviour is not fully governed by general law (Cohen & Manion, 2000). They argue that the social world could be best understood from the standpoints of the individual actors. However, emphasizing the subjective meaning of social actions carries the risk of missing out the relationship between actions and external factors. The critical epistemological framework maintains that research can look beyond the perception that individuals have, to one which examines factors that often shape these perceptions (Candy, 1989). Critical theory seeks to understand the relations among value, interest and actions – an urge to change the world as opposed to describing it (Candy, 1989).

Regardless, there is indeed a debate as to how research or social inquiry is to be approached and handled (Blaikie, 2007). As argued by Blaikie, there is a tendency for researchers to take a stance. Very often it is heard that one is a positivist and another is an interpretivist, which leads to an assumption that someone can conclusively subscribe to a specific camp and address inquiry from one of the two philosophical beliefs. However, the many factors that may impinge on the outcomes of research, made me believe that at times context and nature of inquiry influence the philosophical assumptions that one adopts. Hence, adhering to a particular school of thought may prevent one from fully uncovering the reality around phenomenon being researched. This may be naive thinking but for the moment I stand by my argument that philosophical assumptions underpinning an approach to social inquiry can be contextual and not stable. Perhaps with more exposure to and engagement with research activities I may revisit this current position.

I also believe that in line with developing philosophical assumptions towards approaching social inquiry, I should not subscribe to one school of thought just yet for two reasons: The first reason is that my research professional life is still too young. I need to develop a good grasp of the world by seeing reality with multiple lenses and from different angles. I cannot afford just yet to confine myself to one camp. The second reason is that because of the context and location in which I intend to develop my research career, I feel that gaining insights into multiple perspectives would be more enriching. Educational research in Seychelles is in its infancy. I may find myself at any moment being required to deal with people with different philosophies or themes within multiple contexts. It is useful that at this stage of my career I have a grip on more than one way of approaching inquiries yet adopt the most relevant stance according to the phenomenon under investigation.

3.2.2 Philosophical assumptions of this research

This study, in the first instance, was an inquiry into the outcomes of a systemic reform in a small developing state. It was also an investigation into those factors that in one way or another had influenced the outcomes of the reform. Drawing lessons and implications for subsequent instructional reform initiatives in Seychelles or other small states was a subsidiary intent of this study. One important observation which should be boldly highlighted is that this study was conceptualized five years after the reform was implemented. This limited the scope of the inquiry in two ways. First was the fact that the amount and variety of longitudinal data were limited. Hence, questions that explore the development of the teachers' perceptions and attitudes towards the reform, those that seek to inquire about pre and post effect of the intervention, and those that attempt to compare control and treatment groups could not be fully answered. Second was that the participants were required to recall past experiences. So much will have occurred since then which could have influenced the participants' memories, interpretations and attitudes to the reform. Indeed, the participants may not have even articulated these beliefs and attitudes at the time. As a result, the data were not sufficient to help me understand how time had contributed to any shift in belief or attitude. These limitations inevitably not only restricted the questions I could pose, but also the choice of research design and method. I hence discussed my ontological and epistemological position in line with these limitations.

The issue of what knowledge exists in this specific inquiry were: teachers' attitude to the reform, change in pupils' achievements, change in instructional practices, relationships between reform usage and change in practices and achievements, and practices in terms of coordination and supports that have had an impact on the nature and direction of the changes. Specific to my research, these are

some realities that we might want to know. The next question then relates to my ontological position: objectivism or constructivism. According to Grix (2002) an objectivism stance asserts that social phenomena and their meanings have an existence that is independent of the social actors while a constructivism stance takes an alternative view; social phenomena and its meaning are continually being fulfilled by the social actors. Viewed in this line, my research best fits the constructivism stance in that in this specific inquiry I sought to understand meaning and explication of how teachers enacted reform and the different factors that conditioned their experiences. Nevertheless, there were issues that needed to be dealt with using empiricist assumptions as the best choice (Blaikie, 2007).

To answer the question regarding my epistemological position I begin by arguing that many of the inquiries which seek to understand teachers' work in the context of school processes (Hodgen, 2003; Venkatakrishnan & Brown, 2009; Wood et al., 1991) are framed within an interpretivist stance. An interpretivist approach allowed space for combining research methods and methodologies such that rigor could be fostered in the analysis (Johnson & Onwuegbuzie, 2004).

In my study, the roles of practitioners involved in the implementation of MLS were so critical in helping me to develop insights in the reform. There were many instances where constructions of meaning were necessary. The teachers' input helped me build new understandings and challenge my personal views of seeing reform in Seychelles. Hence, my position in this study could be summarized as discussed in (Leech, Dellinger, Brannagan, & Tanaka, 2010):

Constructivism [interpretivism] is [better achieved] through relativism (i.e., reality is locally constructed and co-constructed), the epistemology is transactional (i.e., co-created), and the methodology is hermeneutical (i.e., the investigator's experiences and bias impacts the research (pp. 17-18).

The ultimate decision however, is not about determining a specific epistemological stance. Instead, it is about the combination of methods and methodologies that best provide insight about the phenomenon under study (Johnson & Onwuegbuzie, 2004). On a pragmatic level, and again given that research is relatively underdeveloped in Seychelles, an interpretivist approach is more appropriate to generate new ways of thinking, and to understand the variety of differing and competing world views. Whereas the scientific approach is more appropriate to generating testable theories. An interpretivist approach in my point of view offers more scope to mixing approaches hence creating a better picture of the phenomenon under study.

3.2.3 Social research in the small states

There is a new perspective being advanced by Crossley and Holmes (2001) with regard to doing research in the small island states. The two authors speak of small states as being ecologically different to industrial countries and not simply a scaled down version. They argue that the context of small island states is totally different from that of developed states. They cite the St Lucia's case, where almost everybody knows everybody else and anonymity is rather nonexistent. The pressure to disseminate research and the multiple functions of officers not only challenge the research process but offer a case for new methodologies (Crossley & Holmes, 2001).

One of the major implications of the current debate for small states is that care should be taken not to uncritically imitate those models of educational research that are currently fashionable or are already challenged elsewhere. Rather, it is argued that efforts to strengthen research capacity must give attention to the distinctive 'social ecology' of small states. This can affect the relationships that can be developed between research partners and the methodologies used (Crossley & Holmes, 2001, p.10).

There is an urgency to review epistemological issues and cultural values in the research considerations of small island states (Holmes & Crossley, 2004). The main argument is that research capacity in these islands has to be strengthened so as to accommodate the often neglected “local knowledge” which in many cases forms the hub of knowledge sources in these countries. Local knowledge, consisting of oral histories, is so common yet under-used in the construction of reality in research in this small state. This can easily be translated to Seychelles where people seldom record or document their research activities. When it comes to producing a literature review, in many instances, the studies are undermined by the lack of local references. Subsequently, research in the small island states is compacted with literature from the western world. However, there may exist rich sources of local knowledge which cannot be reported because they are not in documentation form. Educational research in the small states should be re-thought so that local resources could be utilized argued Holmes and Crossley (2004). This had implications to my study. For instance, since in Seychelles literature is scarce and local publications are limited, I relied on unpublished documents usually in the form of reports and minutes meetings, and on officers’ accounts (memories of events) to build stories about the reform.

3.3 Design of the research

This study is an evaluation into the impact of the MLS reform. I begin this section by justifying my evaluation design. I further support my rationale with some past studies as precedence to how I carried out my own study.

3.3.1 Rationale for the design

My decision to carry out an evaluation was on the one hand purposeful and on the other hand convenient. Five years into the reform I was faced with a situation where little was known and written about the reform. A proper evaluation of the reform was yet to be conducted. Further, the data which existed as part of the monitoring process of the reform was limited to only certain aspects of the reform, although much of the data had not been analysed at that stage. In addition, the reform had been implemented throughout the Seychelles and there was no possibility to compare schools that were using the reform with schools that were not using it. Thus, I was restricted in what I could do in a number of ways. Nevertheless, I was convinced that an evaluation was needed to answer several questions which people concerned with the development of mathematics in Seychelles had started to ask. Since I was out of Seychelles for most of the time, I could not carry out a comprehensive ethnographic study per se which is often favoured in the study of policy implementation (Venkatakrisnan & Brown, 2009). Nevertheless, the qualitative component of the study did make use of ethnographic methods such as interview and observation. However, the time dedicated on the field was short.

My initial round of readings about educational change and teacher enactment of reform (Datnow & Castellano, 2000; Earl et al., 2002; Millett, Brown, et al., 2004b; Spillane, 1999) directed me towards a longitudinal study. However, whilst the existing survey data did allow for this, I judged the collection of additional longitudinal data to be impractical given the constraints of time and distance. I wanted an approach which would allow me to inquire into the outcomes of the reform and obtain some forms of longitudinal perspective about the teachers' engagement. Furthermore, to do justice to the work that the Mathematics Working

Group had done up to then, in particular with regard to collection of data on certain aspects of the reform, I thought that an evaluation into the impact of the study would fulfil the purpose of this research. There again, the word impact carries the idea of an experimental design such that the real effect of the reform can be isolated.

Whilst acknowledging the inherent limitations, I note that it is possible to research and evaluate impact in a naturalistic phenomenon such as this and without an experimental design study. The teachers' perceptions of the reform, especially their accounts of their experiences (Bantwini, 2009; Ryder & Banner, 2012) provide a basis for discussing impact and a ground for evaluating impact of policy implementation (Venkatakrishnan & Brown, 2009). Discussing pupils' achievement in pre and post reform context provides another alternative (Anghileri, 2006; Brown, Askew, Rhodes, et al., 2003; Millett, Brown, et al., 2004b). Pupils' achievement data also serve as a basis for evaluating teachers and schools (Hamilton et al., 2003). Thus, I developed my approach to study the implementation of MLS pragmatically within the constraints of the context, existing data and my own position as a sole researcher. I decided on the following:

- a) To use secondary data wherever available and appropriate. Namely, there were questionnaire data previously collected by the Mathematics Working Group which could be used as baseline data. There were pupil achievement data collected through the SACMEQ study and the IPAM project which could be used to develop a longitudinal perspective of the reform and hence assess change.
- b) To administer a new survey with teachers about their perception and experience of the reform five years later.
- c) To select four schools for in-depth fieldwork. Notably, I wanted to inquire about teachers' actual practices and ask them questions about their practices.

d) To acquire views of key informant on teachers' use of the reform and their perception of change occurring as a result to using MLS.

To me, this approach was appropriate enough to capture a sense of the impact of the reform. The decision taken essentially necessitates the utilisation of both quantitative and qualitative methods (Cohen & Manion, 2000). This called for a mixed methods paradigm as argued by Johnson and Onwuegbuzie (2004). Mixed methods as the model of inquiry, issues about reliability, validity and reflexivity are treated later in this chapter.

Through the change discussion model, I seek to inquire into the nature of change, and explain what was going on in schools as a consequence of implementing the reform. Although the model describes the influence of several factors that facilitate or inhibit the teachers' decision to change, my study focuses mostly on one of its components, *the situation*. I zoom in on the *zone of enactment*, the location where the teachers meet, construe, interpret, and implement reforms or policy decisions. By so doing, I examine the interplay between the teachers as the persons implementing the policy, the pupils, the professional community, and the policy. Whilst the other aspects of the model, private and public arose during the interviews, these are not the focus of my study and are only addressed insofar as they touch on the main focus. Hence, the nature of the questions I posed sought to understand the teachers as 'enactors' or interpreters of policy suggestions and, hence, the factors that assisted and/or constrained their implementation of the reform. In the table which follows, I describe how the research questions, data collection approaches and components of the change discussion models are related in my study.

Table 3.1 Overview of the methods, sampling and data analyses as related to the research questions

Research questions	Sampling/Participants	Links to the change discussion model	Methods of data collection	Data analysis
1. How has the teaching of mathematics in primary schools changed with the implementation of the MLS reform?	I targeted all teachers teaching mathematics in primary school (n = 289). 219 (76%) responded.	Teacher and policy	Questionnaire	Quantitative
	6 teachers selected from each of 4 case study schools. The teachers were selected on a voluntary basis.	Professional community	Focus group interview	Qualitative using constant comparative approach
	8 subject leaders selected using convenience sampling.	Professional community	Focus group interview	Qualitative using constant comparative approach
	2 key informants selected on purposive basis	Professional community	Individual interview	Qualitative using constant comparative approach
	P6 and P4 teachers: I targeted all teachers at these two levels in the 4 case study schools. However, I got a sample of 11 teachers. (convenience/opportunity sample)	Policy	2 lessons from each teacher were observed using the non participant lesson observation. Post lesson interviews were held with each teacher.	Content analysis of lessons using a developed framework. Post lesson interview data were analysed using constant comparative approach
2. How do primary pupils' achievements in major examinations in Seychelles before and after the MLS reform compare?	Secondary datasets of pupils' achievements SACMEQ II and II (n = 1484) and 1480 IPAM Test (n = 1080)	Pupils	Both datasets are secondary data. SACMEQ data drawn from an international study involving 15 countries of Africa. The IPAM data were drawn from a locally developed project	SACMEQ data is cross sectional. IPAM data is longitudinal Both data sets were analysed quantitatively employing classical test analysis procedures.
3. How do primary school teachers and mathematics subject leaders describe and evaluate their experience of teaching mathematics using the MLS approach?	Teacher questionnaire (n = 219) 6 teachers selected from each of the 4 case study schools (convenience sample)	Professional community	Focus group interview	Qualitative using constant comparative approach
	8 subject leaders selected using convenience sampling	Professional community	Focus group interview	Qualitative using constant comparative approach

To understand the intra and inter-relationships within and between teachers' zone of enactment, I used an approach similar to the one that the Leverhulme project team used in its attempt to study UK teachers implementing the National Numeracy Strategy (Simon, Millett, & Askew, 2004). I observed a sample of teachers, and I interrogated them to obtain a deeper understanding of the relationship between their practices and the MLS reform. I describe the research approach thoroughly from Section 3.4 through to Section 3.6.

Through the change discussion model, I examined factors that might have facilitated or constrained the teachers' decisions and choices relating to the implementation of the MLS reform. The model also offers possibilities for studying relationships among these factors. The different data collection methods and techniques that I used allowed me to capture aspects of those relationships which I believed were significant to understanding the outcomes of MLS. Focus group discussions, classroom observations and post lesson interviews enabled me to gain access to what the teachers were doing. Hence, I was able to inquire into the relationship between the teachers and the policy on the one hand, and the teachers and their professional community on the other. The interviews with some key informants and some subject leaders added information to my inquiry into the different *zones of enactment*. I supplemented the dataset with secondary data collected from i) a past teacher-survey, and ii) pupils' achievement data derived from two previous projects. I needed those secondary data to develop a historical account of the reform and an understanding of the learners' performances in the context of the reform. By linking the findings from the pupils' achievement data to the teachers' self-reported data, I have been able to interpret the impact of the learners' performances on the teachers' experience of the reform.

3.4 Mixed methods as an inquiry approach

According to Johnson & Onwuegbuzie (2004) mixed methods research is increasingly being used as an alternative to the traditional mono-method approaches to conceiving and implementing inquiries in education and social science in general.

My study employed this approach. Johnson & Onwuegbuzie argue that:

“Mixed methods research also is an attempt to legitimate the use of multiple approaches in answering research questions, rather than restricting or constraining researchers’ choices (i.e., it rejects dogmatism). It is an expansive and creative form of research, not a limiting form of research. It is inclusive, pluralistic, and complementary, and it suggests that researchers take an eclectic approach to method selection and the thinking about and conduct of research.” (p. 17)

Johnson & Onwuegbuzie (2004) describe mixed methods as a class of research in which the researcher combines quantitative and qualitative research techniques or language into a single research design. This third research paradigm is acclaimed for a number of reasons. Specific to my study, qualitative and quantitative methods of research produced different perspectives of the impacts of the reform. Secondly, under this approach I could conduct analyses using different approaches. Quantitative analysis of pupil test results provided good estimates of individual students’ ability. Qualitative methods were useful for analyzing focus group interview data, teachers’ classroom activities, learners’ tasks and classroom processes. A third advantage relates to the fact that I could use findings from qualitative methods to interpret findings from quantitative methods. For instance, since the IPAM tests had already been constructed long before this evaluation, I could not re-administer a second test to verify pupils’ achievements. Because of the greater flexibility of qualitative research it was possible to interview the teachers

about the pupils' performance on particular items, thus acquiring more data for additional interpretations. In other words, a mixed-methods research design allowed me to integrate findings from mixed research techniques. This provided scope for triangulation and complementarities (Jang, McDougall, Pollon, Herbert, & Russell, 2008). The expression pragmatic researchers has been coined by Onwuegbuzie and Leech (2005) to describe researchers who are flexible in their research techniques, collaborate with others with multiple epistemological stances and view research as a holistic endeavour requiring prolonged engagement, relentless observation and triangulation. It is this kind of approach which I used to study the MLS reform.

3.4.1 Research methods

Quantitative data: The evaluation consisted of a teacher survey which generated some quantitative data about the teachers' experience to the reform. Furthermore, there were secondary datasets consisting of pupils' achievement data from two projects – the SACMEQ studies and the IPAM project – and some teacher questionnaire responses from the latter project.

In ascertaining impact using quantitative methods, experimental designs are usually developed to measure the effect of the initiative and other counterfactuals on the outcomes. Such design was not possible in my study as this evaluation was conceived after the reform had occurred and the process of randomizing students to class could not be done. Furthermore, this study occurred in a natural setting and the process of controlling what went on was not possible.

Qualitative research methods were used to complement the assessment of impact. This process created opportunity for critical insight into the perspectives and concerns of the teachers. Focus group interviews were held with the teachers and

mathematics subject leaders. A sample of lessons was observed, contextual data about the schools were collected, the teachers were interviewed following the lessons, and the perceptions of key informants were sought.

3.4.2 Rationale for the selection of methods

The decision to include pupils' achievement data in the study was to gain insights into the impact of the reform on achievement. The most convenient way to obtain such insight at this stage of the reform was to use secondary data. The data were carefully administered and readily available to serve the purpose I wanted. The SACMEQ achievement data covered the period before and after the reform (even if it was limited to the first years of the reform). So it was possible to obtain a cross sectional analysis of pupils' learning from the SACMEQ data. Then there was the IPAM project data which included achievement data on a cohort of children from P2 to P6. This data set provided opportunity to obtain a longitudinal view of learning. Since the data started to be collected in 2005, it was possible to ascertain patterns of performance before and after the reform.

The survey was essential to inquire into the teachers' experiences and practices. I also wanted to capture the teachers' patterns of using the reform such that fidelity or compliance indicators could be developed and used as alternative ways to measure change and impact of the reform on practices.

The focus group interview was necessary to get the teachers to talk about the reform (Fishman, Marx, Best, & Tal, 2003; Whitney, Golez, Nagel, & Nieto, 2002). In view that I could not follow them throughout the reform it was important to get a sense of change. I felt that their self-reported data could provide such a possibility. I also felt that putting the teachers in groups was a good idea to stimulate

discussion, get them to recall past activities and due to my past relation with them, I felt that focus groups would be less intimidated.

I wanted to carry out observation of lessons to develop insight into how the teachers were actually using the reform ideas in practice (Franke, Carpenter, Levi, & Fennema, 2001; Spillane & Zeuli, 1999). Relying solely on their self-reported data only was not necessarily an advisable approach. Making claims on practices necessitates observation data. In all the cases post lesson interviews succeeded the observation to further elaborate on outcomes and occurrences in the lessons (Spillane & Zeuli, 1999).

Interviewing key informants was useful to obtain alternate views from people other than that of the teachers. Also, document reviews such as teacher lesson plan files and school reports were necessary to obtain some contextual data (Prawat, Remillard, Putnam, & Heaton, 1992) however, it was not that intensive and was limited to school level data. Other such data were captured from the work of the MWG.

3.5 Development of the instruments

In this section I expand on the research methods to include a discussion about the development of the instruments.

3.5.1 The tests

The tests were not constructed specifically for this study. Both tests were constructed by different organizations. The SACMEQ test was constructed by the research coordinators from the different countries (Izard, 1996; Leste et al., 2005) while the IPAM test was constructed by members of the MWG in Seychelles.

The construction of the SACMEQ tests was undertaken so as to ensure that the test structure was congruent with the content (domains) and behaviours (skills) derived from detailed analyses of the curricula, syllabi, exams, and textbooks used in the various countries. In the end only one test, common to all the countries, was prepared. The test included anchored items selected from the following earlier studies: the Zimbabwe Indicators of the Quality of Education Study (Ross, Machingaidze, Pfukani, & Shumba, 1998), the SACMEQ I, and the IEA's Third International Mathematics and Science Study (TIMSS) (Mullis et al., 1997).

SACMEQ III was developed from SACMEQ II. The SACMEQ II test consisted of 63 items and SACMEQ III consisted of only 49 items. The decision to add or remove items on the tests was made by the SACMEQ coordinating centre based on their analyses of pupils' performance in SACMEQ II. Of the 63 items of the SACMEQ II, 47 (representing 75%) were repeated on SACMEQ III test. The 49 items of SACMEQ III means that 96% (47/49) of its items were items of SACMEQ II. This implies that the two tests were almost equivalent.

The IPAM test: The Pupil Learning Growth Study was developed using the SACMEQ test construction model. The items were drawn from the SACMEQ test. In view that the SACMEQ test covers the primary school curriculum, in 2005, a first set of items was drawn from SACMEQ to reflect the P2 standard. The design was such that in each successive year the test would consist of a set of common items and new items reflecting materials of the relevant grade level. Test 1, the P2 test, was administered in 2005. The test was in Creole. Teaching in P2 in Seychelles is done through Creole as the medium of instruction. All subsequent tests were written in English and were of multiple choice formats. The P2 test was used to establish the baseline from which growth in pupils' mathematics ability could be estimated.

Below (Table 3.2) is the blueprint of the tests reflecting the target competency level of the items at the various grade levels. The items of P2 and P3 tests ranged from Level 1 to Level 4 with more items at Level 1. As the pupils moved from lower grade to a higher grade they were tested on items of higher cognitive skills. Items of the P6 test were sampled across Level 1 to Level 7 of the SACMEQ competency levels.

Table 3.2 Blueprint reflecting the distribution of test items by grade (standards) by competency levels

Grade Level	Hierarchy of levels						
	1	2	3	4	5	6	7
P2	13	7	4	1			
P3	12	8	4	1			
P4	13	8	9	6	2	2	
P5	9	9	10	6	3	2	
P6	13	10	7	8	10	7	5

Development of the blueprint and the alignment of the tests to the primary school curriculum was a measure to ensure that the tests have high content validity. All tests were constructed by MWG. The administrations were coordinated by the Research Section of the Ministry of Education.

3.5.2 The questionnaire

In order to make sense of what was going on in schools in terms of the impact of MLS, it was important to have an indication of the extent to which MLS as a reform agenda had been taken on board. Although it was difficult to provide a correlation between use of the structure and achievement, it was expected that teachers' responses to the questionnaire would provide a basis for discussing change. What was essential in this study was the extent to which teachers were complying with the

requirements of the reform in terms of their overall use and perceived impression of the impact of the reform on teaching and learning.

The items of two teacher questionnaires were reviewed: SACMEQ II study (SACMEQ, 2000)¹ and the TIMSS Study (Mullis et al., 1997). The idea was to ascertain how teachers' practices are captured in a questionnaire of this nature. Using ideas from these two specific cases, I generated a blueprint based on the general ideas which the MLS reform sought to promote in terms of improving the teaching of mathematics. The questionnaire blueprint consisted of eight domains or strands.

Table 3.3 Strands covered by the questionnaire

Strands/Dimension	Item number
Instructional strategies	Q9
Pupil engagement task	Q10
Teacher confidence	Q11
Collegiality	Q12
Leadership support	Q13
Compliance	Q15
Impact on teaching	Q16
Impact on teaching	Q17

In this study the teachers' self-report measure was limited because of a number of reasons. The teacher questionnaire was not able to determine, for example, whether the reform had improved pupils' conceptual understanding, whether pupils' participation had improved over time, or whether past lessons increased understanding. Moreover, there might have been validity issues if the teachers had incorrectly understood what the questions were asking them. There could have been situations where the teachers might have given an incorrect picture of what was going on in their classrooms. However, to a very large extent self-reported data

¹ See <http://www.sacmeq.org>

provide a good measure of the classroom practice reality (Ross et al., 2003). The questionnaire is presented as Appendix 8

3.5.3 The teacher and subject leader focus group interview

The focus group interview was developed around the teachers' attitudes to the reform. The questions were developed to capture the teachers' perception of the reform as well as how they have been using it in practice. The interview began with a discussion on the teachers' goal of mathematics teaching and how they believed the introduction of MLS in schools had or had not interfered with their overall goal of mathematics teaching. This discussion was useful as it helped explicate the source and degree of importance of the value teachers placed on MLS. Hence, teachers' allegiance to the reform idea was discussed within this context. If one's perception or value coincides with a reform request, the likelihood of him or her complying with the reform is high.

The discussion then progressed into identifying which groups of teachers were most benefitting from, or affected by, the use of the reform. When MLS started, there were complaints and critiques by local educators in Seychelles that such prescriptive change to teaching would limit creativity and kill teachers' drive to teach. Engaging teachers in discussing this issue provided an indication as to how they saw the usefulness of the reform. Using the teachers' inputs provided a good way to assess the place of MLS in the mathematics teaching context.

The third part of the discussion led teachers into discussing changes they had felt and witnessed as part of their engagement with the reform. Teachers who were teaching before and after MLS was implemented in schools, were in a very good

position to comment about the changes, and more importantly, the impact of the reform on their practice.

The final part of the focus group interview looked at teachers' suggestions for an alternative to MLS. Outcomes of this part of the discussion were aimed at looking at how teachers viewed the development of mathematics teaching in Seychelles. Critical in this part of the discussion was the teachers' belief of prescribed classroom practices and their roles in helping them accumulate pedagogical knowledge. The interview consisted of 10 main prompt questions and was planned to take between 45 and 60 minutes. The questions used in the interview are appended to this thesis (Appendix 9 for the teachers and Appendix 10 for the subject leader focus group interview questions).

3.5.4 Classroom observation

The main aims of lesson observation in my research were twofold. On the one hand it was meant to contribute towards the development of a classroom perspective of mathematics teaching in the context of the reform regime. On the other hand the evidence collected through this process was meant to triangulate and complement findings from the teachers' self-reported questionnaire and the interviews. Observation was an effective way to gather data on practices in its real context. To make claims on instructional practices, lesson observation is inevitable. Lesson observation presented an opportunity to see teachers in actual practice hence, allowing the option of questioning and probing the ways they enacted the reform rhetoric.

In my study I sought to ascertain the applicability of MLS, the kind of classroom ambiance it evoked and factors that impinged on teachers' capacity to use the reform ideas as prescribed. Specifically, I wanted to: a) assess the fit between

MLS and actual practice as a basis for evaluating the use of the model, b) collect information to generate post lesson discussions with teachers on how MLS facilitated or constrained their teaching, c) acquire examples of how teachers enacted the MLS reform during their actual mathematics lessons, d) ascertain how teachers' background and experience shaped MLS lessons, and e) build a profile of MLS lessons.

In the context of promoting reform-oriented instruction and changes to traditional practices Grubb (2000) provides an interesting remark which supported my idea of carrying out lesson observation in this specific study:

“As generations of reformers have lamented, anything can happen when the teacher closes the door, and so the most carefully constructed reforms may be undone when teachers revert to old and familiar practices” (Grubb, 2000, p.696).

When teachers report through questionnaire or informal communication that they are applying reform ideas as suggested, we can only assume that this is true. Observation is the most reliable means of ascertaining how they are engaging with the reform. Moreover, important practical considerations are lost if no systematic observation is done. Even if it is agreed that teachers may at times adapt reform ideas to fit the classroom realities, or reject a call for reform if it is not promising, it is also important to know behind those closed doors, the extent to which reform ideas are tried out before they are adapted or ignored altogether (Grubb, 2000).

These are some examples of how observation has been employed in some previous related studies. Moyer (2001) used lesson observation as a technique to capture how 10 middle grade teachers responded to calls to teach using manipulative aids. Data from her observations were supported by interviews. She was able to make a claim that in spite of the fact that the teachers were seeing their students having fun

with the manipulative aids, what they used or how they used it was not necessarily appropriate for the teaching and learning of mathematics as most of the teachers in the sample left manipulative aids to be used towards the end of lessons as enrichment activities rather than a support to learning. The observations were also good opportunities to implicitly uncover cultural scripts (Moyer, 2001) – what Schmidt (1996) refers to as characteristic pedagogical flow. Venkatakrisnan and Brown (2009) use lesson observation to trace teachers' implementation process of a curriculum policy. Over a four year period they periodically collect data about classroom occurrences to study how the implementation of a specific mathematics strand would impact on classroom practices of students in key stage 3. One group of studies which widely used observation as their principal method of data collection is the learners' perspective study (Clarke et al., 2007). The studies were international comparative research which sought to understand classroom patterns and structure across a wide range of cultures with the aim of uncovering best practices in mathematics teaching. Although the design of this study provides a wide scope to capture what goes on in classrooms, the fact that the principle data collection method is through video, renders its applicability expensive and difficult to replicate especially in instances such as this current study.

On the whole it can be argued that classroom observation is becoming increasingly popular in study which aims at evaluating or examining implementation of reform ideas across a wide range of curriculum areas in education. The form used to capture data for this study is appended to this thesis (Appendix 13).

3.5.5 The post lesson interview

The post lesson interview was designed to a) follow up issues noted and identified during the observations, and b) to acquire information on teachers' general believes

concerning mathematics teaching in general and the MLS specifically. Although there were some specific prompt questions (see Appendix 14), the nature and number of additional questions varied from teacher to teacher depending on what occurred during the observation and also what the teachers said.

3.5.6 The key informant interview

I believed that some people, especially those who worked with the teachers on a regular basis and those who have certain influences on the teachers' work were in a very good position to talk about the reform. I was mainly interested in getting their perception of what was going on in schools with regard to the implementation of the MLS reform. I was targeting people in the following sections or groups: Mathematics Working Group, Education coordinators, Education Quality Assurance Section, and the National Institute of Education. The interview protocol for the key informants is found in Appendix 11.

3.5.7 Piloting the instruments

It was important to pilot the instruments prior to the main field work. I managed to pilot the questionnaire before I left for Seychelles. Then I used the first week when I got there to pilot the teacher focus group, the individual interviews, and the lesson observations. I could not pilot the key informant interview and the subject leader focus group because of unavailability of time.

Through one contact person in Seychelles, I arranged with one primary school and managed to get eight volunteer teachers to read and fill out the questionnaire. I sent the questionnaires to my contact person who in turn printed out and distributed them to the teachers. The teachers were given three days to complete the questionnaire. They were asked to write concerns and suggestions regarding the

questionnaire items – the styles and length. No teacher commented on the questionnaire. Before the main survey, when I arrived in Seychelles I got the chance to meet up with the teachers who participated in the pilot. I further gauged their impression. They all agreed that the questionnaire was satisfactory, that through the items they could really talk about their impression of MLS, and that they did not have any concerns regarding the questionnaire design.

Regarding the observation, two teachers volunteered to have their lessons observed. I managed to observe two of their lessons in a row. This allowed me to further clarify what I wanted to achieve in the main fieldwork. After having observed both lessons, I carried out the interviews and there again I could properly amend the draft questions. What I noticed from the interviews was that the teachers found it difficult to criticise their own lessons. Furthermore, they found it hard to explain why they chose a particular step or decision during their lesson. I had the impression that they found my questions inquiring about their lessons as an attempt to challenge what they were doing as opposed to seek their experiences with the reform. This activity was quite useful as I made sure during the main fieldwork to clearly tell them the kind of questions I would be asking and the rationale behind each question hence improved on the rapport between us.

In the same school, on one afternoon, through the help of the subject leader I gathered six teachers for a focus group interview. This allowed me to rehearse some of the questions, got a feel of the expected answers, and prepared for additional prompt questions. Our interview lasted for 55 minutes. Even if focus group interviews were not popular methods of data collection in the schools in Seychelles, I was amazed to see teachers feeling comfortable and willing to participate. My prior contention that the teachers would be stimulated to talk within the entourage of their

peers was justified. Eventually, I got a good piece of conversation which served as a foundation to other focus group interviews in this study.

Copies of the final instruments are found in the appendix section of the thesis. Details about the strengths and weaknesses of the various instruments will be taken up as I discuss the data collection. Although the pilot study was not extensive, it was indeed very useful as it gave me an opportunity to review and test the instruments prior to the main fieldwork.

3.6 Data collection for the main study

In this section I describe the data collection process for the main study. The description includes the selection of schools, teachers and other participants who were involved. Since for the each specific method I used different participants, I introduce them as I present the data collection for different methods.

3.6.1 Access to secondary data

The SACMEQ II data file were available on CD (Ross et al., 2004). I extracted the relevant data I needed from the CD. No permission was required since the data was in the public domain. I requested and received the SACMEQ III data from the Seychelles national coordinator who granted me permission to use the mathematics achievement results related to my study. In both cases I used pupil mathematics achievement data only. The part of the SACMEQ II data which I used consisted of 1484 pupils while that of the SACMEQ III data consisted of 1480 pupils.

I could access the IPAM data from the Ministry of Education. Being the coordinator of the project I had permission to use the data for the purpose of writing about mathematics education in Seychelles. No additional permission was required to

use the data in this study as long as I protected the anonymity of the schools, teachers and pupils. The IPAM data consisted of 1080 pupils.

3.6.2 The questionnaire survey

For the questionnaire administration, I had to access the schools through the office of the Principal Secretary (PS) of the Ministry. I wrote to the PS for approval of this study. Following approval, I sent a letter to all the primary schools detailing the study. Then I wrote another letter to all the teachers to request their participation. The mathematics subject leaders assisted me with the distribution and collection of the letters and participation/ethical forms. All state primary schools agreed to participate in the questionnaire survey.

I photocopied all the questionnaires and with the assistance of the subject leaders I was able to distribute them to all the teachers ($n = 289$). The teachers were given one week to complete the questionnaire after which they were asked to put it in an envelope and return it to their subject leader. All the completed questionnaires ($n = 219$) were eventually sent back to me. With the help of two graduate students in Seychelles we entered and cleaned the questionnaire data in SPSS. The entire process of entering and cleaning the questionnaire data took three weeks.

3.6.3 Selection of the schools for the in-depth study

For the in-depth field work in the four schools, which involved observing and interviewing teachers, I made my selection of schools first and then I wrote to individual schools asking for their participation. When I got to Seychelles in June 2011, I requested and organised a school visit to talk to the teachers about the study. Afterwards I began the recruitment of teachers. I distributed the participation forms

and allowed one week before I went back to the school to finalise participation and to agree on a plan of work.

To keep the study manageable I decided to choose four schools. To obtain variations in the teachers' experiences, I decided to select schools with different backgrounds. My past involvement with the schools enabled me to select schools with interesting features. The school sampling process was purposive (Cohen & Manion, 2000). I chose Alpha Primary because there was a general impression within the Ministry of Education that its teachers were resistant to change. What was noted in terms of the MLS change was that the teachers in this particular school had on several occasions challenged the MLS reform. Further, Alpha had always emerged among the top schools in the P6 National Examination. Hence, I found this school a very interesting site for the research. Beta Primary was selected more or less on the same basis as Alpha. Whilst the management of the school were eager to begin the MLS teaching approach, the teachers showed resentment. But contrary to Alpha, Beta Primary was among the lowest performing schools in the P6 National Exam. Gamma Primary was selected because in previous networking sessions its teachers had continuously reported that they were finding MLS useful and that they had noticed progress in their pupils' achievements. In one seminar presentation in 2008, the teachers at Gamma School reported on how the idea of lessons having a structure had diffused across other subject areas in the schools. They were having distinct lesson structures for English, Science, and Social Science subjects. Kappa school was selected on the basis that they had been among the best performing schools over the past 15 years. I thought it would be interesting to see how the teachers in this school were enacting the reform. Collectively the schools were interesting sites for the in-depth study.

3.6.4 Lesson observation and post lesson interview

My plan was to observe classes at P3 and P6 level so that I could compare teaching across two different cycles. P1 – P2, P3 – P4, P5 – P6, are in the cycles, early childhood, middle primary, and upper primary respectively. The P3 teachers in one school did not consent to be observed but its P4 teachers did. I agreed with the volunteer teachers and the school management on a working plan. The teachers identified the two successive lessons which they wanted me to observe. On average I spent one week in each school. There were no special arrangements made for the observation. In other words I observed the lessons as they were intended to have occurred in the different schools.

The teachers had explained to the pupils about my visit and the research prior to my arrival. The pupils were expecting me in their classes and around the schools. The pupils were told that I would not be teaching or helping them with their work. During all the observations, I acted as a non-participant observer (Cohen & Manion, 2000). I sat at the teachers' desks. I took running notes and completed my observation schedule accordingly. I had my small audio-recorder. Some teachers agreed for their lessons to be audio-recorded while some were a bit reluctant. I ensured that I captured all the interesting moments of the lessons.

Nevertheless, I felt that the observations were restricted and limited in a number of ways. Firstly, since I was the only person carrying out the observation of the lessons, the option of comparing findings and discussing interpretations were not possible. Other than the views of the teachers, all other claims that I reported later about the use of the structure in schools were based on my interpretation. Secondly, the method of data collection limited what I could capture. In view that the lessons were not video recorded, it was difficult to observe all the classroom events and

occurrences at the same time. I could not capture all the pertinent occurrences during the process. Thirdly, due to my previous professional engagement with the reform, it could be possible that some teachers might have been thinking that my role in this specific study was not divorced from my role as an official of the Ministry. They might have acted in ways that did not necessarily reflect the real way they enacted the reform ideas. I felt that some had purposely prepared their lessons to satisfy my visit to their schools but I observed too few lessons to fully attest this claim.

To compensate for these limitations, I felt that the idea of observing the teachers twice and carrying out post lesson interviews would be useful. Furthermore, using the subject leaders' knowledge of the teachers and general teaching practices in their schools provided more insights into the actual mathematics teaching taking place even if I thought the leaders' input might not have been fully impartial. These limitations justify why triangulation (Gravemeijer, 1994; Schoenfeld, 2000) was a major component of this study.

Following the observation of the two lessons, the teacher and I met in an available empty room to conduct the post lesson interview. I chose an empty room to allow the teacher to talk freely without fearing that someone else would be listening to her/him. I chose to have the interview done after both lessons had occurred to avoid taking too much of the teachers' time while at the same time I did not want our conversation about the first lesson to influence the teachers' action during the second lesson.

3.6.5 Teacher focus group interviews

In all four schools the teacher focus group interview followed the same approach. Each group consisted of teachers from P1 to P6. At Alpha, Beta and Kappa primary, where there were several teachers at a grade level (year group), the subject leaders

explained that the teachers themselves agreed on who would represent that particular year group. Initially, I was not focussing on a teacher per year group. However, in mentioning that I wanted six teachers, the school had taken it that one teacher per grade level would be ideal. At Gamma primary – a one-form entry school – this represented the entire mathematics teacher population.

The interview occurred in one empty room during an afternoon session. There were only the six participants and myself in the room. I did not want to bring in the leaders for fear that the teachers would not talk freely about their experiences. The interviews were audio-taped and I also took relevant notes. The average duration of the interviews was 55 minutes. There were some cases when after the interview I would ask the teacher to explicate a point or comment which I felt I had not understood properly. There were also instances when the teachers spoke in Creole. In long extended conversation of this nature it is typical for Seychellois teachers to code switch.

3.6.6 Collection of contextual data

This involved collecting background information about the school such as the school plan, mission, and teacher and student population, about the schools. In my case it also entailed inspecting related documents such as the teachers' lesson plan files, pupils' sample activities, and teaching and learning materials. I collected the information in periods in-between observations. The teachers were happy to allow me to inspect their lesson plan files. In other instances they even allowed me to photocopy relevant pages.

3.6.7 Subject leader focus group interviews

It was possible in July 2011 on my visit to Seychelles to have a meeting with the subject leaders. I made this request through the PS office. In the meeting I got the chance to describe the study with the leaders so that they could, on their side, reassure their teachers that this research was not an activity for the Ministry of Education. All the leaders turned up for the meeting. In the meeting I also requested their participation in the study. I selected the first eight leaders who agreed to be participants.

The meeting occurred on an afternoon. It was held in one training room at the Education Headquarters. There were only the participants and myself in the room. The interview was audio-taped and lasted for 75 minutes. During the interview I also took related and relevant notes that I thought would facilitate the transcription. There were also instances of code switching during the interview.

3.6.8 Key informant interviews

I managed to get two education officials for an interview. Both officers had been working with the schools well before the introduction of MLS. One of the officers had more than 25 years working with mathematics programmes in schools. The other had been a subject leader, head teacher and school support provider. Both had great knowledge of what was going on in schools.

The interview was kept very informal and unstructured to generate a relaxed conversation. It was held in the participants' office. I did not audio-tape the conversation but I took notes of the participants' responses. The reason I did not audio tape the interview was that in both instances, I was going there to look for an appointment. Instead we ended up talking about mathematics in schools in which

subsequently, the officers answered all the questions I had wanted to ask. We spent on average 45 minutes per interview.

3.7 Validity, reliability, and reflexivity issues

Although this study applied a mixed-methods approach, it is appropriate to treat the issue of validity and reliability by considering the quantitative and qualitative methods separately in the first instance. More about validity and reliability will be taken up in the data analysis chapter when I talk about rigor in my research processes.

3.7.1 Validity and Reliability in the quantitative dimension of this study

The first sets of data used in this study are drawn from the SACMEQ II and III study. The validity and reliability of the SACMEQ study are well established. The mathematics test for both studies was developed from a blueprint which was well agreed by members of the participating Ministries of Education in the fifteen member countries. The tests, as agreed by those national coordinators, have strong content validity evidence as they cover the primary mathematics curriculum of the countries. The mathematics tests developed for the IPAM project were formulated from blueprints developed from the SACMEQ studies. At least there was evidence that the different tests had strong content validity. The reported internal consistency reliability of the SACMEQ tests II and III as measured by Cronbach Alpha Coefficients were 0.89 and 0.82 respectively. These values for the IPAM tests from 2005 to 2009 were 0.79, 0.82, 0.82, 0.83, and 0.91 respectively suggesting that all the tests have high internal consistency reliability.

The second method which generated quantitative data for this study was the questionnaire. Piloting the questionnaire was an effective way to enhance the content validity of this instrument. However, its construct validity was ensured through factor analysis which was done on the data. Reliability of the questionnaire was considered by making the questionnaire relatively long and asking questions from a variety of areas. More about validity of the questionnaire are discussed in Chapter 4 when I report on the results of the factor analysis

3.7.2 Validity and reliability in the qualitative dimension of this study

As Patton (2002) notes, qualitative research uses a naturalistic approach that seeks to understand phenomena in context specific settings, in my case in the mathematics classrooms and schools, and their findings are produced without having to manipulate statistical procedures (Strauss & Corbin, 1998). Hence, rather than talking about validity and reliability per se, it is best to talk about terms that encompass both, such as, credibility, transferability, and trustworthiness (Patton, 2002). To ensure such trustworthiness, this study employed triangulation, a method of collecting data from multiple sources using different methods and techniques (Mathison, 1988). In other words the assurance of validity and reliability of the study was embedded in the research approach itself.

3.7.3 The Issue of Reflexivity

Reflexivity is a perceived way of ensuring rigor in conducting research (Finlay, 1998; Guillemin & Gillam, 2004; Pillow, 2003). It involves critically reflecting on how the researcher constructs knowledge from the research processes and on the sorts of factors that influence the researcher's construction of such knowledge. A reflexive researcher, hence, is one who is aware of all the potential influences and is

proficient enough to step back and take a critical look at his or her own role in the research process. The goal of being reflexive in this sense has to do with improving the quality and validity of the research and recognizing the limitations of the knowledge that is produced, thus leading to more rigorous research.

This study is about evaluating a reform, the development of which I was very instrumental in. The main subjects, whom I observed or interviewed, were all aware of my involvement with the project. It would have been very unwise on my part if I did not take steps to eliminate biases as knowledge was being constructed. More importantly throughout the data collection I repeatedly reminded the teachers of the purpose of this study and what I was trying to achieve. Furthermore, during the data analysis and interpretation, I carried out a lot of discussions with two colleague students who in several ways allowed me to look at the data critically. Through the continuous supervision meetings I was reminded to distance myself from the work I did at the Ministry of Education but to focus on the data only.

Using the issues I discussed with regard to evaluating the reform (Cuban 1998), reflexivity became important in that it led me to view the impact of the reform from the teachers' perspective, in particular, and then from the reformers' perspectives.

3.8 Ethical considerations

Several steps were taken to ensure that the research was ethically sound and to the best of my ability ensure that the integrity of the participants was respected. First of all no real names, be it of the teachers, pupils, subject leaders, or schools, were used. In cases where the use of names becomes important, pseudonyms was employed.

Secondly, in situations where contexts or events were being described all measures were taken to ensure that no individual could be identified.

I sought approval from King's College and the Ministry of Education in Seychelles for this study. In addition, I sought the schools' and the teachers' consent in order to carry out the field study. With regard to the questionnaire, I clearly spelled out the intents of the study and invited only willing and volunteer teachers to participate.

3.9 Summary

Framed within a broadly interpretivist approach and using the change discussion model as the overall framework for carrying out this research, I employed a mixed method design for data collection. I used both secondary and primary datasets. A questionnaire was administered to 219 teachers involved with the teaching of mathematics. Four schools were selected for in-depth fieldwork. In each school, a six-teacher focus group interview was carried out; samples of P3 and P6 lessons were observed; and post lesson interviews were carried out with the teachers I observed. Additionally, I carried out a focus group interview with eight mathematics subject leaders and individual interviews with two education officers who worked with the teachers in schools. Secondary data were drawn from the SACMEQ II and III pupil-achievement data files (n = 1484 and n = 1480 respectively), the IPAM pupil-achievement data file (n = 1080) and the teacher questionnaire responses (n = 435). Contextual data were also collected about the teachers and the schools.

In this study, my ultimate goals are to establish the nature of change in terms of instructional practices and pupils' performances, and determine how the particular nature of the teachers' *zone of enactment* have facilitated or inhibited the

teachers' decision to implement the reform. The mixed methods approach I adopted in this study, allowed me to triangulate data collected from multiple sources. Most of the data were collected from four schools with different background. It was important in the first instance to analyse data from each school separately to enable comparison. The fact that different schools translate and interpret policies differently (Braun et al., 2010) suggests that different *situations* give rise to different *zones of enactment* specific to that situation. Subsequently, teachers in different schools enact reform with different tenacity. It is on this ground that I justify the idea of analysing the school data separately. In the end however, I combined the data to obtain an overall picture so that the situation would reflect the state of mathematics teaching in Seychelles in the context of the MLS regime. The data collection processes and the data captured for this study are summarized in the table which follows.

Table 3.4 Summary of data collection processes

Methods of data collection	Pilot details		Main study	
	Date	Sample	Date	Sample
SACMEQ II – Pupil test	N/A	N/A	N/A	1484
SACMEQ III – Pupil test	N/A	N/A	N/A	1480
IPAM – Pupil test	N/A	N/A	N/A	1080
Teacher Questionnaire	Mar 11	8	July 11	219
Lesson observation	July 11	4	Jul/Aug 11	22
Post lesson interview	July 11	2	Jul/Aug 11	11
Teacher focus group	July 11	1	Jul/Aug 11	4
Subject leader focus group	Nil	Nil	Aug 11	1
Key informant interview	Nil	Nil	Aug 11	2

Most of the data were collected over two months. However, I brought to this thesis my personal knowledge from my participation in the implementation of the reform. The validity, reliability and reflexivity issues have been discussed. Taking into

consideration the constraints and limitations, and the context within which the study was conceived, the approach and methods adopted for the study were appropriate for the research aims and purposes. The next chapter describes the data that were collected under these methods and the analyses conducted on the data.

CHAPTER 4 Data and Analyses

This chapter describes my datasets and the various approaches to data analysis that I adopted in this thesis. As discussed in the methodology chapter, I employed a mixed methods approach to achieve the major intents of this research. Hence, data for this study are both quantitative and qualitative and my dataset contains primary and secondary data. The primary data were collected through interviews, questionnaire and lesson observations while secondary data were drawn from two data archives: the SACMEQ studies and the IPAM Project. I have described both projects in the background chapters. I also referred to some data which were collected as part of the work of the MWG to monitor the development of the project.

This current chapter is very useful since I do not present findings from individual instruments one by one. Instead, I combine results from the various instruments to produce a coherent story. Hence, it is important that I present an overview of data collected from the various instruments as a way of establishing a basis for the results chapters: Chapters 5 to 8.

I begin this chapter by describing the quantitative dataset followed by the qualitative data. The quantitative dataset for this research was made up of the pupil-achievement data drawn from the SACMEQ studies and the IPAM project. The second batch of quantitative data consisted of data collected from the teachers through the administration of a questionnaire about their perceptions of mathematics teaching in general, and more specifically about their perceptions of the reform. The

questionnaire data complement and triangulate data that were collected from the classroom observation and teacher focus group interviews. The qualitative data on the other hand were drawn from four teacher focus groups and one subject leader focus group interview, eleven post lesson interviews, two key informant individual interviews, and twenty-two classroom observations. Data from the interviews were analyzed using a constant comparison approach while data from the lesson observations were analyzed using a conceptual framework which I developed specifically for this part of the study.

4.1 Pupils' achievement data

I reported elsewhere how the tests were constructed so that I could establish not only the validity of the results that the tests generated but also the trustworthiness of the analysis and claims I shall be making in relation to pupils' achievements. In this section I report on how I analyzed the pupils' achievement data in relation this study.

4.1.1 The SACMEQ data

I used both SACMEQ II and III data in this thesis. Since SACMEQ II was done in 2000 (before the reform) and SACMEQ III in 2007 (one year after the reform) I could use the results to develop a pre/post reform comparison. However, SACMEQ III was done just one year after the reform started. Even if I could not talk extensively about effect of the reform I could get a tentative idea of how the situation looked, at least during the first years of the reform.

I used one way ANOVA (t-test equivalent) to compare the means. I compared the variations in scores. Since SACMEQ also grouped the pupils by competency levels, I was able to compare the distribution for 2000 and 2007. I was

also able to identify and compare the pupils' performance on the common items on both tests.

I did not attempt any multivariate analysis even if I had other background details about the pupils for three reasons. The first reason is that I wanted to keep the analysis, at this stage, simple. Secondly, extra analyses would make the research too big given the time limit, and thirdly, I felt that just an overview of the situation was sufficient.

4.1.2 The IPAM Data

The Pupils Learning Growth Study started in 2005 as part of the quest to ascertain how the pupils' mathematical ability grew throughout primary schooling. The study was hence done to acquire longitudinal data such that a pattern of mathematical growth for the Seychellois pupils could be established. The dataset provides an opportunity to study the relationship between MLS reform and pupils' achievement in that the learners' tests related to the period before and after the implementation of MLS. However, the fact that the study was not designed purposefully to evaluate MLS reform, meant that additional data needed to be collected. Given the context into which I was doing the PhD, I would have required more time to collect the missing data. Hence, I chose to limit my analyses to whatever was available at the time. Given the purpose of the study, what was available was adequate enough to develop an argument about the impact of the reform on pupils' learning.

The IPAM achievement dataset consisted of pupils' results by school for each of the five tests from 2005 to 2009 inclusive. Using the SACMEQ analysis protocols, I was able to group the pupils in competency groups as per their achievement. Then I examined how the pupils moved between competency groups each school year. I identified the anchor items (common items to all tests) and drew

growth curves for each of the items using the item difficulty indices. For each set of scores I computed the standard deviation to make an argument about variations in the pupils' performances.

4.2 Teacher questionnaire

The questionnaire inquired about the teachers' self-reported practices. From the data, I developed insights into how teachers had responded to the call to reform their practices. The data also provided insight on issues which could have possibly challenged or supported the enactment of the reform. Ultimately from the teachers' responses I developed an argument on how MLS had benefited the teaching of mathematics in Seychelles state primary schools. The data were analyzed using SPSS software and to a lesser extent, Microsoft Excel. Questionnaire is a reliable means of generating data about the teachers' practices even if data from questionnaires are self-reported (Ross et al., 2003). Nevertheless, findings from this method of data collection become more meaningful when they are complemented by findings from other methods of data collection.

4.2.1 Validity and reliability of the questionnaire

Both validity and reliability are two important features of any measurement instrument (Ross et al., 2003). The worthiness of data and subsequently, the findings, is better evaluated when information about the reliability and validity of the instrument from which they were collected are known. For this questionnaire I determined the content and construct validity and internal consistency reliability of the instrument.

Specific sets of items on the questionnaire sought to measure distinct concepts. It was important to know the extent to which these items were consistently measuring what they purport to measure. Validity assesses the extent to which the instrument measures what it purports to measure. To assess the content validity of this survey, I used ideas from Ross et al. (2003) to develop a blueprint from which I constructed the items. Then in March 2011, I piloted this survey in one primary school in Seychelles. Seven teachers volunteered to try out the survey. In July 2011, I met the seven teachers and asked them about their experience of answering the questions. I also asked them about the clarity of items and whether they believed the questionnaire could capture an accurate picture of what was going on in schools with regard to the teaching of mathematics under the MLS regime. All the seven teachers expressed that they could relate well with the questionnaire, and that the items really probed into their teaching and aspects of their attitudes to the reform. From these responses I inferred that my questionnaire had both face and content validity.

To assess the construct validity of the questionnaire I performed principal component factor analysis with varimax rotation on the different sets of items (Bryman & Cramer, 2009). The basic idea underlining such analysis determines the extent to which items of the questionnaire measure the same construct or factor. In my case, different sets of items were intended to measure different factors. For instance, items of Q9 intended to measure how frequent the teachers used some routine instructional practices and items of Q11 intended to measure the teachers' perception of their confidence in teaching mathematics. It was therefore not practical to carry out factor analysis on all the items at the same time. Hence, I performed the analyses on distinct sets of items, treating each domain separately. In simple term, principal component analysis attempts to combine two or more correlated items of

the questionnaire into one factor. It then determines the correlation between the important factors with each of the variables already existing in the data. These important factors are also rotated to determine how each variable (in my case each item within a specific set) are loaded onto them. The validity issue relates to the construct validity of the questionnaire – the extent to which the items measure the construct: the more the principal factors, the more constructs are at play. However if for instance a set of items has one or two principal factors, and such factors combined account for a high percentage of variations in the data, then it suggests that the instrument has high construct validity. I report on the results of the analyses along with the reliability indices (Cronbach Alpha) for the item sets in Table 4.1.

My analyses suggests that the questionnaires have high internal consistency reliability (Cronbach alphas in all cases are more than 0.7). The analyses also suggest that the questionnaire has high construct validity per item domain. The number of principal components for the various item sets was four or less. In almost all (except one case) for each item domain, the principal components combined accounted for at least 50% variations in the total scores.

Table 4.1 Summary of principal component analysis

Item Sets	Number of items	Cronbach Alphas	Number of Principal components	Total Cumulative variance (%)
Q9	16	0.74	4	49.2
Q10	10	0.70	4	64.6
Q11	10	0.91	1	56.2
Q12	8	0.81	2	56.7
Q13	10	0.84	2	57.4
Q15	8	0.79	2	56.0
Q16	9	0.83	2	68.4
Q17	8	0.83	1	47.7
Q16+Q17	17	0.88	4	65.5

N.B Q16 and 17 combined to form a measure of the teachers' attitude to MLS

4.2.2 Test of normality

In SPSS, I assessed the normality of the data pertaining to Q9 to Q16 using Shapiro-Wilk test procedures. These were the sets of questions onto which I was likely to compare groups and carry out significance tests. The results revealed that the data were not normally distributed, implying that any significant tests to be carried out would require nonparametric procedures.

4.2.3 Teacher demographic

I begin by providing some demographic data about the teachers who responded to the questionnaire. I explained earlier that all teachers who taught mathematics in the primary schools (at the time of the study) were eligible to answer the questionnaire. The total respondents were 219 representing 76% of the teachers who were affiliated with the teaching of mathematics in the schools. These 219 teachers were distributed across the 23 primary schools of the country.

I further divided the schools into small, medium and large based on a general principle commonly employed by the education authority in Seychelles. One and two streamed schools were classified as small schools. Three-streamed schools were classified as medium schools and schools with more than 4 streams were classified as large schools. This classification gave an outcome as in Table 4.2 below. The numbers relate to the number of schools per segment.

There were twelve small schools. Their pupil population ranged from 90 to 288. The pupil population in the medium sized schools ranged from 575 to 700 while the pupil population in the large sized schools could reach 1000. Class size in Seychelles ranged from 20 to 30 pupils. However, there was one small school with an average of 15 pupils per class while there were several instances in other schools where some classes could have a pupil population as high as 33.

Table 4.2 Distribution of schools by size classification and by geographical locations

Size classification	Geographical location of schools						Total
	North	Central	East	South	West	Island	
Small	3	0	2	2	3	2	12
Medium	2	1	2	1	1	1	8
Large	0	3	0	0	0	0	3
Total	5	4	4	3	4	3	23

The geographical location of the schools describes their position on the main island of the Seychelles. The central schools are the town schools and at the same time they are close to the Ministry of Education headquarters. They are all within walking distance from the headquarters. There are five of them of which three are classified as large schools. In terms of schools on the main island, those in the West and South are considered far (relatively) from the Ministry, approximately 20 – 25 km away. The island schools are on a different island to that of the Ministry of Education headquarters but they can be accessed by small plane or ferry.

Table 4.3 shows the demographics for the teachers. I have included the seven broader variables which I used in the questionnaire. For each variable I have reported the number of teachers that fell in each of the variable levels. Since the school size differed considerably, I have decided not to organise the number of teachers per school. Instead, I have used the teachers' grade level (or cycle) as the main unit of analysis. In Table 4.3, cases where for a particular variable the total number of teachers does not add up 219, are because of missing data. It appears that some teachers omitted certain demographic data as a tactic not to reveal their identity. Even if they chose not to write their names on the questionnaire they thought they might be identified. Their decision not to indicate certain demographic data justifies this assertion.

Table 4.3 Demographic information about the teachers

Variables	Variable levels	Teacher grade level groups			Total
		Early Childhood	Middle Primary	Upper Primary	
Teacher gender	Female	85	64	57	206
	Male	1	1	6	8
Teacher age group	<25	16	9	11	36
	25 - 35	25	32	25	82
	36 - 46	25	12	23	60
	47 - 55	14	11	3	28
	>55	6	0	1	7
Length in years teaching maths at the school	Less than one year	9	5	5	19
	Between 1 to 5 years	25	27	20	72
	Between 6 to 10 years	11	13	17	41
	More than 10 years	41	20	21	82
Teacher highest teaching qualification	Untrained	5	9	0	14
	Certificate level	21	11	4	36
	Diploma Level	60	44	58	162
	Bachelor or Higher	0	1	0	1
School geographical location	North	16	10	13	39
	Central	23	25	14	62
	East	14	10	8	32
	South	12	7	7	26
	West	11	8	8	27
	Island	11	5	13	29
Number of teaching periods	1 – 7	8	58	24	90
	8 – 14	77	7	32	116
	15 – 21	-	-	7	7
	22 – 28	-	-	-	-
Class size	0 -30	78	51	30	159
	31 – 60	8	14	28	50
	61 – 90	-	-	5	5

4.2.4 Gender of teacher participants in the questionnaire

In this particular sample, there were more female (n = 206) than male (n = 8) teachers. Five teachers did not indicate their gender. This imbalance of female – male teachers in the sample reflected the overall gender composition within the teacher population in the Seychelles primary schools. Primary school teaching in the country has tended to attract females more than males. Males who considered teaching

usually go into the secondary teaching or upper levels of the primary cycle. Further, I am aware that in Seychelles, male teachers are more likely to teach mathematics as part of their subject options. Male teachers could also be found in other non examinable subjects such as physical education, and art and craft curriculum areas.

4.2.5 Teaching cycles (grade levels)

In the Seychelles primary schooling stage, grade levels are classified into cycles. The early childhood cycle consists of pupils from Crèche - reception to Primary 2 (P2). The age range is from 3.5 yrs to 7 yrs. The middle primary level includes P3 and P4. The age range is from 7.5 yrs to 9 yrs. The upper primary level includes P5 and P6. The age range is from 9.5 yrs to 11 yrs.

In the survey more respondents (40%) were from the early childhood cycle. Thirty percent were from each the middle primary and the upper primary cycles. In the early childhood, there was one teacher for each class. Some classes also consisted of one teacher assistant who in most cases was uncertified. At the other cycles there could be one teacher for more than one class. There was no teacher assistant at these two cycles. Figure 4.1 illustrates the distribution of teachers across the three main year groups.

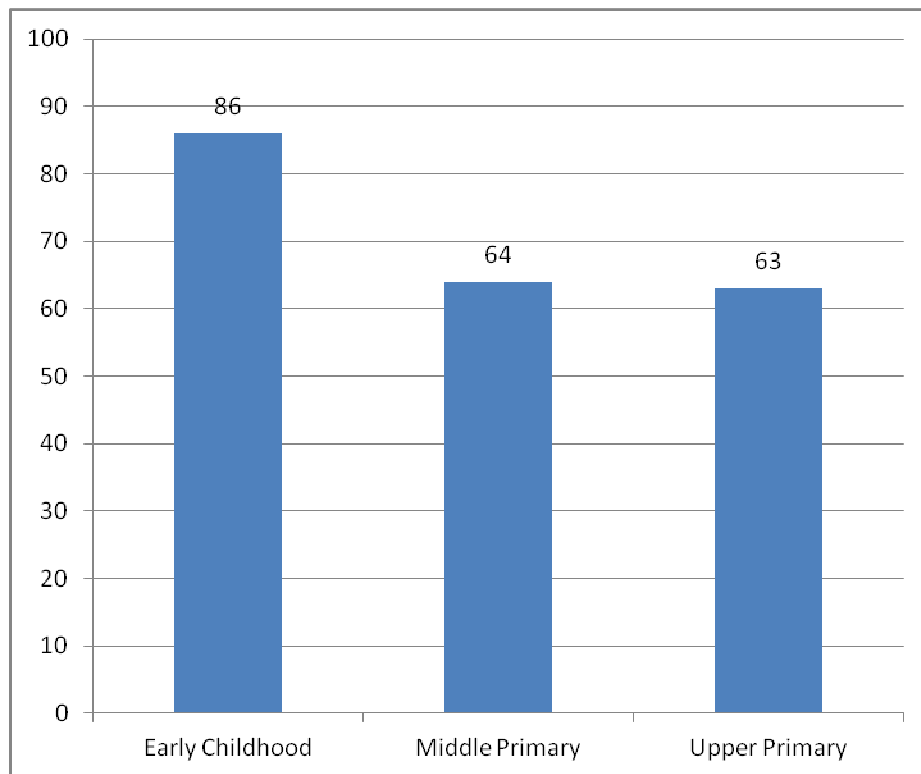


Figure 4.1 Bar graph showing the number of teachers (only those who indicated the level at which they taught) across the three main cycles

4.2.6 Teacher age group and length of teaching mathematics

The age group 25 – 35 years was the modal age group (38% of the respondents). Fifty five percent of the total respondents were below 36 years. However, 52% of the early childhood respondents were over 35 years. Sixty four percent of the middle primary school respondents were below 36 years of age. Fifty two percent of upper primary school respondents were also below 36 years of age. There were only 8 respondents (4%) over 55 years of age.

Fifty eight percent of the respondents were more than five years into the teaching of mathematics – (58% were around at the launch of MLS and had been in the same school). This implies that these 58% had post MLS experience of mathematics teaching within the same school. Sixty percent of both the early childhood and Upper primary school teachers were more than 5 years into the

teaching of mathematics. This value is 51% for the middle primary school teachers. Data regarding the number of years a teacher had been teaching mathematics in the same school suggest that the teacher movement had been very stable. This is consistent with the usual teacher movement pattern (knowledge which I had about teacher movement in schools in Seychelles). Primary school teachers tend to remain in a school for a long time. Furthermore, the year group which they teach also remained unchanged for many years.

4.2.7 Teacher qualifications

Table 4.3 also shows the teacher qualifications. An average primary teacher in Seychelles is a female with a local teaching diploma, has been teaching for about five consecutive years in the same school, teaches all examinable subjects in a class of 30 pupils and has not attended any post certificate in-service training.

In the present sample, there were more teachers (76%) with a diploma qualification and a smaller proportion (6%) were untrained teachers. There was only one teacher in the group with a Bachelor degree. 93% of the upper primary school teachers were trained to a diploma level while 69% of the early childhood and the middle primary teachers combined were trained to that same level.

4.2.8 Distribution of the respondents across geographical region

Table 4.3 reports the distribution of teachers across the geographical regions. Relative to the Ministry of Education headquarters (HQ), the region West, South and Island are the furthest. The HQ is in the central region. There were no known issues regarding teachers' placement in schools. Teachers were normally placed in a school which were close to their residential zone. Nevertheless, there were some known cases of teachers being placed in schools outside their residential area. Chi square

test for independence done on teachers' year level (Early Childhood, Middle and Upper primary) and geographical location of schools obtained a result [$\chi^2 = 8.415$, $df = 10$, $p\text{-value} = 0.588$] suggesting that teachers' grade level was independent of the school geographical zone.

4.2.9 Mathematics teaching loads

Table 4.3 also includes the teachers' mathematics teaching periods. At the time of the research a teaching period was 40 minutes long. Teachers at the early childhood level taught 8 maths periods per week while at other levels they taught 7 maths periods. That was the case if the teacher taught in his or her class only. Some schools made special internal arrangements whereby a teacher who was more mathematically oriented than others might take extra classes. My interpretation of figures in Table 4.3 regarding the teachers' teaching period suggests that the majority of the teachers at the early childhood or the middle primary taught in their respective class. The 77 early childhood teachers who chose the category 8 – 14 might be indicating that they taught their 8 allocated periods. While the 8 teachers who selected the category 1 – 7 might be indicating that they had allocated one of their mathematics periods to their teacher assistant. In middle primary, 58 teachers taught mathematics in their respective class. However, 7 teachers seemed to have been allocated a second class within their cycle. The situation at upper primary suggested that 24 teachers taught mathematics in their respective class, 32 had been allocated a second class and 7 of them seemed to have been allocated a third class. These figures reported in Table 4.3 about the teachers' teaching periods, indicates that some form of arrangements were being made within the school to promote teacher specialization – a tendency for the teachers most oriented in a subject to teach as many classes as possible.

4.2.10 Pupils per mathematics teacher

The last demographic data in Table 4.3 relate to the number of pupils that a teacher was responsible for teaching mathematics to in the primary schools. The overall picture was that 74% of the teachers taught between 1-30 pupils, 26% taught at least 31 pupils. It can also be inferred from Table 4.3 that the upper primary teachers had more pupils under their care than the teachers at the other two levels. This was possible since a teacher at the upper level of primary schools could teach mathematics in more than one class.

4.3 The teacher focus group interviews

A summary of the participants is presented in Table 4.4. For each school, I report on the gender distribution and I present the participants' average age and number of years of teaching experience. The teachers' participation in the focus group was voluntary. In all the four schools I tried to recruit participants of different ages and number of years of teaching experience so as to compare their views and impression. In view that the number of female teachers exceeds the number of male teachers by a large margin, I found it impossible to establish a gender balance within the teacher sample. The participants' average age with their average number of years of teaching experience per school are shown in Table 4.4. Teachers from Alpha primary school were relatively more senior in age and more experienced than teachers from the three other schools.

Table 4.4 Background of the participants in the focus group interviews

School	No. of teacher per gender		Average (in yrs)	
	Female	Male	Age	Teaching experience
Alpha	6	0	36	14
Beta	5	1	31	10.5
Gamma	5	1	28	10
Kappa	5	1	33	11.3

4.4 The subject leader focus group participants

The subject leader focus group interview consisted of eight subject leaders of which 2 were male and 6 female. Their age group ranged from 34 to 52 years and their years of teaching experience ranged from 10 to 35 years. In terms of leading schools, 3 of them were subject leaders at the start of the reform while the other five had 2, 3, and 4 years of experience leading mathematics at their respective schools. They were teachers at the start of the reform and were promoted after vacancies had arisen in schools. Seven of them had an Advanced Diploma in Education Leadership.

4.5 The classroom teacher participants and data

The 11 teachers who made up this sample consisted of 9 females and 2 males with ages ranging from 25 to 55 years and years of teaching experience ranging from 1 to 36. At this point I need to make an observation about the teacher participation in this study. In view that this research was held under the ethical policy of King's College London, the teachers had the choice to decide whether they wanted to participate or not. Usually, this is rarely an option in education research in the Seychelles context.

Having given this choice, many teachers opted not to be observed. So I could not access all the teachers from the two initial targeted levels (P3 and P6). Hence, I had to go by voluntary basis. What I found interesting, and that happened in two of the four participating schools, was that when one teacher at a given year level decided not to participate in the study, all the remaining teachers at this year level followed suit. Given the time restriction I had for the study, I found it very difficult to negotiate with different schools.

Table 4.5 Description of the teachers who were observed and interviewed

School	No. of teacher per gender	
	Female	Male
Alpha	2	0
Beta	5	0
Gamma	1	1
Kappa	1	1

The resulting sample fits the purpose of the study. Since some schools are small and in some instances only two teachers were observed and interviewed, I have decided to omit some descriptors about the teachers as not doing so might easily reveal their identity.

4.6 The key informant data

The 2 key informants volunteered to participate in the study. Their duties involved supporting the teachers with their instructional activities in schools. One had once been a head teacher in a school while the other had been a member of the Mathematics Working Group at one point.

4.7 Approach to qualitative data analysis

The aim of the data analysis was to arrive at some pertinent themes grounded in the data. To this end, I used the notion of thematic analysis embedded in the grounded theory approach (Braun & Clarke, 2006; Bryant & Charmaz, 2010; Harry, Sturges, & Klingner, 2005; Onwuegbuzie, 2009; Strauss & Corbin, 1998) to analyze my data. I began by transcribing the focus group data verbatim as far as possible. In addition to that, there were instances when a) teachers spoke in Creole, in which case I had to do the translation; b) teachers decided not to be audio-taped on certain points of view, in which case I had to take note of their comments, and c) after the focus group I felt that certain issues were not clear, in which case I got the teachers to elaborate or explain what they meant. These few deviations did not affect the validity of the data. Instead they provided a more accurate representation of what the teachers wanted to express.

Onwuegbuzie (2009) advised on analysing data from each focus group separately. In such cases, the group becomes the unit of analysis. Analyzing individual groups separately allows the researcher to assess whether themes emerging from one group also emerge from the other groups. This is an approach to determine when data saturation is reached (Onwuegbuzie, 2009).

After transcribing my interview in MSWord, I imported scripts into Microsoft Excel for the data analysis (Meyer & Avery, 2009). It is true that MS Excel was not designed for analysis of qualitative data. There are specialized software designed deliberately for this purpose e.g. Nvivo, Nu*Dist, and Weft (Weitzman & Miles, 1995) to name a few. In view that my qualitative dataset was not voluminous I was not compelled to venture into specialized software. Instead I used my knowledge and experience of Ms Excel to achieve the analyses. Through

Ms Excel I was able to place each chunk of data into a specific cell and add its code in the adjacent cell. I consider this method as the digital version of the post-it notes approach as one would usually do manually. The advantage of this method over the post-it approach is that Excel facilitates sorting and regrouping. Furthermore, the colouring feature of the software is a plus. The use of Excel uses minimal office space.

In this current study, I undertook an iterative process of constant comparison of data to tag chunks of speech in the transcript with meaningful labels termed as codes (Strauss & Corbin, 1998). Constant comparison of data entails moving backward and forward through the transcript attempting to match expressions or parts of statements that convey the same demarcated messages or general ideas. I created names for specific statements made by the teachers. Following thorough reading of single lines of the transcript, I used a two to three-word descriptor to reduce the statement into meaningful ideas. A coded idea was not permanent. It could be recoded until a high degree of satisfaction was reached about its position in a given set of ideas. Likewise name of codes were not standard or permanent. In my case, the names chosen for a particular code reflected the general idea embedded in the data of the given set. For example, consider the quote below made by Teacher 1 from Gamma Primary School.

I was at NIE when MLS was introduced in school and we were told that it was for... to improve their performance, to see whether it has an impact – the way the teaching was going on. (GAM T1)

I was at NIE suggests that the teacher was still a trainee at the time MLS was launched. It further indicates that at NIE, there was a way of exposing pre-service teachers to what was happening in schools. I coded the phrase, I was at NIE, as *pre-*

teaching exposure. The phrase, we were told, suggests that some formal methods of communication were passed on to trainees. I coded it as *formal authority*. Then there is what the teacher reported as the objective of the reform, [to improve their performance...]. Rather than coding the objective, I coded the sense of this quote as *awareness of the expectation*. This response, in my opinion, conveys the message that there was some form of exposure of MLS even before the teachers got to the school and that this exposure was made possible through a formal mechanism which I referred to as *authority* to be more in-tune with the school context.

I made similar kinds of decisions throughout reading the transcripts. As I progressed in the reading of the transcripts, I compared other statements with previously defined codes. During this process I determined whether new statements could be grouped to existing sets. If not, I created new codes. Inevitably, this process resulted in some chunks of speech fitting more than one code. However, during the second round of reading, I tried to fit the data to the best possible code to lessen the issue of several interpretations of one piece of data. I believe though, that the process of making several interpretations to one chunk of text was useful in the first round of reading and coding it allowed me to see the teachers' expressions in multiple perspectives and select the most coherent interpretation.

In my opinion codes reflect the frame of mind a researcher is working in. I found it useful to describe my codes as I progressed and equally useful to jot down my thinking frame as I read the transcript. In view that I was working alone on this process, I found it useful to repeat the coding of the same transcript on a second day in order to increase reliability in the data set.

The open coding process was then followed by the first level of code categorization; axial coding (Bryant & Charmaz, 2010). In this process, I compared

codes with one another and fitted them into meaningful conceptual categories reflecting commonalities among them (Harry et al., 2005). This phase is termed axial coding in Strauss and Corbin (1998). It implies the idea of clustering codes around specific points of commonality, or axes. I found this process very iterative and challenging. Codes can be very unstable in a given category. As soon as I changed my interpretive lens, a code could become inappropriate for a given category. For instance, the code, *resources*, could be grouped in the category **support** if I considered factors that facilitate learning. However, in the teachers' self-reported data, resources in Seychelles have been very scarce. Hence, such code best fits the category **challenges to learning**.

At a third analytical level labelled as selective coding in Strauss & Corbin (1998) I began to uncover stories or themes embedded in the data. I considered the categories formed by the codes and I attempted to see how they related to one another. For example, in the Kappa Focus Group, the categories, **Remediating Approach** and **School Level Support** are related to one another in that they consisted of data which deal with supporting learning and teaching. In the context of my data I merged them together and labelled them as **localized means to support teaching**. The categories, **teaching inadequacy** and **learners' engagement** are related in that teachers were expressing teaching gaps and they were finding these gaps insufficient to alter the learners' engagement patterns. Such explanations may be viewed as themes. I called this step in my analysis the second level of categorization. Harry et al. (2005) argue that this is the stage of the analysis where theory building incepts. According to them the underlying stories connecting the categories are themes. Seeking interrelation between themes are preliminary stages of theory building. However, in my study, I limited my analysis to the point where themes

emerged. In describing the findings I will be outlining the themes that I have uncovered as part of the analysis I have been describing thus far. I believe that I would need more data in order to move on to the theory building phase.

During the first phase of the analysis I treated the school separately to uncover the specific experience of each one. I began with the Gamma school, then Kappa, Alpha and lastly Beta primary. There was no rationale for this order. Codes obtained from preceding analyses were useful in tagging data in subsequent school analyses. The first and second levels of axial coding were done separately for each school. One observation which came up as a result of individual school categorization of codes was that although the prompt questions were similar for all the focus groups, issues that emerged from the interviews were different from all the schools. Still there were cross-cutting issues.

4.8 Approach to analyzing the lesson observation data

The analysis is based on 22 lessons from 11 teachers. Each teacher was observed twice and interviewed after the second lesson. The lessons are analysed and discussed using a conceptual framework which I elaborated upon in Chapter 6.

4.9 Trustworthiness

The general idea of trustworthiness as applied in this part of the thesis encompasses the issue of validity, reliability and objectivity. To differentiate these terms from quantitative data analysis, the notions of credibility, transferability, and neutrality or conformability (Lincoln & Guba, 1985) are used instead.

Credibility is concerned with the truth of the data. In order to ensure credibility in my findings, in the first instance, I developed a thorough relationship

with my dataset. I carried out several rounds of reading and recoding to ensure that I became familiar with what the participants were saying and also to ensure that my codes reflected the major ideas of their experiences. Secondly, I triangulated the major findings from this approach to findings collected from the observations and questionnaires.

Transferability refers to the extent the findings are replicable. Using guidelines proposed by Lincoln & Guba (1985) I concisely defined my codes and described the categories and kept records of them so that if someone were to replicate the process, there would be high likelihood of getting consistent findings.

Neutrality or conformability relates to the issue of objectivity. This was a challenge to ensure in this study. I was warned by my supervisors, at the start of my PhD, to take an interested – disinterested stance so as to view the reform in Seychelles with an objective lens. This was essential in view of my past involvement with the reform. So to ensure that the findings were unbiased, I consistently talked to a PhD friend about what I was seeing. I allowed him to challenge some of my claims. Regardless, I believe that biases cannot be avoided altogether. The essential factor, however, is the ability to control and reduce biases wherever possible.

4.10 Summary

This chapter presents an overview of the participants involved in the study and description of the data onto which the results chapters are based. Since I will not be presenting findings from each instrument separately, I thought it would be useful to describe the various datasets in the first instance. Essentially, this chapter serves as an introduction to the result chapters.

CHAPTER 5 Contributions of MLS from the perspective of the main implementers

In this chapter, I begin to explore the impact of MLS on teaching. This entails an inquiry into teachers' and subject leaders' perceptions of the benefits of the reform. I use both primary and secondary data for this purpose. Here I begin to provide evidence to answer the first research question:

- How has the teaching of mathematics in primary schools changed with the implementation of the MLS reform?

The change discussion model provides a lens to examine how teachers interpret and implement policy. It also helps in examining how the framing of policy places constraints and affordances on the teachers' actions and thus on what is often termed as 'compliance'. By reporting on the contribution of the MLS from the implementers' perspective, I seek to develop an understanding of the relationship between the teachers and the reform they were asked to implement. This should allow me to ascertain how the teachers' image of the reform (policy) facilitated or inhibited its implementation. In this chapter, I view the teachers as being at the centre of the "*situation*". I look at how they viewed the reform, and I inquire into their motivation to change or not to change their practices. I also investigate how they believed their pedagogy has changed over the years and, from their perspectives, I determine how other factors within their *zone of enactment*, related to their capacity and motivation to change. Additional data, namely interviews with the subject leaders and others involved in the reform at ministry level, complement this overall picture of how the teachers responded to, interpreted and implemented the reform.

5.1 Teachers' reporting on MLS

I begin this chapter by exploring outcomes of the reform from the teachers' perspectives. The teachers strongly endorsed MLS as an effective teaching tool and felt that the reform was influencing their practices even if the changes in their practices were yet to be manifested in pupils' achievements. All along the teachers had shown a positive response to the reform. Such positive attitudes were evident from the pilot to the actual implementation of the reform. As a result of the everyday engagement with the reform teachers built their perceptions on practical evidence.

5.1.1 Teachers' impression of MLS during the pilot stage

The teachers' first interaction with the reform happened during the pilot stage. The two teachers who participated in the pilot study, Lena and Limia (pseudonyms), saw MLS as an eye opener to the way they were planning lessons. I still hold what Lena said about the lesson structure:

We used to take almost one hour to plan a lesson. This week, I do not know whether you or maybe the format we had been using, I spent about 30 minutes developing a lesson. Still everything is there. I get my thinking organised. It's really helpful using this MLS [Lena, MLS Pilot Stage, 2005]

Lena and Limia taught at the same year level. Usually they would remain after school hours and planned their lessons together. They explained that they developed materials together and later on shared these learning materials with each other. They made sure that their lessons never clashed. Hence, when one would be teaching, the other would not need the materials. During the pilot, they were left to operate in the same way. MLS was introduced to them as a tool to assist their teaching.

Lena's comment that her planning time had reduced by almost 50% is a first sign that the teachers might have welcomed the initiative at an early stage. Lena felt amazed that she and her colleague were able to plan a proper lesson in a reasonably short time. Since they normally stayed behind after school to plan lessons, the reduction in planning time implies that they got more time to plan lessons for other subjects or perhaps even went home earlier.

Limia was also positive about the new approach to planning and teaching mathematics. She explained how she got her lesson contents organised with less difficulty:

See, since you asked us to begin with the mental, then the review and then the focus of the lesson, already you are giving us 10 minutes of materials. It's up to us to decide what to put in the mental, review etc... but we have some mental activities. I use the purple book for the mental. There are nice sums in it - very appropriate to the children. Then I just recap what we did yesterday. Ya, it flows well [Limia, MLS Pilot Stage, 2005].

Again, Limia was positive about the idea that the approach provided her with a structure to follow and instilled coherence in the lesson. In both responses the teachers were positive about the planning benefit which the new approach to teaching was bringing. Nevertheless, Lena and Limia talked about some limitations of the reform in their classes. Lena for instance, noted:

I don't have much time to go over practices and help out pupils with difficulty. There is no provision for this. I can't see where marking comes in, especially [marking] the home-works. I give lots of homework and I like doing the correction together with the children (Lena, MLS Pilot Stage, 2005).

In reacting to the limitations they experienced during the four day pilot, Limia noted, "maybe, dousman dousman i a vini [slowly, slowly, they will get there]". That reaction was a very optimistic one. It pointed to hope and really portrayed Limia as

having taken a learner's seat. The observation suggests that both teachers appeared ready to learn.

5.1.2 Teachers' impressions during the early years of the reform

Teachers' impressions of the reform were captured through site visits, seminars and symposia: In mid 2007, the School Division of the Ministry of Education organised a networking session for the teachers about the MLS approach to teaching. Two symposia were held: one in August 2008 and another in June 2009. Those forums served three major roles: to publicize and showcase the work of schools, to create possibilities for teachers across schools to network their teaching ideas, and to provide the system with feedback on how the teachers were coping with the reform.

In all of these forums, there were more positive than negative responses from all the schools which indicated that the teachers had welcomed the MLS call to renew their teaching. Even if the teachers reported new challenges to their teaching roles, their priority was to improve their teaching and learning atmosphere. It was as if the call to reform their practices had created a platform for deliberating on mathematics curriculum improvement approaches (Walker, 1971). There was a new ambiance in schools which stimulated the teachers to talk about improving mathematics teaching and learning.

Using a more systematic approach, in 2007, I reviewed the end of year reports of 10 schools to find out what the teachers were saying about the MLS reform. Usually schools would write whatever they were doing in their school report. This was a means to communicate their challenges and successes to the system. I developed a conference paper out of that investigation (Valentin, 2007). The schools reported that the teachers had been stimulated to review their practices in line with the new approach and that they [the teachers] had welcomed this approach to

teaching mathematics. To me this was evidence that they were positive about the reform call. The bulk of the school report however concentrated on what the teachers had reported as initial impacts of the reform in just the first year of its implementation.

The schools mentioned that MLS had an impact on teaching. A subject leader from one of the ten schools noted: “At last, good lessons are being done in the school” (One Subject leader in 2007). Two schools wrote about the gradual disappearance of the episodes of expository teaching. A small sample of teachers in one school, describing themselves as, “disliking the teaching of mathematics”, claimed that they were more comfortable in accessing materials to be included in the lessons: a view which was shared by Limia in the pilot implementation. The schools also reported on how the teachers’ attempts to enact the reform ideas had resulted in better teacher-teacher professional relationships. This suggested that the reform had an impact on the culture and ethos of the schools. These observations could have been a contributing factor in triggering the teachers’ positive attitude to the reform.

The extent to which teachers use a new teaching approach can be a measure of how positive they are. I believe that teachers who are positive about a new approach to teaching tend to use it abundantly and have teaching or learning oriented goals for using the new approach. However, this argument can be contested when the approach which the teachers are being asked to adopt is mandatory. For instance, there was evidence from two schools in this present study that they were compelled, being firmly requested by their school management to base their lesson on MLS and to follow the structure to the letter. Under such conditions, a high frequency of incorporating the reform may not necessarily be a result of a positive attitude towards the reform.

In 2008, the Mathematics Working Group conducted a survey to ascertain how the teachers were coping with the reform. A sample of 435 teachers, which included class teachers, assistant teachers, and everyone else teaching mathematics in the primary schools, were surveyed about their impressions of the reform. In a question to ascertain how often the teachers were using the reform, the responses were as follows: 85% reported “very often” or “always” and 15% reported “rarely” or “never”. A second item required the teachers to select – from a set of options – their prominent motivation to incorporate MLS into their teaching. It is from this second item that, evidence suggesting positive attitudes has emerged (see Table 5.1).

Table 5.1 Teachers’ motivation to using MLS in their daily practice

Motivation to use MLS	(%)
To facilitate planning	39
To improve the conduct of the lesson	29
To satisfy the recommendation	11
To improve some aspects of the teaching	10
To improve pupils’ learning of mathematics	7
To organise pupil learning activities	4
Total	100

These values illustrate the teachers’ strong allegiance to the call to adopt the structure. Almost 40% of teachers reported that their main motivation to incorporate MLS in their teaching was to facilitate planning. Almost 30% claimed that their main motivation was to improve the conduct of the lesson. Just 11% of the teachers chose, “to satisfy the recommendation” as their main motivation which suggested that there were stronger pedagogical reasons which stimulated them to use the new teaching approach. There was an option of “others” and teachers did not write any other reason. What emerged as disturbing in those results was that more teachers (11%)

selected “to satisfy recommendation” than “to improve pupils’ learning of mathematics” (7%).

5.1.3 Teachers’ impressions five years into the reform

In this research, carried out five years after the reform was implemented, the teachers’ positive attitude to the reform still prevailed. The extent to which the teachers reported that they were incorporating MLS in their teaching was as high as it was at the implementation of the MLS, hence leading to the suggestion that institutionalization of the teaching model was imminent. The teachers were asked to indicate how often they use MLS as a basis for their lesson organization and structure. They were to choose from the four-point Likert scale: always, most of the time, rarely and almost never. The overall responses are shown in Figure 5.1.

The bar graph illustrates that the teachers showed high adherence to the call to incorporate MLS into their daily lessons. Most teachers (87%) reported always using MLS. In fact 99% of the teachers reported always or most of the time to this question. There were only two teachers who responded rarely. I tend to reject the argument that this high frequency could be due to the model being mandatory. Yet, I do not totally exclude the fact that the reform, being a compulsory activity, had accelerated the process by which teachers had had access to it.

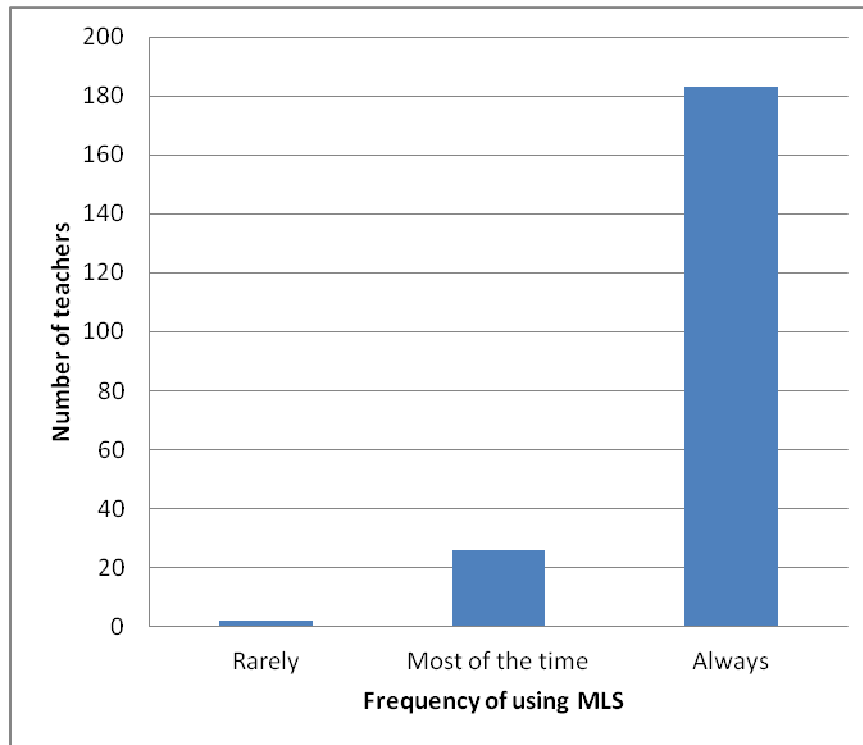


Figure 5.1 Bar graph showing the teachers’ reported frequency of using MLS for organizing and structuring the lessons (n = 211).

Further information on the teachers’ attitudes and impressions were captured through the questionnaire data. The teachers were presented with a set of items (Q16 and Q17) to which they were to indicate their level of agreement. The items inquired into their perception of the impact of the reform on teaching and learning. Some computed item statistics (mean and standard deviation) are presented in Table 5.2.

The data show the following about the teachers’ attitudes to MLS: Overall the teachers were positive about the new approach, indicated by strong means on those items that inquired about the impact of the reform on their teaching. The most positive items were: I find MLS a useful tool ($M = 3.13, SD = 0.62$), followed by MLS is having a positive impact on my teaching ($M = 3.10, SD = 0.56$). This pattern of response was consistent even when the teachers’ responses were arranged by cycles. Even if the teachers were less positive on the issue that MLS has had an

impact on the pupils' learning, they were relatively positive about the fact that pupils were interacting better with the teachers ($M = 3.05$, $SD = 0.53$).

The teachers were required to teach mathematics in mixed ability classes. Analysis of the items inquiring about the impact of MLS on the teaching of mixed ability classes reveal that the teachers were not highly positive that MLS had aided their teaching in that area ($M = 2.83$, $SD = 0.65$). The data show that about 26% of the teachers disagreed or strongly disagreed with the statement that MLS had been useful in helping them cope with the teaching of mixed ability classes.

Table 5.2 Mean and standard deviation of items inquiring about the teachers' opinion on MLS: Data presented by teachers' grade levels

Items expressed in a positive way	Early childhood		Middle primary		Upper primary		Total	
	<i>Mean</i>	<i>Std Dev</i>	<i>Mean</i>	<i>Std Dev</i>	<i>Mean</i>	<i>Std Dev</i>	<i>Mean</i>	<i>Std Dev</i>
	16f I find MLS a useful tool	3.10	0.61	3.16	0.67	3.15	0.60	3.13
16a MLS is having a positive impact on my teaching	3.12	0.52	3.14	0.50	3.05	0.66	3.10	0.56
16b It was a good idea to introduce MLS in schools	3.09	0.57	3.08	0.54	3.02	0.59	3.07	0.57
17a Pupils interact better with the teacher	3.10	0.53	2.98	0.53	3.05	0.53	3.05	0.53
16e MLS does not limits what I can do in class	3.01	0.62	3.08	0.62	3.00	0.70	3.03	0.64
16d MLS does not restrict teachers' creativity	2.93	0.65	3.06	0.58	2.93	0.73	2.97	0.65
16c MLS is applicable at all levels	2.86	0.75	3.07	0.61	2.95	0.73	2.95	0.71
16g Maths teaching has improved with the introduction of MLS	2.98	0.55	3.02	0.57	2.75	0.68	2.92	0.60
17b Pupils in this school seem to like mathematics	2.88	0.57	2.82	0.56	2.84	0.52	2.85	0.55
17h There has been a change in pupils' ability even with MLS	2.89	0.58	2.81	0.63	2.81	0.71	2.85	0.63
16i MLS offers scope to deal with mixed ability teaching	2.93	0.64	2.89	0.54	2.63	0.72	2.83	0.65
16h MLS has motivated me to like the teaching of mathematics	2.82	0.66	2.89	0.60	2.75	0.75	2.82	0.67
17c Pupils understand mathematics lesson better	2.83	0.56	2.83	0.50	2.76	0.54	2.81	0.53
17g Pupils are better controlled in MLS lessons	2.80	0.53	2.82	0.50	2.66	0.60	2.77	0.55
17f Pupils show more motivation towards learning maths	2.70	0.58	2.70	0.50	2.65	0.55	2.68	0.54
17e Pupils are doing mathematics at a higher level	2.50	0.64	2.42	0.53	2.37	0.58	2.44	0.59
17d Pupils are generally scoring more in mathematics	2.49	0.61	2.26	0.60	2.25	0.58	2.35	0.61

To facilitate comparison among groups of teachers, I worked out an index for teachers' attitude to MLS by adding the teachers' scores for items of Q16 and Q17. Given that the resulting distribution did not pass the normality test, I used nonparametric tests to compare means. I present a summary of the indices in Table 5.3 and results of the Kruskal – Wallis test in Table 5.4

Table 5.3 Computed indices for representing teachers' attitude to MLS

Variables	Mean	Std. Dev	N
School geographical location			
South	50.54	6.84	26
East	47.84	6.23	32
Island	47.21	9.39	29
West	46.33	8.02	27
Central	45.6	8.99	65
North	44.28	9.94	40
School Size			
Medium	47.51	7.69	79
Small	46.78	8.79	86
Large	44.89	9.61	54
Teacher grade level			
Early Childhood	47.09	8.29	87
Middle Primary	46.62	9.21	65
Upper Primary	45.62	8.76	63
Teacher age group			
36 - 46	47.95	6.22	62
>55	47.57	4.89	7
47 - 55	46.40	8.53	30
25 - 35	46.20	8.59	82
<25	46.19	9.82	36
Years of maths teaching service			
Less than one year	47.80	10.50	10
Between 1 to 5 years	47.08	8.99	61
More than 10 years	46.93	7.08	106
Between 6 to 10 years	45.45	8.49	40

Data from Table 5.3 shows that certain variables such as school geographical location or teachers' years of teaching mathematics could have possible influence on teachers' attitudes to the reform in that the means of the indices among groups within

the variables appeared to differ considerably. For instance, when the teachers are organised by geographical location, it appears that those teaching in the South were most positive while those teaching in the North were least positive about the MLS. I used Kruskal-wallis tests to enhance these comparisons. The results are tabulated in Table 5.4.

Table 5.4 Kruskal – Wallis test results for the comparison between various groups of teachers and their self-rating index score on attitudes to MLS

Variables	χ^2	<i>df</i>	sig
School location	6.12	5	0.29
School size	2.09	2	0.35
Teacher cycle	0.40	2	0.79
Teacher age	0.63	4	0.96
Teacher length of service	1.56	3	0.67

The five tests all show non-statistically different results. This implies that none of the variables tested have an influence on the teachers' attitudes to MLS. Kruskal – Wallis tests are not significant in any of the cases.

The teachers' positive attitude to the MLS teaching approach was further amplified in the following analysis. There were nine statements presented to teachers which they had to rate on a four-point scale indicating their level of agreement or disagreement. There was a general statement which was intended to gauge the extent to which teachers felt that the introduction of MLS was a good idea. The eight other statements attempted to identify specific aspects of the MLS which might provide further information to explain teachers' views on how they felt about MLS in their teaching: for example, an indication as to whether MLS was limiting their practices, whether the template was a useful tool, and whether MLS was having a positive impact on their teaching. The first part of the subsequent analysis was to find out

how teachers responded to the first general statement (It was a good idea to introduce MLS in schools). A frequency count indicated that 90% of the teachers agreed or strongly agreed that it was a ‘Good idea to introduce MLS in school’. In the second part of the analysis I used the teachers’ responses to this question and correlated it with the eight other descriptive variables to establish a relationship between the teachers’ acknowledgement that it was a good idea to have MLS, and their responses about its functionality (see Table 5.5).

Table 5.5 The correlation coefficients between ‘Good idea to introduce MLS’ with eight descriptive variables

Descriptive variables	Correlation values
MLS is having a positive impact on my teaching	0.81**
MLS is applicable at all levels	0.13
MLS does not restrict teachers’ creativity	0.32**
MLS does not limit what I can do in class	0.31**
I find MLS a useful tool	0.27**
Maths teaching has improved with the introduction of MLS	0.51**
MLS has motivated me to like the teaching of mathematics	0.50**
MLS offers scope to deal with mixed ability teaching	0.44**

** Significant at .01 level (2 – tailed)

An examination of Table 5.5 reveals that significant correlation coefficients are recorded for seven of the eight descriptive variables. The item that is most positively correlated is a relevant marker of the power of the MLS to make changes to the way teachers were teaching. This begins to create a picture of teachers’ positive responses to this innovative MLS model. Prior to MLS, little thought was given to structuring the lessons so that the teacher could explore ways of developing mathematical concepts. The MLS forced teachers to look at their mathematics lessons differently

and to concentrate on the mathematical ideas that they wanted to pass on to the pupils. These could be some of the reasons why they felt that their teaching had changed through MLS and, since they thought that introducing MLS was a good idea, the change is assumed to be in a positive direction, that is, they felt that their teaching has improved. The correlation of the key statement with the descriptive statement, mathematics lessons have improved, is 0.51 and this is also a significant correlation.

The key statement correlates strongly and significantly too with teachers' feeling that MLS had motivated them to like the teaching of mathematics ($r = 0.50$), and teachers' feeling that MLS assisted them in the teaching of mixed ability classes ($r = 0.44$). Apart from one item (MLS is applicable at all levels of the primary cycle) which showed a weak correlation with teachers' feeling that it was a good idea to introduce MLS in schools ($r = 0.13$), all the remaining correlate moderately with this key statement (see Table 5.5).

There were some initial speculations that MLS would not be appropriate at all levels. That point of view came out again from the teachers who had used the structure. However, the fact that teachers' reasoning that it was a good idea to introduce MLS has a strong correlation with other attitude items, suggests that the teachers had really endorsed the initiative as part of their practices.

Specific to the issue of attitudes to the reform, the teachers' responses converged on the following: MLS was impacting positively on their teaching even if they were being cognitively and instructionally challenged. Specific to this issue of benefits, five years into the reform, the teachers outlined what they were getting out of the reform which I argue could be possible factors influencing their overall positive attitude to the reform. For example, Teacher 6 from Kappa Primary talked

about the benefit of planning using the prescribed template. Her answer was typical of others who spoke on similar uses. They liked how the template generated coherent lessons:

“The main advantage for me is the ability to establish lesson flow and make lesson go on well. Also as someone who was not used to like teaching maths, I have a very good template to make the lesson appear coherent.” [KAP06, July, 2011]

Teacher 2 from Alpha primary talked about how MLS had been useful in getting her to select content for the lessons and organise the material into a logical sequence.

This further reinforces the point that KAP06 was making:

My mental activity is devoted for recall of facts such as properties of shapes or sometimes some mental calculations. Already five minutes are over. The review of last lesson and preview of current lesson are automatics hence already 10 minutes of the lesson are gone. I like this idea of one mathematical idea per lesson it makes thing so simple. The moment you have your mathematical idea, you can ask yourself – what explanation can I make to get children to understand this mathematical idea? And because you need to link with real world, I try to look for something real to put into my explanation. What I want to say is that MLS is so structured that it also gives you a direction to move. [ALP02, Focus Group Discussion, July, 2011]

Teacher 3 from Kappa Primary talked about the connectedness in lesson contents as a result of her engagement with the structure:

MLS has brought an order in the teaching in the sense that now lessons flows. It is no longer a bulk of mathematics activities but something connected. There is a proper sequence and if your lesson plan is with you in class, you can always refer back to it to re-establish your direction [KAP03, Focus Group Discussion, July, 2011].

All three examples commend the structure for providing a coherent lesson which came out clearly from the teachers’ point of view that coherence was missing in lessons prior to the implementation of the reform. These are positive statements reinforcing my claim that teachers have been positive about the reform.

It emerged from the focus group interviews in the four schools that the teachers believed the MLS reform had impacted on their instructional practices. For example: one teacher acknowledged that her lesson planning was more focused upon using MLS. Another teacher argued that she had succeeded in doing away with chalk and board teaching and had begun to make investigative lessons part of her practices (BET T6). GAM T3 talked about outdoor lessons as a response to varying lesson strategies. Furthermore, GAM T3 felt that her teaching was no longer teacher-centered. The teachers perceived a change in their practices. Contrary to this overall positive attitude to the reform there were two teachers who criticized MLS as being rigid and too prescriptive: the biggest criticisms of the reform at its launch.

The teachers had contrasting opinions on whether the pupils' achievements had changed as a result of the reform. There were contradictions even among teachers in the same school. For example, at Alpha Primary School, ALP T2 and ALP T5 claimed "no better result" in their class. Yet, ALP T2 believed that the boys' attitude to mathematics had improved. ALP T3 reported that a slight improvement had occurred in her class and that her pupils were handling "complex problems". ALP T4 was undecided on this issue.

All the teachers converged on the opinion that the ultimate aim of the reform was to improve pupils' achievements yet they believed they had been put at the centre of the reform instead of the pupils. The fact that the ultimate aim was yet to be achieved, they felt that "*the system should go back to the drawing board*". Curriculum arose as the main issue that the teachers felt should be dealt with.

What I also take from the data is that those teachers who initially had negative attitudes at the implementation of the reform eventually ended up developing a positive relationship with the reform. The teachers' initial attitude was

not permanent and did not affect future enactment of the reform. Teacher 3 from Beta Primary made this point quite clear:

At First I did not entertain the idea. When MLS started I had my own style. I felt that it was kind of limiting me from doing my mathematics lessons. Because I used to have different styles of teaching. So when you followed MLS, it was kind of guiding you in just one way of doing your mathematics lesson. And I did not know about the information [i.e. the different requirements to follow]. I remember we had a talk with X [somebody from the Mathematics Working Group] but then he kind of changed my views about the MLS. Because when we started it was about, you start with this and this step and so on, and then he made us see that you can change. You do not have to... for example, your mental – you can change with your focus. The subtitles [various segments] are only there to help you. But at first as it was passed on to us I felt it was limiting us [BET T3]

Two teachers from Alpha Primary, ALP T2 and ALP T5, who also started off with a negative attitude later on felt good about their teaching as a result of their engagement with the reform. In the end ALP T5 remarked, *“if [since] we believe that we have succeeded in improving the quality of teaching by MLS, then we should look for something similar for the learners”*. What ALP T5 was suggesting was that if intensive effort, somewhat similar to what the teachers were exposed to, was diverted onto the learners, it was possible that there would be positive outcomes for learners’ achievements.

5.2 Teachers and their pedagogy

There were two ways by which I inquired into the impact of MLS on teachers’ practices: from their self-reported impressions and experiences, and through direct observation of some lessons. I have devoted Chapter 6 to discussing the nature of mathematics lessons under the MLS regime. However, in this section I mainly report on findings from the teachers’ self-reported data and I argue that on the basis of these

self-reported data, MLS might have had an impact on the way the teachers addressed the issue of mathematics teaching in their classroom.

5.2.1 Teachers reporting on their general practices

Two questionnaire items inquired into the teachers' classroom teaching of mathematics as a way of uncovering patterns of practices. The first one required the teachers to report on their instructional practices, mainly their teaching strategies. The second one required them to indicate how they engaged their pupils in the lessons. Given that the two questions required the teachers to reflect on their practices, and these questions made references to traditional and reform-oriented practices, it is possible to form a perception of the teachers' location on the traditional – reform approach continuum from the responses. In this section I report on findings from my analyses.

The teachers' self-reported data of their teaching strategies suggest that most of them were attempting to do away with the traditional approaches to teaching mathematics. The teachers were presented with sixteen teaching processes. The processes were drawn from a list of processes which teachers in Seychelles were likely to use during mathematics lessons. Some encompassed the reform ideas while some included traditional teaching approaches. The teachers were required to indicate how often they enacted each process as part of their regular mathematics instructions. They were to select one option from the 4-point scale: rarely, sometimes, most of the time, and always. For analysis purposes the options were scored 1, 2, 3, and 4 representing rarely, sometimes, most of the time, always respectively, indicating a measure of popularity of each activity. Hence, a score 4 would indicate that the items (the process) was very popular. For each process, the item mean and standard deviation were computed. The results are presented in Table

5.6 in which the items have been written in decreasing order of item means. This shows that activity which emerged as most popular is placed on top of the list.

Table 5.6 Statistics for items measuring the teachers' reflection of their practices

Items with labels as appeared on questionnaire	Item mean	Std Dev
d) Assign homework for pupils to get practice	3.73	0.48
e) Explain homework with the class before giving them out	3.66	0.61
c) Check pupils' understanding at the end of the lesson	3.49	0.63
n) Incorporate learning/ manipulative aids in the lesson	3.22	0.66
a) Teach topics in the context of everyday situations	3.00	0.55
b) Make provisions for pupils to work at their own pace	2.97	0.60
o) Organise pupils in ability grouping	2.94	0.82
p) Allow pupils time to copy notes	2.82	0.98
l) Correct test or go over home-works	2.70	0.91
i) Use Investigative and/or problem solving	2.66	0.64
g) Teach using exposition	2.55	0.70
h) Conduct an entire practical maths lesson	2.47	0.63
m) Work with pupils on a one to one basis	2.43	0.71
j) Conduct drill and practice in an entire lesson	1.90	0.85
f) Conduct an outdoor lessons	1.89	0.63
k) Conduct whole class discussion for the entire lesson	1.81	0.90

Items relating to assigning and explaining homework occurred as most popular amongst the list ($M = 3.73$, $SD = 0.48$ and $M = 3.66$, $SD = 0.61$ respectively). Two other items which occurred as popular were, i) checking pupils' understanding at the end of the lesson ($M = 3.49$, $SD = 0.63$), and ii) inclusion of manipulative aids in lessons ($M = 3.22$, $SD = 0.66$). The results show the teaching of mathematics in the context of everyday situations as a relatively popular practice to the others in the list ($M = 3.00$, $SD = 0.66$). However, in the interview, the inclusion of real life situations in lessons emerged as a difficult practice. Hence, it could be argued that a difficult practice does not necessarily mean an unpopular one. It may be possible that the

teachers had attempted to include real life examples in lessons as required by MLS despite their difficulties and challenges.

Conducting whole class discussion for the entire lesson occurred as the least popular activity in the list ($M = 1.81$, $SD = 0.90$). Yet, there are large variations in the way the teachers responded to this item ($SD = 0.90$). Other unpopular practices as reported by the teachers were: conducting outdoor lessons ($M = 1.89$, $SD = 0.63$) and conducting drill and practice lessons ($M = 1.90$, $SD = 0.85$).

I further analyzed the teachers' pattern of responses for the three most and least frequent teaching processes. I report the results in Table 5.7. Most teachers assigned homework most of the time or always. The teachers' effort to do away with the traditional approaches to the teaching of mathematics, notably drill and practices and whole class discussion can also be inferred from the table.

Despite the teachers' attempts to revamp their practices in general, mathematics lessons remain an indoor activity. It could be argued on the one hand that the tropical climate of Seychelles limits the teachers' choices for conducting outdoor lessons. Most of the time it is sunny and the temperature rises well above 28° C. On the other hand, it could be argued that the teachers have not been creative enough to devise mathematics lessons that can be taught on beaches, or under the lovely shades. Some primary schools are close to the beach. With no fan or air condition systems in most classrooms, the lesson environment, especially in the afternoon, does not offer a favourable context to teaching and learning a highly academically demanding subject like mathematics.

Table 5.7 Teachers’ pattern of responses for the three most and least popular practices as occurred from the survey

Item label	% respondents per option of the Likert Scales			
	Rarely	Some times	Most of the time	Always
d) Assign homework for pupils to get practice	-	1.9	22.8	75.3
e) Explain homework with the class before giving them out	0.5	5.6	21.4	72.6
c) Check pupils’ understanding at the end of the lesson	-	7.4	36.4	56.2
j) Conduct drill and practice in an entire lesson	36.8	40.6	18.4	4.2
f) Conduct an outdoor lessons	24	64.5	9.7	1.8
k) Conduct whole class discussion for the entire lesson	45	35.1	13.7	6.2

In terms of variations in the teachers’ responses, the data show that there were more variations in the way the teachers responded to Items K and J while there were least variations in their responses to Items E and D. In other words, it could be argued that the teachers were more consistent in their responses about the most frequent practices. For instance, with regard to assigning homework for pupils to get practice, the most popular approach among the list, 98% chose most of the time or always, with only 2% responding sometimes. With regard to how often they conducted whole class discussion for the entire lesson, (an unpopular practice) 45% responded rarely, about 35% responded sometimes, 14% responded most of the time, and 6% responded always.

I also compared the teachers’ responses across cycles. At the start of my analysis, I expected that teachers at different cycles or grade levels to be different in their approaches to teaching mathematics and in the way they engaged learners. Data from this study show an opposite finding. I computed Spearman rho correlations on

the data for analysis of patterns of responses across cycles. In such a case, I examined the order of the variable ranking to ascertain whether pattern of practices differed among teachers of different grade levels. To be more specific, this analysis tests whether there is any correlation among the teachers of different cycles in their approach to teaching mathematics. I report the finding in Table 5.8.

Table 5.8 Correlation of pattern instructional practices across cycle

Statistics		1	2
Grade level			
Early childhood (1)	Correlation Coefficient		
	Sig. (2-tailed)		
	N		
Middle primary (2)	Correlation Coefficient	.979**	
	Sig. (2-tailed)	.000	.
	N	15	
Upper primary (3)	Correlation Coefficient	.946**	.957**
	Sig. (2-tailed)	.000	.000
	N	15	15

** Correlation is significant at 0.01 level (2-tailed).

The correlation values between any two grade levels are high ($\rho > 0.90$). This indicates that the pattern in which the teachers selected the strategies was consistent across grade levels. This contradicts my earlier hypothesis which suggested a weak correlation. The data in Table 5.8 suggest that the teachers' practices across grade levels were alike. In terms of the teaching of mathematics, this is quite concerning as low graders were taught in a similar manner to high graders. At the same time it shows perhaps that the teachers' enactment of MLS had influenced their practices and had made practices similar throughout the primary school. MLS prescribed the same teaching guidelines irrespective of grade levels. On the one hand, one can argue that such specific decisions should lie in the teachers' judgment of what teaching in

their individual classroom should look like. On the other hand, it can equally be argued that the recommendation to vary practices and strategies had resulted in this overall consistency in responses. In other words, the teachers were no longer viewing a particular cycle to be more responsive to any particular teaching approach.

5.2.2 Strategies of engaging the pupils in lessons

The teachers were presented with 10 statements, each one describing a possible way of engaging the pupils with tasks as part of the instructions, homework, or assessment. Most of the items could be grouped into the categories ‘traditional’ or ‘reform-oriented’ tasks. A few others could fit into either category. The teachers were to select from the options – rarely, sometimes, most of the times, and always – the one that best describe their pattern of practice. A concern of this question was to ascertain the teachers’ tendency to involving students in the lessons: those who were attempting the reform oriented approach, and those who were still adopting the traditional approach. Table 5.9 presents the means and standard deviations of the items, showing the teachers’ pattern of responses across grade levels.

When the results are considered as a big group, the data show that the teachers were more likely to involve their pupils in discussing various ways to solve a problem ($M = 2.97$, $SD = 0.75$). They were less likely to engage their pupils in reciting lesson notes ($M = 1.50$, $SD = 0.77$). This pattern was rather consistent regardless of the level at which the teachers were teaching. There is an indication that the teachers were deviating from traditional ways of engaging their pupils in mathematics tasks. In order to develop a better understanding of the situation I separated the items into the two distinct groups –traditional and reform-oriented – and I examined the pattern of responses from that angle.

Table 5.9 shows that items with the highest means are: Getting pupils to discuss different ways to solve a particular problem ($M = 2.97$, $SD = 0.75$), Getting the pupils to justify their answer or explain their reasoning ($M = 2.81$, $SD = 0.81$), and Getting pupils to use manipulative aids to solve problems ($M = 2.78$, $SD = 0.83$). However, inconsistent with this overall pattern of response is Item C, getting pupils to memorize, fact, rules, and definition of formulae ($M = 2.66$, $SD = 0.89$), which on its own is a very traditional approach to engaging the pupils in the lessons. Relative to the other items, Item C has a high mean.

The teachers expressed lower use of the following approaches to engaging pupils: recite lesson notes ($M = 1.50$, $SD = 0.77$), work on non-routine problems ($M = 2.06$, $SD = 0.70$), and practice computational procedures ($M = 2.06$, $SD = 0.97$).

Table 5.9 Item statistics relating to teachers' reported ways of engaging pupils

	Early Childhood		Middle Primary		Upper primary		Overall	
	Mean	Std	Mean	Std	Mean	Std	Mean	Std
	<i>Dev</i>		<i>Dev</i>		<i>Dev</i>		<i>Dev</i>	
Pupils' engagement activities								
Discuss different ways to solve a particular problem (R)	2.82	0.76	3.09	0.63	3.05	0.83	2.97	0.75
Justify their answer or explain their reasoning (R)	2.67	0.85	2.91	0.79	2.89	0.79	2.81	0.81
Use manipulative materials to solve problems (B)	3.17	0.75	2.65	0.72	2.38	0.82	2.78	0.83
Memorize facts, rules, definitions or formulae (T)	2.40	0.85	2.85	0.85	2.83	0.89	2.66	0.89
Work on problem or exercise on the front board (T)	2.66	0.78	2.62	0.72	2.52	0.80	2.61	0.77
Complete worksheets (B)	2.57	0.79	2.49	0.71	2.25	0.62	2.45	0.73
Read or work out problems from a textbook (B)	2.48	0.85	2.29	0.68	2.29	0.85	2.37	0.81
Practice computational procedures (T)	1.85	0.90	2.10	1.00	2.27	0.99	2.06	0.97
Work on non-routine problems (R)	2.06	0.70	2.04	0.69	2.07	0.70	2.06	0.70
Recite lesson notes (T)	1.58	0.78	1.50	0.78	1.40	0.73	1.50	0.77

Key: (R) signifies reform oriented practices, (T), traditional practices, (B), practices which might relate to both categories

When the results were organised by teachers' cycle, there was a slight difference in the most popular form of pupils' engagement activity across cycles. While at the middle and upper primary level, the most popular way of engaging pupils was, *getting them to discuss different ways to solve problems*, at the early childhood level, the most popular activity was, *getting pupils to use manipulative to solve problems* ($M = 3.17$, $SD = 0.75$). Nonetheless, *discussing different approaches to solve problems* was the second most popular activity ($M = 2.82$, $SD = 0.76$).

Three of the items relate to traditional approaches to engaging pupils in the lessons: practicing computational procedures (Item B), memorizing facts, rules and definitions or formulae (Item C), and reciting lesson notes (Item J). The means of Items B and J were generally lower than the means of the other items. In fact Item J emerged with the lowest mean for all three grade levels. Overall its mean was 1.50. However, Item C was the lowest in the Early Childhood case, but relatively strong for the middle and the upper primary levels. This observation suggests that some elements of the traditional approach to engaging pupils in mathematics lessons remained dominant at the upper and middle primary but to a lesser extent at the early childhood. One could also argue that the situation was such since generally the nature of tasks or contents of the early childhood mathematics curriculum did not necessarily lay themselves to the memorization of facts, rules or procedures.

Four of the items related to the reform-oriented approaches to engaging pupils in the lesson: justifying answers or explain reasoning (Item A), discussing different ways to solve problem (Item E), working on non-routine problems (Item G), and using manipulative aids to solve problems (Item H). It emerged that these items had relatively stronger means than other items of the group. Using manipulative aids had the strongest mean at the Early Childhood ($M = 3.17$) level

while discussing different ways to solve problems emerged with the strongest mean at the other two grade levels ($M = 3.09$, and 3.05) for the Middle and Upper Cycle respectively. The data suggest that the teachers had attempted to include the reform-oriented approach among their strategies to involve students in the lessons.

The other items within this domain which I hypothesized could be possible pupil engagement approaches across the traditional-reform continuum had average means ranging from 2.37 to 2.61. Getting the pupils to work on problem at the board had a strong mean (2.66). Teachers generally liked this approach. Getting pupils to complete worksheets also had a mean slightly above average (2.57).

If it is taken into consideration that the teachers had been advised to vary their approaches to engaging pupils, there is evidence that this had happened. Moreover, it can also be claimed that the teachers reported engaging their pupils more using the reform-oriented approaches than the traditional ones.

5.3 Determining the impact of the MLS on practices

I explained elsewhere that isolating the effect of a reform initiative such as the MLS on teachers' practices could be difficult in the absence of a quasi-experimental study. In the case of my research I could not develop experiments since the research for this PhD was done five years after the reform started and the implementation of MLS was being conducted in all the schools. Secondly, since an evaluation like the one being done here was not thought through at the start of the reform, there were limited data that captured teachers' practices over time. Hence determining the effect of MLS on practice over time was difficult to achieve. However, I used an alternative approach to examine the effect of the reform using the teachers' self report of their practices.

I based my approach on the assumption that teachers' self-reported data of their practices are trustworthy in providing an accurate picture of reality (Ross et al., 2003). Given that the questionnaire I administered inquired about the teachers' use of MLS, it was reasonable to consider measuring the effect of MLS on practices in terms of the teachers' differential use of the reform. This entailed grouping the teachers according to how they claimed they had used the reform and then, compared practices among groups. I differentiated the teachers based on their self-reported data of their practices and I looked for the effects of MLS on practices along that line. Details of this analysis are given below.

Item 15 of the questionnaire required the teachers to indicate how frequently they incorporated each component of the structure in their teaching. Given that scores 4, 3, 2, and 1 were allocated to the responses, always, most of the time, rarely, and almost never, respectively, I could combine the scores of the items and obtain a composite score for each teacher. That score represented the teachers' level of use of MLS. I then transformed the set of scores to have a mean of 10 and standard deviation of 5 and called it the MLS Perceived Compliance Index. Transforming scores was necessary since I was to combine the perceived compliance indices with other composite scores in subsequent analyses. It is essential and practical to have all sets of scores transformed to a common mean and standard deviation before combining to reduce the effect that sets with large variations have in the final composite score. Next, I subdivided the teachers into quartiles based on their Perceived Compliance Index (see Table 5.10). Teachers in the upper quartile were those with the highest index, while teachers in the lower quartile were those with the weakest index. However, it does not mean that teachers in the lower quartile had weak compliance index. Since in general the teachers were highly compliant with the

MLS reform, all the scores were generally high. Quartile analysis as described here was done to differentiate the teachers according to how they claimed they used the structure.

Table 5.10 Percentage distributions of teachers within the different quartile groups for the variables, cycles and age group

Variables	Variable levels	Quartile group				Total %
		Lower Quartile	Second Quartile	Third Quartile	Upper Quartile	
Cycle	Early Childhood	25.3%	20.7%	23.0%	31.0%	100
	Middle Primary	13.8%	24.6%	38.5%	23.1%	100
	Upper Primary	22.2%	30.2%	31.7%	15.9%	100
Age group	Below 25	25.0%	27.8%	25.0%	22.2%	100
	25 - 35	19.5%	28.0%	34.1%	18.3%	100
	36 - 46	24.2%	21.0%	25.8%	29.0%	100
	47 - 55	13.3%	16.7%	36.7%	33.3%	100
	above 55	14.3%	28.6%	14.3%	42.9%	100

Table 5.10 provides insight into how teachers were distributed across the quartiles for two specific variables: cycle and age-group. For instance, for the variable cycle, more of the early childhood teachers (31%) fell within the upper quartile, fewer of the early childhood teachers (20.7%) fell in the second quartile. Contrary to this, fewer of the Upper primary teachers (15.9%) were in the upper quartile. The values hence suggest that teachers of lower graders used MLS more than teachers of higher graders. It could be possible hence that since teachers within the upper primary were generally semi- specialist teachers (with Maths as an option), they depended less on MLS as teaching tool.

An interesting pattern emerges about the percentages of teachers in the upper quartile as the teachers' age-group increases: the percentages increase. Notably teachers more senior in age, those above 55 years, were in the upper quartile

(42.9%). It could be argued then that teachers who were more senior in age might have been using MLS more than their younger counterparts. This observation seems to relate very well with the observation about the use of MLS at the different cycles. Teachers who were more senior in age in state primary schools in Seychelles were likely to be teaching at the lower grade levels.

Dividing teachers into quartiles hence made it possible to compare differences in practices and attitudes amongst teachers in terms of how they had used the reform. Taking specific items from Question 9 and Question 10, I computed and compared means for teachers within the four distinct quartiles. Items of Question 9 related to the teachers' practices while Items of Question 10 related to the way the teachers engage the pupils in their lessons (see Table 5.11). The means per items for each quartile group are displayed. The difference among quartile groups can be determined.

Kruskal-Wallis tests done on the results for the difference in mean among teachers within the different quartile group showed significant differences for only four of the twelve items. These are shaded in Table 5.11. Their items were: *Assign homework for pupils to get practice*, *Work with pupils on a one to one basis*, *Teach using exposition* and *Organise pupils in ability grouping*. In all cases, teachers within the upper quartile group reported doing these practices more frequently than teachers in the other quartiles. In other words, it can be assumed that on the basis of these data, the teachers who used the MLS lesson template more frequently also assigned more homework, worked more with pupils on an individual basis, taught more using exposition and organised pupils more in ability groups. Unfortunately these observations contradicted, to some extent, what the MLS reform sought to achieve.

MLS reform ideas made no mention as to how teachers should manage homework. What could be argued from the data is that, possibly the teachers had tended to leave aside those computations and practices for the pupils to carry out as homework. I noticed that during the mathematics lessons I observed, little time was available for pupils' consolidation practices. Cases of individual attention were minimal and ad hoc. It could be suspected therefore, that some forms of adaptation or configuration had occurred with the use of MLS to cater for individual attention. However, this was not apparent in the actual lessons I observed.

The data also support the claim that the teachers who used MLS more often also used exposition more than other strategies. One of the aims of MLS was to reverse this situation. However, the use of exposition as the dominant strategy prevailed. MLS has been ineffective in changing the situation. Furthermore, MLS sought to lessen ability grouping in the classroom. The data suggest that the practice of ability grouping prevailed and was even more prominent among those teachers who used MLS more regularly. The findings from the compliance analysis suggest that the introduction of MLS has been ineffective in dealing with many "traditional routines." It could be possible that MLS continued to promote the routines or it might have been ineffective in provoking a change in what the teachers used to do. From the data it is seen that the teachers who were more senior in age were the ones who used MLS more. This demonstrates the difficulty in changing the practice of those teachers – they used the structure but they did not change their practices.

Table 5.11 Mean score per quartile for some selected teacher practices and was of engaging pupils in the lessons

	Lower Quartile N = 46		Second Quartile N = 49		Third Quartile N = 65		Upper Quartile N = 53		Kruskal Wallis Test	–
	Mean	<i>Std Dev</i>	Mean	<i>Std Dev</i>	Mean	<i>Std Dev</i>	Mean	<i>Std Dev</i>	χ^2	α value
Pupils' engagement activities										
Assign homework for pupils to get practice	3.55	0.59	3.65	0.52	3.80	0.44	3.89	0.32	14.96	0.002
Work with pupils on a one to one basis	2.50	0.66	2.16	0.58	2.51	0.69	2.56	0.82	11.29	0.010
Teach using exposition	2.63	0.58	2.28	0.67	2.61	0.66	2.67	0.80	10.77	0.013
Organise pupils in ability grouping	2.82	0.81	2.81	0.86	2.88	0.75	3.25	0.81	10.45	0.015
Complete worksheets	2.32	0.71	2.30	0.61	2.50	0.66	2.64	0.88	7.16	0.067
Conduct an outdoor lessons	1.98	0.75	1.72	0.57	1.89	0.53	2.00	0.67	5.68	0.128
Conduct drill and practice in an entire lesson	2.05	0.81	1.75	0.73	1.88	0.89	1.94	0.92	5.31	0.150
Practice computational procedures	1.89	0.91	2.26	0.96	1.98	0.92	2.02	1.04	3.77	0.287
Recite lesson notes	1.49	0.74	1.40	0.69	1.45	0.66	1.71	0.94	3.58	0.311
Memorize facts, rules, definitions or formulae	2.75	0.84	2.49	0.85	2.75	0.87	2.66	0.98	3.16	0.368
Work on problem or exercise on the front board	2.59	0.66	2.58	0.69	2.53	0.79	2.70	0.88	1.97	0.579
Conduct whole class discussion for the entire lesson	1.82	0.90	1.80	0.86	1.73	0.81	1.92	1.04	0.58	0.901

5.4 Relationship between teachers' use of MLS and other variables

In a subsequent analysis I computed a composite score for each of the variables: teacher confidence, teachers' perception of the school-based collaboration, curricular leadership, attitude to MLS and perception of impact of MLS on pupils' achievements. These became five distinct dependent variables (DV). I used the teachers' quartile as the independent variable (IV) and compared the mean on each dependent variable. The values are reported in Table 5.12. The comparison also allowed me to assess the impact of the use of MLS.

Table 5.12 Comparison of mean for teachers of the different quartile groups on five major variables

Quartile group		Variable indices being compared				
		Teacher confidence	Teacher collaboration	Curricular leadership	Teacher attitudes	Impact on pupils
Lower Quartile	Mean	28.15	22.37	28.63	24.22	20.24
	N	46	46	46	46	46
	Std	7.02	4.47	7.18	5.85	5.05
Second Quartile	Mean	30.53	23.74	31.19	24.83	19.85
	N	53	53	53	53	53
	Std	4.25	4.37	3.95	4.94	4.36
Third Quartile	Mean	30.70	23.76	31.44	27.21	21.27
	N	66	66	66	66	66
	Std	4.96	3.33	4.04	3.76	4.28
Upper Quartile	Mean	32.94	24.52	30.52	27.43	20.48
	N	54	54	54	54	54
	Std	3.95	3.78	5.47	4.41	5.90
Kruskal-Wallis	χ^2 α	20.34 0.000	7.07 0.070	7.58 0.056	19.12 0.000	5.14 0.167

N = number of teachers, Std = Standard deviation

Data from Table 5.12 show that for three of the five dependent variables (teacher confidence, teacher collaboration, and teacher attitudes) the mean increased from

lower quartile to the upper quartile. The two exceptions relate to the variable curricular leadership and impact on pupils. However, the differences in means were significant only for the variables of confidence and attitudes. The findings suggest that for teachers in Seychelles, the frequency of using MLS had some forms of rank order correlation with teachers' perception of their confidence to teach mathematics, and their perception of their overall attitude to the reform.

The most remarkable pattern that can be seen about the variations in the data in Table 5.12 is that for all the variables, responses of the teachers within the lower quartile group were generally more varied.

5.5 Outcomes from the key informants' perspective

The mathematics subject leaders who had been at the frontline of the reform were the most appropriate group, other than the teachers, to talk to about the reform in schools. Even if their views could be biased in favour of what was happening in their own schools, collectively it was possible to form a picture of the impact of the reform from their perspectives. Furthermore, the key informants who supported the work of the teachers provided valuable insight into the outcomes of the reform. Four issues will be considered in this section: a) MLS as a lens for viewing lessons, b) MLS as an approach to effective mathematics lesson, c) MLS as a source of teachers' strengths and weaknesses, and d) MLS as a change lever. But first, I provide an overall impression of the leaders' perceptions of what was going on in their schools.

5.5.1 Overall impression

Commenting on how the teachers had responded to the call to renew their practices under the MLS reform, contrasting yet interesting views emerged from the leaders.

L01, a leader who at the inception of the reform was an ordinary teacher in a different school remarked: *“By now we are familiar with the MLS. They [the teachers] feel at ease employing this structure in the mathematics teaching and they are positive about the idea”* (L01, Subject Leader FG). L03, who had been leading mathematics education in his school since the beginning of the reform made an observation outlining the teachers’ challenges: *“Certain aspects of the MLS were not easy for the teachers to take on board, to understand. But I think the important element I should endorse is happening in school is, there is a variety of strategies being used when teaching mathematics”* (L03, Subject Leader FG). However, L04, another long time leader, noted that lessons in her school could not be fully described as consistent with the MLS reform. She noted:

[...] but sometimes you get the feeling that whenever you are not there [in the class], they are not making good use of the MLS components. You can feel they are putting on a show or they are not even sure whenever you are there in the class. You sometimes wonder what is happening when you are not. Sometimes they are not making use of the MLS components.

L04’s remark really broke the ice since three other comments that followed hers revealed the impression that not all teachers had been faithful about the call to improve their practices. There was a non-compliance tendency when the leaders were not around or when the teachers were left alone in their classes. There was also a mis-match between planned and actual lessons. Planned lessons, as L05 argued, consisted of all major components of the lesson template, giving an impression that the teaching was highly compliant with the reform, when in actual practice only limited aspects of the reform were being attended to.

At the same line, with regard to varying the lesson strategies, L02 contended that some teachers in her school gave the impression that multiply strategies were

being used. However, when the lessons were deeply assessed the strategies that the teachers had indicated did not reflect the lesson they planned or delivered. L02 and two other leaders described such behaviour as “tricking”. L03 on the other hand argued that some teachers lacked the ability to distinguish between teaching strategies.

Through further discussion with regard to teachers’ enactment of the reform L05 remarked that she could tell whether the teachers had been complying or not when she went on to replace a teacher who was absent for instance. She said that the pupils would show unfamiliarity with certain classroom procedures, instantaneously generating an indication that the teacher in question had not been using that particular procedure.

The leaders’ perception of the teachers’ use of MLS reform suggest that whilst most teachers were generally complying with the reform call, there were some cases of teachers not complying. This was indeed expected as not all teachers would be expected to follow the requirements to the letter. Teachers have reasons not to comply with certain aspects of the reform while others would apply the reform on a more regular basis than others. L03’s comment embraced the situation: that changing the teachers’ practices had not been an easy task even if after five years into the reform there was evidence that teachers were using a variety of strategies in the teaching of mathematics.

5.5.2 A lens for viewing lesson

The subject leaders talked convincingly about how, with the introduction of MLS, the nature of their work had changed. All eight leaders in the sample agreed that the outcome of their lesson plan inspections was no longer simply a report telling the

teachers that their lesson was weak or strong, but one which could provide ameliorative feedback:

I am now having a sense of direction. I can look at lesson with a critical mind. For instance, I can tell teachers, look this lesson is too abstract. Some teachers used to come with lots of exercises. I can now tell them. Look how do these exercises fit together. Also I can advice teachers to vary their strategies. I have devised a table for each teacher, recording, per lesson per week - the types of strategies he or she has used, the pupils' grouping and the way the pupils' tasks have been presented. These are guidelines of MLS and I put a lot of emphasis on them. Then at the end of the week when I do conferencing with the teachers, I can tell them whether they are sticking to one variation or whether they are varying their techniques [FGD, L02].

In the eyes of the subject leaders MLS was seen as a lens for viewing lessons, when they reported on issues such as:

- Now I know what to look for when I observe lesson [L03]
- I can tell whether a teacher has planned a lesson or not [L04]
- I am no longer lost in class when I observe my teachers [L06]

L05 talks about how she had changed her observation from always observing an entire lesson to observing only specific components of lessons. This, she claimed, facilitated conferencing and feedback with the teachers:

I can decide to observe only the first three components for example. I remember when we were still at the start of the introduction of MLS, when I went round the class to observe only mental, lesson review and focus to gather examples and ideas for the workshop. I noted what I saw and then brought them in the PD sessions. Even today if I know a particular teacher is good at one aspect and one is relatively weak, I kind of go and observe just that particular aspect of the lesson as opposed to observing everything [L05].

5.5.3 Indication of what constitute effective mathematics lesson

The MLS reform was indeed a search for quality and an effective model for mathematics lessons. I need to emphasize here that the mathematics leaders in Seychelles were drawn from the teaching pool. They too fell into the category of

teachers who were locally trained and who had little exposure to recent advancement in mathematics education. It could be possible that for them too, what constitutes effective mathematics lessons was unclear. They too, were not confident in advising teachers on their instructional practices. When the MLS reform project started, some of the leaders showed a lack of confidence in telling teachers whether some of their techniques or approaches were appropriate given the characteristics of pupils under their care. The MLS, as revealed in the leaders' focus group discussion, represented a model mathematics lesson. Both the teachers and the leaders endorsed this model as being effective. This point is clearly revealed in the excerpt below:

JV: How then do you use MLS in your everyday practice?

L04: For me MLS is a good tool. The fact that it comes from the Ministry, I consider it a very good model of mathematics lesson. It has everything it takes to make a lesson effective – an introduction that stimulates the learners, a review and preview of lesson. For the conceptual development, if the teacher follows the guideline properly, their pupils should be able to get the concept. Then the conclusion, even if many of us still cannot do it as expected.

5.5.4 Source of teachers' strengths and weaknesses

In the interviews and responses to the questionnaire, the teachers and the subject leaders indicated how teaching under the constraints of MLS imposed several demands on them. The teachers had revealed their inability to incorporate some elements of their teaching. They had further indicated that strategies such as investigation or problem solving are difficult to incorporate in the lessons. The subject leaders' remarks with regard to how MLS had assisted their daily duties also brought out the issue of MLS being a need identification tool:

Teachers' inability to apply themselves with the reform general ideas were apparent and I was able to organise training or support visit for them [L04].

In the focus interview the leaders further discussed issues surrounding teachers' ability to teach as expected:

JV: What are some teaching strengths and weaknesses in schools?

L05: Teachers find difficulty to conduct investigation lessons. This is very evident plus you seldom see investigative lessons. Teachers have problem developing a concepts. They have a lot of problem especially with regard to incorporating real life example in the lessons. And then they cannot conclude lessons.

L06: But their mental is good though. Everybody in my school likes mental activities and they do it very well.

JV And I've seen that there are no discussions between teachers and pupils. Could this be because it is not stressed on the MLS guidelines?

L06: It could be. Maybe next time you revise the MLS, this should be a point to consider.

Quality of lessons, in other words the standard that was being built with regard to mathematics lessons in primary schools in Seychelles, was measured against the MLS. However, even if the teachers highly valued the structure, it appeared that they were following it uncritically: what was prescribed in the reform ideas was incorporated into lessons and what were not prescribed was excluded altogether. More problematic however, was that even if leaders saw the structure as a tool to assess teaching needs, they could not extract other pedagogical deficiencies from the structure. This could also be an indication that the leaders themselves needed more pedagogical knowledge or diagnostic skills with regard to supporting the teachers.

5.5.5 A context for school – level change

My personal involvement in schools and with data which I had about the quality of teaching prior to 2006 (Ministry of Education 2005) clearly indicated that the

teachers' learning ambiance had changed. It also indicated that school-based support structures have changed. The leaders viewed this change as a context to teacher-teacher collaboration and a context to review school-based approach to curriculum improvement support.

The many new ideas introduced to teachers incited them to collaborate to support one another. This point was revealed even by the teachers in their interviews where they stated that they had begun team planning in schools. Schools with more than one class per year group benefited from this approach. Their teachers could group and share ideas while those in one streamed schools had not benefited much. So, with the arrival of MLS, there had been more instances of team planning in schools.

Furthermore, support is not only a matter of team planning. In some schools teachers had even tried out the idea of peer teaching. Some leaders in a same region went as far as initiating networking. The introduction of end of cycle assessment and target setting had resulted in more schools having to network with each other. Networking had become a popular activity amongst schools in the South Eastern part of Mahe, and at least to my knowledge two schools in the northern part of that island. These occurrences suggest that the context for reviewing school based approaches to curriculum improvement support has changed considerably:

Teaching is no longer a solitary activity in my school. Most teachers look forward to team planning and networking sessions [L05].

This remark encompassed what leaders perceived as an impact of the introduction of an initiative such as MLS in schools. It improved collegiality among the teachers and makes the profession more interactive. The implications for all of these for pupils' learning and achievement are the focus of the subsequent section.

Consistent with the change discussion model, in this chapter, I have looked at the teacher as the principle person implementing policy (and hence enacting change), and investigated how and why they felt their practices had changed. The evidence which I have presented in this chapter shows that the reform provoked some changes in the teachers' practices. To interpret these changes in relation to the change discussion model, I argue that collegiality among members of the school community might have played a role in making the changes possible. Whilst the extent of change has not been as significant as initially anticipated by the MLS developers (including myself), my data support the fact that the teachers, nevertheless, perceived themselves as being highly motivated to improve their practice.

5.6 Summary

This chapter presents findings in relation to the first research question: the impact of the reform on teaching. Teaching covers aspects such as the teachers' practices and leadership processes. The views of the teachers, subject leaders and key informants are considered in this chapter. Data presented in Section 5.1 reveal that the teachers and the subject leaders were all overwhelmingly positive about MLS since it was introduced in schools. Data presented in Section 5.2 reveal that the teachers felt the MLS was positively influencing their practices while a deeper analysis into the teachers' self-reported data, results of which I presented in Section 5.3 and 5.4, show that the traditional routines were still prevailing and some components of the reform were difficult to be incorporated in the lessons. Furthermore, the teachers, the leaders and the key informants all claimed that the context of teaching mathematics in Seychelles had changed following the introduction of the reform. This is presented in

Section 5.5. The teachers' positive perception of the reform on their practices is an invaluable prerequisite to instructional change. Results presented in this chapter were fully generated from the participants' self-reported data.

CHAPTER 6 The actual mathematics lessons

This chapter examines the nature and quality of mathematics lessons in the state primary schools, five years into the MLS reform. The overarching intent is an inquiry into the pupils' opportunity to learn mathematics. I examined how consistent the lessons were with the recommendations of the MLS. I inquired into the quality of tasks and classroom discourse of these lessons and determined the extent to which both resonated with current vision of what mathematics teaching should look like. The chapter presents further evidence to answer the research question about the impact of the reform on teaching practices. The chapter is based on the assumption that to make claim related to teachers' practices, classroom observation data are paramount.

In this current chapter I adopt a similar approach to Chapter 5 and I position the teacher as the central actor in the reform process. Here, I extend on the earlier analysis by using data from the lesson observations in order to understand how the change was facilitated or hindered in actual practice. In relation to the change discussion model, I discuss the relationship between the person and the reform in a concrete sense.

6.1 Framework for analyzing the lessons

To make arguments about the impact of a teaching reform, it is important to have a sound picture of how the reform is implemented in actual practice. I present here a conceptual framework for investigating the classroom implementation of MLS and

developing insights into the nature of mathematics lessons in state primary schools. The framework is based on principles of pupils' opportunity to learn. The concept of opportunity to learn (OTL) is increasingly gaining attention in educational research (Abedi & Herman, 2010; Bozack, Vega, McCaslin, & Good, 2008; Little, 1993; McDonnell, 1995; Wang, 1998). OTL relates to the extent to which the teachers' behaviour and actions throughout the lesson create meaningful learning experiences for the pupils. A lesson is effective if it stimulates learning. Therefore, the classroom ambiance that the teacher creates is very important (Hill, Rowan, & Ball, 2005). OTL also encompasses the cognitive engagement of pupils with lesson materials or lesson tasks. Some tasks are simply activities to be completed, while some engage the pupils cognitively. The latter group of tasks is believed to have strong OTL. Wang (1998) contends that OTL measures explain differences in pupils' achievements among classrooms. I include two major dimensions of this framework for investigation: a) structure and b) instructional contents. I describe the two dimensions below. When considered in connection to one another, it defines the area of the mathematics teaching/learning space that could be altered if meaningful academic engagement is to happen.

6.1.1 Structure

Lesson structure relates to the overall organization of materials and sequence of activities within a lesson, occasionally referred to as patterns of lesson (Hiebert & Stigler, 1999). To further understand the nature of lesson structure I consider two important features of lessons: segment and instructional coherence. Lesson segment relates to the plan and structure of the lessons. Instructional coherence relates to the

logical connections between materials within and between segments of a lesson. I expand on the discussion below.

Learning to plan, develop, and structure a lesson are common components in most teacher training programmes (Bishop, 1985). Trainee teachers are shown to structure lessons around one mathematical idea or set of objectives, and they are expected to use such skills later in their professional practices. The main structure of most lesson plans, as taught to teachers, consists of an introduction, a development, some pupils' activities, a feedback session and a conclusion. These components are referred to as lesson segments (Clarke, 2002). The contents of each segment depend on the nature of the topic, background of the pupils, and largely on the teacher's preference and competence. Hence different teachers decide differently on what they include in the introduction, development or conclusion and on how they end up structuring the segments of a lesson.

The fact that teachers are trained to construct and develop a lesson having the structures, introduction, development, and conclusion, indicates that the organization of lessons is critical in facilitating the presentation and construction of knowledge. So, the fact that many teachers tend to abandon this taught structure in their actual practice, challenges the practical application of lesson structures.

Some international comparative studies have revealed some interesting findings about the structure of mathematics lessons. For instance, the Learners' Perspective Study (LPS), regrouping nine countries, (Clarke, 2002) has indicated that mathematics lessons from most of the participating countries have some form of inbuilt structure. For example, while it appears that mathematics lessons in the United States have a general structure as in Figure 6.1, (Hiebert, Stigler, & Manaster, 1999) the Australian lessons fit a different pattern (Clarke, 2002). The structure of

mathematics lessons in Germany fits closely to that of lessons in the United States (Jablonka, 2004). Although the structure presented in Figure 6.1 is used for comparing lessons in the LPS project, it does not imply that lessons following this specific structure bring about high attainment results.

Description of the structure
a) Reviewing previous material;
b) Demonstrating how to solve problems for the day;
c) Practicing; and
d) Correcting seatwork and assigning homework.

Figure 6.1 General segments (lesson pattern) of mathematics lessons in USA

Andrews (2003) describes how in the Hungarian context, the different segments of a lesson are clearly differentiated.

“They [lessons] began with a public review of homework, comprising two or three multiple response problems which were solved collaboratively. This was followed by a ‘warm-up’ period involving the oral setting and mental solving of a few single response problems. Lastly, the main body of the lesson involved several cycles in which a multiple response problem was posed, attempted individually before solutions were shared publicly. Lessons ended with homework being set.” (p.201)

In this respect Andrews (2003) argues that mathematics lessons are more than a set of procedures. Segments of the lessons and learning experiences are not a subsequent result of knowledge transmission but reflect a collaborative venture where both the teacher and the pupils have meaningful contributions. What is missing however, in these descriptions is how the various segments relate to pupils’ achievements.

Now I move on to talk about instructional coherence. As part of the notion of lesson structure, instructional coherence is a concept that is sometimes associated with sequencing. Chen and Li (2010) define instructional coherence as linked events

and the meaningful discourse reflecting the connectedness of arguments, which benefits students' learning of mathematics. Stein and Glenn (1982) use the metaphor, “a good mathematics lesson is like a story” to indicate the significance of coherence.

Hiebert, Stigler and Manaster (1999, p. 198) further comment:

“A primary feature of lesson organization is coherence – the connectedness of the mathematics across the lesson. Imagine the lesson as a story. Well-formed stories consist of a sequence of events that fit together to reach the final conclusion. Ill-formed stories are scattered sets of events that don't seem to connect. As a reader knows, well-formed stories are easier to comprehend than ill-formed stories and well-formed stories are like coherent lessons. They offer students greater opportunities to make sense of what is going on.”

The notion of coherence suggests that the mathematics lesson is not simply a sequence of activities. Instead, each event is deemed to be interconnected such that the ‘story’ has a beginning, development, and an ending, as well as a consistent theme that runs throughout. Instructional coherence is often seen in terms of how well lessons follow a logical and structured sequence of events and how well lessons focus on one or more related topics. In other words coherent lessons consist of sequences of events that are related to each other and have a more logical representation and effectiveness than those lessons that are not coherent (Fernandez, Yoshida, & Stigler, 1992).

Hiebert et al. (1999) provide an example from a German lesson of how the process of weaving together ideas and activities makes the connection clearer. “...next step is a step you will need to pay close attention to because we're dealing here with different numbers from those we dealt with yesterday” (p.198). In other words, the structure of mathematics lessons relates to the organization of materials in the lesson into a logical frame (Chen & Li, 2010). When viewed in this way, a lesson looks like an integrated and connected set of events rather than a chunk of

mathematical activities. In well-structured lessons students are able to work out the relationships among events and the various segments (Chen & Li, 2010) because of the story-like characteristics – a beginning, body and ending (Stein & Glenn, 1982). Using story as the metaphor also entails that lessons have a climax and storyline (Shimizu, 2009).

Having discussed the two components of lesson structure, segments and instructional coherence, I now turn on to argue that understanding lesson structure can be an avenue for improving practices and, ultimately, pupils' achievements (Schmidt, 1996; Stigler, Gallimore, & Hiebert, 2000). Many education systems of some developed countries look up to the mathematics lessons which are conducted in Japanese schools since the Japanese students outperform students from other countries in the international comparative studies. Shimizu (2009) claims that Japanese mathematics lessons have some distinct features that make them effective. Shimizu (2009) discusses that other than mathematics lessons having a “yamaba”, (climax), teachers like attempting “kikan-shido” implying that teachers like moving around the class to check on the students' work and assist them with difficulties. A third feature which is believed to characterize successful lessons in Japan is “matome” or summing up (Shimizu, 2006). This is basically the last part of the lesson where the teacher makes a conclusion in accordance to the lesson goal and specific objectives.

In a different group of international studies (Schmidt et al., 1996; Schmidt, 1996) researchers claim that lessons are not necessarily consciously thought through by teachers. Instead, lessons flow unconsciously through a familiar structure which teachers have inherited through experience or specific country culture. Schmidt et al. argue that the rules for deciding the choice of activities, actions, learning experiences

and routines are largely done unconsciously. Such lesson characteristics seem to be common within a particular country. What they mean here is that in a given country most lessons appear to take the same form or structure without the teachers' being conscious of it. They have used the term, "characteristics pedagogical flow", to define such phenomenon (Schmidt et al., 1996; Schmidt, 1996). Similarly in Seychelles, there was a common mathematics lesson pattern – a national lesson script – which all teachers were using. It appears that maybe the teachers were following what they have seen other teachers doing and over time the 'pattern' has become the norm for teaching mathematics. Unfortunately, that pattern observed in Seychelles was not bringing satisfactory results. The introduction of the MLS in schools was an intervention to induce a new characteristic pedagogical flow, which teachers would be conscious of and essentially raise the pupils' achievements in mathematics.

6.1.2 Instructional content

Instructional content is the second dimension of this opportunity to learn model which I want to explore. I begin this section by arguing that, if the teaching of mathematics lessons is to be effective, teachers must move their effort beyond structuring and sequencing materials. It is imperative that the contents of instruction are given heed. The ultimate aim is to make mathematical ideas meaningful to the pupils thus ensuring that their conceptual development is enhanced. The discussion surrounding pupils' conceptual development is grounded in the procedural – principled knowledge debate which seeks to alter the traditional way of approaching mathematics teaching. In the next section, I elaborate on this discussion.

The current discourse of what counts as mathematical knowledge makes a distinction between procedural and principled knowledge (Lampert, 1986). The former is concerned with knowing the predetermined computational procedures to

solve mathematical tasks. Principled knowledge in contrast, is concerned with knowing key ideas and notions that can be used to solve problems in mathematics. Principled knowledge assumes a deeper engagement with mathematics tasks and is considered more appropriate for the development of pupils' conceptual understanding (Lampert, 1986). The argument that pupils do mathematics without an understanding of what they are doing, occurs when the teaching for procedural understanding prevails over the teaching for principled understanding. It is the desire of mathematics reformers to limit such occurrence in schools. It was an intention of the MLS reform to instil in the teachers an initiation towards teaching principled knowledge. Spillane and Zeuli (1999) contend that pupils "must develop the ability to engage in mathematical thinking, learn to develop conjectures, frame and solve problems, as well as explain, justify, and defend their solution" (p. 4). Pupil-engagement tasks, be it in textual or oral form, provide the best indicator of the shift from the procedural knowledge to the principled knowledge views of conceptualizing mathematics teaching. The pupils should be made to engage with problem situations that allow them to develop reasoning and discussion, make inferences, and form conclusions. Closed problems and tasks that seek to test mastery of skills are not appropriate for this purpose. I shall now take a closer look at pupils' engagement tasks.

What a teacher seeks to achieve in a mathematics lesson is that the pupils learn something as planned. This intention becomes possible through the tasks that the teacher engages the pupils in. Pupil engagement task, hence, refers to what the pupils are instructed to do, be it calculations, symbols to manipulate, word problems to decode, or a discussion to be part of (Stein, Grover, & Henningsen, 1996). In this research I restrict my discussion of engagement task to classroom activity, the

purpose of which is to focus the pupils' attention on a specific mathematical idea (Stein et al. 1996). Engagement task as a concept also encompasses the intellectual and physical products that are expected of the pupils (Shimizu, Kaur, Huang, & Clarke, 2010). Furthermore, engagement task has been categorized as authentic, rich and complex to explicate the connection between classroom engagement with mathematical ideas and out-of-school use of the same mathematical ideas (Shimizu et al., 2010). Engaging with tasks, then, becomes the way by which pupils make sense of the mathematical idea. If teaching is to be meaningful and learning possible, the tasks that teachers assign to the pupils should be properly developed – the task conditions and cognitive demand carefully aligned to serve the purposes the task purports to serve.

Amongst the teachers' challenges to create meaningful tasks that evoke pupils' learning, is the need to mould a learning environment in which pupils will engage with the tasks. Stein et al. (1996) have argued that tasks are implemented in settings in which various factors, such as: classroom norms, task conditions, and teachers' and pupils' habits could potentially affect the teaching outcomes. Ultimately, experiences which the pupils gain through their engagement with the tasks within the classroom setting form the bedrock of their knowledge of and attitudes to mathematics (Kaur, 2010). This introduces another component of this instructional content model – the classroom discourse.

Drawing from Hiebert and Wearne (1993) I define classroom discourse as the kind of conversations which the teacher and the pupils do during lessons. Social cognitivists and constructivists both point to the value of small groups in which students interact to achieve the intents of the lesson (Yackel, Cobb, & Wood, 1991) or the teacher – pupil interactions in the mathematics classroom (Aubrey, 1995).

Mathematical discussion such as developing arguments, discussing ideas and proposing alternatives are defining features of quality mathematics lessons (Walshaw & Anthony, 2008). Hence, teachers who are capable of achieving these in their classrooms are viewed as teachers who have embraced the reform calls. The teachers' role is critical in getting the pupils to meaningfully make sense of the classroom materials. Research suggests that teachers mediate the pupils' learning through the kind of classroom ambiance they create (Askew et al. 1997). This ambiance is rich in opportunity to learn when the teacher creates contexts either verbally or through tasks to stimulate higher order thinking (Walshaw & Anthony, 2008).

To teach mathematics effectively teachers need both the subject matter (content of mathematics) and the pedagogical knowledge. The term pedagogical content knowledge encapsulates this idea (Shulman, 1986). It describes (a) teachers' knowledge of ways of representing and explaining a topic to make it comprehensible to the learners, and (b) the teachers' knowledge of students' thinking, in particular, knowledge of the conceptions, preconceptions and misconceptions students bring to the learning of a topic that make it easy or difficult to apprehend. This definition suggests that teacher knowledge plays an important role in the teaching and learning of a particular topic (Carpenter et al., 1996). It becomes clear then that if teachers are to create an ambiance for opportunity to learn in a primary mathematics classroom, then the need for them to have sound PKC is highly necessary. In their Cognitive Guided Instruction study, Carpenter and his team modelled the link between teachers' pedagogical content knowledge and pupils' achievements. The main argument of their study is that if teachers know how children think and solve particular problems, they will be able to pose the exact questions to clarify

misconceptions, stimulate preconceptions, and hence improve the learning experience (Carpenter et al. 1996). Hence, primary school mathematics lessons ought to be rich in discussion which allow for pupils' thinking and meaningful engagement with lesson materials.

Classroom discourse, when done meaningfully, influences learning in fundamental ways (Hiebert & Wearne, 1993; Stein et al., 1996). Therefore, it is vital that teachers create space for pupils to discuss mathematics ideas. One way to achieve this is through questioning. Teacher questioning or classroom discourse does not imply whole class discussion during an entire lesson. It could be achieved, for instance, during the time when the teachers get the pupils to review a past lesson or when teachers introduce new teaching ideas. Classroom discourse is more than engagement. It is about the talk and discussion, and about the opportunity the teachers create for asking questions and getting pupils to ask questions. Furthermore, the nature of the questioning is not simply questions to be answered. It should be about questions which stimulate high order thinking – hence getting the pupils to synthesize, analyze and evaluate ideas. Pupils at all ages have the potential to be engaged with tasks with higher cognitive demand.

In the context of my study, with the teachers' backgrounds taken into consideration, the procedural – principled knowledge debate provides a very robust scheme for exploring the changes happening in schools following the introduction of MLS. It allows me to move beyond the identification of which components of the template were being included or excluded in the lesson to a deeper exploration of how the teachers organised curriculum materials to stimulate learning. Spillane and Zeuli (1999) used the terms behavioural and epistemological regularities to describe what goes on in the classroom. Behavioural regularities relate to the teacher – pupil

relationship and pattern of practices. The epistemological regularities relate to the mathematical tasks and talk (lesson contents) during lessons. Reformers argue that the epistemological regularities have to be changed in the first instance, if meaningful teaching of mathematics is to occur.

6.1.3 Summary of the framework

This conceptual framework is developed as a lens to study the lessons I observed in this study. It consists of two major dimensions: structure and content. The framework suggests that under the dimension of structure, I consider how lessons in Seychelles fit the MLS proposed ideas and then determine whether any other structures arise from the teaching. Then it suggests that I examine the lesson coherence as this was indeed the prime purpose of the MLS reform idea. The second dimension of the framework relates to lesson contents. This dimension suggests that I analyse the nature of the pupils' engagement tasks and then analyse the classroom discourse. The framework suggests that I do this in line with contemporary arguments on what constitutes effective mathematics teaching. This can then establish a context for further development in mathematics education in Seychelles. Ultimately, the overarching intent of this framework is determining the extent to which lessons under the MLS regime create opportunities for pupils' learning. Given that there is no prior study that can be used as comparison, findings from this analysis may be used as baseline data about the nature of mathematics lessons in Seychelles under the MLS regime and at the same time serves a story about the impact (or otherwise) of the MLS reform in the mathematics classrooms.

6.2 Inquiring about the lesson structure

To develop an argument as to whether MLS has had an impact in the classroom, two fundamental questions are worth answering: Were the teachers using MLS as the main teaching approach and if yes did the status of mathematics teaching resonate with what the reform approach advocated? Data generated from these two questions provided the main context for the first level of analysis of the lessons. Even if I have inferred from the analysis of data collected through the teachers' questionnaires and focus group interviews that the teachers were overwhelmingly positive about the reform, it is still difficult to make claims about practices in the absence of classroom observations. Moreover, I want to move to a second level of analysis in which I seek to determine how mathematics education in Seychelles can be further developed. With these intents in mind it becomes imperative to know what was going on in actual classrooms in terms of the teachers' enactment of the reform. In the section which follows I report on the nature of the lessons I observed in relation to the MLS reform suggestions. I begin to address the first component of the conceptual framework; the structure.

I managed to get a snapshot through the observation of 22 lessons of 11 teachers spread across 4 schools. Four schools in Seychelles represented 17% of state primary schools in the country. Under the assumption that schools can have their own culture, already I was tapping into the culture and practices of four different schools. Even if the sample schools were too few to generalise the findings, I argue that whatever I saw in those 22 lessons was a valid representation of the existing status of mathematics teaching in the Seychelles. Since findings from questionnaires and focus group interviews have shown little variation in the teachers' responses –

attitudes and perception of behaviours and practices – I am assuming that classroom practices would follow the trend.

6.2.1 Patterns of the lesson

The fact that the MLS requirements specified six distinct lesson segments led me to carry out a “fit analysis”, examining the extent to which the existing practices resonated with the reform requirements. Analysis of the lessons segment-wise shows some discrepancy between MLS suggestions and the existing practices. A simple count of lessons containing each of the six segments suggests that the lessons deviated considerably to what the reform prescribed. I tabulate my finding below: the number of lessons which consisted of each of the six major segments (see Table 6.1)

Table 6.1 Evidence of MLS in actual lessons

Segments of MLS	<i>n</i>	%
Mental activities	19	86
Review of last lesson	19	86
Preview of current lesson	17	77
Development of conceptual understanding*	14	64
Pupil consolidation task	20	91
Lesson conclusion	12	55

The table illustrates the number of lessons containing each of the major segments of the MLS requirements. I should note that assessing whether lessons consisted of a conceptual understanding segment may be difficult to determine. To be consistent with the MLS reform requirements the significance of development of conceptual understanding in this table means the number of lessons that consisted of an instance when the teacher attempted to: a) relate the mathematical ideas to some examples

from real life, b) give out key examples for the pupils to follow, and c) stimulate the pupils' use of prior knowledge. Fourteen (64%) of the lessons met these criteria.

Table 6.1 considers the lesson segment as the unit of analysis and does not necessarily give a picture of what went on within individual lessons. For example, I can tell that pupils' activity occurred in most lessons, mental activities and lesson reviews were quite popular and that lesson conclusions appeared in just over 50% of the lessons. However, I cannot tell from these figures the occurrence of all or some of the segments in individual lessons. What I can infer, however, is that MLS was not being implemented as prescribed, suggesting that there could be implementation issues with regard to its actual use in the classrooms.

The reform anticipated that the teachers would follow the structure in all their lessons. The actual practice showed that this was seldom achieved. Hence, attempting to understand when and why teachers approximated or deviated from the suggested approach became a point of focus. I now turn to look at individual lessons as the unit of analysis to gain more insights into the actual practices. In the analysis I reviewed each lesson and noted when the teacher moved from one segment to the next. In view that these segments had been clearly demarcated in the MLS lesson I could tell when a teacher, for instance, changed from the mental to the review of the lesson focus etc. I also noted the time that a teacher spent on a particular segment. I present findings of this analysis in the chart which follows.

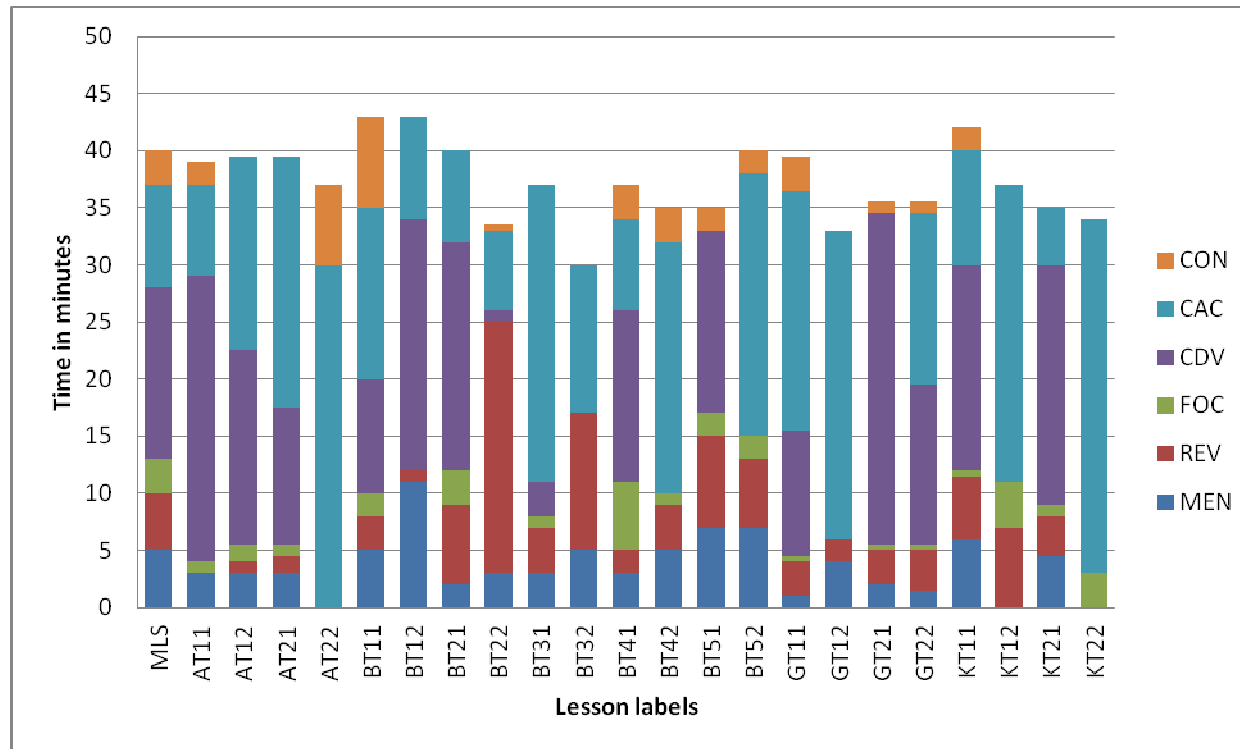


Figure 6.2 Comparison of the observed lessons to the MLS reform requirement

This chart offers a better picture of the situation. It compares the patterns of actual lessons and the MLS suggested lesson template. Moving across the chart are the lessons. In the lesson labels, the first letter relates to the school initials – Alpha, Beta, Gamma and T1 or T2 etc is a unique identification for each teacher in that particular school. The last number in the label relates to the first or the second lesson. As an example, BT32 means: the second lesson of Teacher 3 in Beta primary school. Moving up the chart provides the continuous timeline of the lessons and the occurrence and change of segments within individual lessons. For instance, Lesson AT11 contained five of the six segments: a review of the last lesson was missing in that lesson. The teacher carried out the mental activity and established the focus of the current lesson within the first four minutes. Before the fifth minute the teacher had begun her steps to develop the pupils' conceptual understandings. About 25 minutes were spent on that segment. She then engaged the pupils in some sorts of consolidation activities for 9 minutes. She carried out a lesson conclusion for 2 minutes.

The data extracted from Figure 6.2 reveal the following about the 22 lessons. Like I stated, this analysis was done in line with what the teacher had been asked to do with regard to their mathematics teaching. None of the 22 lessons fitted the MLS requirements in terms of the segments and the corresponding time allocation per segment. However, in terms of the occurrence of segments, 5 lessons fitted the MLS pattern. The lesson ranged from one to six-segment lessons. Eleven lesson patterns were found altogether. These patterns are tabulated in Table 6.2.

Table 6.2 Patterns of lessons that emerged from the 22 lessons

Pattern of lessons	No. of lessons
Mental, Review, Focus, Conceptual Development, Activity, Conclusion	5
Mental, Review, Focus, Conceptual Development, Activity	5
Mental, Review, Focus, Conceptual Development, Conclusion	2
Mental, Review, Focus, Activity, Conclusion	2
Mental, Review, Activity	2
Review, Focus, Activity	1
Mental, Review, Conceptual Development, Activity, Conclusion	1
Mental, Review, Conceptual Development, Activity	1
Mental, Focus, Conceptual Development, Activity, Conclusion	1
Focus, Activity	1
Activity and Conclusion	1

Even if the teachers did all sorts of manoeuvring with their lessons, the MLS segment order was preserved in all the lessons. For example, in cases where a lesson had more than one segment, the order of the segments was consistent to that of the MLS lesson template. Establishing the focus of the current lesson would always come after review. It was logical not to expect lesson conclusions to occur before the pupils' activity had been done. However, alternating the position of review and mental activity could have been possible yet the order, as prescribed in the initial template, was preserved.

I also noted that the length of the lesson varied. Some lessons (77%) were less than 40 minutes while very few lessons (17%) exceeded the 40-minute time allocation. The shortest lesson in my study (GT12) was 33 minutes long. The longest (BT12) was 43 minutes long. The average length of the lessons was 37 minutes. This clearly demonstrates an issue of time – availability or management in the context of mathematics teaching in Seychelles. The teachers had remarked in the focus group discussion that abiding to the time as prescribed for each component was problematic. While the MLS made provision for 40-minute lessons, in actual practice

teachers got 32 to 43 minutes to conduct a lesson. Generally, time was wasted in-between lessons when teachers changed class and at the start of each lesson when teachers attempted to settle pupils especially if they [the pupils] had been doing a lesson with a different teacher. It was very difficult during the observation to determine whether the teachers were concerned about this time issue. Their planning did not seem to indicate any time issue. I got the chance to see all the lesson plans of the lessons I observed. All lessons were planned to be 40-minutes long. However, most lessons were cut short at the tolling of the bell. In the three instances where the lesson went beyond the 40 minutes, it appeared that the teachers were trying to accommodate my visit – i.e. to ensure that she demonstrated she could carry out a lesson using the MLS reform suggestions.

Coming back to the eleven patterns of lessons clearly indicates that the 6-segment lesson as prescribed by MLS was not being fully implemented by the teachers. There were situations where suppressing segments was necessary. For instance, Lesson AT22, and KT22 were purposefully planned to be 2-segment lessons. Lesson KT12 was also deliberately planned to be a 3-segment lesson. In some other instances, the absence of a segment in the teaching might have been due to an issue of instructions.

The fact that most of the observed lessons differed considerably to the MLS approach gave rise to two important questions: 1) Why were the teachers teaching differently to what had been suggested? 2) Were those lessons which approximated the MLS reform better than the other lessons, and if yes in what way? These two questions introduced the second level of analysis of the lessons in which I began to examine the content of the lessons. This will be the focus of the next subsection.

6.2.2 Content analysis of the lessons

The focus of this subsection is about the contents of the lessons I observed. I intend to place emphasis on the teaching, as opposed to what the learners were doing. I want to present a snapshot of how the teachers were enacting the reform suggestions and essentially discuss the learning experiences that were created. Ultimately I provide answers to the two questions posed above, regarding the difference between the observed lessons and the MLS approach.

In my analysis, I used the chart presented in Figure 6.2 as the basis of the first set of analyses. I noted all the lessons which were not 6-segment lessons and I went through my lesson observation notes and descriptions of those lessons. I also considered post-lesson interview data with the teachers in which some of them talked about their lessons. Three reasons emerged as to why some lessons were not conducted as suggested. The remainder of this sub-section elaborates on the three themes.

- 1) Trying innovative ideas
- 2) Follow-up lessons
- 3) Instructional and Cognitive challenges

- **Trying innovative ideas**

One major criticism of the MLS at the start was that it would kill the teachers' creativity. Data from the Beta and Kappa primary school teacher focus group brought up that issue again. For instance, one teacher from Beta Primary reported, "*MLS limits me however in one major way. Teachers are asked to improve. When we go onto the internet we find nice lessons or ideas we cannot incorporate in the lesson especially if [these lessons do not] fit the MLS model*" (BET T4). There was this general impression that teachers could not try out new ideas. What I observed from

the Alpha Primary school was that one teacher could attempt some new ideas. Suppressing certain segments of the MLS template was her choice to make her new ideas possible. I present a description of this lesson which ultimately shows that for some innovative teachers deviating from MLS may be inevitable. Consider the vignette below.

Lora (pseudonym) was the mathematics teacher. After she had greeted the kids she told them that they would be working on the topic that they were doing the day before. Lora asked the children, “Do you still remember what we were doing?” All the pupils answered, yes. She addressed the peer tutor (this is a group of best performers in her class). “Do you think you can manage [the activities]?” The peer tutors answered yes.

Lora then asked the pupils to get organised into their groups. The children took around three minutes to organise themselves. The teacher ensured that the pupils were in their respective groups. On two occasions she asked a child to move to a different group.

Once the grouping was done, she put a problem on the board. The problem was written on a manila paper so that all children could see from where they were sitting. The problem read: *Joe has 43 stamps. Jane has 24 times the number of stamps. How many stamps [has] Jane ~~has~~?*

The teacher reminded the pupils that they should discuss the answer and show their working. With regard to marking their work, the pupils were told that the answers to the problems were found on different answer sheets on the teacher’s desks. The teacher reminded them that they were to mark their own work and do correction if necessary.

In groups, the children worked on the problems. The teachers went round to assist the pupils. I could not capture what was happening in groups. Hence, I do not have any data about the pupils’ group interactions and discussions. However, I could notice that they were engaged in the activities and there were on-task discussions happening among the children. Occasionally the teacher’s voice was heard either reminding the pupils of what they should be doing or clarifying mistakes that she had been seeing as she moved around the class. There were few instances when she had to reprimand a child for behaviour problem.

They spent around 27 minutes working on the tasks. During that time only 3 pairs (out of 10) completed two problems. The others worked on one problem only. After the 30th minute Lora got the children to get back to their original seats. A member of each group presented to the other children what they had been doing. The teacher encouraged the children to talk about whether the activities were enjoyable, difficult, and on whether they managed to achieve something. 4 children talked about their work. Lora reassured those who got incorrect answers that they would be able to understand the work better at a later stage. The class ended at the tolling bell.

Lora called this lesson peer tutoring. She had introduced peer tutoring in her class in the previous year (2010). Her conception of peer tutoring was to get pupils of mixed ability to work on problems in pairs or small groups. Such lessons deviated considerably from MLS lessons in that the structure was not followed at all. Lora explained that her peer tutoring lessons were always preceded by a lesson in which she would do all her explanations hence she found no reason to use the MLS approach during those classes. Lora further reported that she had had a lot of problems with her subject leader before the subject leader finally accepted such practice. However, it appeared that such practice had become common in her class since the pupils knew who their teammates were and what they were expected to do. During that specific lesson it took the teacher only three minutes to organise and settle the pupils.

The tasks included some arithmetic word problems of multiplicative structure which the teacher had written on cardboards. Those cardboards were placed on the teacher's desk and the pupils were to work on one problem at a time in their respective group. The answers were on separate cardboards. After completing a problem the pupils marked their work using the answer sheet. If they got it right, they moved on to another problem. If they got it wrong, they copied the correct solution from the answer sheet. To help with the solution, the teachers had written an example on the blackboard.

In that specific lesson there were 10 pairs of mixed or identical gender. The teacher later told me that she tends to put (using her own language) "a bright child with a slow learner so that the slow learner can benefit from his or her peer." There were very few instances of teacher-talk in that class since the teacher was busy, moving from pair to pair, to see what the children were doing. It appeared that she

had some targeted pairs. I noticed that her movement from one pair to the next was not in any obvious order. However, she would move to a pair as soon as the pupils called for her assistance. When she was with a pair, I could see her explaining and questioning the pupils.

However, I noticed that many pupils were getting difficulties with the problem. Later Lora told me that she liked peer tutoring as she got a chance to work with pupils on an individual basis. She said that she had begun to introduce her colleague teacher to this teaching approach. At the time of the research, she was the only one using this approach at her school. A brief interaction with the subject leader on this approach revealed that the leader had reservations on teachers not abiding to MLS as had been agreed. She did not disapprove or commend the move. She told me that sometimes she conceded with the teachers' approach so that the subject leader would not be seen within the school as a "dictator" (using her own words).

What I want to argue from Lora's case is that creativity might be an internal virtue of a teacher. By this I imply that teachers who have a good command of their pedagogical knowledge will use reform suggestions as an approach to further development and will always attempt to test ideas. I do not see Lora's action as defiance, as her approach to peer tutoring was one which she justified and carried out on a repeated basis. Certainly her approach is better than that of a teacher who used MLS uncritically.

- **Follow-up lessons:**

I have named this second instance when a teacher might decide to omit some segments of the MLS as follow-up lessons. The way lessons were sometimes organised in certain schools was that a teacher could have a lesson in the morning and a second one in the afternoon. My data has shown that when such practice

happened, the afternoon lesson would normally be considered as a follow-up lesson and it was likely that these lessons would deviate from the MLS suggested approach. For example, KT12 was a follow-up lesson of KT11. Also, KT22 was a follow-up lesson of KT21. The fact that the same situation occurred with both teachers in the same school, does not necessarily imply that the phenomenon was a culture in that school. Follow-up lessons may occur on different days. GT12 was a follow-up lesson of G11. The two occurred on different days. I present here the situation in KT11 – KT12 to illustrate the occurrences in preceding and follow-up lessons. Consider the vignette below.

Dada (pseudonym) taught at the middle primary level. She had developed her first lesson using the MLS approach. The focus of lesson KT11 was revising the approach to subtracting numbers which involved decomposition [borrowing]. Dada talked a lot. Her lesson was very teacher centred. She spent about 18 minutes on going over the procedures to subtract numbers – borrowing for examples from tens or hundreds, decomposing them into units or tens respectively. She allowed 10 minutes in her first lesson for pupils' consolidation activities in which the pupils worked on two examples on their own. In her closure of the lesson she told the pupils that they would be getting more exercises to practice in the afternoon lesson.

This is what she did in Lesson KT12. She did not carry out the mental activities. Instead she began her lesson by telling the kids, "we are going to review a little bit of what we did this morning. Dada demonstrated once more how subtraction is done. She worked on one problem. Her pupils participated in answering the questions she posed. They spent 7 minutes on that activity. Then she spent another two minutes to organise the class activities, ensured that everyone had their exercise-book. She then wrote 4 subtractions on the board which the pupil worked on for the rest of the lesson. At the tolling end of lesson bell she got the children to pass forward their exercise books.

Dada felt that in the second lesson there was no need for the mental segment. Later on, in the post lesson interviews, she remarked that she wouldn't waste more time on mental activity as she needed time for practice. In that context Dada was viewing mental activity as a waste of time while the Mathematics Working Group had seen this part of the lesson as a moment for stimulating the pupils' thinking and motivating them for the lesson. When asked why she did not conclude this lesson by

summarising the main points, Dada responded that she had done enough reviewing and that these exercises had been a summary of the main points in themselves. Evidently, Dada's last remark points to the issue of how the teachers perceive and conceive the MLS reform suggestions. While by inspection we could be coding a lesson as missing in segments, in the teachers' interpretation she could have integrated that part into something else. In this example, it seems that Dada had made the conclusion a feature of the pupils' activity. She remarked that the activities serve as a conclusion of the main points in themselves.

This argument about suppressing certain segments of the lessons was also an area of discussion in the focus group discussion at Gamma Primary. In their argument to revise aspects of the MLS, the teachers strongly felt that getting them to plan two separate lessons for two lessons which happened on a same day was like giving them additional work. They would prefer something similar to what Dada did: attempting to do all the explanations and conceptual development bits in the first lesson and moving directly into pupil consolidation activities in the afternoon lesson. Automatically then, when a teacher would have decided to conceive a lesson as follow-up lesson, some segments of the template would become inappropriate (redundant). More data were required to determine how many lessons could be termed as follow-up lessons in a row in view that some topics required more time to deliver and expand than others.

- **Instructional and cognitive challenges:**

My data suggest that along with the two previously stated instances when lessons lacked all the suggested segments there could be a third instance teacher pedagogical knowledge. While the first two instances could be based on the teachers' judgment, this third instance might be beyond the teachers' control. This third instance relates

to the challenges imposed by the implementation of the reform ideas: instructional and cognitive challenges.

With regard to instructional challenges, I noted time, availability or manageability, as serious issues in the schools. Some teachers barely have 40 minutes to conduct a lesson while some had problems managing the time they had. In relation to the latter situation some teachers unintentionally spent more time on some components of the lesson than on others. I noted during the observation that the teachers left the activities within the different segments to die out naturally rather than developing strategies to wrap them up and move on. My observation suggest that many lessons were conducted with no awareness of time: reviews ended naturally. Teachers' explanations while developing the pupils' conceptual understanding could go on and on. Consolidation activities were usually stopped by the tolling of the bell. The "natural flow" approach had its impact on the end of lesson segments. Practically, the teachers had insufficient time to formulate proper conclusions. When I asked the teachers why they had not concluded their lessons as suggested, their main answer was, "we did not have enough time". Nonetheless, I observed that there were possibilities in many of these lessons when they could have cut short the activities and attempted a wrap up or an end of lesson plenary session.

Moreover, in some lessons (like in the case of lesson BT22) the teacher was stuck with her expository approach. Besides, lesson BT22 was a follow-up lesson. Approximately 22 minutes were spent on the review of steps to compute simple multiplication, when in reality what was being done at the board could have been effectively done by getting the pupils to work on their own or in pairs. It was an afternoon lesson and most of the pupils were tuned off the procedures, as was the teacher. The teacher's explanation consisted of severe procedural errors. She had

completely lost her algorithm of computing multiplication of pairs of 2 and 3-digit numbers. In the end, the conclusion was too brief, consisting only of a question asking the pupils whether they had understood her steps or not.

In terms of cognitive challenges, my data suggest that this could be a significant factor in why teachers sometimes do not implement a particular segment or even deviated from what the MLS suggested. There were aspects of the reform which challenged the teachers cognitively. Here I want to highlight three features of the reform which could have been cognitively challenging to the teachers: a) investigative features of the lessons, b) inclusion of real life situation in lessons, and c) formulating lesson conclusion.

(a) **Investigative features of lessons:** The MLS reform specifies that teachers should aim at developing lessons with investigative features. None of the lessons I observed could be classified as strong in investigative features. Furthermore, lessons that contained open ended tasks were not adequately explored. A classic example happened in one class at Beta Primary.

The teacher had set a task for pupils to find out which number from 1 – 15 have remainder when they are divided by 3. The pupils worked in groups of 4. They were given some counters as aids. The teacher did not specify a time limit but the pupils took around 15 minutes to do the tasks. The teacher had named that lesson, an investigational lesson.

Following the tasks the pupils were asked to come and write their answers on the board. All the groups got all the answers apart from one group who also included the number 13.

There was no discussion following this nor any talk about how they have done the tasks. In the post lesson discussion the teachers' reported that her decision to label this lesson as investigational was because the pupils have been working on their own and they have used discovery approach to get the answer. The teachers' conception of discovery in that context was formed from the fact that no adults' intervention was present.

My analysis of this situation was that the teacher could have a good conception of what an investigational activity should look like but could not set up such a type of

task for the pupils. Moreover she could not manage discussion such that the mathematical idea embedded in the tasks could be explored. In this specific case the pupils' engagement with the mathematics ideas was not taken into consideration. The way the lesson was handled appeared as if the teacher was mainly after the answer (the product) but not the process.

(b) Inclusion of real life situations: The MLS requirement to include real life situations in the lesson explanation had challenged the teachers' understanding of mathematics. This part really exposed some teaching weaknesses, in particular, the teachers' low subject matter knowledge. I observed that some teachers did not really understand what was expected from them by such a requirement. In most cases either the example they gave was irrelevant or simply did not add anything more to the pupils' understanding. One example which clearly illustrates this argument occurred in all the Four-grade classes which I observed. For the purpose of this discussion I will report the real life activity which occurred in two classes. The activity in the other classes was indeed very similar.

These classes were doing multiplication of pairs of two-digit numbers. In the first class the activity was: On a table there are 12 baskets. In each basket there are 23 apples. How many apples are there altogether? In the second class the problem appeared as such: A bus can take 45 passengers. How many passengers will 13 such buses take? The main activity which happened in the lesson however, was getting the pupil to learn the algorithm of the calculations.

The intended message of including real life examples in lesson – to reduce abstraction – was never conceived as expected by the reformers. This was evident in the teachers' approach to conducting explanation.

(c) Formulating lesson conclusion: From my point of view the problem associated with formulating lesson conclusions was twofold. There was the time related factor

which I argued previously was associated with instructional challenge. There was also the cognitive aspect of the issue. Whilst I have indicated that 55% of the lessons included a conclusion, I need to point out that not all of these conclusions approximated to what MLS suggested. The general observation was that the teachers would ask pupils questions about how they have seen the lesson. In concluding lessons, the teachers were more concerned about the pupils' attitudes to the lesson as opposed to what they have learnt. It is true that inquiring into the pupils' attitude may provide good feedback about the outcomes of the lesson. I argue that the MLS suggestions required the teachers to put most emphasis on the contents – mathematical ideas addressed in the lesson conclusion.

I turn now to address the second question which, as I stated above, arose from analyzing the patterns of lessons within the 22 lessons I observed: Were the lessons that matched the MLS suggestions better than the other lessons, and if yes in what way? I begin to address the second component of the first dimension of the conceptual framework: lesson coherence.

6.2.3 The quality of the lessons

The main purpose of introducing MLS in schools was to improve the quality of the daily mathematics lessons. In view of the situation prior to 2004 in which lessons were described as disorganised and lacking coherence, MLS was introduced to fill the gap. What was envisaged by the reform was an approach that would induce clarity, connection and lesson flow. As I pointed out in the analytical framework, the need to develop lessons that had starting point, climax, a closure, and a storyline that ran throughout. Hence, under the general ethos of MLS the teacher should consider the flow of the lesson and the logical presentation of the materials. Parallel to that should be the issue of opportunity to learn. Materials should be developed and

presented to pupils in ways that stimulate thinking and promote problem solving and investigation.

One aspect of mathematics teaching which has been well developed through the implementation of MLS is lesson coherence. Lesson coherence relates to the link of materials, the flow of the lessons, and the overall progression and development of the topic. Coherence was apparent in all lesson types and patterns but obviously it was more apparent in lessons with more segments. For lessons which began with a mental activity, teachers would normally tell the pupils, “We are going to begin our class by the mental sum as usual” (e.g. GT21). In instances where the mental segment would be conducted orally, the teacher specified, “we won’t be doing it in the exercise-book today, we will be doing it orally” (e.g. BT31). In a way the teacher clearly led the pupils along the way. In the 17 lessons which contained a focus for the current lesson as a segment, the teachers were able to establish a sense of direction which was a possible way of getting the pupils to make sense of the purpose of the lesson. I admit however, that I needed more data to argue whether the pupils could really make sense of the lessons when the teacher told them what they would be doing in the lesson.

For instance, in lesson BT41 the teacher, Tania, used the sitting arrangement to get the pupils to review the previous lesson on coordinates. She got the kids to tell their position using column and row arrangement. She stated a reference such as E3 and asked the pupils to identify who was sitting in the stated reference position. After 5 to six pupils had answered the questions, the teacher told them that in the current lesson they would be working more on grid reference. As she was saying this, she was taking out a chart. She stuck the chart on the front board and began asking new questions based on the chart so that the kids could relate to the chart.

Tania related Rebecca’s position in the actual classroom. “Stand up Rebecca.” (*Rebecca stood up*) “Does everyone see Rebecca?” (*Every child responded yes*). “Now this is the position of Rebecca on the grid. We are no longer going to use names. Instead we are going to use point.” She further asked the pupils, “what is Rebecca’s position in the classroom?” (*The pupil answered*). OK this is where I put it on the grid.

(The teacher plotted Rebecca's position). Like that she got the pupils to make sense of the graph.

Moreover, during the observation, I could clearly see from the lesson review that the topic was still in its development stage. The pupils were still learning how to read grid references using rows and column labels. I indicated in my field notes that they were hesitating. The teacher realised that the pupils were not yet fully conversant with the topic. She used scaffolding and prompts to guide the pupils during the review and later used the lesson preview segment to make connections between known materials and new materials. The strategy of asking Rebecca to stand and getting the pupils to state the actual position before she would plot it on the grid was a scaffolding strategy – good connector. The teacher further added more examples as she shared the focus of the lesson with her pupils.

Another representative lesson is that of Freda's at Alpha Primary (AT12). Although Freda's lesson was very procedural – focusing on getting pupils to know the steps to solve a particular item – it was both coherent and had a story line which ran throughout. Consider the other vignette which follows.

After Freda had done the review of the last lesson, she glued a statement on the board which she had prepared in advanced. The statement was actually her definition of what factors of numbers were. The statement reads: *What is a factor? A factor is a whole number that divides exactly into another whole number.* Pointing to the statement, Freda, told the class, “today, we're going to learn about factors. She got three pupils to read the statement before she started generating some pupils' ideas of whole numbers from which she could make sense of the definition. Every now and then she was redirecting the pupils' attention of what factors of numbers – pointing back to the definition.

At one point she got the pupils to work out factors of 8. The statement was revisited.

The teacher made sure that the definition of factor is kept on the board for the pupils to refer to. Each time the children gave a number which they thought was a factor of another number, the teacher got them to review the definition. By the thirtieth minute

the pupils knew the definition by heart. They were no longer reading it. Instead they were reciting it. There was clearly a storyline that ran throughout the lesson. Even if Freda's lesson could be classified as teacher-centred with emphasis placed on procedural knowledge, it was highly coherent. In terms of coherence, I argue that all the lessons I observed, regardless of whether they approximated MLS or not, were strong in this feature. However, there were more opportunities to observe this feature in lessons with more segments than in those with few segments.

6.2.4 Summary of analysis on lesson structure

Section 6.2 is based on the assumption that prior to determining the impact of a reform on practices, one has to determine whether the reform was enacted as suggested in the first instance. I began the section with an analysis of fit between the MLS suggestions and actual teaching practices. I did that by looking at how the teachers incorporated the components of the MLS into their actual practice. I noted that just a small proportion of lessons consisted of all the segments of MLS. This led to further questions. Then I argued as to why some teachers chose, or chose not, to incorporate segments of MLS. Furthermore, I examined whether the difference affects the nature of the quality of the lesson. I analysed the lessons in terms of coherence. I noted that most lessons were highly coherent in that they had a storyline that ran throughout. Nevertheless, it did not mean that the contents of the lessons were fully in line with what MLS had suggested. This led me to proceed with the analysis using the second dimension of the conceptual framework.

In the next section of this chapter I analyse the engagement tasks and the classroom discourse in line with current debate on effective mathematics teaching. I expand on the opportunity to learn model which I described in Section 6.1.

6.3 Analysis of engagement tasks

I have found the classification proposed by Kaur (2010) relevant as a basis for analyzing consolidation and practice tasks in the classes I observed. The framework presented in Table 6.3 provides a rubric to assess the cognitive demand – intellectual requirement – of the tasks. I have added a new descriptor (generates pupil-pupil discussion) for Level 2.

Early I specified that my intention in the analysis was to look at how the tasks included features that allowed the pupils to think and reason mathematically. Here I argue that the higher the cognitive demand of the tasks the more it stimulates the pupils' thinking ability hence the more opportunity for meaningful learning.

Table 6.3 Rubric for assessing the cognitive demand of tasks

<i>Level of cognitive demand</i>	<i>Characteristics of tasks</i>
Level 0 [Very Low] Memorisation tasks	<ul style="list-style-type: none"> • Reproduction of facts, rules, formulae • No explanations required
Level 1 [Low] Procedural tasks without connections	<ul style="list-style-type: none"> • Algorithmic in nature • Focussed on producing correct answers • Typical textbook word problems • No explanation required
Level 2 [High] Procedural tasks with connections	<ul style="list-style-type: none"> • Algorithmic in nature • Has a meaningful/ real world context • Explanations required • [Generates pupil-pupil discussion]
Level 3 Very High] Problem Solving/ Doing mathematics	<ul style="list-style-type: none"> • Non- algorithmic in nature, requires understanding of mathematical concepts and application of • Has a real world context/ a mathematical structure • Explanations required

Kaur (2010) uses this framework to assess the nature and quality of practice and assessment tasks in three secondary schools in Singapore. Kaur's framework was applied to Year 8 pupils whereas my analysis related to primary school pupils. Hence, I cannot use results of my analysis to compare to Kaur's findings. The difficulty to assess the cognitive requirements of tasks is eminent. Tasks that can be highly cognitive at primary level may be not so highly cognitive for secondary pupils hence making the classification of tasks under respective cognitive scales difficult. Moreover, pupils' excessive access to a particular task may lower the cognitive demand of the task. Under this assumption it may be argued that the cognitive demand of a task is pupil and context-related which subsequently undermines the analysis that I will be discussing shortly. Nevertheless, other researchers (Stein et al., 1996) have used cognitive demand of tasks along with other dimensions to assess the quality of tasks used in reformed classroom environments.

To render the classification and analysis of tasks more valid and reliable I accompanied the analysis with some levels of qualitative descriptions of the tasks and explanation as to why I classified them as such. The limitation of this process is that it has been done by me only. Nevertheless I believe that if someone repeats this analysis, the kind of outcomes he/she will get will be consistent with mine. Hence, in my point of view the qualitative discussion of the tasks becomes more useful than the classification itself.

6.3.1 Classification of tasks

The tasks I used in this analysis were those tasks or activities that the teacher instructed the pupils to do. In my case, they were in the form of mathematical exercises mostly in written form. These tasks were either written on the board, chart or worksheets. In the case of mental tasks they were also expressed orally.

For the analysis, I related mainly to the following tasks: mental activities, learning tasks and consolidation activities. Mental activities were those tasks assigned to stimulate the learners at the start of the lesson. Learning tasks were those tasks that the teachers assigned to the pupils so that they could learn the mathematical ideas. Generally, these were done as part of the whole class interactive session within the conceptual development segment. Consolidation activities were those tasks assigned to get the pupils to solve problems or compute calculations in relation to the mathematical idea(s) of the lesson.

First I began by extracting the tasks from each lesson. I coded each task using Kaur's (2010) descriptors. While doing so I encountered one issue. For instance, for the mental activity, most teachers would assign 5 items for this task. The items within the set were not necessarily homogenous in all cases. Some could be a word problem and the rest could be simple arithmetic computations. So rather than classifying each item individually, I chose to classify the set of items as a group, but I noted the exceptions within the group. For the sample of lessons observed there was no exceptional case where classification of individual task would have been most appropriate. Outcomes of my classification are presented in Table 6.4.

Table 6.4 Classification of tasks according to their cognitive demand for the 22 lessons observed

Types of tasks	Levels indicating the cognitive demand of tasks				No. of lessons
	0	1	2	3	
Mental activities	2	15	2		19
Learning tasks	1	12	1		14
Consolidation tasks		19	1		20

Table 6.4 reports the number of lessons (out of 22) by type of tasks by level of cognitive demand of the tasks. The row total does not add up to 22 since some lessons did not consist of certain types of tasks. For example, there were 19 lessons which consisted of mental activity tasks. For 2 of those lessons I classified the tasks at Level 0. For 15 lessons I classified the mental activity tasks at Level 1. For 2 of the lessons I classified the tasks at Level 2. No lesson consisted of a mental activity task at Level 3. Similarly for 1 lesson, I classified the learning tasks at Level 1, for 12 lessons I classified the tasks at Level 1, and for another lesson I classified them at Level 2. With regard to pupil consolidation tasks, for 19 lessons I classified the tasks at Level 1 and for 1 lesson I classified the tasks at Level 2. There was no instance when I could classify a task at Level 3.

The general observation was that most of the different tasks were coded 1. As the description of this classification suggests, most tasks were algorithmic in nature, focussed on getting the correct answers and were typical of the textbook exercises used in the primary schools in Seychelles. Examples of those tasks are given in the subsequent paragraphs of this subsection.

a) Classifying the mental activity tasks:

Typical mental tasks focused on solving simple calculations and this observation was common across the board. Examples of such tasks were:

- 1) Share 10 apples among 5 boys. How many does each one get?
- 2) 4 divide by 2, 3) 4 multiply by 3,
- 4) What is 6 by 4, 5) How many tens and units in 25?

Freda, AT12

Although in this set of tasks, Item 1 (an arithmetic word problem of semantic structure, quotition) could be regarded as challenging to primary school children, the remaining items of the set required only simple computations. I argue that they could be answered without any sophisticated knowledge of mathematics given that the pupils were in Primary 5 (10½ yrs old). Based on the Seychelles mathematics curriculum, these tasks appear in the P3/P4 syllabus.

Mental tasks within two lessons were at the lowest cognitive level of this classification. The tasks required the pupils to regurgitate formulae. One of the two tasks belonged to Lesson KT21. It was a P6 (11½ yrs old) lesson but these types of task usually begin to appear in the P4 syllabus. It was obvious to me during the observation that the pupils were not being challenged to produce answers to those tasks. For this activity, the children were required to raise their hands to answer the question and in that specific session many of them would raise their hand even before the teacher ended the question. Examples of such tasks were:

- 1) Write down the formula to find the area of a circle
- 2) Write the formula for volume of a cube
- 3) What is the formula for calculating area of a right angle triangle? **Joe, KT21**

Mental tasks in two lessons were open-ended and could be classified at Level 2. One of them was:

- Use any of the four basic operations (+ - × ÷) and make the total
40. **Lora, AT21**

At a first glance the latter task might seem to be straight forward for the group of pupils (11.5 yrs old). In fact it was not. It took them a while to formulate multiplication statements. None of them could work out a division statement until they were prompted by the teacher. The scope of this task was about its opportunity

to learn. Through this task, the pupils could learn that there could be multiple ways of arriving at a specific total. They got different options from their peers' responses which I suppose supplemented what they already knew. The open-endedness of the task raised its cognitive requirements from Level 1 to Level 2.

The other activity was observed at Beta Primary. The teacher placed a chart on the board. On the chart there was a story which read as such:

Steam is coming out from a kettle. Each letter from the word steam is worth a value. S = 1, T = 5, E = 8, A = 10 and M = 24. The whole word is worth 48 points. From the letters in steam I can form the word, EAT. What is the value of the word Eat?

[Jena, BT31]

During the mental segment the teacher formed new words from the letters in STEAM and the children in groups looked for the value of the formulated words. The fastest to get the answer scored a point. The children were really stimulated by this task. They were eager to answer and they were shouting, "Miss, Miss, Miss" after each word was said. This mental was relatively different from the ones I saw all along. There were also good opportunities to learn in this task and this became apparent when children in a group were using values from previous words to compute values of new words. From where I was sitting I could see that the pupils in one specific group were developing their own strategy to get an answer. One case was in the example which follows.

The teacher had formulated the word EAT and the score was 23. Then she got them to work out the score for MEAT. Some pupils started all over again to get the score, whereas a boy in one group quickly realised that it was $23 + 24$. I could hear him saying, "Zis met sa venn kat (24)" [meaning, simply add the twenty four]. **(BT41)**

It was clear that some pupils had discovered their own strategy to score the words – adding or subtracting scores of previous words. I was expecting the teacher afterward

to make some form of references to the task but she didn't. In the post lesson discussion she admitted that she had not realised that some pupils were doing this. Had she elicited a discussion about pupils' solution strategy after the mental activity, I could have classified the task as a Level 3 task.

b) Classifying the learning tasks:

With regard to the learning tasks, most tasks that were assigned to get the pupils to learn mathematical ideas were at Level 1. Those tasks required the pupils to follow steps or procedures. In 5 of the 22 lessons the pupils were doing multiplication of a two-digit number by another two-digit number. The teachers were showing them the procedures. The intent of the lessons was to get them to use the procedures accordingly. I even encountered a situation where the procedures that the teacher was showing were incorrect and conceptually wrong. The teacher did not realise the error until we got into the post lesson discussion.

The tendency to focus learning tasks at teaching pupils to get the right answers was also apparent in the next situation. The following vignette relates to one lesson in which the teacher was introducing the idea of grid references – getting the pupils to read coordinates using rows and columns. It shows a different learning task which I encountered in the schools but still points to the fact that activities were geared at getting the right answer by following a right procedure.

The teacher, Yves, is a new and young teacher. Following the mental activity with the pupils and a review of what they did in the lesson before, he quickly told the pupils that they were going to work on something new and that was, grid references and coordinates. Then he told his pupils that, he knew they had done the activity before but they would be looking at it again (Hence, I assume that the phrase, working on something new, he used at the start, means something different from the previous lesson). He then told the pupils that they would begin the lesson with a little scenario about people going to the cinema.

Yves called out six pupils and gave each one a paper pretending to be the cinema tickets. On each of these papers he had written a unique

reference such as A2, C4 and B2. No one knew what was on others' paper and even the remaining 16 pupils were unaware of what was written on any of the papers. They were simply watching. I knew what was going on by guessing using my knowledge of array arrangement in the curriculum. Yves asked the pupils to find their respective seat by using the information on their ticket.

Apparently, the sitting arrangement had been done and labelled before the class begun. The pupils were not told what connections were there between the tickets and the desks arrangement. One can commend this task for its open ended nature while other like myself, can argue that it was rather ambiguous unless it is true that the children had done it before. The other issue with this task was that the other pupils were completely left in the dark. Regardless, all the six pupils could locate their seat.

These were the conversation between the teacher and the six pupils following the activity.

Y: Was it easy to find your seat?

P: (three of them yes.

Y: Are you sure?

P: (Alvin) Yes

Y: Alvin, why yes?

A: Because A1

Y: How do you know this (pointing at the seat) is A1

A: (Pointing at the table) ... because there was an A there and a 1 there

Y: Yes, an A there and a 1 there (also pointing at the table). The others how did you find your seat?

The same type of questions and answers followed for the other six pupils. After all the pupils had answered questions about their seat location, the teacher explained to the rest of the class how to identify rows and column and using the whole class arrangement as cinema sitting arrangement he began quizzing pupils about pupils' seat locations making reference to row and column label. (Yves, GT21)

Leaving aside the other pedagogical issues that could be raised from this vignette, I want to illustrate the fact that teachers limited themselves to procedural tasks. Further, they kept on dwelling over points even if there was evidence that pupils were ready to move on with higher order activities. In this vignette for instance, the pupils' responses to the activity suggested that they knew what to do and could link clearly this concept of naming locations using a rows and column array. The teacher nonetheless kept on asking the children questions about things that they knew. To me this lowered the cognitive requirement of the tasks.

Learning tasks represent the core of the lesson since they are the tasks that address the main mathematical ideas or concept of the lesson. The fact that in no

lesson were these tasks classified at Level 3, suggest that in general (with very few exceptions), the pupils were not engaging in high cognitive activities during lessons – a scenario which could indicate that the lessons generally had low opportunity to learn features.

c) Classifying the consolidation tasks:

In all the lessons I observed, the nature of the consolidation tasks was not different from the learning tasks. However, contrary to the learning tasks, the consolidation tasks were all written tasks and could be attempted in groups or pairs. Consolidation tasks were purely an extension of the learning tasks. They consisted of the same type of tasks which I describe as simply “more examples”. Evidently, their nature of cognitive demand remained the same. There was only one exception though in that it was relatively open, unstructured and it elicited some group discussions. One occurred in the Lesson GT11 – an outdoor lesson.

As part of the introduction of a data handling lesson, the teacher (Samia) had taken the kids outside the class, next to these school gate to record the types and number of vehicles that passed next to their school. The activity was a group activity. The teacher had got them to copy a table and their role outside was to complete the table.

It is true that this was a simple data collection process. However, from my point of view, this tasks elicited discussion and had good learning opportunities. From where I was standing I could see the children discussing amongst themselves. For instance, they argued about whether a vehicle was a van or a bus. Another issue which stimulated discussion amongst the pupils was when a vehicle which they had previously recorded going past the school returned. They argued a lot as to whether or not to record that vehicle on its return. Subsequently, I could see from their working sheets that different groups were obtaining different types and numbers of

vehicles for that exercise. To me, that activity offered a wonderful opportunity for discussion. Unfortunately, when they got back to the classroom the teachers did not use the various responses to ignite a discussion.

It can be argued that classifying learners' tasks in terms of their cognitive challenges is not a straight-forward activity. At the same time it is a debatable one. Furthermore, I would argue that the way the teacher handled the tasks sometimes determined the cognitive requirements of the tasks. Some tasks, such as within the mental segment in Lesson BT41, have strong cognitive requirement yet the teacher handled these tasks as low cognitive activities. My conclusion is that teachers were not necessarily aware of the potential of the tasks they were setting. The situation also suggested that they lacked the skills in challenging their pupils' cognitive ability. This brings me to discuss one issue relating to the nature of tasks and what cognitive demand of tasks may mean to some teachers in the state primary schools in Seychelles. This is the issue of differentiation in relation to mixed ability teaching. This discussion is relevant here in view that I am dealing with the nature and quality of pupils' engagement tasks.

6.3.2 The issue of differentiation

Teachers in Seychelles talked a lot about the idea of "high flyers" and low ability pupils. Even if MLS guidelines did not make any distinction between the two groups, in class, one could visibly see that some teachers were attempting to differentiate work, so to speak. Their main argument was that they ought to cater for all the pupils. Teachers had been advised by other groups, who support their work, to have three sets of tasks each time they teach, targeting the top, average, and low ability pupils. In three of the lessons that I observed, I could see the teachers' attempts to differentiate. However, differentiation occurred only during the consolidation

activity segment. All other procedures in class remained common to all pupils, suggesting that their conception of differentiation applied to allocation of task only.

Further, throughout my involvement with teachers in the primary schools in Seychelles, I noted that more work was needed with them on the issue of task differentiation. Let me illustrate my argument with an example. In the lesson at Gamma Primary in which I saw the outdoor lesson, the teacher confirmed that the tasks she allocated to the two groups in the follow-up lesson (GT12) reflected her attempt to differentiate. She had labelled the groups Cola and Fanta and had developed a different exercise for each group (see Figure 6.3). The first task was assigned to the Group Cola, and the second one to the group Fanta. The Fanta task was supposedly less challenging than the Cola task because according to the teacher pupils belonging to Cola group are academically more able than pupils in the Fanta Group.

The tasks required the pupils to complete the tally table by either inserting the tally or count for the total number represented by the tally.

Group Cola		Group Fanta	
Frequency	Number	Frequency	Number
	7		3
	22		10
	37		25

Figure 6.3 Exercises allocated to two different ability groups in one class [GT12]

Clearly, unlike what the teacher was thinking, the two tasks were at the same cognitive level. The teacher's argument was that the second task was simpler. It included smaller numbers which were easy for the pupils to manipulate. My assessment of the two tasks was that they were equivalent and if I were to classify them I would have placed them in the same category. What could be the difference though was that the second task may take less time to complete. In my view, pupils who are successful on the cola tasks will also be successful on the Fanta task.

Directions and suggestions from the Mathematics Working Group had discouraged teachers from developing multiple tasks. The position of the Working Group on this issue was that the teachers should concentrate their effort on improving the quality of their engagement tasks by focusing on one set of tasks which clearly covers a wide range of cognitive skills. The teachers lacked both competence and time to venture into designing multiple tasks for one lesson. The point made through the presentation of Figure 6.3 justified the position which the MWG had adopted in relation to differentiating learning tasks in the primary schools.

However, it became obvious from the teachers' remarks, both in the post lesson discussion and in the focus group interview, that they have been getting conflicting messages around this issue. Other groups that supported them had been advising them to differentiate their tasks. One teacher from Beta Primary explained her position, her way out, on that issue: *"when I know the IPAM team are coming, I plan the IPAM way. When I know the Special Needs people are coming I plan their way"* (BET 03). Comment by BET 03 suggests that the system should come up with one stance on the issue of differentiation while at the same time invest in further in-service training to support the teachers in devising tasks that effectively increase the pupils' learning opportunity.

To further make sense of what was going on in the classes and make the learning opportunity argument complete, I use the next subsection to present some of the most pertinent findings in relation to the classroom discourse in the Seychelles. My study was not a dedicated study on classroom discourse. However, given that I have used lesson observation, I find it relevant to discuss classroom discourse as a way of investigating practices. This analysis is congruent with the conceptual framework I presented in Section 6.2 of this chapter.

6.4 Inquiry into classroom discourse

The issue of classroom discourse is being brought here to discuss the kind of verbal engagement which happened during the lessons I observed. I was particularly interested in the teacher-pupil discourse. I could not capture pupil-pupil discourse in a systematic and meaningful way. This may be done in subsequent research. I relied on my field notes and the audio-records of the lessons to capture the teacher-pupil talk. The intention was to find out the nature of teacher-pupil conversation, in particular the level of questions or prompts that the teacher used in class to get the pupils to make sense of the mathematical ideas in focus.

What was known from the research conducted before the MLS reform was that teacher talk dominated the lessons (Mathematics Working Group, 2005). A teacher could be seen talking throughout the lessons, mainly explaining to the pupils how to do calculation procedures. When the pupils were involved in the discussion, it was to answer a yes or no question or answer questions regarding how to compute the answer to an exercise. It was found that the teachers seldom engaged their pupils in mathematical discussions. Both the why questions and other higher order questions were uncommon at all levels in the primary classes.

During the early years of the reform the teachers were sensitized on the need to change the way they engaged pupils in the lessons in terms of mathematical conversations. The subject leaders received training on teacher questioning skills. Using the cascade training model that was being advocated through the IPAM project, the leaders trained their teachers at school level on this aspect of the lessons. There were even TV clips that were produced by the Ministry of Education on classroom talk to sensitize the teachers on pupil engagement, in particular, pupil-questioning. The script of one TV clip read:

It is important to encourage pupils' talk in the mathematics classroom. One effective way to ignite the pupils' discussion is to create opportunity for them to ask questions (Clip produced by National Audio Visual, for the Ministry of Education, 2006).

I could argue that there is evidence that the teachers were mobilised and sensitized to change the way they engage the pupils in mathematical conversations in the classroom. The extent to which these efforts were reflected in the actual practice lies in the analyses which follow. I wanted to develop insights into the nature and quality of classroom discourses that went on in the lessons.

To contextualize my discussion, I considered two lessons, both belonging to two teachers (Freda and Jill from Alpha and Beta Primary respectively) whom their leader had described as very compliant with the MLS reform and good in developing effective lessons. I decided to use their lessons principally for that reason. Secondly, following the observations, I found that these two lessons brought about interesting anecdotes for illustrating issues around classroom discourse in the primary schools.

6.4.1 Findings in relation to classroom discourse

Teacher-talk prevailed in the 22 lessons. MLS prescribed what teachers should be doing within specific blocks of time or lesson segments. Contrary to what the reform

sought to achieve, teachers' voices were heard a little too much during the lesson. Here my focus is not on the amount of talk per se, but on the quality of the discourse. When I went through my observation notes, this is how I could describe the overall picture.

During the first 10 minutes of the lessons the teachers' major emphasis was on quizzing the pupils. During the mental activities they asked factual or procedural questions which required the pupils to give one correct answer. During the review of the last lesson, they again quizzed the pupils on what they did. In all the lessons the teachers wanted to know whether the pupil could still remember the topic or theme of the last lesson. They achieved this by leading another series of questions. If there were computations involved, the teachers focussed their questions on ascertaining whether the pupils could still remember the steps they were shown. When teachers attempted to establish the focus of the lesson, they would again achieve this by a simple statement. From the 10th minute right up to the 26th minute, the lessons were dominated by the teacher explaining procedures or demonstrating procedures. Other than the classes in which the pupils did peer tutoring or worked outside, all the rest saw the teachers talking and carrying out expository teaching.

From the 10th to the 26th minute, the conceptual development segment, the MLS really anticipated a change in the way teachers handled the lesson to facilitate pupils' understanding. Unfortunately, all plenary sessions done during the lessons were teacher-led and dominated by teacher-talk. Moreover, the teacher-talks and their efforts to engage the pupils in the lessons challenged only lower cognitive aptitudes of the pupils. I argue that there had been a change in the way teachers addressed the presentation of the lesson, yet the quality of discussion had not changed. I turn now to analyze in depth one important segment in one of Freda's and

Jill's lessons to illustrate the point I want to make about the quality of classroom discourse.

Freda, a teacher from Alpha Primary, was labelled as cooperative and hard working by her subject leader. Freda herself was keen on me being in her class. In addition to that, she is an experienced teacher and had been in teaching for more than 30 years. Jill, from Beta Primary, was labelled by her subject leader as a very good teacher, with her class used as an example to other teachers who were struggling. Jill has been in teaching for more than 15 years. She reported enjoying the teaching of mathematics. The excerpts from both classes cover the segment of conceptual development. I begin with the excerpt from Freda's class and then Jill's class after which I present an overall analytical comment of both excerpts.

6.4.2 Analysis of Freda's lesson

Freda's lesson occurred in a P5 class (average pupil age was 10 years). The lesson was about factors. According to Freda, factors was a new topic to the pupils. In this vignette F stands for Freda. K relates to the pupils. I numbered the responses K1, 2, 3, etc... to indicate that different pupils were talking. If the teacher addressed the pupil by their name, I use the child's initial. When several or all the pupils talked all at once I used AP to indicate their responses. Freda began her class with a very quick review.

F Today we are going to learn about finding factors. Have you heard of this word?

AP Yes

F Factor. We are going to learn about factor. (*Slight pause*)

F What is factor?

(*Note: Factor, phonetically sound similar to fakter, the creole word for postman*)

F Is "factor" somebody who brings letters?

(A few children said, yes. Then there was a larger group who shouted, no. But you could hear the yes – no reply)

F Have you ever heard of this word?

(Again there was this yes – no chorus reply)

F In factor.... When we are doing factor... *(she wrote the word factor on the board)*, what are we doing now? *(There was a slight pause)*. What is the lesson about?

(No response from the pupils)

The topic Freda intended to teach was new to the pupils. Certainly the children could not figure out what Factor was all about. The teacher added some humour which instead of helping out, introduced more confusion. She was relatively prompt to see that she needed to change her approach to get students to arrive at an explanation.

F *(In loud voice)* ... the lesson, the lesson. What is the lesson about?

K1 Maths.

F Yes, but what in maths? Ok but [so] what do letters have to do with maths? *(Pupils appeared rather confused)*

F Factor. We're going to deal with factor, so we're going to deal with

K2 With numbers.

F *(Happy voice)* Yes, with numbers. It's a kind of number. So if you don't know, say it's a kind of number.

Freda had not been successful in stimulating a productive discussion in the first part of the segment. Further, she had indirectly introduced a false conception of what constitute Maths. She was happy that the pupils had managed to tell her that factor is a kind of number. Yet, her suggestion to say factors is a kind of number since they were dealing with maths could lead the children to believe that any topic in maths has to be about numbers.

(Slight pause). If you have heard of this word factor, you're going to tell me what it is?

(There was silence in class for a short while)

F You don't know the definition?

AP *(In a chorus reply)* No.

In terms of scaffolding, finding ways to link and advance the discussion, Freda was not realistic here. There was clear evidence from the previous part of the lesson that the pupils did not know what factor was about. Asking them questions about the definition was not a smart move. Perhaps these could have been instances where she could have used examples and got the children to formulate a definition deductively. This would have certainly engaged the pupils cognitively while at the same time reduce teacher talk and teacher-led discussion.

*(At this point the teacher placed a chart on the board on which there was a definition of factor written: **What is a factor? A factor is a whole number that divides exactly into another whole number.**)*

F Read it for me, Elma.

E *(She read).* What is a factor? A factor is a whole number that divides exactly into another whole number.

F Read it for me, Hazel.

(Hazel began to read. The teacher interrupted her.)

F No. Read only what is a factor. *(She meant, the definition only. Hazel read the definition. The teacher got Dianne to read it. Dianne read it. After Dianne had read, the teacher read the definition one more time.)*

That was an interesting moment in Freda's lesson. Look at the emphasis she placed on ways of knowing. I began to feel immediately that her teaching emphasized procedural knowledge. Getting three pupils to read the definition over and over, and another time by her, were simply a matter of learning a definition by heart. Nevertheless, Freda had her own way of getting the pupils to make sense of the definition.

F Who can give me a whole number? Hands up! Any whole number. *(No pupil responded)* A whole number. *(In a shouting voice)* Anyone! Yes, Jean Luc, give me a whole number. *(Jean – Luc did not react).* Ah, Jean Luc, you don't know any whole number?

(Jean Luc said something in a soft voice. The children next to him said, "dir pli for" meaning "say it louder")

J One third.

- F One third, a whole number? (*addressing to the whole class*) Any one!
Any whole number that you know!
- K3 Two thirds.
- F (*In a disappointing voice*) I dir mwan “one third” mon dir li non, ou dir mwan “two thirds”. (*Translation: He said one third, I said no and now you tell me two thirds*).

Note that the teacher code switched (Setati & Adler, 2000). This was not done to clarify the concept but to express a disappointing remark. In a way she wanted to tell the child that she was not following. However, my analysis of this part of the lesson suggests a more profound issue occurring. Either the pupils could not locate “thirds” in number groupings or simply did not know what the teacher wanted from them. From a mathematics teaching point of view, Freda could have wisely used the learners’ first language to convey a meaningful discussion.

- F It’s not. It’s not a whole number. One third, two thirds, three thirds, these numbers are not a whole number,. Give me a whole number.
(*A girl called out 10*)
- F Very good. 10 is a whole number. Third is part of a whole. It’s not a whole. 10 is a whole number. Give me another one. Give me another whole number, Nell.
- N 20
- F 20. Another one (*pointing at one girl*).
- K4 11
- F 11. Elza, another one.
- E 30
- F (*Addressing a boy with raised hands...*) Yes
- K5 14
- F These are whole numbers. All these numbers when you count, starting from 1. Start counting.
(*Pupils in class started to count together...*) 1, 2, 3,6
At 6 the teacher stopped them.
- F OK thank you. These are whole numbers, no?
(*In a chorus voice, all pupils answered*) Yes.

From a teaching point of view one can argue that what Freda did to assess pupils' prior knowledge about whole numbers was appropriate yet the pupils' responses were too short for a good assessment. On the other hand simply assessing the prior knowledge may not be enough. What Freda failed to do in this discourse was to highlight the pupils' misconception. The pupils were giving answers like one third or two thirds for examples of whole numbers, but throughout that part of the discussion Freda made no attempt to bring in the issue of fraction. In my view that was a missing moment. Clearly there was evidence of a teacher putting emphasis on getting correct answers as opposed to introducing rich deliberations in the discourse. Note also how Freda was satisfied as the pupils were giving her whole numbers. Looking at what was happening I questioned whether the pupils understood what whole numbers were or whether their responses were purely led by the answer 10. This is why perhaps introducing a small discussion of whole numbers and fractions could have helped enrich the discourse by clarifying doubts.

What I have tried to illustrate in the scenarios so far was the inability of teachers to develop rich deliberations. Furthermore, I have presented cases of teachers focussing on procedural knowledge. What has also been visible in the excerpt was the nature of the classroom talk: fully teacher-talk, teacher-led discussion. I now move to another section of the lesson to argue how classroom discourse in that lesson did not progress, in terms of its cognitive challenge.

This part of the lesson occurred some 10 minutes later. The teacher had organised the pupils into groups and they were using counters to find out factors of the number 6. In the first activity, which was led by the teacher, the pupils were asked to take 6 counters and put them in groups of 1. The teacher had led them to realise that since they got 6 equal groups of one, then the number 1 is a factor of 6.

Likewise, the teacher had led them to put the six counters into groups of 2. The fact that they had got 3 equal groups of 2 then 2 is a factor of 6. They had done it for 3 and I will now present the discourse at the time they were determining whether 4 was a factor of 6 or not.

F How many groups of 4 do you get?

(A large group of pupils said, one while the rest of the class did not answer.)

F And then, what do you have.

K7 2 remaining.

F So what can you say? *(There was no answer being given out and the teacher intervened. Both the teacher and one child (K7) said, one group remainder 2.)*

F So $6 \div 4 = 1$ remainder 2. Is 4 a factor of 6?

Some children said, yes and some said, no. The teacher paused. One child said no again. The teacher asked, why? Another child replied, "because of the remainder 2".

The Teacher said:

F Yes, 4 is not a factor of 6.

Then the teacher wanted to ascertain whether the pupils had understood what factor is all about.

F What are the factors of 6? *(All the pupils said 1, 2, 3, 6.)*

F 1, 2, 3, 6. Ok?

AP Yes.

F Ok?

AP Yes.

The question, how many groups of 4 do you get, followed by the second question, and then what do you have, restricted the development of a productive discussion. In my opinion, the use of her definition of factor which she had on the board could have played a more effective role. Posing the question, is 4 a factor of 6, and why do you say so, in the first instance could have elicited a discussion. This question came out eventually. However, suddenly agreeing with the first answer prevented her from determining whether other children were thinking in the same way. Moreover, this

observation re-emphasized the fact that the teacher placed more importance on correct answers. Furthermore, a why question after the pupils had named all the factors of 6 could have provided some forms of feedback to the teacher about the pupils' new knowledge of factors.

The teacher had led the pupils to work out whether the numbers 1 to 6 were factors of 6 using one approach. For the consolidation activity she asked the pupils to work out factors of 8 and 12 using the same approach. The pupils had not necessarily fully understood how to begin the activity. The teacher had to intervene on a number of times to get them started. This perhaps was an indication that the method shown in the conceptual development segment was unclear. Moreover, it was not clear to me how the pupils would work out factors of bigger numbers. I was expecting this point to be taken up in the subsequent lesson. Surprisingly, the teacher went on to work on a different topic altogether in the next lesson: an observation which led me to question the issue of sequencing lessons in schools. However, that was not a focus of this analysis hence, I will make no further elaboration.

6.4.3 Analysis of Jill's lesson

I turn now to present an analysis of a second lesson in a different school. Here, I want to further demonstrate the low cognitive engagement in mathematics lessons. Jill's lesson happened in a P4 class (pupils' average age was 9 yrs). Her lesson was about multiplying pairs of 2-digit numbers. In her previous lesson, the pupils had been working on multiplying numbers by 10, 20, 30 etc... The key phrase that they had been using was *multiplying by multiples of 10*. The lesson I observed was meant to be a continuation of the previous one.

J (Phrase translated verbatim) In the lesson today, you should know how to multiply a number that has multiples of 10 plus another digit, a single digit.

(She then proceeded)

J You will find your own way how to do that. Your own way. I'm not telling you how to do it but in groups among yourselves, you discuss to find ways. You might have different ideas but at the end you will get the same answer.

(This was meant to be an investigation lesson)

J Example, (she wrote on the board as she told the pupils) 40×13 . Here 13 is what?

K1 Unit

J The one is what?

K2 Ten

By accepting the answer that 13 is the unit and one being ten, I assumed that the teacher had made a mistake. I suppose she meant 3 instead of 13. Unfortunately mistakes like these are unnoticed in classrooms if someone is not observing the teachers and the message that pupils get out from them are also unknown.

J Now in 13, is there a multiple of 10?

AP No

J There's no ten there?

K3 There is!

J *(Addressing K3)* What is it? The multiple of 10 in it will be what?

K3 zero

J *(pointing to the number 13)* No, the 1 here is what?

K4 10

J So 1×10 is what?

AP 10

J *(Making reference to 13)* This is a multiple of 10. We have 1 ten and 3 units. When we add it, there will be the multiple of 10 and 3 is the single digit. *(There was a pause. She referred to her plan and said)*

J The first sum will be 18×13 . *(She wrote this one the board)*

The conversation above, between Jill and the pupils, was to introduce what the lesson was about. Clearly there were some conceptual errors in the introduction, let alone the teachers' explanations. The conclusion which I draw from the first part of Jill's

lesson is how appropriate textbooks could have helped her to develop a more accurate introduction with minimum conceptual error. There were also technical errors in the teachers' use of some terms. For instance, the use of sum in the last sentence of this excerpt can be misleading. Occasionally, the teachers used the word sum to refer to a calculation. My intent in this analysis is to move further down the lesson to illustrate the prevalence of low cognitive engagement, even in lessons of teachers who were being labelled as effective by their leaders. Leaders' perception of their teachers and perception of effective lessons would be a good theme for further research.

Jill asked the pupils to get into groups. That appeared to be a routine activity as the pupils just turned around and formed their groups. For six minutes, the pupils worked on the calculation. From where I was sitting I could see some interactions going on. The pupils were engaging with the task. I could hear the children in the group sitting closest to me talking about the task. I did not record what they were saying. The teacher could be heard encouraging the pupils to discuss.

The lesson presented in the excerpt was meant to be an investigation lesson. When I examined its tasks and the nature of its activities, to me, it did not occur to be an investigation lesson. As part of the consolidation activities, the teacher got the pupils to work in their groups to find the answer to the multiplication 18×13 . I present below the working of two groups and an excerpt of the discourse which followed as the groups presented their work to the other children in the class.

$\begin{array}{r} 18 \\ \times 13 \\ \hline 484 \\ \hline 2 \end{array}$	$\begin{array}{r} 18 \\ \times 13 \\ \hline 124 \\ \hline \end{array}$
Nikita's Group	Group 2

Figure 6.4 Solution of 2 groups to the question, 18×13

Nikita's group was the first to present. In the excerpt N stands for Nikita and J for the teacher, Jill, K represents Kids responding, and AP representing all pupils responding altogether.

- N 18 times 13, 8 times 3 equals 4. No, 8 times 3 equal 24. 1 times 3 equal 3
- J Where is it, the one that you're multiplying? Touch it! Ok. 1 time 3 equal what?
- N 3
- J Ok
- N 1 time 3 equal 3
- J Where do you get the 3 from?
- N 1 time 3 then you add the 2
- J Ok. Go on. (*Interrupting Nikita, Jill pointing to the board...*) Now look at the answer.
- J (*Addressing Nikita*) Move a little bit.
- J (*Addressing the whole class*) See what she did. Do you want to ask her anything? You're happy with that? You don't know if it's correct or not?
- K5 It's not correct.
- K6 Miss, why did you write the two down?
- J (*Addressing Nikita*) Why do you write the 2 down?
- N Because it is equal to 24
- J So when it is 24 you put it under the line, why? Tell her.
- N Because it has to go under the line. To be under the same column.
- J (*Addressing Nikita*) But there is something else you did not tell her.
- N Because the sum is not done. Because it is ten.

- J Ok. Very good. In 24, (*addressing Nikita*) give me the chalk. In 24, the 4 is what?
- AP unit
- J The 2
- AP Ten
- J So you put it under the unit now. So you are working with the unit, you carry the ten because you are not ready to use the ten. When you're ready to use the ten, you use it altogether. Ok? (*Addressing the whole class*) Anything to ask her? Happy?

Here again the teacher put emphasis on working out the answer to the calculation using the traditional algorithm. The discussion which happened amongst Nikita, the teacher and other pupils was challenging only in respect to getting Nikita to clarify the steps and be clear on the procedures. The why question was not meant to generate conceptual discussion, instead, it was asked to answer a question about completing the procedure.

The teacher attempted to involve all the pupils in the discussion. She sought participation by offering them the chance to ask Nikita questions. Here again the questions that the teacher was after were questions that the children would ask Nikita as a way of getting her to be clear on the processes that her group had gone through. At one point K5 shouted that the working was not correct. The teacher ignored this response. It was not clear why. It could be possible that the teacher did not realise that K5 had spoken or perhaps from the teachers' knowledge of her class knew that K5 could be responding haphazardly. The teacher pointed out that she would comment on the task after all other pupils had presented their solution.

Let me now move onto the wrapping section after three groups had presented their work. Addressing the class, Jill declared:

- J I'm sorry to tell you, you didn't get the right answer. You did your best but not the right answer. Now let me show you. [...] This is one method that you can use. There are others. This is one way. I will show you. And this way is called the breaking down method. We are going to break down the numbers.

And the teacher proceeded with the algorithmic explanation. All the questions and her attempts to involve the pupils were purely to complete the steps to computing the procedures. During the explanation the teacher also asked pupils questions about table facts such as the answer to 3×8 and procedural facts ... “what do we do with the 3 etc. In the end the teacher told the pupils, “This is the way. It is much easier for you to tackle” (Jill Lesson BT31). By saying this, the teacher had imposed one method on the children.

6.4.4 Overall analytical remarks of the two lessons

During the post lesson interview I asked both teachers to indicate to me the extent to which the lesson I observed reflected what they would normally do in their class. Both teachers confirmed that the lesson was typical of what goes on in their class. They said they placed great emphasis on getting the pupils to understand the process before they would move forward. What went on in the lessons seemed to confirm that. The teachers put emphasis on procedural knowledge. There were several moments of going over and over steps. There were also several instances of getting pupils to repeat answers to questions that they had demonstrated they already knew. These were visible in both classes and indeed the same pattern occurred in the other lessons.

Another observation which was in fact common during the two lessons was that teacher talk prevails during the lesson even if there was a great will on the part of both teachers to involve the pupils in the lesson. However, even if there was that well-intended will to involve the pupils in the discussion during the lessons, the level of discourse may be characterized as one which was low in cognitive demand. The vignettes captured features of the classroom discourse that converged on the nature of pupils' learning in the two classes. First the mathematical discussions were not

rich in principles and concepts. Pupils did not engage significantly with mathematical ideas and concepts but instead were involved in answering close-ended questions. These questions limited their access to higher cognitive thinking. For example, in Freda's lesson, when the pupils were given the definition of factor, the teacher focused their attention on memorizing the definition even if her intention was to get them to use ideas from the definition to work out factors of numbers. She shaped the pupils' use of the definition. Ultimately she got them to work out factors of numbers in her own way.

The same occurred in Jill's lesson. Even if she began her class with the hope that the pupils would discover their own method to compute the multiplication, "*You will find your own way to do that. Your own way. I'm not telling you how to do it but in groups among yourselves you discuss to find ways. You might have different ideas but at the end you will get the same answer*" (Jill's comment at the start of the lesson), the pupils ended up being taught one specific method to compute multiplication: "*... this is the way. It is much easier for you to tackle [the problem]*" (Jill's comment at the end of the lesson).

In the tasks in both lessons, mathematics was presented as a statement of an end product – definitions and procedures to memorize, imitate, and regurgitate. Even if one could argue that the use of the definition of factors in Freda's lesson was to orient the pupils to the key idea of what factors of numbers are, I contend that the process by which the teacher chose to engage pupils with the definition could have been confusing. More higher-order questions would have been useful. In Jill's lesson, the teacher missed opportunities to talk about the pupils' strategies. It would have been good to get the pupils to discuss why they did whatever they did. She left it with the pupils to do the questioning. It was clear that the pupils did not have

adequate experience to develop the conversation on their own. The teacher should have picked this up and led the discussion herself. Considering the reform idea that seeks to get pupils to appreciate the doing of mathematics (Lampert 1990), Jill failed to capitalize on this goal of reform.

The tasks contained scope for problematizing the mathematics (Hiebert et al., 1999) which both teachers could not incorporate into the development of the lesson. However both teachers attempted group-work. Group-work, when constructed meaningfully, allows the pupils to interact in social contexts. Such social interaction enables the pupils to discuss their understanding. Theoretically social interaction mainly in the form of discussion and verbal communication has been linked with pupils' understanding of mathematics (Cobb, Yackel, & Wood, 1992). When pupils talk about their working or ask their peers questions on what they did, they clarify their personal thinking, and when collaboratively working on tasks, they may realign their perception of the task and see the challenge differently (Schoenfeld, 1989). This is possible only when the tasks are well prepared and prompt questions are well selected. It is not clear how this was made possible in the lesson I observed.

Jill's intention, to allow the pupils an opportunity for developing their own solution model, was a good idea but she did not follow this action. It would have been a good idea to use the pupils' example to get them to talk through what they did so as to clarify their doubt. The way the lesson progressed illustrates the fact that the teachers wanted a correct answer. She completely ignored the children's solution process.

Ultimately, the two teachers presented mathematics tasks and knowledge as if to learn mathematics means to learn procedures and computations. Freda focused

her attention of getting pupils to know how to work out factors using her own approach. The examples given for finding factors of 6 illustrated this. Jill focussed her attention of getting the pupils to know by heart how two numbers are multiplied. The emphasis on learning one method (the breaking down method) illustrated this observation. Hence procedural knowledge was emphasized while principled knowledge was undermined.

6.5 Summary

Data from this chapter serves as evidence to answer the first research question. Observation data was critical to make claims about teachers' instructional practices. One pertinent finding which emerges in this chapter is that the teachers' actual practices deviated from what the self-reported data suggested. Although in general the lessons were coherent, only five lessons contained all the components as proposed by the MLS lesson template. The teachers' lessons were different from the model in three main respects. Another important finding which emerges in this chapter is that the quality of pupils' opportunity to learn in the lessons was low. The tasks were not cognitively engaging. The lessons promoted procedural knowledge. There is enough evidence to claim that the ideas which were advocated in the reform were inadequate to provoke change in the teachers' practices. No data was collected directly from the pupils and they were not the focus of the observation.

The evidence I have presented in relation to the actual conduct of the lessons reveals the central role of the *zone of enactment* in enabling teachers to make (or prevent them from making) deep change. In other words, I have provided examples to show how the teachers' zone of enactment mediates change.

CHAPTER 7 Pupils' mathematics achievements

A subsidiary aim of the MLS reform was to improve the pupils' learning in mathematics. In this study, however, my focus is primarily on the teachers. I do not focus on how the teachers brought about changes in the pupils' learning nor on how the pupils influenced the teachers to change. Attempting to include such pupil data would have certainly been instructive, but would have made this study too big to manage by one researcher alone. Instead, I look at how the pupils' attainment before, during, and after the reform period. The data provide evidence to make inferences about the relationship between the pupils' learning and the policy (reform).

To develop an insight into the pupils' achievements as a consequence of the reform, I felt that the SACMEQ data and the IPAM data were valid enough to serve this purpose. Construction of the tests used in these two projects, and the processes by which data from the two tests were generated, have been described elsewhere in this thesis (Section 3.5.1 and Section 4.1). It was not possible to collect additional achievement data for this current study. Cross sectional and longitudinal analysis on the data revealed two major findings: a) pupils' learning growth from 2006 to 2009 was slow but positive, and b) variations in pupils' achievements scores vary with the overall use of the reform. Evidence reported in this chapter provides answer to the second research question about the impact of the reform on achievement.

7.1 Cross sectional analysis of achievements

I used pupils' achievements in the SACMEQ studies to develop my argument for this section. Pupils' achievements from the P6 national examination were discarded in the analysis since the contents of the mathematics tests had been inconsistent over the years. On the other hand, the tests from the SACMEQ studies shared a common blueprint and consisted of large proportion of equivalent items. Hence results from both tests could be used for comparison. In the first analysis, I compared the basic descriptive statistics of SACMEQ II and III data. Since the SACMEQ II was administered in September, 2000 and SACMEQ III in October 2007, I have reason to consider the pupils' achievements in SACMEQ II administration as pre-reform achievement and achievement in SACMEQ III administration as post-reform achievement even if the administration of SACMEQ III was done during the first year of the reform.

The number of candidates who sat SACMEQ II and III mathematics tests were 1484 and 1480 respectively. The mean of SACMEQ II test was 47.96% and standard deviation 16.84. These two statistics for the SACMEQ III tests are 46.36% and 14.78 respectively. Numerically, both the mean and the standard deviation went down in the SACMEQ III results. ANOVA conducted on the two sets of scores suggested that the mean for the 2007 results was significantly lower than the 2000 mean [$F(1, 2962) = 7.54$, $p\text{-value} = 0.006$]. Comparison of variations of scores using the standard deviation showed that the value went down from 16.84 to 14.78 suggesting that pupils' scores became more homogeneous after the reform. These results are presented in Table 7.1.

Table 7.1 Basic statistics for the three tests

Descriptions	SACMEQ II 2000	SACMEQ III 2007
No. pupils	1484	1480
Mean raw scores (%)	47.96	46.36
Standard deviation	16.84	14.78

Matching the items of the two tests and comparing their item difficulty indices (item means) revealed that, a) of the 47 items common to both the SACMEQ II and SACMEQ III, 57% of the time, items of SACMEQ II test had a better mean than items of SACMEQ III test. The means were common for only 5 (11%) of the items. This implies that the 2007 cohort did better on only 32% of the common items. The item means are displayed in Table 7.2.

Table 7.2 Comparison of item means: SACMEQ II (y items) and its corresponding SACMEQ III (z items)

SACMEQ 2000		SACMEQ 2007		Δ
Items	Means	Item	Mean	
y20	0.76	z14	0.6	0.16
y49	0.2	z39	0.11	0.09
y02	0.55	z02	0.47	0.08
y32	0.24	z25	0.16	0.08
y09	0.65	z08	0.6	0.05
y06	0.59	z06	0.54	0.05
y04	0.78	z04	0.74	0.04
y17	0.17	z11	0.13	0.04
y57	0.32	z44	0.28	0.04
y27	0.38	z19	0.34	0.04
y28	0.57	z20	0.53	0.04
y19	0.44	z13	0.41	0.03
y08	0.92	z07	0.89	0.03
y16	0.12	z10	0.09	0.03
y26	0.2	z18	0.17	0.03
y03	0.84	z03	0.81	0.03

Continues...

Table 7.2 (continued)

SACMEQ 2000		SACMEQ 2007		Δ
Items	Means	Item	Mean	
y33	0.28	z26	0.26	0.02
y45	0.38	z34	0.36	0.02
y31	0.55	z24	0.53	0.02
y42	0.46	z21	0.44	0.02
y36	0.67	z28	0.65	0.02
y10	0.07	z09	0.05	0.02
y54	0.3	z41	0.28	0.02
y23	0.33	z15	0.32	0.01
y01	0.89	z01	0.88	0.01
y24	0.36	z16	0.35	0.01
y29	0.6	z31	0.59	0.01
y44	0.45	z33	0.45	0.00
y05	0.91	z05	0.91	0.00
y51	0.23	z36	0.23	0.00
y18	0.62	z12	0.62	0.00
y59	0.51	z46	0.51	0.00
y30	0.33	z23	0.35	-0.02
y43	0.17	z32	0.19	-0.02
y63	0.2	z47	0.23	-0.03
y53	0.31	z35	0.34	-0.03
y56	0.37	z43	0.41	-0.04
y25	0.82	z17	0.86	-0.04
y38	0.65	z29	0.71	-0.06
y58	0.63	z45	0.69	-0.06
y40	0.76	z22	0.83	-0.07
y48	0.32	z38	0.4	-0.08
y55	0.26	z42	0.34	-0.08
y39	0.67	z30	0.76	-0.09
y35	0.55	z27	0.64	-0.09
y47	0.5	z37	0.6	-0.10
y50	0.49	z40	0.59	-0.10

$\Delta = \text{difference in mean (y item mean} - \text{z item mean)}$

Table 7.2 shows that the difference in item means was not large. For those items on which the 2000 cohort was better, the largest difference in mean was 0.16. This

occurred once only. For 16 other items the mean difference was 0.03 or lower. Those items on which the 2007 cohort was better also showed a very small item mean difference. The items were generally poor discriminators.

Analysis of the nature and content of the items at which the 2007 cohort was better than the 2000 cohort revealed that the items could be grouped into three main categories. The first category was identification items such as identifying properties of shapes and smallest numbers from list. This category consisted of items which generally do not require mathematical manipulations to work out the answer. The second category of items contained matching and graph readings. In those items there were little mathematical computation or manipulation involved. The third category included items which required some elements of computation but could be done in one step. The three categories of items are demarcated in Table 7.3.

Table 7.3 Nature of items at which 2007 cohort performed better

Items	Description of items
y25	Identify right angle among other types of angles
y30	State the number of edges of a cube
y40	Identify the shape of a present (cube)
y58	Identify the net of a cylinder amongst other nets
y39	Name the shape of a tin
y35	Identify the smallest 2 digit number from a given list
y50	Match a given reading to its corresponding thermometer
y48	Compare temperature readings (colder and hotter)
y53	Interpret a scale drawing diagram
y38	Interpret a pictogram
y47	Extract an information in a row by column table
y56	Formulate an expression indicating the pages to be read remaining
y63	Work out the amount of fuel remaining after a specified amount has been given
y43	Evaluate a number statement using the BODMAS rule
y55	Work out speed-time related problem

A similar item skill audit was done on those items on which the 2000 cohort was better. The items were written at a higher cognitive level. They included items requiring the pupils to: read and interpret graphs; convert units of measurement and fractions; apply rules to solve problems; and compute solutions using no less than two steps (see Table 7.4). In this case four groups of items are demarcated.

Table 7.4 Nature of items at which 2000 cohort performed better

Items	Description of items
y06	Identify faces of a prism
y54	Read and interpret bar graphs
y19	Read and interpret calendar
y16	Adding and converting units of time
y20	Estimate of length in centimetres
y17	Convert grams to kilograms and attempt a partition problem
y10	Convert fractions to decimal numbers
y09	Convert analogue to digital form: The time is expressed on analogue clock (8:40)
y28	Identify equivalent fractions expressed diagrammatically
y04	Solve an arithmetic word problem involving fractions
y32	Area of composite shapes
y02	Add of two numbers when the addends are expressed in words
y27	Select two addends which make a total exceeding a given value
y33	Calculate unknown angle of an isosceles triangles given one angle
y49	Calculate average
y26	Interpret distance time graph and solve related problems
y57	Solve two steps arithmetic word problem: Multiplicative and additive

When the SACMEQ II test was conducted in 2000, it was possible to work out the percentages of Seychellois children who were at each of the eight competency levels. The results are presented in Table 7.5. The pupils were scattered all over the eight competency levels, thus indicating a large variation in their ability to do mathematics. A sample (2.6%) was still at Level 1, a level which contained materials of the early childhood curriculum. At the other extreme, another small sample (1.5%) was at Level 8, a level containing materials that were assessing the knowledge of the

primary school teachers of mathematics. In a third analysis, I compared the percentage distribution of students over the eight competency levels of numeracy. The following results were obtained: i) the percentage of pupils at the lower levels (1 and 2) had decreased from 2000 to 2007; ii) in 2007, the percentages of pupils attaining the top level (7 and 8) have decreased; and iii) only 31.3% of the pupils have achieved Level 5 or better in SACMEQ III results (See Table 7.5).

Table 7.5 Comparison of distribution of pupils over the SACMEQ numeracy levels

Levels	SACMEQ II 2000	SACMEQ III 2007
1	2.6	1.9
2	20	15.9
3	24.2	24.5
4	19.7	26.4
5	13.8	14.4
6	13.3	13.2
7	5.0	2.4
8	1.4	1.3

The results suggest that even if the pupils' scores got worst on the one hand, their ability became more homogeneous, on the other. It may be argued that during the first years of the reform the weaker pupils improved at the expense of the brighter pupils.

7.2 Longitudinal achievements

The secondary data which were available also allowed for a longitudinal perspective on the pupils' achievements. Pupils' longitudinal achievements could be traced through the IPAM project data sets. As described previously, the education system in Seychelles wanted to have an idea of how the pupils' learning progressed through the

primary education system. Tests containing anchor items and new items each year were administered to the pupils from 2005 to 2009 covering Primary 2 through to Primary 6. Since the implementation of MLS started in 2006 it was possible then to describe the pupils' performance in terms of pre and post reform achievements. Findings from this longitudinal study revealed that pupils' achievements became better during the last part of the primary education cycles. No significant improvement occurred from P2 to P3 to P4. For this analysis I excluded the P2 results because the test was in Creole. The language difference weakened the comparability of the tests. P2 and P3 tests were exact replicas in terms of content areas except that the P2 test was in Creole.

There were nine items which were common in all the tests from P3 to P6. The items vary both in terms of the content area and their embedded cognitive demand. First, I computed the item mean. The values are shown in Table 7.6. In order to avoid ambiguities in the argument, I used the term item mean instead of item difficulty. Both concepts however, indicate the proportion of pupils in the analysis who were successful on a particular item. The items were scored 0 or 1 for incorrect or correct answers respectively.

The rate of change of the item means is a measure of the pupils' success on the items over time. If the rate of change is constant, it indicates that there has been no major change in the way the pupils performed on the item in question. In this particular discussion it indicates that no factor has significantly impacted on pupils' achievements of the item. However, if this rate of change of the item means is drastic it would mean that there has been an effect of a factor. Hence, if the rate of change is drastic in any direction, and for all items, it would suggest that some relevant factors have contributed to this effect.

Description of the anchor items, their corresponding level as per SACMEQ competency level, and their means, are tabulated in Table 7.6.

Table 7.6 Comparison of item means for the nine items which appears on all the tests from 2006 (P3) through 2009 (P6)

Item description	Level	2006 P3	2007 P4	2008 P5	2009 P6
Complete a number sentence using with an additive symbol (A)	1	(7) 0.49	(8) 0.51	(9) 0.65	(7) 0.72
Solve quotation simple arithmetic word problem (B)	2	(11) 0.40	(16) 0.63	(15) 0.59	(11) 0.81
Recognize edge of a cuboid and state how many cuboids have (C)	2	(14) 0.43	(22) 0.44	(23) 0.55	(13) 0.65
Identify shaded figures representing a similar fraction (D)	2	(13) 0.38	(20) 0.47	(21) 0.52	(16) 0.64
Link a net with its 3D object (cylinder) (E)	2	(19) 0.62	(37) 0.71	(36) 0.79	(19) 0.87
Interpret a pictogram in context (F)	3	(16) 0.47	(26) 0.60	(26) 0.67	(21) 0.78
Identify a 2D shape with 2 lines of symmetry (G)	1	(22) 0.26	(38) 0.25	(37) 0.34	(23) 0.70
Identify the two unit shapes of a composite shape (H)	2	(25) 0.52	(40) 0.57	(40) 0.66	(25) 0.88
Recognize and naming a cube (I)	1	(17) 0.69	(27) 0.72	(27) 0.79	(22) 0.77

These means were then plotted to facilitate the interpretation of their rate of change.

In such a case the gradient of the item growth curve was taken into consideration.

The following observations were made:

- None of these items had a mean of 1 or 0.
- The item means generally improved over the years. However, there were some exceptions. The mean of Item B was 0.63 in 2007 and dropped to 0.59 in 2008. The mean of Item I was 0.79 in 2008 but dropped to 0.77 in 2009.

- The one item classified as a Level 3 item was not necessarily the most difficult item on the test for this group of pupils.
- The pupils in P6 performed considerably better than P3 pupils on only three of the items (Items B, D and G).

To further study the rate of change in means of those nine anchor items, I generated the growth curve of each one. For visual representation and ease of interpretation I have drawn the curves in threes on one single chart. Of interest on each chart, is not the relative difficulty level of the items, but the pattern of the curves: in other words, the gradient of the lines between two successive years.

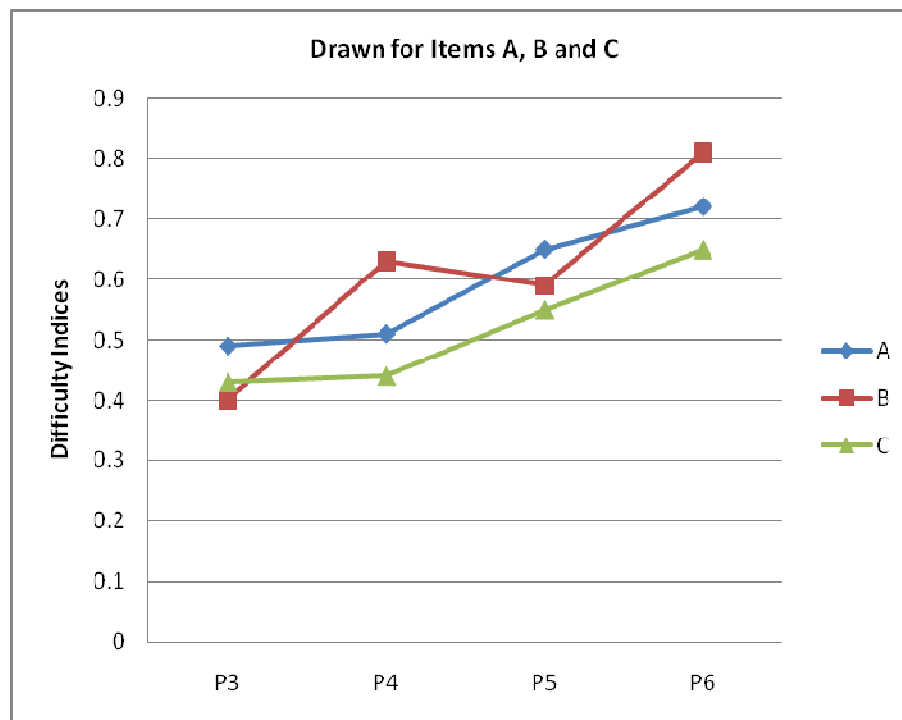


Figure 7.1 Growth curves drawn for the items A, B, C

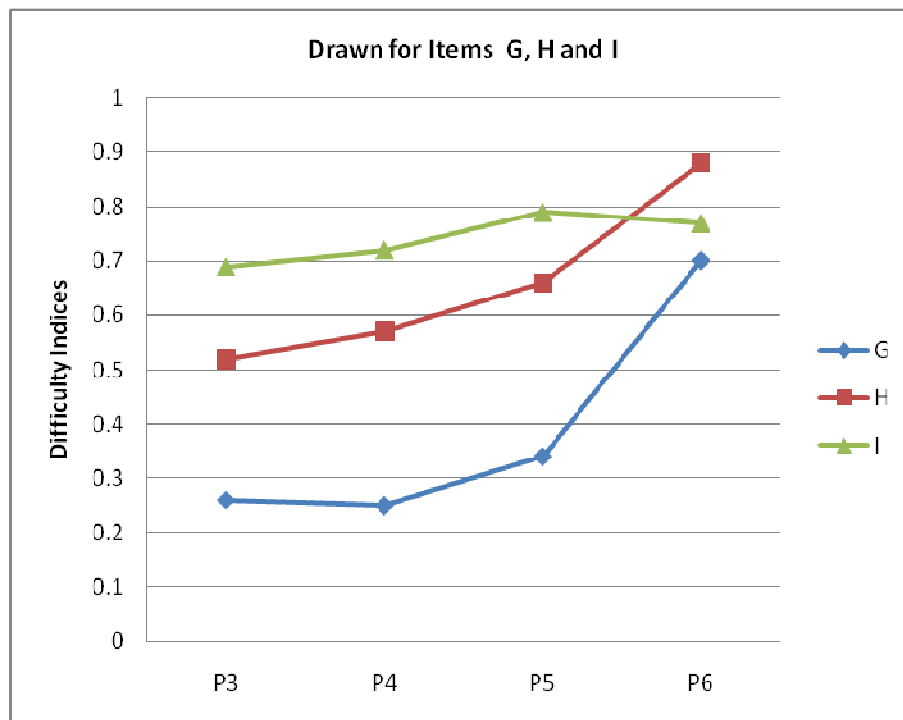
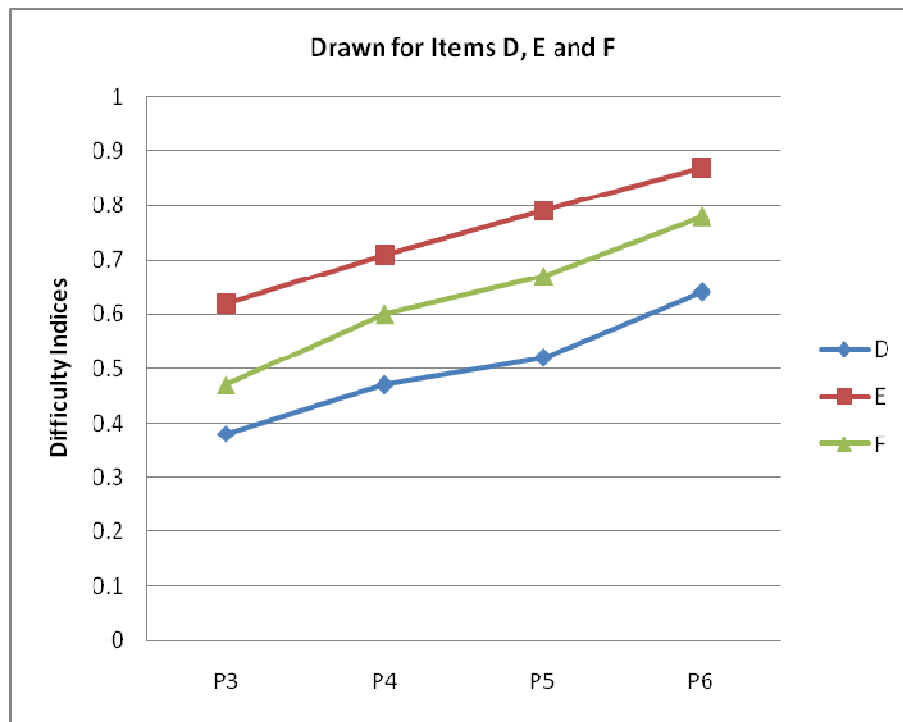


Figure 7.2 Growth curves drawn for the items D to I

The diagram indicates that for two of these items, (B and I) their curves show an upward trend throughout. Another two items (G and H) show a sharper change in the

growth curve after P4. The rate of change of means for Items D, E and F was almost similar from P3 to P6.

In this analysis I was looking for sharp changes in the item growth curves, which would signify whether a change in achievement occurred as the pupils moved from one grade level to the next. When all three diagrams are superimposed there is no clear evidence of significant changes. The average increase in item means during the first, second and third year were 0.07, 0.07 and 0.14 respectively. ANOVA conducted on these three sets of values generated the following result: $F(2, 24) = 2.04$, $p\text{-value} = 0.15$. The result indicates that the average change of difficulty indices during the three years was not statistically significant.

A similar analysis was done for the more sophisticated items which were common only to the P4, P5 and P6 tests. The items were more sophisticated in terms of their embedded skills and their cognitive demand. A summary of the difficulty indices are presented in Table 7.7

Table 7.7 Comparison of item facility indices for the nine items which appear on all the tests from 2007(P4) through 2009 (P6)

Item description	Item levels	2007 P4	2008 P5	2009 P6
(J) Comparing fractions where the numerator is one.	3	(12) 0.28	(13) 0.35	(27) 0.59
(K) Identify the value of an addition: The addends are expressed in words	3	(04) 0.26	(05) 0.18	(26) 0.49
(L) Count the number of days before and after a given event	3	(17) 0.33	(17) 0.53	(30) 0.71
(M) Identify a pattern expressed in graphical forms	4	(21) 0.32	(22) 0.48	(28) 0.58
(N) Interpret a simple chance occurring event	4	(30) 0.34	(32) 0.48	(33) 0.60
(O) Extract information from a bar graph and compute accordingly	5	(36) 0.12	(35) 0.21	(37) 0.29
(P) Identify an algebraic scenario and associate it to its correct number equation	6		(25) 0.58	(31) 0.72
(Q) Compare capacity expressed in different units of measurement	5		(24) 0.28	(32) 0.41
(R) Identify the number of right angles in a diagram	3		(20) 0.29	(39) 0.37

The general trend is that the item means increased from P4 through to P6 except for Item K. An analysis of the growth curve supports this observation. For Items L, M, N, and O the growth curve is more or less a straight line. This indicates a constant rate of change of means.

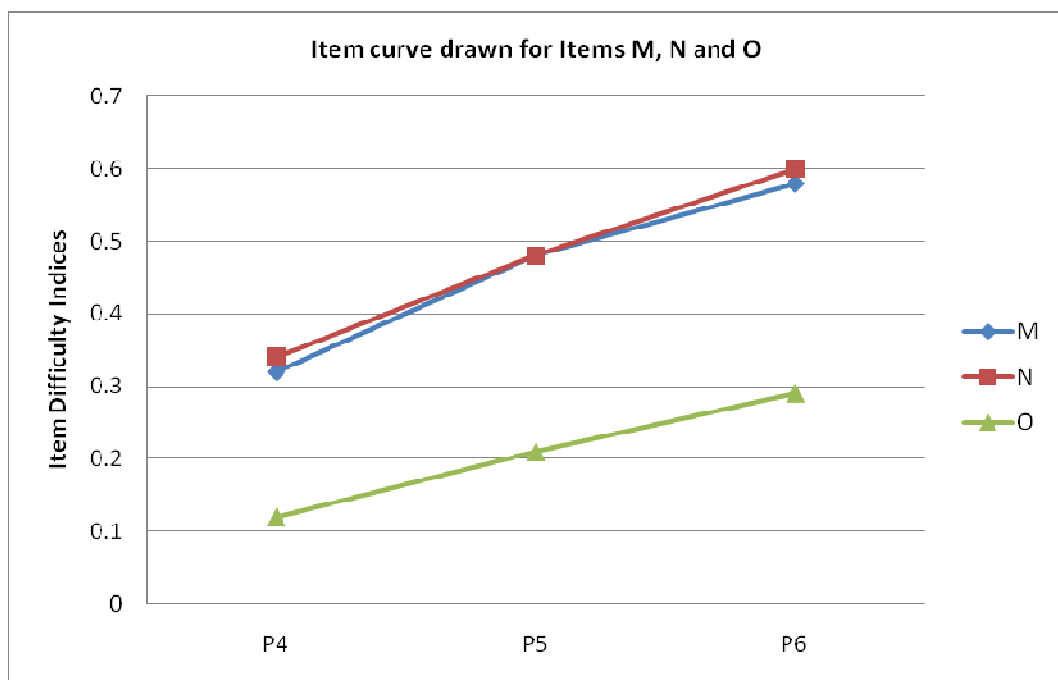
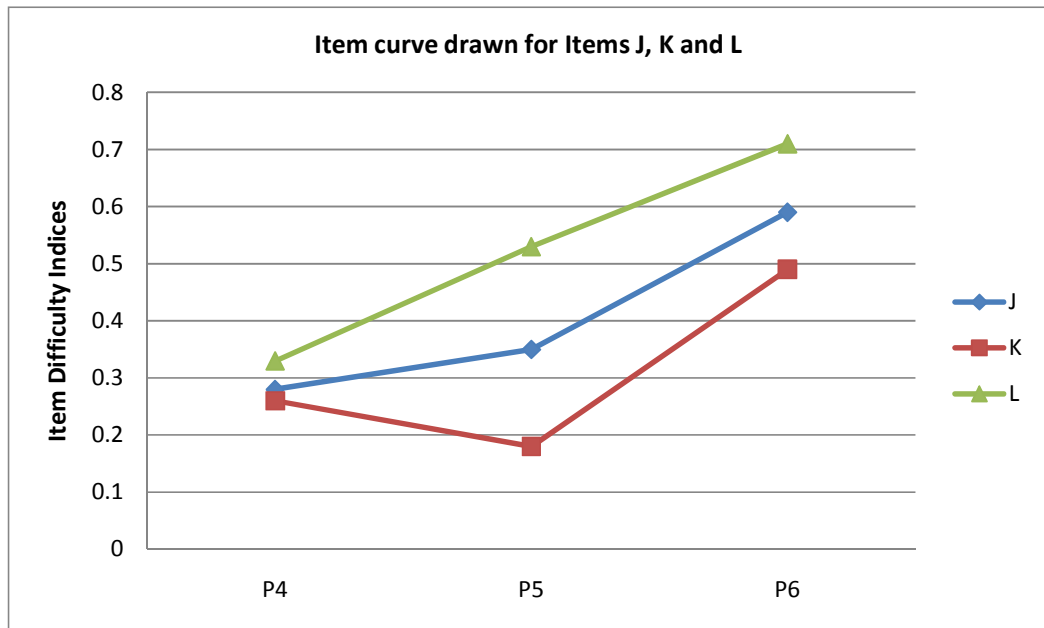


Figure 7.3 Growth curves drawn for items J, K...and O

Items, L, M, N and O have similar growth curves. The segment P5 – P6 for growth curves of Items J and K are sharp and positive. Nevertheless, on the basis of these item growth curves there is no evidence of a difference in performance before and after the implementation of MLS. The average increases in the difficulty indices,

from P4 to P5 and from P5 to P6, were 0.10 and 0.17 respectively. ANOVA done on these sets of increased indices generated a result, $F(1, 10) = 1.9$, $p\text{-value} = 0.19$. This indicates that the average change in item mean during the three years was not statistically significant.

Further analysis of pupils' achievements on the longitudinal data was done using the SACMEQ competency levels. This is described below. I discussed elsewhere that following the SACMEQ II study, the consortium agreed to subdivide primary school mathematics skills into eight hierarchical levels. Subsequently, the children's overall success on the test determined their position along the level continuum. Based on the overall distribution of the scores per test, I established cut-off marks to estimate the pupils' attainment level. Stacked bar graphs were drawn to illustrate the distribution of pupils per year group across these levels (see Figure 7.4).

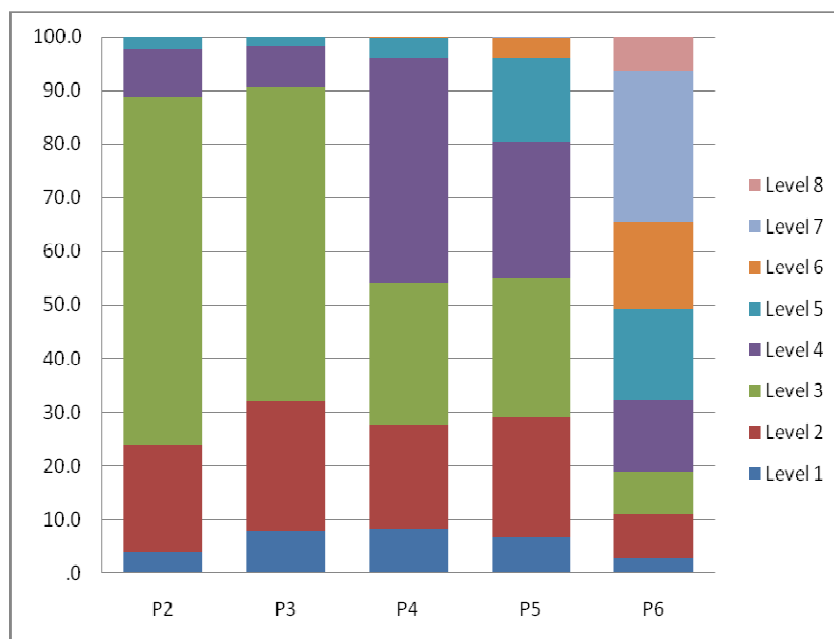


Figure 7.4 Stacked bar chart showing the percentage distribution of P2 to P6 pupils attaining the different mathematics competency levels

The figure shows that the distribution of pupils across the levels was almost similar for P2 and P3 groups. In fact, there were less pupils at Level 1 in P2 than in P3. There was also a very small percentage of pupils at Level 5 in P2 and P3. Most of the P4 pupils remained scattered across the first five levels but the distribution was different. There were almost equal proportions of pupils at Level 1 in P4 as in P3. As the pupils moved from P3 to P4, the proportion at Level 3 reduced and a larger proportion was at Level 4. There was even a small proportion of P4 pupils who had reached Level 6. At P5, the percentage of pupils at Level 1 had decreased, and the percentage of pupils at Level 5 and 6 had increased. At P6 there were more than 50% of the pupils who had reached Level 5 or beyond. There were pupils who had reached even Level 7 and 8.

On the basis of that dataset there was an improvement in the pupils' performance. Between P3 to P4 (2006 to 2007) there was no significant improvement in the pupils' achievements. From P4 to P5 (2007 to 2008) the change in the pupils' distribution across the levels were very radical. Pupils who were at Level 4 in P4 were redistributed across Levels, 4, 5 and 6. Pupils who were at Level 2 in P5 (2008) were redistributed across Levels 2, 3, and 4 in P6 (2009). The appearance of Level 7 and Level 8 in P6 indicates that the rate at which the pupils were changing levels became faster after 2008 and onwards – just 2 years after the reform had begun to be implemented.

When MLS was initiated in 2005, the Ministry of Education used the pupil-performance in the SACMEQ II study to develop a working target. Local mathematics educators in Seychelles agreed to make Level 5 the minimum acceptable level which pupils should have attained by the end of primary school. In 2000, from the SACMEQ data, only 33% of the pupils left P6 having attained this

minimum standard. The target, as stipulated in the National Numeracy Improvement Plan (Ministry of Education 2005), aimed to have at least 50% of the pupils at Level 5 by the time they leave primary education. In 2009, three years after the reform had been in schools, 67% of the P6 pupils were at Level 5 or beyond. This suggests that the target was attained in 2009.

However, this finding has to be interpreted with care. Here the sample was based on 1080 pupils, only those who sat all the tests from P2 to P6. Pupils who missed out at least one test were excluded in this analysis. I happened to get the report from the Ministry of Education for 2009 results in which the pupils were also classified as per SACMEQ competency levels. The MoE's analysis was based on all the P6 pupils in the system ($n = 1276$) who sat the 2009 test. This indicates that 196 (15%) of the pupils were excluded in my analysis. The Ministry's findings showed that 43% of the pupils had reached the desired level. Whilst I would not take a decisive stance to argue that the target set at 2005 had been achieved, I would, however, conclude that there was an improvement in the pupils' performance from 2007 to 2009. This finding can be further supported by a basic analysis of items difficulty indices (item means) of the anchor items on SACMEQ (2000), (2007) and IPAM (2009) tests: all of which were sat by P6 pupils. In Table 7.8, all the items common to the three tests are aligned. There were 20 items. The item mean of all those 20 items per test are tabulated beneath.

Table 7.8 Alignment of items common to the SACMEQ and the IPAM tests along with their respective means (difficulty indices)

SACMEQ 2000		SACMEQ 2007		IPAM 2009	
yItem	yMeans	zItem	zMean	iItem	iMean
y01	0.89	z01	0.88	i14	0.95
y05	0.91	z05	0.91	i06	0.83
y03	0.84	z03	0.81	i04	0.87
y40	0.76	z22	0.83	i22	0.77
y04	0.78	z04	0.74	i05	0.78
y58	0.63	z45	0.69	i19	0.87
y38	0.65	z29	0.71	i21	0.78
y36	0.67	z28	0.65	i11	0.81
y35	0.55	z27	0.64	i12	0.9
y09	0.65	z08	0.6	i10	0.78
y18	0.62	z12	0.62	i30	0.71
y50	0.49	z40	0.59	i35	0.77
y47	0.5	z37	0.6	i34	0.68
y29	0.6	z31	0.59	i28	0.58
y28	0.57	z20	0.53	i16	0.64
y45	0.38	z34	0.36	i20	0.63
y30	0.33	z23	0.35	i13	0.65
y24	0.36	z16	0.35	i26	0.49
y33	0.28	z26	0.26	i60	0.45
y54	0.3	z41	0.28	i36	0.34

The results show that for sixteen (16) of the common items (80% of the time) the item mean of the IPAM items were the best. Considering the fact that SACMEQ 2000 was better than SACMEQ 2007, I compared the mean of the former to that of the IPAM test. The results revealed that the difference in means exceeds 0.10 in eleven (11) cases. This implies that the difference was quite large. To complement the discussion, I aligned the distributions of pupils across the competency levels for the SACMEQ tests and the IPAM 2009 results (See Table 7.9).

Table 7.9 Comparison of the SACMEQ results against the IPAM results

Levels	SACMEQ II 2000	SACMEQ III 2007	IPAM (2009)
L1	2.6	1.9	2.8
L2	20	15.9	8.1
L3	24.2	24.5	8.0
L4	19.7	26.4	13.5
L5	13.8	14.4	16.9
L6	13.3	13.2	16.2
L7	5.0	2.4	28.2
L8	1.4	1.3	6.3

This cross sectional analysis reveal that although in 2009 there were more pupils at Level 1 than in the previous result, there were an incredible amount that have reached Level 7 and 8. This in itself is evidence of improvement.

The next question which arises relates to how much of this improvement is attributed to the MLS reform given this type of analysis. Certainly the present analysis disallows me to make any major claim along this line. What I can say however, is that MLS reform has been the only mathematics education related project during the period 2006 – 2009. There were however, other school-level projects which targeted the teachers’ professional development but they were not comprehensive or as systemic as MLS. This leaves me to argue that MLS, along with the other movements in education, were favourable to the development of mathematics in that they collectively influenced an improvement in the pupils’ achievements in mathematics.

7.3 Variability in achievement scores

My data suggest that there might be a link between variations in the pupils' scores and the use of MLS but this finding needs more examination. This thinking was triggered after a decrease in score variations was observed in SACMEQ III data. Unfortunately, box plots drawn for the IPAM longitudinal data did not add much to the speculation (see Figure 7.5).

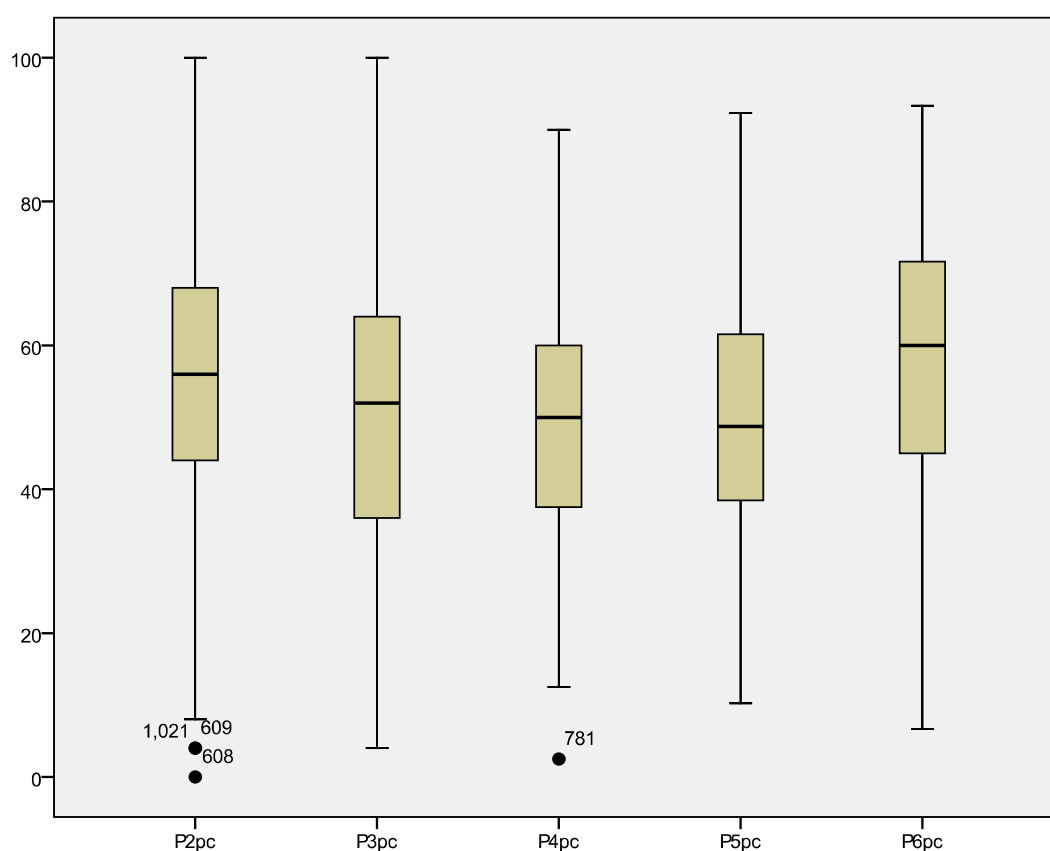


Figure 7.5 Box plot for the score distributions for the P2 to P6 test

There is an inconsistent pattern in the score variability which was further expressed numerically through the calculation of the interquartile range (IQR) of the sets of scores (see Table 7.10). From 2005 to 2006 the IQR went up. During the MLS introduction year it came down and then went up again until 2009. The IQR in 2007

was the smallest – implying that during 2007 the group was more homogenous. This matched well with the SACMEQ data which show that in 2007 the P6 cohort was more homogeneous than in 2000. The year 2007 was the year in which emphasis was being put on the reform.

Table 7.10 Comparison of variations using the interquartile range

	P2 2005	P3 2006	P4 2007	P5 2008	P6 2009
Q1	44.0	36.0	37.5	38.5	45.0
Q3	68.0	64.0	60.0	61.5	71.7
IQR	24.0	28.0	22.5	23.1	26.7

There is a pattern in the data which seems to suggest that IQR relates to the emphasis put on MLS. In 2007, for instance, when everybody was talking about MLS and a lot of emphases were placed on its implementation in schools, the IQR for both the SACMEQ and the IPAM tests went down. In 2008 there was less control on the use of MLS as the subject leaders in schools were on training. The leaders spent little time in schools and were rather busy completing assignments. The leaders reported in the focus group that when they were away there was no certainty that the teachers would comply with the reform requirements. In 2009 the leadership of the reform was transferred to the schools and IQR rose to its highest.

7.4 Summary

The data I presented in this chapter provide a tentative answer to the extent to which MLS had impacted on achievement. I acknowledge that my argument is not strong on the grounds that I was not able to isolate the effect of MLS on the achievement scores. However, using both longitudinal and cross-sectional data I was able to

develop an argument that suggests achievements had improved in the context of the reform. Furthermore, my data connect the use of MLS with a decrease in pupils' score variability. In other words, the evidence suggests that to some extent the reform did have an impact on the pupils' achievement

From my point of view, this chapter contributes to the current conversations on pupils' achievements in Seychelles. My knowledge of what is going on at the moment reveals that policy makers still believe that pupils' achievements are not progressing. The data suggest otherwise. Due to the poor state of empirical research in the country, it could be possible that policy makers do not have the proper findings on which to base their arguments. Data from this chapter will change the course of the conversations.

CHAPTER 8 The implementers' experiences

The principal aim of this chapter is to report on the implementers' experiences of the reform. The bulk of the chapter is a product of a constant comparative approach to data analysis (Strauss & Corbin, 1998). I report on themes which emerged as cross-cutting in schools from the implementers' accounts of their experiences. They appeared as affordances and challenges to reforming instructional practices in the context of a small island developing state. Some of the issues discussed under these themes are complemented by quantitative data collected mainly through the questionnaire with teachers.

In developing this chapter, I anchor my analysis on the notion of context (Braun, Ball, Maguire, & Hoskins, 2011). By context I mean the environment into which the reform was enacted. I limit the environment to the school only. I consider the model I discussed in Section 2.5 of this thesis. However, I inquired into the area labelled as "the situation" in Millett and Bibby (2004) to determine how the reform processes could have been facilitated or hindered. My analysis suggests that although the main implementers liked the reform, implementing policy was a challenge in schools in Seychelles. The chapter is organised under the following headings of mediating instructional change and affordances and challenges to enacting reform.

8.1 Mediating instructional change

Teachers' decisions to take reform ideas on board is affected by a number of factors (Millett & Bibby, 2004; Spillane, 1999). The influential factors include those within

the immediate school environment, termed as the situation, and those operating at the periphery of this environment. On a daily basis within the situation (Millett & Bibby, 2004), pupils and the teachers' professional colleagues exert their influences on the teachers' decisions in a number of ways. Outside the teachers' immediate working environment there are the external professionals, policy makers, the public, and private sectors, all of whom, in meaningful ways, exert their influence on the teachers' decision to reform their practices. Teachers' own beliefs and conceptions do influence their decisions to reform practices (Handal & Herrington, 2003). In a study to comprehend how a group of teachers experienced reform, Ryder and Banner (2012) conclude that aligned personal, internal, and external context provide a mediating support to teacher change but tension within these contexts may create barriers to reform and change. Hence, when evaluating reform, many elements need to be considered in order to understand the nature and direction of reform outcomes. Braun et al. (2011, p. 585) argue "... policies are intimately shaped and influenced by school-specific factors, even though in much central policy making and research, these sorts of constraints, pressures, and enablers of policy enactments tend to be neglected". By school-specific factors Braun et al., refer to aspects such as school intake, staffing background, history, culture, ethos of the school, building, and resources, in addition to external authority. These factors are very much in line with what Millett and Bibby present in their model except that they are conceptualized under different terms. An examination of how those reform levers interact on the implementers' response to the reform, presents a first avenue to making sense of the reform outcomes. As precedence, I refer to Venkatakrishnan and Brown (2009) who argue on five bases for evaluating policy or reform implementation: changes to practices, teachers' self reported data, consultants' views, pupils' attainment, and

students' experiences. The voices of both the implementers and beneficiaries count in describing the context of implementation. Some of these bases were considered in this present research. The voices of the teachers, subject leaders, and key support providers were invaluable. The direct voices of the learners were omitted to leave the research manageable yet they were heard through their achievement results. The issues discussed in this section serve as a lens to analyze the context in which MLS was implemented.

8.2 Affordances

Viewing affordances as factors that make an event possible, I grouped the teachers' responses into those within school features that could have possibly facilitated the enactment of MLS. Through the questionnaire I was able to capture the teachers' perception of the level of support they were getting from their leader and colleagues. Through focus group interview the teachers qualified with examples what it meant to be supported and worked in collaboration with peers in small settings. The responses indicated that there was a kind of internal support structure which had been formed and most teachers felt happy to report on it. Here I talk about teacher collegiality and the support the teachers received from the subject leaders.

8.2.1 Teacher collegiality

Teacher collegiality encompasses the professional and social space into which teachers relate with one another (Jarzabkowski, 2002). The fact that the approach to teaching mathematics which was advocated to teachers was new made it more important to see how teachers used their social interactions to overcome their

weaknesses. An inquiry into the teachers' responses to teacher collegiality in their schools provided some insight.

On the questionnaire, the teachers were asked to indicate on a 4-point Likert Scale, how frequently each of a series of items relating to teacher collaboration occurred in their schools. In that analysis I combined the percentages of teachers who responded "Rarely" or "Almost never" into one category which I labelled as "Not frequent". I combined the percentages of those who responded "Always" or "Most of the time" into a new category which I labelled as "Very frequent". The outcomes are presented in Table 8.1.

Table 8.1 Teachers' responses to items measuring the frequency of teacher collaborative activities

Nature of teacher –teacher collaboration	Very Frequent (%)	Not Frequent (%)
1. Teachers discuss their work with colleagues	88	12
2. I can count on my colleagues for help on my maths teaching	87	13
3. I initiate discussion about the mathematics with colleagues	83	17
4. Teachers share mathematics learning materials	82	18
5. Teachers help one another about maths work	80	20
6. Teachers create time to work with others	72	28
7. Teachers tutor one another about mathematics	59	41
8. I am on my own with my mathematics work	23	77

The most frequent activity related to: teachers discussing their work with colleagues and teachers counting on one another for help with the maths teaching. More than 85% of the teachers answered very frequent to these two items. However, the less frequent among the lot was the activity expressed in Item 8: (I am on my own with my mathematics work). It is clear from this set of data that some forms of teacher collaboration existed in schools and that a large percentage of teachers were part of

that collaboration. In fact the results show that the teachers had been collaborating in a number of ways. Seventy seven percent (77%) responded “not frequent” to the item, “I am on my own with my mathematics work” showing that a large majority felt that they were being supported in one way or another. However, the 23% (almost one quarter) who responded very frequent to the same item triggered further inquiry to understand why some teachers were feeling that they were outside the professional circle in spite of all the effort to strengthen the school-based collaborative network.

One key informant explained that “some teachers lacked the collective charisma” (KI02). Here she was implying that some teachers do not enjoy working in teams. They prefer to be on their own. Some fear that their teaching weaknesses might be unveiled if they participated in groups. The tendency for teachers to be on their own appeared to be a matter of choice by the teachers themselves as opposed to deliberate exclusion by the others. On the contrary, in small schools in which there was only one class per level there was a general tendency where a teacher worked alone in contrast to bigger schools with different classes per grade level. In such cases, teachers’ impression of them being alone was an indication that they had no one to interact with. There was no collaborative structure in place to group these teachers. Later in this chapter, I talk about team planning. It would become obvious then why some teachers in certain schools were at a disadvantage with regard to teaching and learning mathematics collaboratively.

In a subsequent analysis I organised the teachers in groups as per distinct variables to examine how the various variables influenced the responses. The various group results are tabulated in Table 8.2.

Table 8.2 Comparison of various teacher groups on their attitudes to school-based collegiality

Variables	Mean	Std. Dev	N
<i>Geographical location of school</i>			
Central	24.43	4.61	65
South	24.42	2.16	26
East	23.31	4.13	32
North	23.30	3.86	40
West	22.89	3.19	27
Island	22.76	4.36	29
<i>School size</i>			
Large	24.19	4.90	54
Medium	23.57	3.22	79
Small	23.38	4.03	86
<i>Teacher teaching cycle</i>			
Upper Primary	24.33	3.49	63
Middle Primary	24.28	3.85	65
Early Childhood	22.59	4.32	87
<i>Teacher age group</i>			
47 – 55	24.13	3.66	30
>55	23.86	3.18	7
25 – 35	23.85	3.62	82
36 – 46	23.60	3.43	62
<25	23.50	4.42	36
<i>Teacher length of teaching</i>			
Less than one year	24.50	3.27	10
More than 10 years	23.73	3.50	106
Between 6 to 10 years	23.70	3.53	40
Between 1 to 5 years	23.64	4.13	61

To gain better insight into how the various groups impacted on the teachers' perception of collaboration, I carried out a Kruskal-Wallis test on the data and the results of this analysis are tabulated in Table 8.3.

Table 8.3 Kruskal-Wallis test results for the comparison between various groups of teachers and their self rating index score on school based collegiality

	χ^2	<i>df</i>	sig
School location	10.19	5	0.070
School size	3.45	2	0.178
Teacher cycle	9.16	2	0.010
Teacher age	0.74	4	0.947
Teacher length of service	0.76	3	0.859

The results were statistically significant at significance level 0.05 for only the variable of teacher cycle. Upper primary teachers were more positive on teacher collegiality than teachers at the other cycles. Early childhood teachers were less positive on their perception about school-based collegiality.

In the focus group interview, the teachers noted the existence of team planning, a structure put in place successfully by all schools and endorsed and supported by the Ministry of Education to get teachers to work collaboratively. One teacher from Gamma Primary explained a typical occurrence during the team planning session.

[We] prepare lesson, for example in my case, I sit with the teachers in the same level teaching mathematics. So we sit down, we discuss about the activities that we're going to use for the different steps in the MLS. We share ideas. We get ideas from each other. We get ideas to plan a proper lesson. (GAM T1)

Teachers reported that this element of discussion and sharing of ideas occurred during team planning sessions. I note that the teachers talked about working with other teachers at the same level. There was no mention of exchanges across levels and teachers in small schools (one class per year group) were not benefiting from this

system of collaboration. Teachers from Kappa Primary reported that they would bring in their subject leaders or consulted her if they became stuck with ideas or wanted some form of guidelines about developing topics. Outputs of team planning are usually notes about how a lesson should progress but seldom a lesson plan.

Although team planning is a common activity in the schools, it is limited to the one-hour session per week where teachers, as a small group, brainstorm about the contents of the lesson. No teacher for instance, reported on cases of peer observation or teaming as in learning cycles or lesson study (Fernandez, 2005) - the extension of team planning.

What emerged as striking in the teachers' reports on internal support is that they value the collaboration which they had developed with their peers. However, other than team planning and some isolated cases in which the teachers shared their personal teaching resources (teacher-made or commercial ones) there was no other given intrinsic teacher-teacher collaboration which they talked about. On the other hand they talked about cases whereby teachers would cover others' classes in emergencies or absence cases, but such cases were directed by the school management and were not teacher-led activities.

8.2.2 Support from the subject leaders

With regard to the support from the leaders, I could draw from the questionnaire that the teachers were positive about the nature and quality of support they were getting. A summary of the responses are displayed in Table 8.4. At least 85% of the teachers agreed with all items within this domain. The teachers were more positive on these two items: i) the leaders give out supportive feedback, and ii) the leaders do their best to support the development of mathematics. Ninety three percent (93%) of the teachers responded "agree or strongly agree" to these two items. The teachers were

less positive on the items measuring: i) leaders' support to teacher initiative, and ii) the reliance on their leaders for teaching advice. Only 85% of the teachers were positive on these two items.

It is true that these values were all very high. However, I want to make sense of the teachers' responses to two of these items. It is interesting to note that whilst the teachers were most positive of the fact that the leaders gave out supportive feedback, reliance on their leaders for teaching advice emerged as the least positive item. What I could infer from these responses is that perhaps the leaders attempted to create a supportive learning environment but they were not capable of providing professional teaching assistance.

Table 8.4 Percentages of teachers agreeing and disagreeing to items about school leadership support

Statements assessing school-based leaderships	A (%)	DA (%)
f) They give supportive feedback to teaching about their teaching	93	7
i) They do their best to support the development of mathematics	93	7
b) They closely monitor pupils progress	90	10
e) They create possibilities for teachers to discuss teaching ideas	90	10
h) They welcome new teachers ideas about mathematics teaching	90	10
a) They value our mathematics teaching work	88	12
c) They support teachers with instructional-related problems	86	14
g) Teachers cannot rely on them for mathematics teaching advice	15	85
j) They do not encourage new teacher initiatives	15	85
d) They do not show interest to what teachers are doing	13	87

A = Agree, DA = Disagree.

Similar to the situation in the previous cases, the teachers' responses were analysed by smaller groups based on the variables: school geographical location, school size, teacher teaching cycle, teacher age group, and length of teaching service (see Table 8.5). Kruskal-Wallis tests carried out to determine differences among groups within a

particular variable show that there were group differences within the variables, school size ($\chi^2 = 8.8$, $df = 2$, $p\text{-value} < 0.05$) and teacher cycle ($\chi^2 = 13.9$, $df = 2$, $p < 0.05$). The results suggest that school size and the teacher cycle were likely to influence the teachers' evaluation of support they were getting from their leaders. Teachers in the medium sized schools were more positive than those in large or small sized schools about the support they were getting from the leaders. Teachers at the early childhood level were generally less positive than teachers at middle and upper primary cycles.

Table 8.5 Comparison of various teacher groups on their attitudes to school based support structure

Variables	Mean	Std. Dev	N
School Size			
Medium	31.94	3.70	86
Large	29.81	5.96	79
Small	29.57	5.85	54
Teacher cycle			
Early Childhood	29.22	4.99	87
Middle Primary	31.74	4.88	65
Upper Primary	30.90	5.56	63

Teachers in the Gamma and Kappa schools talked positively about the support they have been getting from their subject leaders. School leaders were those teachers' prime recourse for pedagogical dilemmas. Teachers from the Kappa Primary reported that their leader would even intrude in their conversations at times if she sensed that the teachers had been talking about challenges associated with their mathematics teaching. She was described as supportive by the teachers in the focus group interview.

In summing up I can report that the teachers talked positively about how they were supported internally. The teachers were positive about the collegiality that they developed especially among colleagues. The leadership support was also commended in most schools. However, my focus group data reveal that whilst the majority of teachers had strongly espoused the roles played by their subject leaders in supporting their enactment of the reform, there were cases of impediment. I expand on this point in the next section about challenges as I examine how some teachers described the implementation of reform in their schools.

8.3 Challenges to enacting reform

Although the teachers strongly endorsed MLS as an invaluable teaching tool the accounts of their experiences enacting the reform were full of difficulties. When the teachers were probed further, it became clear that the overall picture of high compliance and fidelity needed to be interpreted with care. Nevertheless, there was strong will on the part of the teachers to revamp their practices. If it is the intention of policy makers in small states to understand how schools align their resources and capacity to enact reform calls, then understanding what the implementers have got to say with regard to change of practices, becomes imperative. Data from this research show that the primary schools in Seychelles were challenging sites into which the MLS reform was implemented. This section elaborates on these challenges.

8.3.1 The rigidness of the reform

One key finding which comes out from the teachers' impressions of their experiences relates to the way the reform message reached them. Tracking down the implementation phase, plus data presented in a previous chapter about the process by

which MLS was brought to schools, shows evidence that the teachers were consulted about aspects of the reform throughout. However, deep engagement with the data indicates that the majority of the teachers felt that the opportunity for them to participate came at a point when decisions were already taken about the basic features of the reform. In their responses, the teachers acknowledged that they were told of the reform message and that they were properly sensitized. Yet, they reported that they had no control over what was going on. Furthermore, the way some school leaders acted during the process of reform led the teachers to feel that the reform was about rules which they had to abide to. This leads me to argue that the teachers' decision to comply with the reform was not necessarily fully intrinsically motivated. For instance, ALP T4 remarked,

Anyway, this is the problem with Education. Each time they want to introduce something they put all teachers in the same bag. I think, like that they can implement whatever they like. [ALP T4]

The response clearly sounded like the voice of a teacher who felt she might have been forced to adopt the new teaching approach. The expression, "*they put all teachers in the same bag*" suggests that this particular teacher did not necessarily feel that the overall poor teaching status which existed in schools applied to her. Later in the interview that same teacher remarked: "*...but even if you were frustrated, nothing would happen. It was a sort of rule coming from the Ministry whereby everybody got to do it.*" This statement further confirms that the reform message might have been viewed as rules to obey even if this was not the intention. Then again one can argue that when a reform is made mandatory it automatically carries with it this rule connotation.

The idea that the teachers might have perceived the MLS imperatives as rules to obey is further exemplified below. Teacher 2 from Alpha primary

categorically rejected the idea that there was a need to change although along the way, she felt that MLS had benefited the teaching.

MLS has done good things in schools. However, when we were given the reasons to change to MLS we felt that we were not teaching as we were expected to. And this really demoralised a lot of us [ALP T2].

That teacher viewed the move to improve teaching as a system's lack of respect and appreciation for what the teachers were doing in schools.

We felt bad. We felt that our effort to give the pupils a good education was not being appreciated [ALP T2].

Such was her view about the call to reform practices. Responding to whether she would always feel the same in the face of any teacher-change reform, she replied, "... *well not always. I don't know about my other colleagues. But we would appreciate if they come up with good facts* [ALP T2]. 'Good facts', from the teachers' point of view, means that the system should come up with information as to who exactly was not teaching properly so that intervention or reform could be specific. Presumably, this teacher's thinking could have been a result of her school's past performance in national examinations. Alpha primary had been among the top performing schools over the last decade and the teachers might have come to believe that they were doing well in terms of teaching. Teacher 4 shared this view.

We have always been among the top schools. Sir, but I did not mind the idea of MLS. We knew there was something coming up as the school was told to put mathematics as a priority in their school development plan and we were told that this will happen [ALP T4].

The case reported above describes situations in which the teachers were confident in what they were doing prior to the reform. Although later on the teachers expressed

satisfaction with the reform ideas, the initial exposure phase was rather a disturbing one to their practices.

Even if this discussion is specific to one school, equivalent remarks were made in other schools. With regard to the teachers' initial attitude about the reform, in other schools the teachers reported not liking it, feeling frustrated, and being demoralised. The teachers suggested the following: application of evidence-based data, paying more attention to the teachers' effort, and derivation of accurate fact, as issues which the education system should consider when it thinks of implementing reforms in schools.

Teachers' image of the MLS reform message as a rule to follow was further exemplified in their actual enactment of the reform at school level. At Gamma school for instance, the teachers reported that they were not allowed to alter or amend the reform ideas even if sometimes they did it unofficially. Teachers at Beta primary reported that they were reprimanded by their subject leaders when they did not follow the MLS reform guidelines and that they could not even implement ideas which they have gained, in particular, from the internet. Both instances further emphasize the general idea that the imperative had reached the teachers as rules to follow.

One may argue that the MLS reform messages might not have been perceived as rules by all teachers since there were reported cases when some teachers did not teach according to the prescribed practices. I reported in my lesson observation data that out of 22 lessons only 5 fitted the pattern that MLS was advocating. However, this observation needs to be interpreted with care since deviation – failure to comply – could be a result of teachers' adaptation to make the

reform ideas fit the learning context. It could also be an excellent case of teachers' inability to teach as prescribed.

8.3.2 Instructional demand

The teachers believed that MLS had implications on their workloads. During the focus group interviews, BET T6 for instance, described the requirements, a plan for each lesson, as too much paperwork. She argued, *"...before that [before MLS] if we had 2 lessons during the day we prepared only one lesson plan. But for MLS we have to prepare one for each lesson.* Her colleague, BET T2, explained, *"You have to think of the different strategies that you need to bring in the lesson. You should not be doing the same strategy always. You need to have different lessons every day."* This observation intercepts with data from the other schools regarding the issue of instructional demand as a result of using the structure.

At Gamma Primary the teachers criticised the amount of time devoted to planning as a consequence of implementing the reform. Some teachers were against the notion of producing plans for every lesson, especially when they had two different periods of mathematics on a single day. *"Why do I have to plan all these lessons, I know what I am doing"* (FGD, GAM T6). Teacher 1 from the same school added: *How come when we have double period we prepare only one lesson but when it's two periods in a day, [it has to be] two lesson plans?* (FGD, GAM T1). The responses show that the number of lesson plans which the teachers were required to prepare under the reform had increased and the teachers were having issues regarding that increase. According to their responses, there seem to be two issues in the debate: (1) the number of lesson plans they had to prepare, and (2) the possibility of collapsing segments of the lesson structure to lessen the demand on planning time. What I gather from their arguments was that some successive lessons should be

merged, in which case not all lessons would have to consist of all the MLS components repeated throughout. Incidentally, I note that in actual practice (in the 22 lessons) there were more cases in which lessons were inconsistent with MLS requirements than those which fit the structure. Among the lessons which did not fit the MLS requirements were those follow-up lessons where one happened in the morning and one in the afternoon on a same day. In essence this suggests that in actual practice some teachers were already reconfiguring the requirements.

Some teachers reported that instructional demands were due to pressure exerted on them by their school management. From Beta primary, three teachers, BET T3, T4, and T5 talked about the kind of pressure they faced when members of the school management came to observe their lessons following the introduction of MLS. They felt a pressure to align their practices with their leaders' expectations of the MLS reform requirements. The Beta school teachers gave out several instances when the alignment could not be achieved and the kind of feud which such differences triggered. BET T5 believed that the management focused their observation on the steps included in the lesson as opposed to the contents that she had included in the lesson. Subsequently, at least three of the six Beta teachers in the focus group viewed their engagement with MLS as constraining, confined and limited. BET T3 talked about her experiences when she was reprimanded by her subject leader for altering the order of establishing the focus and the development of pupils' conceptual understanding. BET T4 presented an experience of a disagreement she had with her subject leader on what should constitute the lesson focus. These last two observations re-emphasize the argument of the MLS imperative appearing as rules to obey.

The teachers felt that MLS interfered with other obligations they had to fulfil at school and this added pressure on them especially when they could not synchronize the requirements of the reform and the daily routines within a mathematics lesson. When a teacher said for instance, “...when I got to the school I began to use it because everybody was using it” suggests that there was a common practice going on in school while at the same time, a pressure to be alike, which might have dictated how one abided to reform calls. However, when a teacher reaffirmed that... “I need to cater for the different groups in my class” indicates that teachers faced serious dilemmas when it came to enacting the reform call. While the teachers have personal commitment with regard to their profession, they also have the pressure to be attuned to what goes on in their professional community. Collectively, these relate to the teachers’ obligations. Extending this picture to encompass the reality of classroom practices, teachers’ obligations may be more than what the teachers reported in the interview. Let alone the requirements of MLS, teachers are expected, for instance, to mark exercise-books, give out assignments, complete syllabus for the term’s work, etc... These are additional obligations which have to be fulfilled during daily practices. Surprisingly, the teachers did not explicitly discuss these points. When considering that MLS prescribed a 40-minute lesson and that these issues were not given consideration within the prescription, it leads one to ponder how they happened within actual mathematics lesson time. When the teachers were asked to discuss the limitations of MLS, these points were not raised. Even if one will argue that they were not major concerns since teachers did not report on them, I argue that those factors necessitate attention as they are being handled during the 40-minute MLS teaching time. Evidence accumulated from observation showed instances when the teachers were marking books, reviewing

tests, or homework. Hence, when I talk about obligations in this context I am also referring to the routines which are done by all classroom teachers on a daily basis.

The data suggest that to incorporate certain requirements of the MLS reform into actual teaching practices had inevitably imposed intellectual challenges on the teachers. Organizing mental activities, reviewing the last lesson, and establishing the focus of current lesson, required less intellectual capacity and were common in most lessons. However, fostering pupils' conceptual development – looking for real life examples, selecting or developing pupils' engagement tasks – required higher order teaching skills which, based on the teachers' responses, indicated they had had serious difficulties implementing them. When teachers discussed those aspects of the reform which they had seen more challenging to incorporate in their lessons, they all converged on the remark that the requirement to incorporate real life situations in their explanations was most difficult to achieve. Some teachers even believed that certain maths topics do not have corresponding real life examples or applications. Moreover, varying lesson strategies or pupils' organization were requirements of the reform which the teachers also considered difficult and challenging to incorporate in lessons. The extent to which the teachers' lessons contained those challenging parts was further explored in the data chapter on the nature of lessons.

Findings from the interviews and questionnaire were consistent on the kind of intellectual challenges of the reform. In the questionnaire, the teachers were asked to indicate on a 4 point Likert scale how frequently they incorporated each of the six major requirements of MLS in their teaching on a daily basis. I worked out a frequency table – percentage of respondents by item by options. The findings were most relevant when I reported on the percentages of teachers who responded most of

the time or always for each item since for seven of these eight items at least 97% of the teachers indicated most of the time or always.

I base my argument on the fact that teachers were always expected to incorporate those aspects of the MLS reform into their lessons. The percentage of teachers responding always was high for those aspects occurring at the start of the lesson: conducting mental activities (77%), reviewing lessons (90%), and tell pupils about the focus (73%). Comparatively, fewer teachers responded always to: incorporating real life examples in their explanation (31%) and concluding lessons with some kind of activity (34%). Further dissection of the data showed that 16% of the teachers indicated that they rarely conclude the lesson. Data from this table support claim that some components of the reform were more cognitively challenging than others.

Table 8.6 Teachers’ reported frequency of using each element of the MLS lesson template

Aspect of the MLS reform	% of teachers’ responses to each option	
	Most of the time	Always
(a) Begin lesson with a mental activity	22	77.1
(b) Review the content of the last lesson	9.6	89.9
(c) Tell student the focus of current lesson	26.3	72.8
(d) Incorporate real life example in your explanation	66.5	30.7
(e) Give out key examples for pupils to follow	44.2	54.8
(f) Use pupils’ prior knowledge in your teaching	30.7	67.9
(g) Create space for pupils consolidation task	41.5	57.6
(h) Conclude lesson with some kinds of activity	49.8	33.6

Note: 16.1% of teachers also responded rarely to Item (h)

The fact that the teachers failed to incorporate some aspects of MLS in their teaching introduces the issue of teacher competency and capacity. Some teachers, mainly from the Kappa Primary, viewed their own practices as plausible obstacles to learning. What they said about their teaching practices in many cases showed that they were unable to cope with the demand of the subject and the needs of the learners. The following were descriptors specific to this argument: teacher confidence, teachers disliking the subject, teachers' uneasiness with the subject, lack of pedagogical knowledge, and shallow teaching. One teacher claimed that MLS had been the only lesson model she had been exposed to. Other than the one teacher in the Kappa Primary focus group who believed that she had no problem with the teaching of mathematics, all the others were showing lots of doubts and confusions with regard to teaching the subject. KAP T2 for instance noted,

“Sometimes I blame myself too. I think maybe I have been teaching the wrong concept. This is what I feel. [...] I have been trained to teach maths but I did not like doing maths when I was at school. I've trained, I have to teach maths. First of all I did not feel at ease to start teaching maths. But at times I feel that I am teaching with experience ... I think I need certain... some knowledge on certain topics” [FGD, KAP T2].

This response along with other arguments presented by the teachers during this research support the claim that the training which the teachers had obtained under the cascading approach might have not been effective in building on what they brought to school upon certification. However, the teachers themselves did not feel this way about the learning benefit of the MLS implementation processes.

8.3.3 External support

Teaching support emerged as a theme with inputs from all the four schools. This highlights the centrality of support if reform initiative is to be achieved successfully.

The teachers talked about two sources of support: the internal and the external sources. I reported findings in relation to the internal support in Section 8.2. I reported on how the teachers described their relationship with their colleagues and the subject leaders. In general the teachers strongly espoused the internal support structure at their schools even if there were some isolated cases of impediment. However, what I report in this subsection suggests that there was a huge contrast in the way the teachers viewed internal and external support. The latter had been described as impinging on the teachers' capacity to enact the reform.

The 'external support providers' relate to those people from the headquarters mainly who came to support the teachers' work at the schools. The external support was structured and the support providers as they were labelled, came to school to assist teachers with their teaching problems. These education officials do not only support the mathematics activities but any other issues in relation to teaching and learning in the schools. In the interviews with the teachers they were described as inconsistent and lacked focus in their approach to supporting mathematics education. ALP T3 described her impression:

The support providers [do] not always speak the same language. They all have their own agenda and we are the one to suffer. I think there's a need to have some kinds of meeting at MoE [Ministry of Education] to get all these people to speak the same language. They should not confuse us. Early Childhood Section is saying something. Maths is telling us another thing and the subject leaders sometimes are trapped in the middle. So when we know Maths people are coming, we plan our lesson one way and when we know that the Early Childhood are coming we plan it their way [ALP T3, FGD].

Two teachers from the Beta Primary School gave some specific examples to show how they got confused by the external supporters.

Take graded tasks for example. Some people say that we need several types of tasks covering the same topic but some other people tell us that we need just one set of tasks but covering many objectives. We now then tend to stick to what we have been doing. Having small groups and setting one exercise for each group (BET T5).

This business of mixed ability is a problem... it is a good example. Early Childhood Coordinators [part of the Education Coordinator team] tell you to do differentiation. IPAM people [referring to members of the Mathematics Working Group] tell you to do graded tasks. The lesson plan that I do for IPAM, these ECC [people] do not accept it (BET T6)

The situation indicates that different standards were being applied in schools. It also indicates the authority of the different groups of people who supported school activities. Teachers were therefore compelled to shift from standard to standard. The situation also describes a state of instability as a particular standard or norm might have existed as long as its advocates were around. This might have prevented the teachers from knowing what was really good or effective. The group of teachers, with their limited pedagogical content knowledge of mathematics, might have not been able to judge for themselves which approach or which standard they should use. These teachers certainly needed something more robust and stable.

The subject leaders also viewed the external supports as conflicting and confusing. Each group of people was attempting to impose their own approach on the schools. The leaders sought a common approach or a common stance on issues relating to teaching mathematics. However, they argued that since they were under direct leadership of the Mathematics Working Group, they found themselves more likely to follow guidance from the working group. Yet they feared that if no specific stance is taken by the authority, there will be chaos when the working group will have been phased out.

An interpretation of the data presented under this theme suggests that the

external support was frail and lacked professional expertise. If it was the role of that support structure to assist teachers in the enhancement of their teaching, I argue that the teachers had not substantially benefited from this structure.

8.3.4 Programme and availability of resources

The teachers' immediate response to what was missing in schools in relation to the teaching of mathematics was the resources. Teachers from all the schools converged on this point. They felt that lack of resources prevented them from diversifying the learning experiences, hence affecting the extent to which they could use certain recommendations of the structure such as varying pupils' learning experiences. On a daily basis, a lack of resources could also affect the teachers' choice of topics:

There are some topics which I have never taught in schools because there are no resources. For example reflection: We do not have mirrors at schools and without the mirrors it will be abstract [KAP T4, FGD]

Teachers' reference to resources also included books – both the teachers' and the learners' textbooks. KAP T3 talked about the challenges in her low graders class. She remarked that since the pupils in her class could not write, the unavailability of workbooks meant that time was wasted on writing. Subsequently, the MLS suggestions could not be fully respected. One teacher from Alpha primary (ALP T3) felt that this overall lack of resources could be one of the teachers' sources of frustration and discouragement.

Alongside resources is the curriculum. The teachers felt that the primary mathematics curriculum was overcrowded. They felt that the topics were fragmented and did not offer a coherent set of objectives and mathematical ideas to be learnt. Teachers from Kappa primary were more vocal on this point. Just to restate: Kappa

primary had a history of excellent performance in the end of primary national examinations. One point which they argued in connection to the mathematics programme is the mismatch between assessment and actual teaching. Examples of the teachers' reflection on the issue were as follows:

In the assessment we have different concepts, while in the lesson we are dealing with just one concept (KAP T4).

[...] We are not satisfied with the results. There are other reasons why the results are not good. Maybe we are aiming too high too. Maybe we are giving too many assessments for them to do (KAP T2).

The two teachers were the longest serving teachers in the Kappa primary focus group and were more vocal about the assessment-teaching debate. In fact they contributed most of the data belonging to this theme.

8.3.5 Learners' engagement

MLS was introduced to improve teaching and ultimately pupils' learning. Teachers' accounts of their experiences using the reform, bring about an argument as to how the pupils' lack of commitment and engagement in their own learning might have affected the way the teachers addressed the reform. The two-way traffic analogy in making sense of teaching and learning is relevant here: both the teachers and the pupils have to be fully engaged for the experiences to be worthwhile.

The teachers felt disturbed by the fact that the learners were not performing to the teachers' expectations. In Kappa primary the teachers' discussion kept revolving around that issue. The teachers talked of pupils' attitudes and behaviour as barriers to teaching (barriers to make use of innovative ideas brought to schools). What becomes clear from the teachers' perception of the learners' commitment was

that MLS was not creating a teaching context that could stimulate learning. Along this line KAP T4 remarked, “*MLS is OK. The pupil is our concern.*”

In this section, I am focusing more on the responses from the Kappa primary teachers for two reasons: 1) Data from the focus group interviews show that the Kappa primary teachers brought forward more points than other schools on the issue of how the learners could impinge on the teachers’ ability to apply the reform, and 2) the teachers’ responses highlighted the roles of learners in the overall success of instructional reform initiatives. More interestingly, as the teachers’ responses unfolded, it also became clear what type of mathematics teaching prevailed in the school. KAP T3, reflecting on pupils’ achievements, noted, “*Sometimes they forget, I think. When the task is now, it is fresh in their mind. After some weeks, you give them an evaluation, they have forgotten everything. Marmay nou ti fer sa... [Children, we did all these]*”. KAP T1 presented another reflection relating to the learners’ ability:

Recently in P1 we were teaching addition vertically: One by one, two by one and two by two. One by one went on very well. Two by one also went on very well. When we mixed all three together....!! Some of them had lost track [KAP T1, FGD]

While this reflection relates to the issue of learning retention, it also highlights issues in conjunction to teaching. I view this reflection as a clear example of teachers promoting procedural knowledge in their teaching. It could be possible that the learners were after an alternative approach.

8.4 Summary

The implementers’ accounts of their experiences provide bases to evaluate and discuss the context of the reform. These accounts are grouped under two broad themes, affordance and challenges, explaining how occurrences within the

“situation” might have facilitated or hindered the MLS reform. With regard to affordances, the teachers talked about school-based collegiality and leadership as positive features of the reform. With respect to challenges, the teachers talked about the rigidity of the requirements, instructional demands imposed by the implementation, the inputs of the external support providers, unavailability of resources, the poor quality of curriculum materials, the learners’ poor engagement with the subject and potentially, their own lack of capacity. The teachers strongly endorsed the internal support structure but described the external supports as flimsy. Some teachers, however, had also viewed their leaders as barriers to realizing the reform. In Subsection 8.3.1, I talked about the rigidity of MLS as a reform challenge and how some leaders had operated as if the reform could not be reconfigured to suit local contexts. Furthermore, some Beta primary teachers reported that they received little support from their subject leader. One beta primary teacher viewed the subject leaders’ visits to his class as infrequent, unsupportive, and inconsistent. Teachers from Alpha Primary reported on how their subject leaders had discouraged the practice of teachers sharing lesson plans. In the teachers’ opinion their school management felt that such practices would lead to teacher laziness and lack of creativity.

When the schools are assessed as the principal sites of reform the data seem to suggest that they were challenging sites for pedagogical reform to be effectively implemented. “Challenging site” conveys a notion that schools contained major barriers that might have rendered MLS difficult to be implemented. This chapter has unveiled what reforming practices in schools in a small developing education system might look like.

CHAPTER 9 Discussion

In this chapter, I bring together and interpret the major findings of the research. The findings are presented under the headings: impact on teaching, impact on achievement, and the implementers' experiences. The other major section of this chapter presents a discussion about MLS in the context of the change discussion model. I look into the *zone of enactment* and identify how the teachers might have mediated change given the context that existed in schools in Seychelles.

9.1 Overview of the findings

The MLS reform was introduced in schools to improve initially the teaching of mathematics and ultimately the pupils' achievements in the subject. The study reported in this thesis is being carried out five years after the reform was introduced. It seeks to investigate the impact of the reform and determine the extent to which the reform had improved teaching and achievement. The research is a study on systemic reforms in the context of a small island developing state. Systemic reform is regarded as the development of a unifying set of visions and goals by an education system in order to provide coherent direction and strategy for reform in mathematics education. The prime purpose is to ensure that all the pupils have access to challenging and worthwhile learning opportunities (Cohen, 1995). In so doing, several parts of the system are stimulated to be part of the reform plan.

This thesis consists of four results chapters. Chapters 5 and 6 contain results in relation to the first research question – impact of the reform on teaching. Chapter 5

relates mainly to self-reported data from the implementers' perspectives whereas Chapter 6 relates to data I collected as part of the lesson observations. Chapter 7 presents data in relation to the second research question – impact of the reform on achievements. Chapter 8 relates to the third research question in which I look at the implementers' experiences of the reform quest. Data from these four chapters form the basis of this discussion chapter. The rest of this section is just a summary of the findings. The sections indicated in brackets, represent the location in the thesis of the evidence supporting the findings.

9.1.1 Impact on teaching

- The teachers and the subject leaders were overwhelmingly positive about the MLS reform and perceived it to have impacted positively on their instructional practices (Section 5.1 – 5.4). The teachers' responses about the reform were rather consistent across different groups of teachers (Section 5.2).
- The teachers' self-reported data suggest that the teachers strongly complied with the reform. Generally, the analyses show no statistically significant result among teachers in the various groups (Section 5.2 to 5.4).
- Teachers' self-reported data show that they (the teachers) had found certain components of the reform easier to incorporate in lessons than others. The teachers converged on the issue that they had been challenged both pedagogically and cognitively in their attempts to renew their practices (Section 6.2.1 – 6.2.2)
- Even if there is this general impression by the main implementers that MLS had contributed to improve teaching (Section 5.3), observation data of actual

mathematics lessons suggests that the fundamentals of teaching had not changed (Sections 6.3 – 6.4)

9.1.2 Impact on achievements

- The self-reported data suggest that the teachers had diverging views as to whether or not the pupils' achievements had improved (Sections 5.1.3 and 8.3.5).
- Analyses done on the secondary achievement dataset suggest the following findings: Comparison of the SACMEQ II and III studies shows that the pupils' achievements on the SACMEQ III test were significantly lower than their achievements on the SACMEQ II test (Section 7.1). Comparison of the SACMEQ results against a set of longitudinal data from a locally developed study (which used SACMEQ anchor items) shows that the pupils' achievements got better during the third and fourth year of the reform (Section 7.2). A second finding suggests that variations in the pupils' scores might be related to the teachers' frequency of using the reform (Section 7.3).

9.1.3 Implementers' experiences

- The reform had both pedagogical and leadership significance (Section 5.5)
- Pedagogical reform was a challenge to be implemented in Seychelles (Section 8.3).

9.2 Impact of MLS on teaching

In this section I seek to answer the first research question: How has the teaching of mathematics in primary schools changed with the implementation of the MLS reform? I inquired into the impact of the reform on teaching using three main

approaches: i) through the implementers' self-reported data collected via a questionnaire and a series of focus group interviews, ii) through direct lesson observations, and iii) through analysis of secondary data from past work of the MWG. From the first approach, I analysed responses of a) 219 teachers collected via a questionnaire, b) six teacher focus group interviews, c) one subject leader focus group interview, and d) two key informants collected through individual interviews. From the second approach, I analysed data which I collected by observing twenty-two lessons. From the third approach, I analysed secondary data (questionnaire and informal communications with some teachers) which were available prior to the main study reported in this thesis. In this section I report on the findings then I discuss the extent to which MLS has responded to the teaching needs in Seychelles.

9.2.1 Findings drawn from the self-reported data

The whole of Section 5.1 of the thesis responds to one resounding finding: the Seychellois teachers were overwhelmingly positive about the MLS reform.

- Five years into the reform most teachers (87%) reported “always” to a questionnaire item inquiring about the frequency of using the reform (Section 5.1.3). The item, *it was a good idea to introduced MLS in schools*, emerged as the third most positive item out seventeen items (*mean = 3.07, where the maximum is 4*) (Section 5.1.3).
- The data from the teacher focus group indicate several instances when the teachers commended the reform (Section 5.1.3).
- Data from the subject leaders and key informants reveal how the lessons had changed and the benefits of the reform on instructional processes (Section 5.5).

This finding, the teachers being positive, had been consistent throughout the five years as revealed by the following evidence:

- The two teachers with whom MLS was piloted in 2005 (Limia and Lena) immediately viewed the reform as an approach to support teaching (Section 5.1.1). They gave out examples as to how their teaching was supported by using the reform ideas after just one week of the pilot (Section 5.1.1).
- During the early years of the reform, the teachers indicated in their school reports and in other national forums that they liked the reform (Section 5.1.2).
- In 2007/2008, on a questionnaire, a large percentage of teachers indicated “very often” about using MLS as the basis of their lesson planning and teaching (Section 5.1.2)

Specific indicators that the teachers were positive about the reform could be worked out from the following items: In this main study, the teachers were positive on the following questionnaire items:

- a) I find MLS a useful tool ($M = 3.13$, $SD = 0.62$);
- b) MLS is having a positive impact on my teaching ($M = 3.10$, $SD = 0.56$); and
- c) Although not highly positive, the teachers answered favourably to the item “Maths teaching has improved with the introduction of MLS” ($M = 2.92$, $SD = 0.60$).

Here are some specific examples to describe how MLS improved the teachers’ practices: In Section 5.1.3, Teacher KAP T6 and Teacher ALP T2 commented on how the MLS template helped them in developing coherent lessons. Teacher KAP T3

reported that MLS had brought an order in the teaching of mathematics. In post lesson interviews, Teacher GAM03 talked about how MLS has stimulated her to vary the pupils' learning experiences, and Teacher BET06 talked about reduction in chalk and board teaching in her classes.

Secondary data about the teachers and their practices reveal that quite early into the reform the teachers had perceived MLS to be improving their practices.

- In the pilot stage of the reform, Lena talked about the reduction in the time she spent on planning as a result of using the reform (Section 5.1.1).
- A subject coordinator who spoke about MLS at the 2007 symposium commented: “At last, good lessons are being done in the school” (Section 5.1.2). She meant that finally (possibly due to MLS) they were starting to see good teaching occurring.

When the teachers' responses to the interviews were analysed, one picture that emerged suggests that the teachers' practices were changing to accommodate the reform ideas. However, when the teachers' responses about their pedagogical practices from the questionnaire items were analysed, a different picture emerged: routine practices prevailed. For instance, data presented in Section 5.2 shows that dealing with homework was the most popular classroom activity. Nonetheless, the MLS lesson template did not emphasize either the setting or the review of homework within lessons. With regard to engaging pupils in the lessons, even if the data show that these two reform-oriented practices – “getting pupils to discuss different ways to solve problem”, and “requiring the pupils to justify their answers or explain their reasoning” – featured as the most popular practices, “getting pupils to memorize facts”, and “requiring them to work on the front board”, were also among the top on

the list (Section 5.2.2). What emerged as interesting about the data, on the teachers' approaches to engaging pupils, was that none of the approaches was strikingly more popular than the others. This suggests that possibly the message that teachers should vary learning experiences, was effectively put into practice.

The most surprising finding emerged from my approach to determine in a statistical way, the impact of MLS on teachers' practices. The description of the analysis was presented in Section 5.3. From the analysis in Section 5.3, it appears that changes were somewhat contrary to the MLS structure and pedagogic foci. Teachers with higher perceived compliance index assigned homework, worked with pupils on a one-to-one basis, taught using expository strategies, and organised pupils in ability grouping, more than their counterparts. I argued in Section 5.3 that this finding contradicts, to some extent, what the MLS reform sought to bring about. However, one could argue that practices like assigning homework, working with pupils on a one-to-one basis or even grouping pupils in ability sets, were practices that may reflect teachers' attempts to provide a more structured learning environment that was more responsive to pupils' learning needs. Thus, these changes were in line with the aim of the MLS to provide a more coherent and pupil-orientated structure to classroom teaching and learning. Given the argument that teachers tend not to change practices that they believe will benefit their pupils (Spillane, 1999), my finding supports this argument.

I compared teachers on their confidence, attitude to collaboration within the school, attitude to their school curricular leadership, attitudes of their practices, and general perception of the impact of the reform on pupils' learning. A Kruskal-Wallis test indicated a significant difference amongst the teachers on two variables only: teacher confidence and teacher attitude of their practices. In both cases, the mean

scores increased from lower to upper quartile. This suggests that the higher the use of MLS, the more confident were the teachers, and the more positive they were about their practices. The same pattern was observed about the teachers' attitude to collaboration in their school. However, scores in the latter case were not statistically significant. In other words the use of MLS might have influenced the teachers to build their teaching confidence, stimulated discussion about their practices, improved the collaboration among colleagues even if it might have been less effective in reverting the traditional teaching approach.

The teachers had a strong positive attitude to the MLS teaching approach and there was no statistical difference in the way teachers from various groups thought of MLS. In this study factors like the characteristics of the school in which the teacher taught, the cycle (year group) at which they taught, the teachers' age and the number of years they had spent teaching mathematics, did not affect the way the teachers thought about the reform.

Teachers' perceptions of their practices reveal some interesting findings: Firstly, there was a high compliance attitude in their responses. Secondly, there was a high consistent pattern in the teachers' responses about their instructional practices. Thirdly, there was no statistically significant difference amongst teachers from various groups on the way they said they taught. This suggests that teachers of low and high graders used the same teaching approach. It could be argued therefore that MLS might have contributed to standardize the teaching across the board. Since MLS was mandatory and prescriptive, the teachers might have adopted the reform ideas uncritically.

My data suggest that the teachers were keen to try out the MLS ideas. For instance, teachers in some schools would question why they were not part of the pilot

project (notes from MWG monitoring data) which suggests that the teachers were motivated to be trained. The maths leader at Gamma Primary reported that the implementation of MLS in her school was scaled up well before the allocated time.

We began with the P6 teachers. Then the teachers in the lower primary saw the format. They felt that they were being left out. Even if we told them it is just a pilot they asked why we always begin at the upper cycle. So to calm them down we got them to try it as well (Field notes, Gamma Subject Leader, July 2011)

The remark made by the Gamma School leader clearly outlines one important point. Teachers were in need of training and some were seizing all opportunities that they could. Nobody wanted to be left behind. From my data, it is clear that from the leaders' perspectives, the schools were changing, and the discourse about improving practices and learning was present (Section 5.5.1). However, the teachers lacked stamina to sustain and pursue reform.

The evidence I have presented thus far indicates that the majority of the teachers began to implement MLS with a strong positive attitude – a prerequisite for success of instructional reform. This initial attitude might be the reason why the teachers were complying with the reform call although they had had difficulty to use some of the non-routine practices such as varying strategies and pupils' learning, incorporating real life experiences in their explanations, and formulating a conclusion for their lessons (See sections 5.2.1 and 5.5.4).

The notion of teacher receptivity (Ma et al., 2009; Waugh & Godfrey, 1993) can be used to make sense of this positive impression teachers had of MLS. The teachers welcomed the reform and were ready to try it out. At least 90% of the teachers felt that introducing MLS was a good idea. Receptivity is a key factor for the overall success of classroom change initiatives (Waugh & Godfrey, 1993). It creates an initial basis for teachers to receive and attempt the reform idea. Evidently

the teachers have pivotal roles in schools and they are essential to the success of policy implementations and reform aspirations (Fullan & Stiegelbauer, 1991). But teachers nevertheless, response to reform that they believe will benefit both their practices and their pupils' learning (Spillane, 1999). I infer from this study that the teachers felt MLS would benefit both their practices and their pupils' learning.

Nevertheless, the observation that the teachers were highly compliant with the reform is debatable. On the one hand, the observation may be challenged on the ground that the teachers might have been intimidated by the approach to change, and by the approach by which their attitude to change was assessed. The reformers were themselves, the facilitators, and to some extent they were the evaluators. Hence, the approach might have not been reflexive enough to generate variance in the teacher' responses. On the other hand, I argue that it could be possible that the teachers had wanted something similar like MLS in order to revamp their practices, and this could have been the reason why they were all positive and had highly complied with the reform call throughout. At the start of the project, the teachers were all in favour of some measures to improve pupils' learning. The way they responded to the MLS reform call might have been a means to this end. The high compliance in the teachers' self-reported data could also be due to the fact that the development of the reform was part of a bigger project to improve the quality of mathematics education, which the teachers themselves agreed upon. Since their subject leaders were participating actively in the development of the lesson structure, they [the teachers] might have viewed this reform as a direct response to their needs.

The teachers' actual implementation of MLS is the focus of the next subsection. I present a classroom perspective of the reform, highlighting the practical considerations of the reform.

9.2.2 Findings drawn from the classroom observation data

Through direct observation of the teachers' lessons, I obtained a different picture of the impact of the reform on practices. Here I argue that although the lessons had become more structured and coherent, the quality of pupils' opportunity to learn was still low. I elaborate on this claim below.

Using a two-dimension conceptual framework I developed and presented in Section 6.1, I investigated the actual mathematics teaching practices in the schools. The first dimension of the framework, structure, allowed me to look at the fit between MLS and actual lesson practices. The second dimension, lesson contents, offered a lens through which I investigated into teaching in line with the contemporary discourse on how mathematics education experts suggest mathematics lessons should be for effective pupils' learning experience. My data focused on two aspects only: classroom discourse and pupil-engagement tasks. Results of my observation were presented in Chapter 6. The most pertinent findings are discussed here.

- Although there was a general impression by the teachers that MLS had contributed to improve teaching (Section 5.2 and 5.5) analysis of the lesson observation data suggests that the fundamentals of teaching did not change. (Sections 6.3 – 6.4). My data show that it might have been difficult for the teachers to carry out lessons as MLS prescribed.
 - Only a small percentage of the lessons contained all the requirements as suggested by the reform (Section 6.2.1). In most cases the teachers omitted a few or many of the MLS lesson segments. My data suggest three main reasons for the omissions (Section 6.2.2): when they tried innovative ideas (but very rarely), when there were follow-up lessons,

and when they were challenged pedagogically. Hence in this respect, lessons deviated from what MLS suggested. Otherwise, the lessons were highly coherent (Section 6.2.3).

Prior to the reform, mathematics lessons in the schools were disorganised. They could be described as chaotic (Mathematics Working Group, 2005). The finding being reported here suggests that MLS reform was effective in making lessons more coherent.

I inquired into the engagement tasks and classroom discourses of these lessons. The emerging picture suggests that the quality of pupils' opportunity to learn was low.

- The tasks were generally written at lower cognitive levels with few exceptions (Section 6.3.1).
- The teaching fostered procedural knowledge and the level of discussions was weak in enhancing conceptual learning (Section 6.4.2).

What these findings imply about the MLS reform is that advocating the suggested approach was insufficient to provoke changes in key areas of teaching. This may be because teachers were unable to apply the components of the reform that required high pedagogical skills – those skills that were likely to change the fundamentals of teaching. The cascade approach to teacher training was ineffective in equipping the teachers with the skills to create a learning environment rich in pupils' cognitive engagement.

Although the findings are specific to the 22 lessons, they provide a picture of what was going on in schools in Seychelles: data were drawn from a purposive

sample of schools (approximately 17% of the state primary schools in Seychelles) and the teacher sample, whilst an opportunity one, made up 4% of the teachers who taught mathematics. The message emerging from the analyses was that although the teachers had endorsed the MLS reform, the fundamentals of teaching had not improved significantly. It is true that the emphases were placed on the structure and this fact was clearly reflected in the quality of the lessons. Hence, on the basis of these findings I conclude that the MLS template alone was insufficient to provoke the kind of change the reformers would have liked to see in the lessons. This conclusion is a very good rationale to support future development of the reform.

A second point that I want to make relates to the fact the teachers did not teach as the reform suggested. In the first instance, there were many deviations from the template (Section 6.2.1). Only 5 of the 22 lessons (BT11, BT41, GT11, GT22, & KT11) were delivered as expected. This implied that most of the lessons were indeed non-MLS lessons. Still, the five MLS-lessons were not necessarily high in pupils' opportunity to learn. The overall look of these lessons might have been similar to what the reform proposed in terms of structure, but their contents were not rich. During my analysis I could not trace any special feature in terms of pupils' opportunity to learn that might differentiate those lessons from the others that had only some components of the template. Hence, as can be seen from what I reported in Chapter 6, none of the five lessons in question got special mention in my description of quality lesson, apart from GT11, the only lesson which was conducted outdoors during the study. What seemed to emerge from observing the lessons was that the teachers were more concerned about getting the structure right as opposed to enriching the opportunity-to-learn feature of their lessons.

9.2.3 Response to teaching needs

After having discussed the findings in relation to the impact of the reform on teaching, two questions arise: (1) to what extent did MLS respond to the Seychelles' mathematics teaching and teachers' training needs, and (2) had change occurred and if so, in what area?

In relation to the first question, from Section 5.1 to 5.4, I indicated that the main implementers commended the reform for a number of reasons. These findings suggest that the reform was useful to them. Data presented in Section 5.5 showed that there was also the overall perception by the teachers that MLS had changed the context in which curriculum reform was discussed and incepted. The key informants also believed that the context of teaching changed and that the teachers were stimulated to improve their practices. Furthermore, MLS provided a model of effective teaching to both the teachers and the subject leaders. While the teachers used MLS to shape their teaching, the subject leaders used it to organise their leadership capacity.

Requiring the teachers to teach in a centrally prescribed way was effective in that it encouraged some of them to reflect on what they could do or could not do. For example, in Section 8.3.2, I gave an example where a teacher from Kappa Primary discussed how she reflected on her practices. That was an example of a teacher evaluating her self-efficacy. I also gave out examples where some teachers reported on their challenges to incorporate real life in their lessons (Section 5.2.1) or formulate lesson conclusions (Sections 5.5.4 or 6.2.2) as required by the MLS reform. This was especially effective for the subject leaders as it generated areas of teachers' needs and supports (Sections 6.2.2 and 5.5.2). All these anecdotes represented evidence how the reform had responded to the teaching needs.

The teachers' attitude and their reactions to the reform were the best sources of knowledge that I could use to determine the worth of a pedagogical reform such as the MLS. In this specific case teachers' responses were suggesting that something about the MLS reform was consistent with the teachers' needs. None of the teachers surveyed or interviewed wanted MLS reform to be phased out which further indicate that the reform was worthwhile at least to the main implementers.

What then makes MLS reform a worthwhile experience for the teachers? The following are my conclusions: 1) Teachers commended MLS reform for the lesson template which they said allowed them to develop good, focussed, and coherent lessons. It could well be that with the introduction of MLS the teachers had got the opportunity to review the way they planned and selected materials for the various parts of the lesson. 2) MLS reform occurred in real classroom context. It could be possible that the teachers might have liked the process of change. 3) The leaders viewed the MLS approach to conducting mathematics as a measure of standards. It could be possible that having obtained this standard, their leadership roles had improved and that they had obtained an approximation of what constitutes effective lessons of mathematics. This had subsequently facilitated the way they had led and advised teachers in their schools.

My evaluation of the implementation of MLS suggests a different approach to teacher training in small island developing states needs to be developed. In view that a small country such as Seychelles cannot afford to release teachers on long term training, it was imperative to design reform activities so that teacher learning took a central focus. The approach to reforming the teachers' practices advocated the cascade training method (Wedell, 2005). Such a method was effective in training teachers on site using localized resources – certainly very cost effective for small

states. Unfortunately, it did not expand to stimulate classroom-based teacher learning, a method which researchers suggest is effective for renewal of teacher practices (Borko, Davinroy, Bliem, & Cumbo, 2000). Certainly more research is required to ascertain the benefits of this approach to teacher learning. For the implementation purposes, the cascade training model was possible to get the ideas transmitted across schools and teachers without having to disturb the school routines. Nevertheless it needed to be more effective in provoking deep change. This remains a challenge to Seychelles.

Now I want to take up the second question which I posed at the start of this section: Had change occurred, and if so in what area? With regard to areas where change had occurred I can report that the mathematics lessons were different from what were observed in 2004. The subject leaders and other partners who supported the teachers' work in schools converged on this issue. At least one remarkable change from my observations related to the way lessons started. Prior to the reform, most mathematics lessons in the state primary schools began with a song. The teachers would typically begin lessons with a song which, whilst nominally mathematical, in practice was often the same from lesson to lesson. In 2004, the rhyme, "10 green bottles", had become the anthem of mathematics lessons in primary schools (Mathematics Working Group, 2005). It was sung at the start of most mathematics lessons we observed. The general observation was that all students began to sing the song with great energy. By the time the song reached 6 green bottles, only the teacher and those few children in the front row seats would still be singing. The teachers reported that they had been encouraged through their training to motivate pupils with songs. Although such an approach was not necessarily motivating the pupils, this practice was a common one and prevailed in schools.

MWG opted for something different and more effective. At the time of the research, lessons tended to begin with a mental activity. The observation data indicate that 19 out of the 22 lessons began with a mental activity. However, such change along with others observed in other areas of the lesson, might not have been deep changes. MLS was losing intensity. It could be possible that since the teachers were not getting empirical evidence about their effort, they were not appreciating those changing moments in their practices. This is the best explanation I can give for the contrast – they commended MLS but they actually used it sparingly.

9.3 Impact on pupils' achievements

Ascertaining the impact of MLS on achievements was problematic. In the absence of an experimental design it was difficult to isolate the impact of MLS on pupils' learning. Furthermore, since I needed to ensure that the study was manageable for a sole researcher, I did not collect additional primary data about the pupils. I relied on secondary data to develop insights into the impact of the reform on achievements. I compared the SACMEQ II and III to obtain a cross sectional analysis of achievements and to develop insights into the impact of the reform on achievements during its early years. I then analysed a set of longitudinal data drawn from a local project (the IPAM project) which enabled me to examine changes in achievement in relation to the reform over a 4-year period. I also sought the teachers' perception of the impact of MLS on the pupils' achievements. In my opinion the teachers were in a very good position to talk about this issue in view that they had been with the pupils over the years. I begin this section with the teachers' perceptions of MLS on pupils' achievements.

- From the questionnaire items, it was observed that the mean of items inquiring about the teachers' perception of MLS on the pupils' achievements were lower than those items inquiring about their perception of the impact of the reform on teaching (Section 5.1.3)
 - The mean of the item, “pupils interacting better with the teacher” was relatively higher than the other means ($M = 3.10$) but the mean of the item, “pupils understand mathematics better” was 2.83, where the maximum possible mean could have been 4.0. The mean of the item, “pupils are generally scoring more on mathematics” was the lowest ($M = 2.49$).

Comparison of the SACMEQ II and III data provided an indication of the impact of the reform on achievements during the first years. I presented a thorough analysis in Section 7.1 from which I concluded that performance declined during the first year of the reform.

- Pupils' achievements in 2000 were significantly better than in 2007.
 - The mean raw scores for the SACMEQ II and III were 47.96% and 46.36 respectively. ANOVA conducted on the results indicated a statistically significant result [$F(1, 2962) = 7.54$, $p\text{-value} = 0.006$].
 - Items on which the 2000 cohort performed better were definitely at a higher cognitive level than the item on which the 2007 did better.

The results seem to indicate that there was no progress in achievements during the early years of the reform. One could argue that since 2007 was just one year after the reform was implemented, the likelihood of observing progress was minimal.

However, I argue that even if MLS was implemented in 2006, the whole quest to improve pupils' achievements in Seychelles started in 2003. Hence, the SACMEQ III test was administered four years into a major improvement project. The fact leads to a more general conclusion that whatever strategies were implemented to raise achievement did not work on the pupils. On the other hand the strategies in place contributed to narrow the range of pupils' scores, increasing the lowest attainers, but decreasing the high attainers. I reported in Section 7.1, that the standard deviations of the SACMEQ tests decreased between the years 2000 and 2007 (from 16.84 to 14.78).

Further evidence that the pupils' scores narrowed from SACMEQ II to SACMEQ III was observed in the percentage distribution of pupils across the competency level. In my analysis presented in Section 7.1, I noted that the percentage of pupils at both the top and the bottom levels decreased. Such decrease signifies that the weaker pupils benefitted at the expense of the higher achievers. I could make this inference since in the SACMEQ III results, the percentage of pupils in both the bottom and top groups had decreased.

Comparison of the pupils' achievements using the IPAM data was an examination of pupils' achievements over time. The analyses I carried out in Section 7.2 on the items common to all four years revealed an overall upward trend in the item mean.

- The item means gradually increased over the years except for one item.
- The distribution of pupils across the competency levels changed in a way which reflects a gradual improvement over the years. In other words the distribution shows that pupils were attaining higher

competency levels each year. In other words, the percentages of them at the lower competency levels were decreasing.

- When the distribution of pupils across the competency levels for P6 in 2009 were aligned against the two SACMEQ sets of scores, it clearly showed that an improvement occurred from 2000 (post MLS) to 2009 (pre MLS).

The comparison between IPAM and SACMEQ needs to be made with some caution: the tests were designed locally and the common items had been tested repeatedly, which suggest that the items might have been exposed to the pupils. The placement of pupils at the different levels reflects my interpretation only and does not reflect a national consensus. Nevertheless, considering both, my analysis and the analysis produced by the Ministry of Education for 2009 (see Section 7.2), achievement went up. The Ministry's data for the number of pupils attaining Level 5 or better went up from 31% in 2007 to 43% in 2009. My value is 67%. Regardless, the results show an improvement.

Now taking into consideration that from 2003 to 2007 there was no improvement in pupils' achievement over the 2000 results, but in 2009 there was an improvement relative to the 2000 results, I inferred, tentatively, that MLS might be partially responsible for that improvement.

My findings suggest that the variations in the pupils' achievement scores coincided with key moments in education in Seychelles. For instance, in 2007, when all eyes were on how the teachers were implementing the reform, the IQR went down from 28 in 2006 to 22.5. In 2008, when all the leaders were out of school on advanced training courses in educational leadership, and the implementation of MLS

was not necessarily their priority, the IQR rose to 23.1. In 2009, when the coordination of the project was passed over from the MWG to the respective schools, the IQR rose to 26.7. My interpretation of the IQR scores, along with what I suspect went on in schools, support the claim that large scale implementation of MLS might close the achievement gap. However, there is a deeper story unfolding in this scenario: sustainability of an innovation in Seychelles was strongly related to the intensity of control exerted on the implementers. Such occurrence ultimately raises questions regarding the teachers' intrinsic motivation to revise their practices.

The findings show that while pupils' achievements showed no improvement during the early years of the reform, it did get better progressively afterward. Secondly, the data show that variations in the pupils' scores decreased with the frequency of using the reform idea. This leads me to claim that the method of teaching advocated in MLS tends to bring pupils' performances together. However, findings in UK, from where the idea underlining MLS was borrowed, show that prescribed methods of teaching, to some extent, did push up achievement a little bit within the first four years (Brown, Askew, & Millett, 2003). While in the Seychelles' case a decrease in the score variations was observed, the National Numeracy scenario in the UK showed an increase in the variability of scores (Brown et al. 2003).

On the basis of the evidence presented in this chapter, I can argue that the MLS approach to teaching can be an appropriate teaching strategy to deal with mixed ability teaching – an approach which gained prominence following findings from local research in schools (Leste, 2005). When the reform idea was used abundantly in schools, variability in pupils' scores decreased. It means that the MLS approach to teaching may be useful in contexts where pupils' variation in achievement is large.

9.4 Implementers' description of their experiences

The model for discussing change (Millet & Bibby 2004) provided a lens to view factors that influence the implementation, and subsequently the outcomes, of reform. Through this specific lens I was able to inquire further into the teachers' working context so as to develop better insight and talk deeper about their *zone of enactment*. The implementers' accounts of their own experiences reveal some plain sailing moments but also the pressure of multiple factors which might have impacted on how they had enacted the reform. In this section I discuss these experiences.

9.4.1 Teacher-teacher collaboration

In Section 8.2, I considered the elements of school processes which might have benefited the teachers' attempt to revise their practices. My analyses reveal that both teacher collegiality and subject leadership together formed a school-based support structure which the teachers generally commended. The teachers reported frequent engagement and interaction among themselves. These engagements range from discussion of work to tutoring one another about mathematics topics. More than 80% of the teachers who responded to the questionnaire reported very frequently to items assessing the extent to which teachers in their school participated collaboratively. Only 23% of the teachers felt that they were on their own in their school.

One collaborative activity which was popular in the schools at the time of this research was team planning – a practice which was formally endorsed by the education system – which got the teachers to plan and prepare lessons during a designated time slot. Teachers acknowledged that they benefited from team planning (Section 8.2.1). However, even if the teachers reported that the teacher-teacher collaboration was strong and frequent, only team planning appeared to have been

formalised at school level. Although they have one timetabled slot of an hour per week, I assume that the teachers used other instances for similar collaborations. Teachers like Lena and Limia (as reported in Section 5.1.1) might have used time after school hours to stay behind and collaborate on planning lessons and preparing materials.

The teachers were positive about the collaboration which existed among themselves within the school. However, they were likely to collaborate within their year group. In small schools like Gamma Primary where there could be only one teacher per year level, some teachers could find themselves without a partner to collaborate.

From the data I presented in Section 8.2.2, I can say that in general the teachers felt that subject leadership at their school was in general supportive of the MLS implementation. Teachers' perception of the quality of the roles of the subject leaders with respect to implementing the reform was high. For example, about 93% of the teachers agreed with the statement that their subject leader was supportive. However, it must be noted that the teachers' high perception of the roles played by their subject leaders was not across the board. In schools where the teachers felt their leaders lack flexibility, the data suggest a more nuanced and varied picture (Section 8.3.1). Moreover, some teachers felt that their leaders also had viewed MLS as a rule to obey.

The main point that could be drawn from the teachers' responses was that there was at least a community of practice in their school from which they could rely on for certain level of assistance for the reform. However, the teacher-engagement that those communities stimulated might have not been good enough to provoke the anticipated change.

9.4.2 Leadership capacity

In Chapter 5, Section 5.5, I presented findings in relation to the subject leaders' impression of the reform. The finding reveals that the mathematics subject leaders too were overwhelmingly positive about the MLS reform. According to them, the majority of the teachers have embraced the call to reform their practices in the direction of the reform.

- Teachers had understood what was expected from them
- Teachers had been motivated to change
- Mathematics lessons were getting better

The leaders had endorsed the MLS lesson template as an instructional tool in its entirety. According to them, MLS was a good teaching tool, and at the same time it assisted them in establishing teaching standards. The leaders believed that the introduction of the lesson template had established a benchmark against which teacher-capacity could be measured and discussed. One leader noted, "... we kind of know what to look for in the lessons and findings of our observations are used as a basis for helping the teachers" (Subject leader at Beta Primary). This piece of evidence supports my claim that subject leaders needed some forms of assistance to their daily practices and they might have had it in the MLS reform.

From a leadership perspective, the introduction of MLS in school had created a platform for curricular change and improvement. The leaders claimed that the new approach to teaching offered a lens for viewing lessons through. The leaders felt that observing teaching, developing feedback, and carrying out conferencing became more meaningful as the reform offered them various aspects on which they could focus. Furthermore, the leaders felt that the approach had formulated and instilled, both in the teachers and in themselves, a model of what effective teaching

of mathematics might look like. With regard to providing pedagogical advice to the teachers, the introduction of the new approach in schools had enabled the leaders to work out the teachers' pedagogical needs in respect to the mathematics teaching. The teachers' engagement with the reform had been a source of their teaching strengths and weaknesses. By treating MLS lessons as a model of effective lessons, the teachers had acquired knowledge of what they could do in class and the leaders had used this as a means of knowing where to commence instructional or pedagogical intervention.

It could be argued that the leaders' direct involvement in the project influenced the way they viewed the reform. With the introduction of the IPAM project, the mathematics subject leaders became invaluable partners in the realisation of curriculum innovation activities in schools. They were not viewed as recipients of policy decisions. Instead they cooperated to train teachers, they participated in developing tools in relation to the reform, and they collected implementation data at their respective schools. When school personnel are involved in policy making, the likelihood for them to develop a positive attitude about the process is high. This is a message which emerged clearly from this study.

9.4.3 Challenges to policy implementation

In Chapter 8, Section 8.3, I introduced the challenges which might have impinged on the schools' capacity to implement the reform and the teachers' ability to change. The main findings are summarised here.

- Several context factors impinged on the teachers' ability to implement the reform.
 - the reform message that the teachers formulated might not have been the message anticipated by the reformers (Section 8.3.1)

- the reform imposed a lot of additional demands on the teachers (Section 8.3.2)
- teachers received conflicting messages from people who were meant to support them (Section 8.3.3)
- too many people had power over the teachers' work (Section 8.3.3)
- the availability and quality of resources was poor (8.3.4)
- the learners' engagement might have been problematic

First there is the issue of the reform message which I argue did not necessarily reach the teachers as the reformers would have expected (Section 8.3.1). Although several steps were taken to ensure that the teachers participated in the decision process and had a say at least in modifying the basic ideas of the lesson structure, several teachers had seen the implementation of MLS as rules to obey. When, for instance, a teacher noted that she had no choice with regard to whether she would comply with the reform call or not, when others claimed that they could not reconfigure the lesson template to match the reality of their classrooms, or when a teacher simply said, "I got to do it because everybody else was doing it", clearly justify the "rule" connotation which might have been attached to the reform ideas. In Section 8.3.1, I also presented the comments made by one teacher (ALP T4) who viewed the introduction of MLS as a rule to obey rather than an opportunity to help teachers. She challenged the "one size fits all" approach to mandatory reform. Her reference "*putting everybody in the same bag*" suggested that some teachers believed that teachers should be distinguished and supported accordingly. Her critique suggests that there were teachers like herself, who might have felt better than the others, and possibly better than that general model to teaching mathematics. She could not understand why everybody ought to be doing the same thing. Perhaps to her, MLS

would not add anything more to her professional development. In this case she could have decided not to comply with the reform. If MLS was introduced to stimulate change then the intended message had not been properly conveyed to many teachers like herself. Some other teachers' responses reveal that their subject leaders further sent that "rule-to-obey" message since they were rigid with their implementation throughout.

Despite the fact that the implementation of MLS was meant to follow a consultative-collaborative approach, in actual practice it might not have been the case in certain schools. Spillane (2000), using a cognitive frame to understanding the teachers' sense making of reform messages, argues that teachers' construction of reform messages is based on local belief, reform context and prior knowledge of occurrences in their workplace. Even if the intention was not necessarily to make the reform a rule, the teachers might have constructed this message based on what was going on as they attempted to renew their practices. In other words it could be possible that this image of MLS as a rule to obey was purely what the teacher perceived to be the case but might not necessarily be true in reality.

Another factor in relation to the issue of impingement was the quality and nature of support the teachers received. The support was frail. The teachers reported that the support they received from their subject leaders and collaboration from their colleague teachers generally assisted them in overcoming many of their daily challenges (Section 8.2). Such findings support the roles of school-based collaboration in enacting reform ideas (Webb & Romberg, 1994). Unfortunately, the teachers viewed the support they received from officials from the Headquarters as threats to their practices (Section 8.3.3). This finding leads me to argue that a better alternative in future may be to equip school to take control of their own reform

initiatives. If the alleged expert's support was seen to be conflicting and inconsistent, and teachers were commending their internal support structure instead, it may lead to an assumption that schools in Seychelles may well move along without the external support. However, if schools were to lessen their dependence on external support, then it becomes imperative to improve other elements in schools such as access and provision of teaching resources. The teachers' comments about the unavailability of teaching resources were strong and they [the teachers] were desperate (Section 8.3.4). The introduction of the lesson template alone was inadequate to provoke the intended change in the way the teachers should handle daily mathematics lessons.

The approach to reform did not explicitly address several issues such as how to support teachers managing their daily obligations and other aspects of the curriculum. The reform increased the teachers' workload but no provision was made for such increase in workload. One teacher talked about his solution when he said that he planned his lessons to suit whichever officers were coming to his class (Section 6.3.2). My analysis of the situation suggests that too many people had control and power over what the teachers were doing in schools. Furthermore, too many teams of people were imposing their own reform agenda on the teachers. The case of MWG and the Early Childhood Section on developing graded tasks exemplifies my point - two different teams, both having some degree of power over school life, were both directing the teachers in contradictory directions (Section 8.3.3). It was normal for the teachers to feel confused in that given situation. It is better for people who support the work of teachers not to send contradictory messages. In my opinion contradictory messages that reach schools could be a genuine reason which implementers may use to abstain from entertaining reform calls.

The fact that MLS imposed pedagogical (instructional) and cognitive demands on the teachers should be well underlined. The evidence was presented in Section 8.3.2. Although some forms of training were provided to the teachers with the aim of easing their pedagogical challenges, evidence which I have presented about support shows that several of their dilemmas or challenges remained unresolved. Moreover, evidence from the classroom observation data about how the teachers handled the learning processes (mainly planning tasks or carrying out discussion) clearly demonstrates that the teachers lacked the capacity to teach for effective conceptual development. The teachers themselves acknowledged that incorporating real life examples or developing lessons with investigative features as the reform urged them, were difficult to achieve. This finding points to the direction where local teacher education programmes should focus training in the future.

Another piece of evidence, adding to the teachers' challenges, is that the learners' engagement with mathematics was problematic. Even if the learners were not given a central focus in this study, it was not surprising to see the teachers making reference on how the learners might have impinged on how they implemented the reform. However, not all schools viewed the problems around the learners as that pertinent.

Along the same line, I can say that in the focus group interviews, some issues were more prominent in certain schools than in others. I acknowledge the role of context in enacting reform but with regard to the challenges and affordances, I wanted to extract those issues which were most significant to the Seychelles' context, in other words, cross-cutting across schools.

9.5 MLS reform in the context of the change discussion model

In this section I want to elaborate on the notion of *zone of enactment* (Millet & Bibby, 2004; Spillane, 1999). Spillane's analysis highlights the ways in which reform initiatives such as MLS are mediated by zones of enactment. Millet and Bibby (2004) add the issue of support. They posit that both internal and external sources of support should be available for effective change: Internal support coming from within the professional community and external support coming from the periphery of the school environment. Both, interacting together, should stimulate and enrich a *zone of enactment* – a potential area for professional development and change. Spillane (1999) articulates three main factors – rich deliberation grounded in practice and supported by resources – as essential constituents for the *zone of enactment* if teachers are to make meaningful engagement with reform ideas. Furthermore, Spillane places emphasis on social learning which essentially placed value on the role of collegiality and collaboration if school-based learning is to be meaningful to the teachers. I wish to discuss opportunity to change in my study in relation to this picture of “richness” of *zone of enactment* with a prime focus on culture/context and collective capacity. I have observed from my data that the teachers in Seychelles highly espoused their internal environment. Possibly, for small states, this might be an area to extend the focus in order to gain benefit from policy or curriculum improvement initiatives.

What I draw from the teachers' account of their experiences is that barriers to reform overshadowed opportunities which existed in schools for successful reform implementation. I evaluate the teachers' *zone of enactment* in my study as one which required substantial adjustment before it could provoke worthwhile change in the

teachers' practices. My data suggest that the teachers might have benefitted more from the internal support than the external support.

In this study I rely on the teachers' self-reported data to understand how they benefitted from their social context. The fact that the teachers strongly espoused the teacher collaboration and collegiality, suggests that there were some rich engagements and deliberations when they met, and that, possibly, their deliberations took place around practice. What I can also tell from my data and through my involvements in the project, relate to the nature and quality of the teachers' social learning. The teachers reported poor availability of resources which I argue might have diminished the richness of the *zone of enactment*.

Also relevant in the *zone of enactment* is the teachers' ability to draw a line between what is the optimum balance between pupils' performance and what is to be taught. I reported in this chapter that the teachers were critical of the mathematics programme, and teaching and learning books. What can be said along this line is that the first phase of the quest to improve pupils' achievements focussed on renovating teaching practices mainly, leaving everything else untouched. The teachers might have had difficulty in establishing the balance between learning and teaching since the programme and the curriculum materials were not all in order.

9.5.1 The culture

Different cultures exist in primary schools within a same system. Even if this is so, what emerges from my data is that, possibly due to the central nature of the education system, there was a general culture, in particular, a culture relating to the reform implementation formed in schools. For instance, the teachers found themselves having to rely on their colleagues for inspiration, methods of working, and sharing of ideas and thoughts. Most schools have made this approach possible by

allowing a specific time slot for team planning and professional development. The subject leader, recruited by the Ministry of Education, played a role in ensuring that the teachers' work were facilitated and teacher learning took place at school levels. The teachers operated at cycle level. Unfortunately, under this school arrangement only schools that had more than a class per grade level benefited. The system is yet to develop a learning model that will be suitable for one-streamed schools.

I did mention that there were too many teams that had influences or power on the teachers' work. There were different groups of officials that directed the teachers and more dangerously, those groups usually worked independently from each other. This context might have benefitted those teachers who were more resistive to change in that they could use the unsettled ground as pretext to defer enactment or build excuses.

As others have argued, contexts matter in policy implementation (Ball, Maguire, & Braun, 2012). Even if I am arguing here that the schools in Seychelles were operating on similar structures and arrangements, there were certainly unique moments in specific schools which have had repercussions on the implementation of the reform ideas. As an example, I want to comment on the tension between the rigidity of the leaders' and the teachers' response to reform. In Alpha Primary, despite the rigidity of the subject leader, one teacher decided to attempt peer tutoring/coaching as an approach to teaching mathematics. However, at Beta Primary another teacher preferred to use a compromising approach to deal with conflicting message or leader's rigidity – he developed his lessons to suit whoever was coming to visit his class. This is an example which shows how differences in teacher capacity (unique context) for instance, might impact on the *zone of enactment* and subsequently, the outcomes of the reform.

Culture mediates policy enactment. Culture is specific to the implementation site. Subsequently each reform site invokes different outcomes largely due to the culture.

9.5.2 Collective capacity

Collective capacity and infrastructure (Leithwood et al., 1999) describe conditions in schools which support change initiatives by allowing opportunities for teachers to learn inside and outside schools. In my research the teacher mentioned the existence of school-based support structures consisting of internal support providers and external support even if the latter was described as weak by the teachers. In fact, in all schools in Seychelles provision has been made for an SIP slot – 1 hour 30 min period each week dedicated to teacher professional learning and development. Through my involvement in the project, I know that teachers had extensively used this slot for learning and discussing issues in relation to MLS. Moreover, through the various school links, the teachers teamed up in networking sessions with colleagues from other schools to discuss issues in relation to the learning of mathematics. Together they planned exhibitions, pupils' enrichment activities, and in some instances they also planned mathematics forums. Hence it can be argued that there were opportunities in schools for teachers to learn collectively. However, my data suggest that the approach to teacher training did not appear as a strong notable component in the teachers' account of their experiences. I want to elaborate on this point.

In 2003, the MWG persuaded the Ministry of Education to appoint subject leaders in favour of studies coordinators as the lead mathematics person in school. Studies coordinators managed all subjects while subject leaders were appointed to oversee one or two specific subjects in which they have expertise. In 2006, subject

leaders were appointed in each school. However, in view of the size of the schools and the teacher recruitment issues, the Ministry of Education decided to categorise subjects into groups: a) mathematics and science, b) languages (Creole, French & English), and c) pastoral – to include other subjects of the primary school curriculum. Hence, instead of having a leader for mathematics only, there were leaders for maths and science. As I was part of the team who identified mathematics and science leaders, I am aware that the mathematics and science leaders were appointed on the basis of their strength in mathematics.

Since then, a cascade training model for mathematics teachers had begun. It entailed MWG training the subject leaders who in turn delivered the same training with the teachers in their schools. The school end-of-term reports show evidence that most of the expected sessions did take place in all the schools. The school documents also show that additional sessions were conducted as per specific school need. These sessions were usually led by members of the MWG or educators from the National Institute of Education. I can therefore assume that training did reach the teachers. The effect this training had had on classroom practices cannot be fully determined in this current research. However, what I can claim is that training has not been a notable component in the teachers' description of their experience with MLS. Apart from one school that discussed professional development, the three others made no mention of training.

One can argue that the fact that the teachers did not mention training does not necessarily imply that training had had no effect on their practices. My argument is not about the effect that training had had on practices. Instead, it is about the impact it had had on the teachers' overall perception of the school support. Although there was no prompt question specific to training, I would have expected the teachers to be

discussing training and professional development issues somewhat similar to how they discussed resources. My experience working with Seychellois teachers supports the observation that they dwell on issues which have had significance on their professional lives. Interpreting training in this context suggests that it might have had little impact on their practices.

This argument about training can also be viewed with a different lens. One can contend that the fact that teachers in some schools such as in the Kappa Primary case, were continuously mentioning that they lacked the ability or confidence and that they felt incompetent to alter the pupils' engagement, could be signs that they were indicating that the training they had had was not necessarily answering their challenges.

Nevertheless, responses from the Alpha and Kappa primary teachers suggested some proposals for an advanced scheme in relation to internal support at the schools. Such proposals can ultimately refocus attention on training and professional development of teachers. For instance, the teachers felt that they did not always challenge the pupils to the best of their ability. They agreed that they had been lacking the capacity and competence on certain topics. ALP T1 illustrated a concern: *"I work with my colleague. Most of the times, we rely on one another. Then we avoid planning complicated lessons. We stick to the ones that we feel we can teach comfortably. We keep, even the investigation lessons, simple."* This quote shows the teacher's solution to alleviate teaching weaknesses while at the same time it illustrates the point that some teachers had limited resources to deal with their pedagogical challenges.

The Alpha school teachers made some remarkable contributions. One teacher spoke about renewing technology such as internet facilities at the school. She

remarked, *“If we had internet we could go and do our research. But internet rarely works in our schools and we have just one or two computers with it. We need more resources. I think teachers are discouraged sometimes because of the lack of resources”* (ALP T3). Two other teachers proposed a long term strategy.

We need to develop strategies at our school so that teachers can keep on learning. I think learning should not stop at NIE. In my case, the last time I read a book on mathematics teaching was some 10 years ago. So since we do not have that many reading facility, we should rely on our subject leader. But poor her, she has to cover classes, management meetings to attend. She just can't cope with the loads of work (ALP T4).

Teachers should have at least a central library. We can't even borrow books at NIE after we finish there. Reading materials at the National Library are just novel and newspapers. We need academic textbooks which we can refer to. But with a good computer room, with at least more than two computers with a reliable internet access, things would be easier (ALP T1).

ALP T4 and ALP T5 talked about continued workshops which can be organised at appropriate times to support the teachers' work. The use of the word appropriate timing has significance in the context of training in education in Seychelles. During the past the teachers had expressed concerned that the Ministry of Education organised training for teachers at inappropriate times: either during the school holidays or sometimes on Saturdays. Saturday is a household activity day for most Seychellois families. Any attempt to get people out of their home on Saturdays requires extra motivation. Moreover, professional development sessions in schools which occurred at the end of a school day was very unpopular and this idea was still being resisted by teachers. It is probable that teachers' avoidance of discussing training was a direct means to do away with those ministry-led professional development activities fearing that they might occur at inappropriate times.

What is essential to consider in this discussion of change model is that learning plays a central role in the process of change. Teachers need to unlearn rooted practices and learn to construct new alternatives. If teachers are not stimulated to embrace learning in the process of change, much of our work to revamp teaching and subsequently improve the pupils' practices will be futile and worthless. I mentioned in the introductory chapter that teachers in Seychelles generally like participating in reform quests, hence this overall absence of training in the accounts of their experiences, needs to be interpreted with care.

9.6 Summary

The positive outcomes of MLS are that the teachers were claiming changes in their practices and the leaders were reporting improvement in the quality of teaching. Moreover, the leaders were reporting that they were getting new teaching and leadership tools. Pupils' performances were showing a slight increase, variations in pupils' achievement scores were decreasing, and a platform for discussing mathematics education improvement was being created. However, on a negative note, the data reveal that the reform imposed considerable demands on the teachers' practices. The teachers unanimously agreed that their workloads had increased and their ability to teach mathematics had been challenged as a result of the reform.

I infer that the teachers' knowledge and pedagogical gaps were exposed during the implementation. Those requirements of the model which required them to use higher pedagogical skills such as developing problem solving and investigative lessons; developing complex instructional tasks; incorporating real life examples in lessons; facilitating the pupils' conceptual understanding; and formulating lesson conclusions, were indeed more difficult to do. Spillane and Zeuli (1999) have argued

that when it comes to reform, instruction is “not monolithic” (p. 2). In other words, teachers tend to revise some dimensions of their practices while leaving others unaltered. Subsequently, the teachers’ difficulty in incorporating the various elements of MLS in their practices suggest that the fundamental features of mathematics teaching were still under developed in the primary schools even after five years of implementation. Many teachers were using a limited range of teaching strategies. In fact these conditions were imposed on teachers to increase variations so as to cater for mixed ability classes. Hence, the fact that the various teaching and learning strategies were largely not being implemented suggests that mixed ability teaching might be a challenge to achieve under the MLS regime. Furthermore, my data suggest that the MLS reform had not addressed how the teachers should align the reform requirements and their daily teaching obligations.

The lesson observation data reveal that the actual teaching practices differed considerably to what the teachers reported about the enactment of the reform. Although the teachers reported that they heavily incorporated the reform into their daily teaching practices, their lessons lacked many components of the reform. Furthermore, although some of them reported that they modified the template to cater for their pupils’ needs, it is evident that in many cases where they did not teach as requested, there were clear indications that they could not achieve what MLS was asking them to do. Moreover, when the lessons were analyzed in line with the current discourse in mathematics education about effective mathematics teaching, the quality of the lessons was far from ideal. The disparity between teachers’ perceptions of their practices in relation to the reform and their actual practices is a common observation even in developed countries such as the United States (Hiebert & Stigler, 1999).

As I attempt to make sense of the disparity between the teachers' self-reported data and the observation of their actual practices, I am reminded of Cuban (1998). He argues that one needs to be careful when evaluating outcomes of reform involving teachers in that the teachers' judgements of success may differ considerably to that of the reformers or policy makers. So the fact that most of the teachers liked the reform and believed that their practices were changing in the direction suggested by the reform ideas, could be signals that improvement was taking place. However, the lens through which the lessons were being assessed failed to capture the teachers' progress. The disparity could well be indicating a deeper story: teachers' conception of quality teaching may differ from that of the reformers. This finding should premise future discussion about quality teaching.

Although the evidence that the use of MLS has provoked change in teaching and learning is not strong, the experience illustrated in this Seychelles' case is certainly not a failing one. Cuban's (1998) argument concerning evaluating reform was immediately relevant in this study: the implementers and the reformers usually have different criteria for evaluating reforms. While a reformer might have judged the MLS implementation as unsuccessful in that it failed to provoke a change in classroom discourse and in the nature and quality of pupils' learning tasks, it could certainly be judged successful by the teachers in that it stimulated the way they addressed mathematics lessons, induced in them a coherent model of lesson planning and delivery, and in many instances, as the teachers claimed, they have acquired a new approach to teaching mathematics altogether. To some teachers, their engagement with the reform had been a learning experience. This might have been the case especially for those teachers who lacked pedagogical knowledge or for those

teachers who expressed during the focus group interviews that they did not know how to proceed with their lessons.

It could be possible that some findings in this chapter appear conflicting. In my view such conflicts lie in the nature of the phenomenon under study – educational change involving changing teachers’ practices – and to a lesser extent in the design of the research. In their discussions about conflicting findings in mixed methods research, Slonim-Nevo and Nevo (2009) distinguish between contradictory and inconsistent findings. Contradictory findings, they argue are logically impossible. Yet, inconsistent findings, “...indeed constitute an unsurpassable challenge for researchers only insofar as the inconsistency in question is logical, not otherwise” (p. 110). Conflicts are not contradictory and occur at all levels of reality argue Slonim-Nevo and Nevo, and from my point of view they provide focus for subsequent inquiry. The implications of these findings are taken up in the subsequent chapter.

CHAPTER 10 Conclusion

In this study, I have evaluated the impact of the MLS reform. At one level of analysis, I have examined the nature of change, in terms of, teachers' practices and pupils' achievements. At a second level of analysis, I have used the change discussion model to examine how the changes were mediated. In the first results chapter, Chapter 5, I have reported on the outcomes of the reform from the implementers' perspective. I have discussed how the teachers and the subject leaders in particular, explained changes that happened to teaching and learning. In Chapter 6, I have examined the impact of the reform from an observational standpoint. I have inquired into the lesson observation data and I have attempted to study changes in the teaching practices, and to a lesser extent, pupils' learning, from that perspective. In Chapter 7, I have specifically addressed changes in the pupils' achievement using an objective measure, a set of secondary achievement data. In Chapter 8, I have attempted a second level of analysis. I have looked into the implementers' experiences to try and qualify the changes. Using primarily, the change discussion model as the main lens, I have attempted to pinpoint those factors that might have facilitated or impeded these changes. My inquiry has focussed on the teachers' '*zone of enactment*', the location where the teachers interact with the intents of reformers. The major findings, as presented in Chapter 8, point to how such zone mediates change. I have presented a thorough discussion of all the findings in Chapter 9.

In this chapter, I elaborate on the implications of the findings. The research has implications for Seychelles, in particular. I also extend the findings to provide insight into policy reform in SIDS. This research contributes knowledge to the

building literature in SIDS. In this Chapter 10, I also discuss some limitations of the study. Furthermore, I reflect on the areas where further research may be useful. Finally, I reflect on how this research contributes to my own personal growth.

10.1 Successes and failures of the reform

This study has provided a set of important findings about the MLS reform in terms of a) its impact on teaching and achievements, b) its contribution to other aspects of mathematics education in the country, and c) the affordances and challenges towards implementing policy reforms that address curriculum initiatives. The study has revealed that the reform had some very successful aspects, some aspects that were partially successful, and of course, there were some failures.

10.1.1 Successful aspects of the reform

- Mathematics lessons in Seychelles were more coherent and structured than they were prior to the reform. Comparison was made with the lessons observed in 2004 as part of the audit to study the state of mathematics teaching. One major change was that lessons began with mental activities, which all teachers noted was more effective than singing the 10 green bottles nursery rhyme which they used to do. The teachers and the subject leaders converged on the issue that lessons were better than they were prior to the reform. The MLS lesson template presented a model which the teachers liked even if they used it sparingly. The teachers felt that they have got a good teaching tool.
- Pupils' achievements in mathematics, in 2009, were better than they were in 2000 or 2007. This was evident by the percentage of pupils at P6 who had reached at least Level 5 established by the SACMEQ countries. Another piece of

evidence was that, out of the 20 “anchor items” on the SACMEQ II, III and the IPAM P6 test, in 2009, the pupils were better on 17 of those items.

- For the subject leaders, MLS was a benchmark for effective lessons. They used it to improve their leadership capacity: a standard to assess lessons and advise teachers on their teaching, and a means towards identifying the teachers’ training needs.
- The teachers viewed MLS as a model for effective lessons. Getting them to teach in a particular way enabled them to know what they can or cannot do.
- In the four schools that I carried out the fieldwork, the teachers were motivated to examine pedagogical changes in other curriculum areas. The idea that lessons should have a structure was transferred into other subjects. In some schools the teachers introduced ELS (a structure for English lessons), and SLS (a structure for Science lessons) to improve the overall flow of lessons in other curriculum areas.

10.1.2 Less successful aspects of the reform

- It was difficult for the teachers to incorporate all the components of the structure in their teaching. Those components which required advanced pedagogical skills such as linking lessons with real life experiences, facilitating the pupils’ conceptual understanding, formulating lesson conclusions and developing lessons with investigative features, were more difficult to incorporate in lessons. The application of the reform imposed a lot of pedagogical demand on the teachers.

- My data suggest that the use of MLS narrowed the spread in the pupils' achievement scores. However, the lower achievers improved at the expense of the higher achievers. It would have been good for everybody to benefit more from the reform. The 2009 data showed an increase in achievement but a wide gap in achievement scores.
- The teachers did not receive the expected level of support and training. Several factors, such as school-based support, teaching and learning resources and teacher characteristics, directly or indirectly impeded on how they enacted the reform. The approach used to implement the reform was ineffective in rectifying these issues.
- The reform process was poorly coordinated, monitored, and evaluated.

10.1.3 Some failures of the reform

- The fundamentals of mathematics teaching (the quality of classroom discourse and the pupils' engagement tasks) have not improved. Teaching advocated more or less procedural learning and most of pupils' tasks were mainly at a low cognitive level. Mathematics lessons continued to be held indoors. In other words, even if the data suggest that the teachers were stimulated to change their practices, deep change did not occur. The reform was ineffective in dealing with the deep rooted practices.
- The major stakeholders, notably members from other sections of the Ministry of Education and the main teacher education institution, were not properly integrated into the reform process.

10.2 Implications for education in Seychelles

I argued at the start of the thesis that it was becoming difficult to make claims about MLS given that there was no research done on the reform. My study has now provided some important findings about the reform which will have implications for the development of mathematics education and for future policy reforms in relation to curriculum initiatives. In this section I elaborate on some of these implications.

10.2.1 Development of mathematics education

The research has identified areas of mathematics teaching in the country that were strong and those that were weak. Hence these findings can be used as a basis to advance the development of mathematics education locally.

The study has revealed that conducting systemic pedagogical reform is no less challenging in small states. Contexts matter in policy implementation (Ball, Maguire, Braun, & Hoskins, 2011). Regardless of the size of the system, reforms come with their challenges. The reform in Seychelles had shown how it can be difficult to implement policy ideas especially when there are poor coordination structures and alignment of all the different policies and obligations.

Knowledge about the improvement in the pupils' achievements will certainly have an impact on future academic discourse on pupils' attainment in the country. The findings do indicate a degree of improvement in the pupils' ability. This is certain to change the debate. Before the study, the general impression was that pupils were not progressing in mathematics. My data indicate otherwise. The debate may become more interesting since pupils' achievements improved when data about actual teaching suggested that the quality of lessons was low. This observation will

definitely trigger more investigations using more sophisticated approaches into what may be going on in schools in Seychelles.

10.2.2 Future policy reform in curriculum areas

The study reveals that mathematics teaching is urgently in need of further reform. There is a need to address classroom discussions and reform the quality of pupils' engagement tasks. The study suggests that MLS alone was ineffective in changing the fundamentals of teaching. The way forward requires further thought but the need to conduct additional reform on mathematics teaching should remain a national target.

There is a need to reform the way policy ideas are implemented, in particular, the need to align all the resources and capacities so that the implementers get a more enriching experience. The implementers' accounts of their experiences accumulated in the present study establish a premise onto which subsequent reform could rely.

10.2.3 Professional development of teachers

The failure of the reform to deal with some deep rooted teaching practices triggers a discussion about the subsidiary purposes of reform vis-a-vis professional development. Of concern in Seychelles, was the need to develop a school-based model of learning that keeps teachers in the classroom, while at the same time encourage them to move on with their professional development. Fostering learning through projects like MLS is of paramount importance in small states like the Seychelles. I concur with Spillane and Jennings (1997) who argue that:

... reformers may also want to consider ways of crafting policies that take more account of what we know about teacher learning. Seeing teachers as learners would bring into policy-design conversations the things we know about

learners – that they respond to learning opportunities in different ways; that they bring to their learning dispositions, experiences, and knowledge that influence how and what they learn; and that their learning takes time and hard work (p.477).

From the position taken by Spillane and Jennings (1997), reforms can be viewed as a process of systematic learning, hence, making it more meaningful to all those involved. Everybody needs to be engaged. This could be the direction in which the Seychelles' education system, including other SIDS, should advance their thinking. Transforming schools into sites of learning will be a crucial element of reform in SIDS. Since Seychelles cannot afford to release teachers to go on long training courses for practical reasons, the possibility of learning on site may be more affordable and sustainable. My study suggests that this aspect of the reform was weak. It requires serious thought. Furthermore, Spillane and Jennings contend,

If [reform initiatives] were viewed as an occasion for teachers to learn, then reformers, when crafting policies, might ask such questions as: What might teachers learn about teaching, learning, and subject matter from these policies? How might they learn these things? How might policies not only engage teachers with alternative visions of instruction but also help them appreciate the similarities and differences between these visions and their own current theories and practices? (p.477)

Educational reform movements, as Borko (2004) contends, are setting ambitious goals for pupils' achievements through the provision of a range of opportunity for teacher development. Professional development that emphasizes the nurturing of teacher knowledge and enhances instructional practices as a means of promoting students' achievements is gaining prominence even in small education systems. It is now essential for all education systems to maximize benefits from these development programmes by making teacher learning part of the core process of reform.

Teachers in Seychelles have a disposition to learning. The high level of compliance and the way they have survived the reform activity amid challenges

suggests that the teacher population is a learning population. This is why the education system must capitalize on this positive aspect of the teaching force – use it as affordances to provoke more reform in teaching and learning. Teachers embark on reform which they believe will benefit their pupils (Datnow & Castellano, 2000). They also embark on reform initiatives that benefit their own professional growth (Guskey, 1986). This is a strong message that my research has revealed. The cascade model that was advocated during the reform period can be further developed to make on-site learning a reality in Seychelles.

10.3 Implications for the reform in the small states

Even if context matters in policy reform, as I have argued before, there are some unique features of SIDS which make the findings of this study relevant to be considered for future reforms.

The mere fact that the structure of lessons which prevailed in Seychelles had changed, as a result of the reform, suggests that the characteristic pedagogical flow (Schmidt, 1996) of a country is not permanent. Similar to the lesson learnt about the NNS in UK (Millett, Askew, et al., 2004), national scripts can be changed. Hence, systems that believe the overall state of teaching is weak, may use the Seychelles finding along with the NNS finding to induce a new script through prescribing how teachers might teach. Making the improvement mandatory might catalyse the process. This finding has implications for other countries.

Other than its geographical isolation and economic vulnerability (Campling & Rosalie, 2006), Seychelles is similar to other countries in SIDS in a number of ways. In relation to mathematics education in particular, developing countries find themselves with a large number of untrained teachers in the primary schools or

teachers who in spite of their weaknesses in mathematics are required to teach this subject. In this respect my study is a typical case in that it provides a basis to discuss how teachers in this community can be supported along with findings that can support the decision of policy makers to take the Seychelles' approach. At a different level my study may be regarded as a paradigm case in that it generates findings that may support the development of curriculum issues to countries with limited resources such as Seychelles. Findings from this study may significantly address the needs of other countries in SIDS which share the problem of weak pupils' achievements and poor teacher pedagogical knowledge.

The findings presented in this study will certainly trigger more discussions about policy implementation in SIDS. I open the window by addressing two issues using findings from the Seychelles' case as the basis for the discussion. My reflection is presented in the next two subsections.

10.3.1 Was the approach appropriate?

The implementation of MLS was mandatory and the way the teachers were asked to teach was prescriptive. Usually teachers are resentful about mandated or imposed prescribed practices (Hargreaves, 2004). Opponents of imposed prescribed practices view it as neglecting and marginalizing teachers (Bailey, 2000). However, I infer from my study that the way the implementation of MLS was done was far from marginalizing teachers. Even if the teachers reported that initially they were included only after decisions about the reform had been taken, they felt they were part of the development of the structure. However, what clearly emerged from some teachers (especially the few who perceived themselves to teach well) was that they wanted the system to differentiate them from the others. The expression "putting all the teachers in the same bag" made by one teacher, was a clear indication that not all teachers

believe in the “one size fits all” approach to professional development (Little, 1993). My data suggest that those teachers wanted more flexibility which could allow them opportunities to try out their own ideas within the context of reform practices.

On a national level, throughout the process, there were several instances when the teachers, the leaders, and the reformers, worked together. Taking into consideration the involvement of teachers and how their inputs were considered, show that the process of change that was advocated through MLS did not marginalize teachers. The application of mandatory practices in schools does not necessarily entail marginalizing teachers.

However, given the characteristics and background of most Seychellois teachers, it was relevant to begin the reform with a top-down approach. With limited resources and capacity, if the teachers were left on their own they would have not known what to do. Sometimes directions from above are needed to shape the teachers’ work. It is important nevertheless to blend top-down suggestions with a degree of bottom-up initiatives to encourage compliance as well as critical application of the idea (Fullan & Stiegelbauer, 1991). In the context of reforming practices, Webb and Vulliamy (2007) provide support government mandated reform policy. They argue that over time the teachers in their sample learned to incorporate strategies in their practices and learned to reassess the worth of strategies which initially they were reluctant to adopt. Teachers mediate policy change in that their effort over time provides support and evidence of the worth of a particular change suggestion. However, compliance is sometimes achieved at great cost to morale, confidence and creativity of the teaching profession.

What I am trying to argue here is that the approach to reforming teaching as embedded in the MLS reform might be an alternative to consider in small

jurisdictions, especially in those contexts where teachers lack the capacity or may be reluctant to take initial steps. The bottom line however, is the creation of space for critical engagement (Ball & Bowe, 1992; Bowe et al., 1992) of the teachers so that in the end they would not view innovations as “one size fits all” businesses. Millet and Bibby (2004) use the term ‘rich deliberation’ to describe the kind of discourse that the teachers and the reformers ought to be engaged in so as to impact on their zones of enactment.

10.3.2 Can the MLS successes be sustained?

Sustainability and vulnerability preoccupy dialogues about developments in SIDS. Essentially SIDS should aim at developing effective and affordable models that last. The size and geographical location of SIDS are such that practitioners often perceive themselves as isolated and without support. Furthermore, at school level, since the country is developing very fast and people tend to move on with new development and opportunity, it is important that additional human capacity be developed to support and compensate for the changing environment. The necessity for building reform capacity (Crossley & Holmes, 2001) as a prerequisite to sustainable development resonate in the Seychelles project.

There were poor research studies done on the reform. The project was largely controlled by MWG. By 2009 the coordination of the project was passed over to the different primary schools. Given the context of the schools and the availability of human resources it appeared that it was more difficult to sustain the ideas of the project. This presented a major threat to sustainability. The observation that the teachers were using MLS sparingly could well be a sign that the reform ideas were decaying. What I argue should be important, especially to small contexts like the Seychelles, is that infrastructure be developed to encourage schools to keep on

improving especially when the initial drive of policy makers recedes (Earl et al., 2002). Parallel to this, structures should be developed in schools to ensure that impediment factors such as negative school culture, staff instability, and fluctuating policies would not take their toll on the foothold of reform in the long run (Fullan, 2000). The actual school context in SIDS under the auspice of the School Improvement Programme has the mechanism to this end (Purvis 2007). However, the actual operation is far from ideal. Schools remain far from being autonomous. Unfortunately, in several instances, schools have to rely on a disjointed structure for their directions. Examples of inconsistency and conflicting messages that teachers may receive were reported in this study. These are threats to the sustainability of the successes of MLS which I reported at the start of this chapter.

What teacher-change model then do we implement in order to make this change a reality, deep, and worthwhile? There is no proper solution. Nevertheless, as Ridgway and colleagues, cited in Watson & Geest (2005), observe:

Simply importing curriculum materials into the classroom is not sufficient to implement change that can lead to improvement. Simply providing professional development is not sufficient alone. Simply providing leadership that supports reform is insufficient without materials, professional developing, and accompanying resources (cited in Watson & Geest, 2005, p.212).

In a way my data support this observation. Despite the fact that MLS has reached the classrooms, had been construed and attended to with great audacity, and even if teachers have received training in line with their classroom practices, there was minimal deep change. The lack of proper materials and resources, along with inappropriate leadership and school-based support, were clearly noticeable and reported by the teachers as weaknesses in the process.

With regard to developing a sustainable teacher change model – after all, this is the prime consideration of a small state like the Seychelles – lesson study (Fernandez, 2005) is gaining prominence. This method of getting the teachers to learn within their professional circle and from their immediate peers appears sustainable and cost effective as it minimizes the amount of time that teachers have to be out of school on training while at the same time, it facilitates learning in real situations. It requires substantial research though to see how lesson study can be integrated in schools in Seychelles.

10.4 Limitations

My study cannot provide a full account of the impact of MLS. In the first instance there is a shortage of longitudinal data which limit the extent to which I can talk about the teachers' process of change and adoption of the reform. Furthermore, I cannot talk about change in individual schools. Nonetheless, I believe that MLS might have had different impacts in different schools. Secondly, my study lacks new data about the pupils' learning. The available data limits the kinds of inferences I can make about the pupils' learning. All these limitations, on the other hand, serve as an impetus to further research about the reform. They trigger my motivation to inquire more into education policy implementation in Seychelles.

Moreover, given that the classroom data were mainly notes and audio-records, I could not say much about the non verbal issues in classes. The absence of video-recorded data in this study has made me realise how disadvantaged we might be if we decide to participate in international classroom studies.

10.5 Further research

I have already introduced some areas for further research in the previous sections as I discussed the implications of the findings. Here I want to highlight further the most pressing ones. First and foremost, I believe that research and evaluation should be an integral part of future reform initiatives in education in Seychelles. Secondly, I believe that in order to make the school-based professional development more meaningful to both the reformers and the implementers, we should seek ways to foster rich deliberations amongst the participants. This intention calls for more action research in schools. Thirdly, I argue that the need to access an affordable and sustainable teacher training model for in-service teachers is paramount. Research is therefore needed to develop and test models that work for SIDS.

10.6 Reflection

The scholarship to pursue a PhD was timely in that I was able to research on one critical activity on which I contributed to its implementation in schools to support the teachers' work. Having been involved with MLS for so long, I felt that research around it would be the best choice for this degree. Through this journey, I critically evaluated what we did, and more importantly I examined how our work transformed others' practices. Carrying out the research was indeed a wonderful and rewarding experience except that along the way, I could not share the findings and fun with other colleagues who were part of the reform. Needless to say, the process of studying the reform challenged my cognitive ability to its fullest. One message which echoed while I was doing this research was that reform in schools should be well coordinated. It is along this line that I want to formulate my concluding reflection.

10.6.1 Reforming teaching in Seychelles: my perspective

Through this research I was able to read about reform conducted elsewhere, mainly in the developed countries. This allowed me to compare what we did and certainly identified gaps in our processes. My first reflection is that we took too many elements for granted, and made too many assumptions. For instance, in the case of MLS we underestimated the process of reform. As reformers we also needed training and additional experience to see the reform through. Specifically in the MLS reform, we collected a lot of data about the teachers and their pupils, yet we seldom analyzed them in time so that our next steps could be evidence-based. I realised that we were expecting too much from the teachers. I admit that our knowledge of teacher change, the process of reforming practices, and models of curricular reform were naive. However, I stand by the steps that we took to improve the quality of teaching. This experience and, obviously, this research, have filled so many gaps in my ability to lead teacher-change activities.

10.6.2 Reflection on this study

Which one is harder, implementing reform or studying reform? I do not have sufficient data or experience to answer this question just yet. I can say however, that studying the MLS reform in Seychelles has been a challenging but intellectually rewarding process. It was challenging in that this evaluation came too late after the implementation of the reform had started. I did not have the data I would have liked to use, hence, this constrained both my analysis and the kind of arguments I would have liked to make. It was rewarding in that I now have a better understanding of, and competence to lead, pedagogical reform. I know what the process entails. The biggest lesson which I have learnt is that evaluation has to be an integral part of the

reform process if evidence-based practice is to be part of the equation. Change is a process. So is reforming.

Another setback of this research process is that the research was carried out away from the site where the reform occurred. Even if I went back to Seychelles to collect the data, I felt that being away constrained me in a number of ways. There were moments when I wanted to go back on the field and ask further questions. I could not. I had to make do with what I collected in that one shot attempt. However, what I feel now is that I have a sense of what happened and my PhD should serve as a baseline study and context for other future studies in this area. I have a story to tell. Researching change and reform is now a theme in educational research in Seychelles and I hope to lead this theme. My study may have little significance in the western countries in view that reform is well researched there. However, this study will have massive implications within the SIDS community and in Seychelles in particular.

10.7 Concluding remarks

This study has revealed a number of important findings about the MLS reform. It has added more to the knowledge of key conditions that are required for realizing the potential of the zone of enactment. My analyses have successfully addressed all three research questions of this study. I have provided evidence to support claims that the implementation of the MLS reform has impacted on teaching and pupils' achievements. I have shown that the change discussion model provides an effective theoretical framework to highlight critical aspects of the school context that may be modified to bring about deep and worthwhile change in teachers who are willing to improve their practices. I have argued that although the implementation of reform may vary from school to school, issues such as professional learning should always

have a central focus in any reform quest. Moreover, provision of space for rich deliberation, characterised by critical engagement and plurality of views ought to be part of the equation.

As its proponents have argued, the change discussion model has provided scope to understand the complex process of change (Millett and Bibby, 2004). I have come to realise that reform events in small states are as complex as in the bigger states. Hence, it would be essential not to underestimate reform efforts even in the smaller states. Understanding the MLS reform and its impact is important for future educational reforms in the Seychelles. The mixed-methods approach I adopted to collect data for the study has produced new and unique findings about this special method to teaching mathematics.

In this chapter, I have discussed the limitations of the study. I have paid particular attention to its implications and to how further research may be developed to study other aspects of this reform. In Section 10.3, I have also discussed how the Seychelles' case may be viewed as a typical and paradigm case of reforming mathematics teaching.

The study represents my contribution towards understanding the effects and implications of mathematics teaching in Seychelles, under the MLS regime. My study is a testimony to the complexities and challenges involved in getting teachers to renew their practices. Finally, through this study, I seek to do justice to the hard work that is taking place in schools in Seychelles, to ensure that all teachers get to enjoy teaching mathematics and all pupils get to enjoy learning it.

References

- Abedi, J., & Herman, J. (2010). Assessing English Language Learners' Opportunity to Learn Mathematics: Issues and Limitations. *The Teachers College Record*, 112(3), 723-746.
- Action Research Committee. (2009). *What happens in schools when teachers are made to do action research: Report of the PARISS project*. Victoria: Ministry of Education, Seychelles.
- Ait Si Mhamed, A. (2012). Tertiary education in small states: Planning in the context of globalization. *International Review of Education*, 58(4), 577-579.
- Andrews, P. (2003). Opportunities to learn in the Budapest mathematics classroom. *International Journal of Science and Mathematics Education*, 1(2), 201-225.
- Anghileri, J. (2006). A study of the impact of reform on students' written calculation methods after five years' implementation of the National Numeracy Strategy in England. *Oxford Review of Education*, 32(3), 363-380.
- Anghileri, J., Beishuizen, M., & van Putten, K. (2002). From Informal Strategies to Structured Procedures: mind the gap! *Educational Studies in Mathematics*, 49(2), 149-170.
- Armstrong, H., De Kervenoael, R. J., Li, X., & Read, R. (1998). A comparison of the economic performance of different micro-states, and between micro-states and larger countries. *World Development*, 26(4), 639-656.
- Askew, M., Brown, M., Rhodes, V., Wiliam, D., & Johnson, D. (1997). *Effective teachers of numeracy: Report of a study carried out for the Teacher Training Agency*. London: King's College London. School of Education.
- Atchoaréna, D., Da Graca, P. D., & Marquez, J. M. (2008). Strategies for Post-Primary Education in Small Island Developing States (SIDS): Lessons from Cape Verde. *Comparative Education*, 44(2), 167-189.

- Aubrey, C. (1995). Teacher and pupil interactions and the processes of mathematical instruction in four reception classrooms over children's first year in school. *British Educational Research Journal*, 21(1), 31-48.
- Australian Education Council. (1991). *A National Statement on Mathematics for Australian Schools*. Victoria: Australia Curriculum Corporation.
- Bailey, B. (2000). The impact of mandated change on teachers. In A. Hargreaves & N. Bascia (eds.), *The Sharp Edge of Change.. Teaching, Leading and the Realities of Reform* (pp. 112-128). London: Falmer Press.
- Baldacchino, G. (2011). The small state in higher education: a conceptual assessment
Introducing small states: typical, yet marginal. *Teaching in Higher Education*, 16(4), 457-467.
- Ball, D. (1991). Research on teaching mathematics: Making subject matter knowledge part of the equation. *Advances in research on teaching*, 2, 1-48.
- Ball, D., & Cohen, D. (1996). Reform by the book: What is or might be the role of curriculum materials in teacher learning and instructional reform? *Educational Researcher*, 25(9), 6-8.
- Ball, S. J., & Bowe, R. (1992). Subject departments and the 'implementation' of National Curriculum policy: an overview of the issues. *Journal of Curriculum Studies*, 24(2), 97-115.
- Ball, S. J., Maguire, M., & Braun, A. (2012). *How Schools Do Policy: Policy Enactments in Secondary Schools*. Oxon: Routledge.
- Ball, S. J., Maguire, M., Braun, A., & Hoskins, K. (2011). Policy actors: doing policy work in schools. *Discourse: Studies in the Cultural Politics of Education*, 32(4), 625-639.
- Bantwini, B. (2009). How teacher perceive the new curriculum reform: Lessons from a school district in Eastern Cape Province, South Africa. *International Journal of Educational Development*, 30(1), 83-90.

- Barallon, L. (2011). *Leadership development in the Seychelles*. Unpublished doctoral dissertation, University of Warwick, UK.
- Barry, K., & King, L. (1989). *Beginning teaching: A developmental text for effective teaching*. Wentworth Falls: Social Science Press.
- Bezzina, C., & Camilleri, A. (2001). The Professional Development of Teachers in Malta. *European Journal of Teacher Education*, 24(2), 157-170.
- Bishop, A. (1985). The social construction of meaning: A significant development for mathematics education. *For the learning of mathematics*, 5(1), 24-28.
- Blaikie, N. (2007). *Approaches to social enquiry: Advancing knowledge*. Malden: Polity Press.
- Borko, H., Davinroy, K., Bliem, C., & Cumbo, K. (2000). Exploring and supporting teacher change: Two third-grade teachers' experiences in a mathematics and literacy staff development project. *The Elementary School Journal*, 100(4), 273-306.
- Bowe, R., Ball, S. J., & Gold, A. (1992). *Reforming education and changing schools: Case studies in policy sociology*. London: Routledge.
- Bozack, A., Vega, R., McCaslin, M., & Good, T. (2008). Teacher support of student autonomy in Comprehensive School Reform classrooms. *The Teachers College Record*, 110(11), 2389-2407.
- Braun, A., Ball, S. J., Maguire, M., & Hoskins, K. (2011). Taking context seriously: towards explaining policy enactments in the secondary school. *Discourse: Studies in the Cultural Politics of Education*, 32(4), 585-596.
- Braun, A., Maguire, M., & Ball, S. J. (2010). Policy enactments in the UK secondary school: Examining policy, practice and school positioning. *Journal of Education Policy*, 25(4), 547-560.
- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative research in psychology*, 3(2), 77-101.

- Bray, M. (1985). Education and Decentralisation in Less Developed Countries: a comment on general trends, issues and problems, with particular reference to Papua New Guinea. *Comparative Education*, 21(2), 183-195.
- Bray, M. (1990). Provision of Higher Education in Small States: Demands, Constraints and Strategies. *Higher Education Quarterly*, 44(3), 264-281.
- Brock, C., & Smawfield, D. (1988). Education and Development: The Issue of Small States. *Educational Review*, 40(2), 227-239.
- Brown, M. (1996). FIMS and SIMS: the first two IEA International Mathematics Surveys. *Assessment in Education: Principles, Policy & Practice*, 3(2), 193-212.
- Brown, M. (2010). *Are We Getting Better at Educating?* Paper presented at the Annual Education Lecture, Department of Education & Professional Studies, King's College London.
- Brown, M., Askew, M., Baker, D., Denvir, H., & Millett, A. (1998). Is the national numeracy strategy research-based? *British Journal of Educational Studies*, 46(4), 362-385.
- Brown, M., Askew, M., & Millett, A. (2003). How has the National Numeracy Strategy affected attainment and teaching In Year 4? *Proceedings of the British Society for Research into Learning Mathematics*, 23(2), 13-18.
- Brown, M., Askew, M., Millett, A., & Rhodes, V. (2003). The key role of educational research in the development and evaluation of the National Numeracy Strategy. *British Educational Research Journal*, 29(5), 655-667.
- Brown, M., Askew, M., Rhodes, V., Denvir, H., Ranson, E., & Wiliam, D. (2003). *Characterising individual and cohort progression in learning numeracy: results from the Leverhulme 5-year longitudinal study*. Paper presented at the Educational Research Association Annual Conference, Chicago, 21-25 April.

- Brown, M., Millett, A., Bibby, T., & Johnson, D. (2000). Turning our attention from the what to the how: the National Numeracy Strategy. *British Educational Research Journal*, 26(4), 457-471.
- Bryant, A., & Charmaz, K. (Eds.). (2010). *The Sage handbook of grounded theory*. London: Sage Publications Ltd.
- Bryman, A., & Cramer, D. (2009). *Quantitative data analysis with SPSS 14, 15, & 16*. London: Routledge.
- Buchert, L. (1995). The concept of Education for All: what has happened after Jomtien? *International Review of Education*, 41(6), 537-549.
- Campling, L., & Rosalie, M. (2006). Sustaining social development in a small island developing state? The case of Seychelles. *Sustainable Development*, 14(2), 115-125.
- Candy, P. (1989). Alternative paradigms in educational research. *The Australian Educational Researcher*, 16(3), 1-11.
- Carpenter, T. P., Fennema, E., & Franke, M. L. (1996). Cognitively guided instruction: A knowledge base for reform in primary mathematics instruction. *The Elementary School Journal*, 97(1), 3-20.
- Chen, X., & Li, Y. (2010). Instructional coherence in Chinese mathematics classroom - A case study of lessons on fraction division. *International Journal of Science and Mathematics Education*, 8(4), 711-735.
- Clarke, D. (2002). *The learner's perspective study: Exploiting the potential for complementary analyses*. Paper presented at the Annual Conference of the American Educational Research Association, New Orleans, April 2-5, 2002.
- Clarke, D. (Ed.). (1994). *Ten key principles from research for the professional development of mathematics teachers* (Vol. 1994). Reston, VA: National Council of Teachers of Mathematics.
- Clarke, D., Mesiti, C., O'Keefe, C., Xu, L. H., Jablonka, E., Mok, I. A. C., et al. (2007). Addressing the challenge of legitimate international comparisons of

- classroom practice. *International Journal of Educational Research*, 46(5), 280-293.
- Cobb, P., Yackel, E., & Wood, T. (1992). A constructivist alternative to the representational view of mind in mathematics education. *Journal for Research in Mathematics Education*, 23(1), 2-33.
- Cockcroft, W. (1982). *The Cockcroft report-Mathematics counts*. London: HMSO.
- Cohen, D. K. (1995). What is the system in systemic reform? *Educational Researcher*, 24(9), 11-31.
- Cohen, L., & Manion, L. (2000). *Research Methods in Education*. London: Routledge.
- Crossley, M. (2008). The advancement of educational research in small states. *Comparative Education*, 44(2), 247 - 254.
- Crossley, M. (2010). Context matters in educational research and international development: Learning from the small states experience. *Prospects*, 40(4), 421-429.
- Crossley, M., & Holmes, K. (2001). Challenges for educational research: international development, partnerships and capacity building in small states. *Oxford Review of Education*, 27(3), 395-409.
- Cuban, L. (1998). How schools change reforms: Redefining reform success and failure. *The Teachers College Record*, 99(3), 453-477.
- Datnow, A. (2002). Can We Transplant Educational Reform, and Does It Last? *Journal of Educational Change*, 3(3), 215-239.
- Datnow, A. (2005). The sustainability of comprehensive school reform models in changing district and state contexts. *Educational Administration Quarterly*, 41(1), 121-153.

- Datnow, A., & Castellano, M. (2000). Teachers' responses to Success for All: How beliefs, experiences, and adaptations shape implementation. *American Educational Research Journal*, 37(3), 775-799.
- Davis, E., & Krajcik, J. (2005). Designing educative curriculum materials to promote teacher learning. *Educational Researcher*, 34(3), 3-14.
- DfEE. (1999). *The National Numeracy Strategy: framework to teaching mathematics from Reception to Year 6*. London: DfEE.
- Earl, L., Fullan, M., Leithwood, K., Watson, N., Jantzi, D., Levin, B., et al. (2000). OISE/UT Evaluation of the Implementation of the National Literacy and Numeracy Strategies: Nottingham: DfEE.
- Earl, L., Watson, N., & Torrance, N. (2002). Front row seats: What we've learned from the National literacy and Numeracy Strategies in England. *Journal of educational Change*, 3(1), 35-53.
- Fernandez, C. (2005). Lesson study: A means for elementary teachers to develop the knowledge of mathematics needed for reform-minded teaching? *Mathematical thinking and learning*, 7(4), 265-289.
- Fernandez, C., Yoshida, M., & Stigler, J. (1992). Learning Mathematics From Classroom Instruction: On Relating Lessons to Pupils Interpretations. *Journal of the Learning Sciences*, 2(4), 333-365.
- Finlay, L. (1998). Reflexivity: An essential component for all research? *The British Journal of Occupational Therapy*, 61(10), 453-456.
- Fishman, B. J., Marx, R. W., Best, S., & Tal, R. T. (2003). Linking teacher and student learning to improve professional development in systemic reform. *Teaching and Teacher Education*, 19(6), 643-658.
- Franke, M. L., Carpenter, T. P., Levi, L., & Fennema, E. (2001). Capturing Teachers' Generative Change: A Follow-Up Study of Professional Development in Mathematics. *American Educational Research Journal*, 38(3), 653-689.

- Fullan, M. (1982). *The new meaning of educational change*. New York: Teachers College Press.
- Fullan, M. (2000). The Return of Large-Scale Reform. *Journal of Educational Change*, 1(1), 5-27.
- Fullan, M., Hill, P., & Crévola, C. (2006). *Breakthrough*. Thousand Oaks, CA: Corwin Press.
- Fullan, M., & Stiegelbauer, S. (1991). *The new meaning of change*. New York: Teachers College Press.
- Geisler, G., & Pardiwalla, M. (2010). Socialization Patterns and Boys' Underperformance in Seychellois Schools. *Journal Statistique Africain*, 11, 62-84.
- George, J., Mohammed, J., & Quamina-Aiyejina, L. (2003). Teacher Identity in an Era of Educational Reform: The case of Trinidad and Tobago. *Compare: A Journal of Comparative and International Education*, 33(2), 191-206.
- Ghina, F. (2003). Sustainable development in small island developing states. *Environment, Development and Sustainability*, 5(1), 139-165.
- Giles, C., & Hargreaves, A. (2006). The sustainability of innovative schools as learning organizations and professional learning communities during standardized reform. *Educational Administration Quarterly*, 42(1), 124.
- Gill, S. (2005). Language policy in Malaysia: Reversing direction. *Language Policy*, 4(3), 241-260.
- Goldstein, H. (2004). Education for all: the globalization of learning targets. *Comparative Education*, 40(1), 7-14.
- Good, T. L., & Brophy, J. E. (1987). *Looking into classrooms*. New York: Harper and Row.
- Goodson, I. F. (2001). Social histories of educational change. *Journal of Educational Change*, 2(1), 45-63.

- Gravemeijer, K. (1994). Educational Development and Developmental Research in Mathematics Education. *Journal for Research in Mathematics Education*, 25(5), 443-471.
- Gravemeijer, K. (2004). Local instruction theories as means of support for teachers in reform mathematics education. *Mathematical Thinking and Learning*, 6(2), 105-128.
- Grix, J. (2002). Introducing Students to the Generic Terminology of Social Research. *Politics*, 22(3), 175-186.
- Gross, J. (2007). Supporting children with gaps in their mathematical understanding: The impact of National Numeracy Strategy (NNS) on children who find mathematics difficult. *Educational and Child Psychology*, 24(2), 146 - 156.
- Grubb, W. (2000). Opening classrooms and improving teaching: Lessons from school inspections in England. *The Teachers College Record*, 102(4), 696-723.
- Guillemin, M., & Gillam, L. (2004). Ethics, reflexivity, and "ethically important moments" in research. *Qualitative Inquiry*, 10(2), 261.
- Guskey, T. (1986). Staff development and the process of teacher change. *Educational Researcher*, 15(5), 5-12.
- Guskey, T. (2002). Professional development and teacher change. *Teachers and teaching: Theory and Practice*, 8(3), 381-391.
- Haggarty, L., & Postlethwaite, K. (2003). Action Research: a strategy for teacher change and school development? *Oxford Review of Education*, 29(4), 423-448.
- Hall, G., & Loucks, S. (1978). Teacher concerns as a basis for facilitating and personalizing staff development. *The Teachers College Record*, 80(1), 36-53.
- Hamilton, L., McCaffrey, D., Stecher, B., Klein, S., Robyn, A., & Bugliari, D. (2003). Studying large scale reforms of instructional practice: An example from mathematics and science. *Educational Evaluation and Policy Analysis*, 25(1), 1-29.

- Handal, B., & Herrington, A. (2003). Mathematics teachers' beliefs and curriculum reform. *Mathematics Education Research Journal*, 15(1), 59-69.
- Hargreaves, A. (2004). Inclusive and exclusive educational change: emotional responses of teachers and implications for leadership. *School Leadership & Management*, 24(3), 287-309.
- Harris, A. (2001). Building the Capacity for School Improvement. *School Leadership & Management: Formerly School Organisation*, 21(3), 261 - 270.
- Harris, A. (2003). Behind the classroom door: the challenge of organisational and pedagogical change. *Journal of Educational Change*, 4(4), 369-382.
- Harry, B., Sturges, K. M., & Klingner, J. K. (2005). Mapping the process: An exemplar of process and challenge in grounded theory analysis. *Educational Researcher*, 34(2), 3.
- Hiebert, J., Stigler, J., & Manaster, A. (1999). Mathematical features of lessons in the TIMSS Video Study. *ZDM*, 31(6), 196-201.
- Hiebert, J., & Stigler, J. W. (1999). *The teaching gap*. New York: The Free Press.
- Hiebert, J., & Wearne, D. (1993). Instructional tasks, classroom discourse, and students' learning in second-grade arithmetic. *American Educational Research Journal*, 30(2), 393-425.
- Hill, H. C., Rowan, B., & Ball, D. L. (2005). Effects of teachers' mathematical knowledge for teaching on student achievement. *American Educational Research Journal*, 42(2), 371-406.
- Hoban, G. (2002). *Teacher learning for educational change: A systems thinking approach*. Buckingham: Open University Press.
- Hodgen, J. (2003). *Teacher identity and professional development in primary school mathematics*. Unpublished doctoral dissertation, King's College London, UK.
- Holmes, K., & Crossley, M. (2004). Whose knowledge, whose values? the contribution of local knowledge to education policy processes: a case study of

- research development initiatives in the small state of Saint Lucia. *Compare: A Journal of Comparative and International Education*, 34(2), 197-214.
- Izard, J. (1996). *Overview of test construction*. Paris: International Institute of Educational Planning. Retrieved May 15, 2012, from <http://www.sacmeq.org>.
- Jablonka, E. (2004). Structure in diversity: Initiation into mathematical practice in classrooms from Germany, Hong Kong and the United States: Research study for Habilitation at Faculty of Education and Psychology, Freie University Berlin.
- Jang, E. E., McDougall, D. E., Pollon, D., Herbert, M., & Russell, P. (2008). Integrative mixed methods data analytic strategies in research on school success in challenging circumstances. *Journal of Mixed Methods Research*, 2(3), 221-247.
- Jarzabkowski, L. (2003). Teacher collegiality in a remote Australian school. *Journal of Research in Rural Education*, 18(3), 139-144.
- Jarzabkowski, L. M. (2002). The social dimensions of teacher collegiality. *Journal of Educational Enquiry*, 3(2), 1-20.
- Jennings, Z. (1994). Innovations in Caribbean School Systems: why some have become institutionalised and others have not. *Curriculum Studies*, 2(3), 309-331.
- Johnson, D. (2006). Investing in teacher effectiveness to improve educational quality in developing countries: does in-service education for primary mathematics teachers in Sri Lanka make a difference to teaching and learning? *Research in Comparative and International Education*, 1(1), 73-87.
- Johnson, R. B., & Onwuegbuzie, A. J. (2004). Mixed methods research: A research paradigm whose time has come. *Educational Researcher*, 33(7), 14-26.
- Johnson, S. (1999). International Association for the Evaluation of Educational Achievement Science Assessment in Developing Countries. *Assessment in Education: Principles, Policy & Practice*, 6(1), 57-73.

- Johnson, S., Hodges, M., & Monk, M. (2000). Teacher development and change in South Africa: a critique of the appropriateness of transfer of northern/western practice. *Compare*, 30(2), 179-192.
- Kaur, B. (2010). A study of mathematical tasks from three classrooms in Singapore schools. In Y. Shimizu, B. Kaur & D. Clarke (eds.), *Mathematical Tasks in Classrooms around the World* (pp. 15-33). Rotterdam, The Netherlands: Sense Publishers.
- Khosa, G., Kanjee, A., & Monyooe, L. (2002). *The Seychelles School Improvement Programme: Baseline Evaluation*. Pretoria: Human Science Research Council.
- Kyriacou, C. (2005). The impact of daily mathematics lessons in England on pupil confidence and competence in early mathematics: a systematic review. *British Journal of Educational Studies*, 53(2), 168-186.
- Lampert, M. (1986). Knowing, doing, and teaching multiplication. *Cognition and Instruction*, 3(4), 305-342.
- Leech, N. L., Dellinger, A. B., Brannagan, K. B., & Tanaka, H. (2010). Evaluating Mixed Research Studies: A Mixed Methods Approach. *Journal of Mixed Methods Research*, 4(1), 17-31.
- Leithwood, K., & Jantzi, D. (2006). Transformational school leadership for large-scale reform: Effects on students, teachers, and their classroom practices. *School Effectiveness and School Improvement*, 17(2), 201-227.
- Leithwood, K., Jantzi, D., & Mascall, B. (2002). A framework for research on large-scale reform. *Journal of Educational Change*, 3(1), 7-33.
- Leithwood, K. A., Jantzi, D., & Mascall, B. (1999). *Large-scale Reform: What Works? Submitted as part of the first annual report: External Evaluation of the UK National Literacy Strategy and National Numeracy Strategy*. Ontario: Ontario Institute for Studies in Education of the University of Toronto.
- Lespoir, M. (2009). *An evaluation of the IPAM Project in Seychelles*. Unpublished Master thesis, University of Warwick, UK.

- Leste, A. (2005). *Streaming in Seychelles: From SACMEQ research to policy reform*. Paper presented at the SACMEQ Research Conference. Paris: SACMEQ.
- Leste, A., Valentin, J. D., & Hoareau, F. (2003). *The SACMEQ II project in Seychelles: A study of the conditions of schooling and the quality of education. Interim Report*. Victoria: Seychelles, Ministry of Education.
- Leste, A., Valentin, J. D., & Hoareau, F. (2005). *The SACMEQ II project in Seychelles: A study of the conditions of schooling and the quality of education*. Harare: SACMEQ.
- Lewis, C., Perry, R., & Murata, A. (2006). How should research contribute to instructional improvement? The case of lesson study. *Educational Researcher*, 35(3), 3-14.
- Lincoln, Y. G., & Guba, E. (1985). *Naturalistic Inquiry*. Newbury Park, CA: Sage Publications Inc.
- Ling, L. M. (2002). A tale of two teachers: teachers' responses to an imposed curriculum reform. *Teacher Development*, 6(1), 33-46.
- Little, J. W. (1993). Teachers' professional development in a climate of educational reform. *Educational Evaluation and Policy Analysis*, 15(2), 129-151.
- Ma, Y., Yin, H., Tang, L., & Liu, L. (2009). Teacher receptivity to system-wide curriculum reform in the initiation stage: a Chinese perspective. *Asia Pacific Education Review*, 10(3), 423-432.
- Macnab, D. (2003). Implementing change in mathematics education. *Journal of Curriculum Studies*, 35(2), 197-216.
- Mathematics Working Group. (2005). Report of a research on five selected aspects of the mathematics education curriculum in Seychelles. Ministry of Education.
- Mathematics Working Group. (2006). *Seychelles National Mathematics Improvement Plan 2006 - 2009*. Victoria: Ministry of Education.

- Mathison, S. (1988). Why triangulate? *Educational Researcher*, 17(2), 13-17.
- Maxwell, J. A. (2006). Literature Reviews of, and for, Educational Research: A Commentary on Boote and Beile's "Scholars before Researchers". *Educational Researcher*, 35(9), 28-31.
- McDonnell, L. M. (1995). Opportunity to learn as a research concept and a policy instrument. *Educational Evaluation and Policy Analysis*, 17(3), 305-322.
- McGrath, S. (2010). Education and development: Thirty years of continuity and change. *International Journal of Educational Development*, 30(6), 537-543.
- McNamara, O., & Corbin, B. (2001). Warranting practices: teachers embedding the National Numeracy Strategy. *British Journal of Educational Studies*, 49(3), 260-284.
- Meyer, D. Z., & Avery, L. M. (2009). Excel as a qualitative data analysis tool. *Field Methods*, 21(1), 91-112.
- Millett, A., Askew, M., & Brown, M. (2004). The impact of the national numeracy strategy in year 4 (II): teaching. *Research in Mathematics Education*, 6(1), 191-205.
- Millett, A., & Bibby, T. (2004). The Context for Change: A Model for Discussion. In A. Millett, M. Brown & M. Askew (eds.), *Primary Mathematics and the Developing Professional* (pp. 1-17). Dordrecht: Kluwer.
- Millett, A., Brown, M., & Askew, M. (2004a). Drawing conclusions. In A. Millett, M. Brown & M. Askew (eds.), *Primary mathematics and the developing professional* (pp. 245-255). Dordrecht: Kluwer
- Millett, A., Brown, M., & Askew, M. (2004b). The impact of the national numeracy strategy in Year 4 (1): Attainment and learning. *Research in Mathematics Education*, 6(1), 175-190.
- Millett, A., & Johnson, D. (2004). The Role of the Mathematics Co-Ordinator: A Source of in-School Support In A. Millett, M. Brown & M. Askew (eds.),

Primary Mathematics and the Developing Professional (pp. 19-55).
Dordrecht: Kluwer.

Ministry of Education. (2005). The National Numeracy Improvement Plan.
Government of Seychelles.

Mitchell, C., & Sackney, L. (2001). Building capacity for a learning community.
Canadian Journal of Educational Administration and Policy, 19. Retrieved
December 15, 2010, from
<http://www.umanitoba.ca/publications/cjeap/articles/mitchellandsackney.html>.

Morrison, K. (2009). School inspection in small states and territories: an overview
and case study of Macau. *Compare*, 39(6), 751-767.

Moyer, P. S. (2001). Are we having fun yet? How teachers use manipulatives to
teach mathematics. *Educational Studies in Mathematics*, 47(2), 175-197.

Mullis, I. V. S., Martin, M. O., Beaton, A. E., Gonzalez, E. J., Kelly, D. L., & Smith,
T. A. (1997). *Mathematics achievement in the primary school years: IEA's
Third International Mathematics and Science Study (TIMSS)*: TIMSS
international study center, Boston College Chestnut Hill, MA.

Murimba, S. (2005). The Impact of the Southern and Eastern Africa Consortium for
Monitoring Educational Quality (Sacmeq). *Prospects*, 35(1), 91-108.

Myers, G. J., Davidson, P. W., Cox, C., Shamlaye, C. F., Palumbo, D., Cernichiari,
E., et al. (2003). Prenatal methylmercury exposure from ocean fish
consumption in the Seychelles child development study. *The Lancet*,
361(9370), 1686-1692.

Myers, G. J., Thurston, S. W., Pearson, A. T., Davidson, P. W., Cox, C., Shamlaye,
C. F., et al. (2009). Postnatal exposure to methyl mercury from fish
consumption: a review and new data from the Seychelles Child Development
Study. *Neurotoxicology*, 30(3), 338-349.

Nathan, M., & Knuth, E. (2003). A study of whole classroom mathematical discourse
and teacher change. *Cognition and Instruction*, 21(2), 175-207.

- NCTM. (2000). *Principles and standards for school mathematics*. Reston VA: NCTM
- Nielsen, D. C., Barry, A. L., & Staab, P. T. (2008). Teachers' reflections of professional change during a literacy-reform initiative. *Teaching and Teacher Education, 24*(5), 1288-1303.
- Nolan, J. (2008). *The Seychelles education and training system: Does it has the capacity to provide the human resources to achieve the objectives of "Seychelles Strategy 2017"?* Victoria: Ministry of Education.
- O'Sullivan, M. C. (2002). Reform Implementation and the Realities within which Teachers Work: A Namibian case study. *Compare: A Journal of Comparative and International Education, 32*(2), 219-237.
- Onwuegbuzie, A. J. (2009). A qualitative framework for collecting and analyzing data in focus group research. *International Journal of Qualitative Methods, 8*(3), 1-21.
- Onwuegbuzie, A. J., & Leech, N. L. (2005). On Becoming a Pragmatic Researcher: The Importance of Combining Quantitative and Qualitative Research Methodologies. *International Journal of Social Research Methodology, 8*(5), 375-387.
- Patton, M. (2002). *Qualitative research and evaluation methods*: Sage Publications, Inc.
- Pereira, P. (2011). Reconstructing Teachers of Mathematics In S. Schuck & P. Pereira (eds.), *What Counts in Teaching Mathematics* (Vol. 11, pp. 145-159). Netherlands: Springer.
- Perry, R. R., & Lewis, C. C. (2009). What is successful adaptation of lesson study in the US? *Journal of Educational Change, 10*(4), 365-391.
- Pillow, W. (2003). Confession, catharsis, or cure? Rethinking the uses of reflexivity as methodological power in qualitative research. *International Journal of Qualitative Studies in Education, 16*(2), 175-196.

- Prawat, R. S., Remillard, J., Putnam, R. T., & Heaton, R. M. (1992). Teaching Mathematics for Understanding: Case Studies of Four Fifth-Grade Teachers. *The Elementary School Journal*, 93(2), 145-152.
- Purvis, M. T. (2007). *School improvement in a small island developing state: the Seychelles*. Unpublished doctoral dissertation, University of Warwick, UK.
- Riley, K., & Torrance, H. (2003). As national policy-makers seek to find solutions to national education issues, do international comparisons such as TIMSS and PISA create a wider understanding, or do they serve to promote the orthodoxies of international agencies? *Journal of Educational Change*, 4(4), 419-425.
- Ross, J., McDougall, D., & Hogaboam-Gray, A. (2002). Research on reform in mathematics education, 1993-2001. *Alberta journal of educational research*, 48(2), 122-138.
- Ross, J., McDougall, D., Hogaboam-Gray, A., & LeSage, A. (2003). A survey measuring elementary teachers' implementation of standards-based mathematics teaching. *Journal for Research in Mathematics Education*, 34(4), 344-363.
- Ross, K., Machingaidze, T., Pfukani, P., & Shumba, S. (1998). The quality of primary education: some policy suggestions based on a survey of schools: Zimbabwe. *SACMEQ policy research: report No, 3*.
- Ross, K., Saito, M., Dolata, S., Ikeda, M., & Zuze, L. (2004). Data archive for the SACMEQ I and SACMEQ II projects. *Paris: IIEP-UNESCO*.
- Ryder, J., & Banner, I. (2012). School Teachers' Experiences of Science Curriculum Reform. *International Journal of Science Education*, 0(0), 1 - 25.
- Sahlberg, P. (2006). Education reform for raising economic competitiveness. *Journal of Educational Change*, 7(4), 259-287.
- Schmidt, W., Jorde, D., Cogan, L., Barrier, E., Gonzalo, I., Moser, U., et al. (1996). *Characterizing pedagogical flow*: Boston MA: Kluwer Academic Publishers.

- Schmidt, W. H. (1996). *Characterizing pedagogical flow: An investigation of mathematics and science teaching in six countries*. Dordrecht: Kluwer Academic Pub.
- Schoenfeld, A. H. (1989). Ideas in the air: Speculations on small group learning, environmental and cultural influences on cognition, and epistemology. *International Journal of Educational Research*, 13(1), 71-88.
- Schoenfeld, A. H. (2000). Purposes and methods of research in mathematics education. *Notices of the AMS*, 47(6), 641-649.
- Scott, F. (2001). Developing human resources for effective school management in small Caribbean states. *International Journal of Educational Development*, 21(3), 245-256.
- Senger, E. (1998). Reflective reform in mathematics: The recursive nature of teacher change. *Educational Studies in Mathematics*, 37(3), 199-221.
- Sergiovanni, T. (1998). Leadership as pedagogy, capital development and school effectiveness. *International Journal of Leadership in Education*, 1(1), 37-46.
- Setati, M., & Adler, J. (2000). Between languages and discourses: Language practices in primary multilingual mathematics classrooms in South Africa. *Educational Studies in Mathematics*, 43(3), 243-269.
- Shimizu, Y. (2006). How do you conclude today's lesson?: The form and functions of "Matome" in mathematics lessons. *Making Connections: Comparing Mathematics Classrooms Around the World*. Retrieved January 10, 2011, from <http://www.edfac.unimelb.edu.au/DSME/research/lps>.
- Shimizu, Y. (2009). Characterizing exemplary mathematics instruction in Japanese classrooms from the learner's perspective. *ZDM*, 41(3), 311-318.
- Shimizu, Y., Kaur, B., Huang, R., & Clarke, D. (Eds.). (2010). *Mathematical tasks in classrooms around the world*. Rotterdam, The Netherlands: Sense Publishers.
- Shulman, L. S. (1986). Those who understand: Knowledge growth in teaching. *Educational Researcher*, 15(2), 4-14.

- Simon, S., Millett, A., & Askew, M. (2004). The dynamics of the teacher decision-making: Case studies of teachers responding to the National Numeracy Strategy In A. Millett, M. Brown & M. Askew (eds.), *Primary Mathematics and the Developing Professional* (pp. 155-184). Dordrecht: Kluwer Academic Publishers.
- Slavin, R. E. (2008). Evidence-based Reform in Education: what will it take? *European Educational Research Journal*, 7(1), 124-128.
- Slonim-Nevo, V., & Nevo, I. (2009). Conflicting Findings in Mixed Methods Research. *Journal of Mixed Methods Research*, 3(2), 109-128.
- Smith, M. (2000). Balancing old and new: An experienced middle school teacher's learning in the context of mathematics instructional reform. *The Elementary School Journal*, 100(4), 351-375.
- Smyth, J. (1991). International Perspectives on Teacher Collegiality: a labour process discussion based on the concept of teachers' work. *British Journal of Sociology of Education*, 12(3), 325-346.
- Spillane, J., & Jennings, N. (1997). Aligned instructional policy and ambitious pedagogy: Exploring instructional reform from the classroom perspective. *The Teachers College Record*, 98(3), 449-481.
- Spillane, J. P. (1999). External reform initiatives and teachers efforts to reconstruct their practice: the mediating role of teachers zones of enactment. *Journal of curriculum Studies*, 31(2), 143-175.
- Spillane, J. P. (2000). Cognition and policy implementation: District policymakers and the reform of mathematics education. *Cognition and Instruction*, 18(2), 141-179.
- Spillane, J. P., & Callahan, K. A. (2000). Implementing state standards for science education: What district policy makers make of the hoopla. *Journal of Research in Science Teaching*, 37(5), 401-425.

- Spillane, J. P., & Zeuli, J. (1999). Reform and teaching: Exploring patterns of practice in the context of national and state mathematics reforms. *Educational Evaluation and Policy Analysis*, 21(1), 1-27.
- Stacey, K. (2005). The place of problem solving in contemporary mathematics curriculum documents. *The Journal of Mathematical Behavior*, 24(3-4), 341-350.
- Stein, M., & Wang, M. (1988). Teacher development and school improvement: The process of teacher change. *Teaching and Teacher Education*, 4(2), 171-187.
- Stein, M. K., Grover, B. W., & Henningsen, M. (1996). Building student capacity for mathematical thinking and reasoning: An analysis of mathematical tasks used in reform classrooms. *American Educational Research Journal*, 33(2), 455-488.
- Stein, N., & Glenn, C. (1982). Children's concept of time: The development of a story schema. In W. J. Friedman (ed.), *The developmental psychology of time* (pp. 255-282). New York: Academic Press.
- Stigler, J., Gallimore, R., & Hiebert, J. (2000). Using video surveys to compare classrooms and teaching across cultures: Examples and lessons from the TIMSS video studies. *Educational Psychologist*, 35(2), 87-100.
- Stipek, D., Givvin, K., Salmon, J., & MacGyvers, V. (2001). Teachers' beliefs and practices related to mathematics instruction. *Teaching and Teacher Education*, 17(2), 213-226.
- Strauss, A. L., & Corbin, J. M. (1998). *Basics of qualitative research: Techniques and procedures for developing grounded theory*. Thousand Oaks: SAGE Publications.
- Sztajn. (2003). Adapting reform ideas in different mathematics classrooms: Belief beyond mathematics. *Journal of Mathematics Teacher Education*, 6(1), 53-75.

- Tabulawa, R. (1998). Teachers perspectives on classroom practice in Botswana: implications for pedagogical change. *International Journal of Qualitative Studies in Education*, 11(2), 249-268.
- Takayama, K. (2008). The politics of international league tables: PISA in Japan's achievement crisis debate. *Comparative Education*, 44(4), 387-407.
- Trencansky, I. (2002). *Consultant Slovaque du ministère de l'éducation de la république des Seychelles. Rapport final de la mission*. Victoria: Ministry of Education, Seychelles.
- Tymms, P. (2004). Are standards rising in English primary schools? *British Educational Research Journal*, 30(4), 477-494.
- Valentin, J. D. (2003). *Proficiency on Arithmetic Word Problems of Seychellois Pupils*. Unpublished Master thesis, School of Education, University of Science Malaysia, Penang.
- Valentin, J. D. (2007). *Improving the conduct of daily mathematics lessons in the Seychelles*. Paper presented at the 4th East Asian Research Conference on Mathematics Education (EARCOME 4).
- Van den Berg, R., & Ros, A. (1999). The permanent importance of the subjective reality of teachers during educational innovation: A concerns-based approach. *American Educational Research Journal*, 36(4), 879-906.
- Van der Eyken, W., Goulden, D., & Crossley, M. (1995). Evaluating Educational Reform in a Small State. *Evaluation*, 1(1), 33-44.
- Venkatakrishnan, H., & Brown, M. (2009). Examining the implementation of the mathematics strand of the Key Stage 3 Strategy: what are the bases of evaluation? *British Educational Research Journal*, 35(1), 5-24.
- Walker, D. F. (1971). A naturalistic model for curriculum development. *The School Review*, 80(1), 51-65.

- Walshaw, M., & Anthony, G. (2008). The teacher's role in classroom discourse: A review of recent research into mathematics classrooms. *Review of educational research, 78*(3), 516-551.
- Wang, J. (1998). Opportunity to learn: The impacts and policy implications. *Educational Evaluation and Policy Analysis, 20*(3), 137-156.
- Watson, A., & Geest, E. (2005). Principled teaching for deep progress: Improving mathematical learning beyond methods and materials. *Educational Studies in Mathematics, 58*(2), 209-234.
- Waugh, R., & Godfrey, J. (1993). Teacher receptivity to system-wide change in the implementation stage. *British Educational Research Journal, 19*(5), 565 - 578.
- Webb, N. L., & Romberg, T. (1994). *Reforming Mathematics Education in America's Cities: The Urban Mathematics Collaborative Project (Ways of Knowing in Science Series)*. New York: Teachers College Press.
- Webb, R., & Vulliamy, G. (2007). Changing classroom practice at Key Stage 2: the impact of New Labour's national strategies. *Oxford Review of Education, 33*(5), 561-580.
- Wedell, M. (2005). Cascading training down into the classroom: The need for parallel planning. *International Journal of Educational Development, 25*(6), 637-651.
- Weitzman, E. A., & Miles, M. B. (1995). *Computer programs for qualitative data analysis*. Thousand Oaks, CA: Sage Publications.
- Wenger, E. (2000). Communities of practice and social learning systems. *Organization, 7*(2), 225-246.
- Whitney, L., Golez, F., Nagel, G., & Nieto, C. (2002). Listening to Voices of Practicing Teachers to Examine the Effectiveness of a Teacher Education Program. *Action in Teacher Education, 23*(4), 69-76.

- Wilson, B. J. (1978). Change in mathematics education since the late 1950's — Ideas and realisation West Indies. *Educational Studies in Mathematics*, 9(3), 355-379.
- Wood, T., Cobb, P., & Yackel, E. (1991). Change in teaching mathematics: A case study. *American Educational Research Journal*, 28(3), 587-616.
- Woodbury, S., & Gess-Newsome, J. (2002). Overcoming the paradox of change without difference: A model of change in the arena of fundamental school reform. *Educational Policy*, 16(5), 763-782.
- Yackel, E., Cobb, P., & Wood, T. (1991). Small-group interactions as a source of learning opportunities in second-grade mathematics. *Journal for Research in Mathematics Education*, 22(5), 390-408.

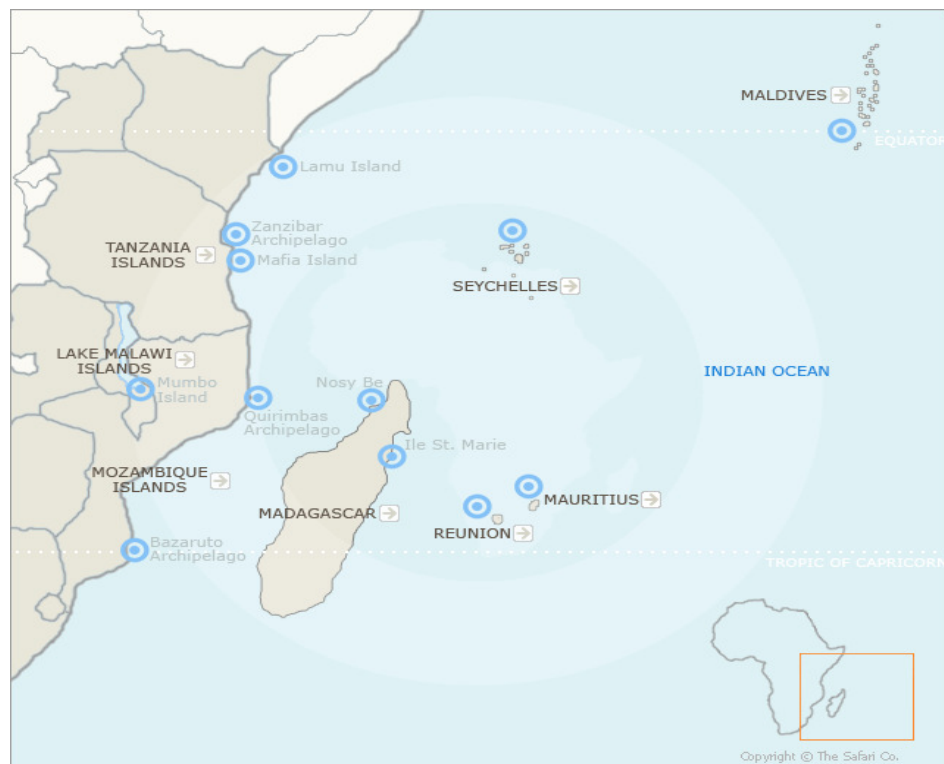
APPENDIX 1. BACKGROUND OF SEYCHELLES

Justin Valentin

Seychelles is relatively unknown in the educational research literature. Very little has been published about its education system. The scarcity of local references in this thesis is explained by the lack of published research in the country. Research is underdeveloped possibly because there are not many scholars with high research credentials. It is therefore appropriate to provide a background of the country. Such background should allow the readers to situate and contextualize the arguments within the thesis.

Socio-economic background

Seychelles is a small island developing state in the Indian Ocean. It consists of 115 islands scattered over one million square kilometres of sea, with a landmass of 445 square kilometres. Only four of the islands have a permanent population totalling up to 89000 (National Statistics Bureau, 2010). Some 74.3% is concentrated on Mahé, the main island. The population growth is less than 2% per year. Life expectancy for male and female is 68.9 and 77.7 respectively. The infant mortality rate was 14.0% in 2010 (National Statistics Bureau, 2010).



Geographical location of Seychelles in relation to other islands of the Indian Ocean and countries of the south east coast of Africa.

[Retrieved from http://www.thesafaricompany.co.za/Map_Islands.htm, 03/10/11]

Seychelles got its independence from Britain in 1976. The country is a multiracial democratic state. Christianity is the dominant religion and Creole is the mother tongue of most residents. However, English, French and Creole form the three national languages and are taught throughout the education system. Everybody speaks Creole fluently. English is the administrative language while French, although seldom used by the overall population, is widely utilized among the Catholic followers for religious purposes. Although there have been attempts at diversification, the Seychelles economy depends mainly on tourism and to a large extent fisheries. The GDP was estimated to be £893 million in 2010. 56.7% of the population work within the private sector.

Educational background

Seychelles provide full and free access to eleven years of compulsory general education, and since the early 90's the net intake rate into primary schools has been 100 percent.

Table 1 School statistics (Government and Private Schools)

	2005	2006	2007	2008
No. of pre-primary schools	32	32	32	32
Pupil enrolment	2838	2823	2835	2923
Teaching staff	189	186	191	206
Pupil/Teacher ratio	15:1	15:1	15:1	15:1
No. of primary schools	25	26	25	25
Pupil enrolment	9204	8942	8802	8744
Male (Boys)	4754	4588	4460	4416
Female (Girls)	4450	4354	4342	4328
Teaching Staff Total	670	692	687	616
Male	101	104	101	94
Female	569	588	586	522
Pupil/Teacher ratio	14:1	13:1	13:1	14:1

Compiled from documents of the Ministry of Education

The education system is highly centralised with a common curriculum framework, common textbooks and learning teaching materials. The Ministry of Education manages the schools through individual head teachers; it controls facilities, resources, staffing, and budgetary allocation. An important objective of the education system is to provide equal opportunities for all and to distribute resources equitably. The teacher pupil ratio is 1:15 even if an average class size would be 30 pupils. In the primary schools, most teachers are trained up to a local diploma level and at secondary level to a bachelor degree level. According to the 2010 education statistics, all primary school teachers were Seychellois while 20% of the secondary teachers were expatriates mainly from Sri Lanka, India, and Kenya.

The national curriculum framework document (Ministry of Education, 2001) specifies the development of mathematical skills as one key objective in enabling students “to function effectively in the daily life as well as in the technological world” (p.5). This objective has been given adequate attention since mathematics as an area of learning appears as soon as a child commences formal education. In terms of numeracy skills (interchangeably used with mathematical

skills) the Mathematics Curriculum seeks to enable all students to calculate accurately; estimate proficiently and with confidence; use calculators and a range of measuring instruments confidently and competently; recognize, understand, analyse and respond to information which are presented in graphs, tables, or charts; and organise and use numerical patterns and relationships (Ministry of Education, 2001 p.17). Mathematics is taught on a period basis in the primary cycle. A period is 40 minute long. The Ministry spells out the time allocation of each the subject. At Cycle 1, mathematics is allocated 320 minutes per week representing 20% of the total school academic time per week. At other levels of the primary cycle, mathematics is allocated 280 minutes per week representing 17.5% of the total school academic time per week. At school level the curriculum is overseen by a subject leader.

Table 2 **Number of teachers by qualification by teacher grade level**

Teachers' qualification	Crèche	Primary	Total
Master Level & higher	-	9	9
Overseas Diploma Non Education	4	4	8
Local Diploma (Non Education)	-	1	1
Local Diploma I (Education)	21	174	195
Local Diploma II (Education)	21	144	165
First Degree (Education)	7	22	29
First Degree (Non Education)	1	6	7
Certificate in Education (Local)	99	225	324
Untrained	53	109	162
Total	206	694	900

Source: Statistical Abstract, National Statistics Bureau 2010)

Despite its size, Seychelles is situated in a context of myriad changes in particular in mathematics education. While the international mathematics community adjusts itself to provide a better learning experiences to its youngsters and a better teaching experience for the teachers, the country, also, is compelled to align its local resources to develop worthwhile programmes to its people. Size may no longer be an issue in the face of reform.

Small Island Developing States (SIDS)

One approach which has been commonly used to define SIDS and determine whether a particular country belongs to this classification has been the population and territorial size, gross domestic product, and the term of trade (Atchoaréna, Da Graca, & Marquez, 2008; Brock & Smawfield, 1988). While a common definition is yet to be adopted, the population size has been the main focus onto which small state is defined – one of a population less than 1.5 million. Since this is the case, Seychelles best fit the definition of a micro-state with its population hardly exceeding 90,000 (Armstrong, De Kervenael, Li, & Read, 1998). Nevertheless, Seychelles belongs to the SIDS community and benefits from grants or projects allocated to both the small states and the developing countries (Atchoaréna et al., 2008).

The following criteria limit the development of SIDS to a very large extent: a) geographical isolation; b) vulnerability to natural disasters such as cyclone, tsunami, or sea level rise (climate change); c) lack of human and physical capacity; d) limited economic scopes – low employment diversification; e) high external

dependency; and f) high risk of poverty. Seychelles share the characteristics of SIDS in all respect. Even if Seychelles is benefiting from the power communication it is isolated in terms of geographical location. Only recently, with the rise of piracy in the Indian Ocean and the Mediterranean region Seychelles has seen how being an island country renders its position susceptible not only to natural disasters but to other world crises and world instability.

Seychelles exports about 95% of what it consumes and because of low employment diversification Seychelles suffer the effect of brain drain in which people leave the countries for better opportunities elsewhere. As Campling and Rosalie (2006) note, Seychelles has achieved impressive social provision since its independence in 1976 but in the face of the range of political and economical challenges, the questions whether these development is sustainable arises.

South African Consortium for Monitoring Educational Quality (SACMEQ)

Since I make reference to SACMEQ every now and then in this thesis, I believe I should give an overview of this organization and describe some of its activities which are relevant to the content of this thesis. Work of SACMEQ has had many implications on the development of mathematics education in Seychelles. The (SACMEQ) Southern and Eastern Africa Consortium for Monitoring Educational Quality is an international non-profit developmental organization of 15 Ministries of Education in Southern and Eastern Africa (Murimba, 2005). Its main mission is to undertake research and training activities that may: (a) expand opportunities for educational planners to gain the technical skills required to monitor and evaluate the quality of basic education; (b) generate information that can be used by decision-makers to plan and improve the quality of education, and (c) provide opportunities for educational planners, to network (Murimba, 2005). The fifteen countries that make up SACMEQ are: Botswana, Kenya, Lesotho, Malawi, Mauritius, Mozambique, Namibia, Seychelles, South Africa, Swaziland, Tanzania (Mainland), Tanzania (Zanzibar), Uganda, Zambia, and Zimbabwe. The SACMEQ headquarters are based at the International Institute for Educational Planning (IIEP) in Paris. Since its inception in 1989, the consortium has been receiving technical assistance from UNESCO-IIEP. SACMEQ is supported by other affiliates such as the International Association for the Evaluation of Educational Achievement (IEA) and the Assessment Research Centre at the University of Melbourne in Australia.

So far the consortium has undertaken three educational policy research projects widely known as SACMEQ I, II and III studies. These studies have been designed to provide information that could be used to guide planning decisions aimed at improving the quality of education in primary school systems. The target population for the studies has been Grade 6 students enrolled in mainstream government and non-government schools, subsequently their teachers and respective heads. This grade was selected because: (a) participation rates would be relatively high and non-selective (in some countries many students leave school between the primary and secondary levels) and, (b) testing at lower grade levels was problematic because of a mixture of languages in the classroom in some countries up to Grade 3. In Seychelles for instance, Creole, the native language, is the medium of instruction up to Grade 2 (P2) and thereafter Creole is an examined subject up to P6.

In most countries national sampling frames were constructed using data from the Planning Division of the each Ministry of Education. The numbers of sampled schools within countries was determined by cluster sampling procedures (Ross, 1985). However, as the Seychelles population is relatively small, the entire

population of 24 schools was included. In both SACMEQ I and II studies the following instruments were employed for data collection: a) A pupil reading test and numeracy (mathematics) test, b) Pupil questionnaire, c) Teacher reading test and numeracy (mathematics) test, d) Teacher Questionnaire, e) Head teacher questionnaire and f) a series of school form to collect school background data. In SACMEQ III study, an additional Health Knowledge test was administered to collect data about the teachers and the pupils' knowledge of HIV. HIV is thought to affect the progress and quality of education in Africa. A data archive for SACMEQ I and II study exists and is being used worldwide by organizations such as UNESCO, World Bank, DFID, Asian Development Bank and many universities across Australia, UK and Africa and by scholars in both developed and developing countries. SACMEQ studies have been externally evaluated four times since 2004 by UNESCO, World Bank and the Netherland Government.

References

- Armstrong, H., De Kervenoael, R. J., Li, X., & Read, R. (1998). A comparison of the economic performance of different micro-states, and between micro-states and larger countries. *World Development*, 26(4), 639-656.
- Atchoaréna, D., Da Graca, P. D., & Marquez, J. M. (2008). Strategies for Post-Primary Education in Small Island Developing States (SIDS): Lessons from Cape Verde. *Comparative Education*, 44(2), 19.
- Brock, C., & Smawfield, D. (1988). Education and Development: The Issue of Small States. *Educational Review*, 40(2), 227-239.
- Campling, L., & Rosalie, M. (2006). Sustaining social development in a small island developing state? The case of Seychelles. *Sustainable Development*, 14(2), 115-125.
- Ministry of Education. (2001). *The National Curriculum Framework*. Victoria: Government of Seychelles.
- Murimba, S. (2005). The Impact of the Southern and Eastern Africa Consortium for Monitoring Educational Quality (Sacmeq). *Prospects*, 35(1), 91-108.
- National Statistics Bureau. (2010). *Seychelles in Figures*.
- Ross, K. (Ed.) (1985) *The International Encyclopedia of Education*. New York: Pergamon.

APPENDIX 2. OFFICIAL REQUEST

**Flat 47 Spectrum Tower
2-20 Hainault St, Ilford,
IG1 4GZ, UK**

20th December, 2010

**Principal Secretary
Ministry of Education
P.O Box 48
Victoria, Seychelles**

Dear Mrs. Delcy,

Re: Request to carry out an evaluation of the MLS reform for my PhD programme

I am requesting permission to carry out a research in the primary schools as part of my PhD programme at King's College London. The research seeks to evaluate the MLS reform to ascertain its impact on teaching and learning. I will be recruiting teachers and subject coordinators from the schools and some support providers from the sections, school coordinators, Mathematics Working Group, and the Quality Assurance. Please find below a brief description of the data collection process. The study will be in **four** parts:

Part 1 will include analysis of existing pupil achievement data which are found in the Ministry of Education data archives. All students and school identities will be barred for anonymity. The analysis of pupils' achievements data will seek to look at trends in pupils' performances before and after the implementation of MLS.

Part 2 will include administering a survey questionnaire to volunteered teachers and subject leaders, seeking their perception of the reform, their overall attitudes to mathematics teaching and their impression as to how they perceive the reform to be impacting on teaching and learning. The questionnaire will be sent to the teachers by post and they will be guided on how and where to return it once completed.

Part 3 will include an in-depth field work in four schools selected on a convenient basis. Participation will be on a voluntary basis. (This activity will cover a period of one month. I expect to spend one week in each school.) In each of the four schools I will conduct the following:

- **One Focus Group Interview with a group of five (5) teachers:** To ascertain a) how the implementation of MLS at school are supported, b) how teachers are motivated to use the reform idea, and c) the kind of consequences which has resulted as a results of MLS:

- **One interview with the mathematics subject leader:** To inquire about how MLS was introduced in their school and how it is currently being implemented by the teachers.

- **Lesson observations and post lesson interviews with the teacher:** To gather data on the actual conduct of MLS lessons. For consistencies, the lesson observations will be done in only Grades 2 and 5 classes of the four schools. For each class three consecutive lessons will be observed and notes taken. The teachers will be interviewed after the lessons on occurrences of the lessons. **No interaction will be done with the pupils prior, during or after the lessons.**

Part 4 will include conducting one focus group discussion with key informants selected from those three main units of the School Division Section (Mathematics Working Group, School Coordinators and Quality Assurance) who provide curriculum support to schools. This will be a one-off activity. A sample of ten (10) participants will be invited to participate in the focus group interview.

Upon receipt of your approval, I will begin to recruit participants. I will take all measures to minimize disruption of teaching and learning and ensure that this study does not interfere with the participants' work. Data from this study will be used to develop my PhD thesis and scholarly papers and for no other purposes. I may be contacted on the address above for further clarification,

Sincerely,

Justin Valentin (justin.valentin@kcl.ac.uk)

APPENDIX 3. INFORMATION SHEET FOR PARTICIPANTS

REC Reference Number:[REP(EM)/10/11-15]

FROM: Justin Valentin (PhD Student)

TO: Seychelles Primary School Management, Mathematics Teachers in the Primary Schools, Mathematics Subject Leaders, Education Coordinators, Member of the Mathematics Working Groups, Staff of the Quality Assurance Section, NIE Lectures

SUBJECT: PhD Research Project: Recruiting Participants

TITLE: Evaluating the Mathematics Lesson Structure (MLS) Reform: Outcomes, Challenges and Implications

Dear Colleagues,

I am conducting an evaluation study of the Mathematics Lesson Structure (MLS) reform as part of my PhD degree and I wish to invite you to participate in the research. Please take some times to read this information sheet. It contains an outline of my research and description of what your participation will involve should you wish to participate. Please be informed that you should only participate if you want to; choosing not to take part will not disadvantage you in any way. So take your time to read the following information carefully and discuss it with others if you wish. Ask me if there is anything that is not clear or if you would like more information. My contact is included in this document.

OUTLINE OF THE STUDY: The aim of this research is to explore the outcomes of the (MLS) reform which began to be implemented in the primary schools in 2006. In view that little is known about this reform the study aims to investigate its outcomes, affordances, and challenges. Furthermore, as the literature on instructional reforms in small developing states is scarce, the findings of this research will contribute knowledge in this area.

ANTICIPATED DATA

- a) I want to administer a questionnaire to teachers teaching mathematics in the primary schools and the mathematics subject leaders to ascertain their attitudes to the MLS reform and their perception of mathematics teaching in general.
- b) I want to observe a sample of P2 and P5 mathematics lessons and carry out post lesson interviews with the teachers I observe. I will not interact with the pupils during or after the observation.

- c) I want to conduct a focus group interview with a sample of 5 – 6 teachers in the schools where I will be doing the observations.
- d) I want to interview some mathematics subject-leaders about the MLS reform.
- e) I want to conduct a focus group interview with school support providers drawn from the following groups: Education Coordinators, Member of the Mathematics Working Groups, and Staff of the Quality Assurance Section.

CONFIDENTIALITY AND ANONYMITY: The information that you will provide will be treated with great confidentiality. I wish to ensure you that I will not disclose any information to any authority. You will remain anonymous throughout the process. My supervisors and I will be the only persons to have access with my data. There will be no way that your identity could be revealed. On the questionnaire, you will be identified by a number. The data will be reported making reference to groups of teachers or the participants. There will be no instance when I will give specific example which could reveal one's identify. The data will be used for the preparation of my PhD thesis and research journal papers but for no other purpose. Your contributions are very worthwhile. I will treat them with high esteem.

YOUR PARTICIPATION: If you agree to participate in the research, please complete and sign the consent form accordingly. Afterwards send it back to me at the address on the enclosed envelop. I will then contact you for further arrangement about the date and venue of the interview and/or observation. However, if at any point you wish to discontinue your participation in the research or withdraw your contribution, you are free to do so by simply writing to me. You do not have to give any reason for discontinuing your participation. Unfortunately, once the research will have reached the report writing stage, it may become difficult for me to remove your contribution.

For further detail about this research and for any other subsequent correspondences in relation to your participation in this study, please email me at the following address: justinvalentin@hotmail.com

Please note well again that it is up to you to decide whether to take part or not. If you decide to take part you are still free to withdraw at any time and without giving a reason.

Faithfully,

Justin Valentin
Department of Education & Professional Studies
King's College London

APPENDIX 4. CONSENT FORMS

CONSENT FORM FOR PARTICIPANTS IN RESEARCH STUDIES

Please complete this form after you have read the Information Sheet and/or listened to an explanation about the research.

Title of Study: Evaluation of a Primary Mathematics Education Reform in Seychelles: Outcomes, Challenges and Implications

Thank you for considering taking part in this research. The person organising the research must explain the project to you before you agree to take part. If you have any questions arising from the Information Sheet or explanation already given to you, please ask the researcher before you decide whether to join in. You will be given a copy of this Consent Form to keep and refer to at any time.

Please complete accordingly

Name: School/Section:

All teachers please indicate the class(es) in which you teach mathematics:

I agree to participate in the study in the following ways:

	<i>Please tick or initial</i>
To complete the teacher or subject leader questionnaire	<input type="checkbox"/>
To participate in the subject leader interview	<input type="checkbox"/>
To have my mathematics lesson observed by researcher	<input type="checkbox"/>
To participate in the teacher focus group interview	<input type="checkbox"/>
To participate in the key informant focus group interview	<input type="checkbox"/>

By signing this form you consent to your participation in the study.

.....
Signed

.....
Date

APPENDIX 5. INFORMATION SHEET FOR THE PUPILS

Dear Children,

My name is Justin Valentin. I am doing my training at one university in London. As part of my training, I want to learn more about how your teacher teaches you mathematics. Therefore, I will come to your class three times in the week beginning to look at your mathematics lessons. You will see me sitting at the back of the classroom writing notes. Please do not pay attention to what I will doing. I will not ask you any questions and I will not look at your work. So carry on with your work and participate in the lessons as you normally do. If you want to know more about this activity, please ask your teacher.

Thank you for welcoming me to your class.

Justin Valentin

APPENDIX 6. MATHEMATICS LESSON STRUCTURE TEMPLATE

0	SCHOOL <input style="width: 90%;" type="text"/>	CLASS ID	<input style="width: 90%;" type="text"/>
	WEEK NO. <input style="width: 40%;" type="text"/>	LESSON NO. <input style="width: 40%;" type="text"/>	DATE <input style="width: 100%;" type="text"/>

1	MENTAL ACTIVITY (1st – 5th minute) Quick calculation, recall of rules and mathematical facts: Write the exact tasks to be given out 	2	REVIEW OF THE LAST LESSON (6th – 10th minute) Bringing out the gist of last lesson: Write the statement(s) you are looking for: Write the method(s) to be used and the sample questions to be asked.
----------	---	----------	--

3A INTRODUCING CURRENT LESSON IS IT LINKED TO LAST LESSON? Y N

3B FOCUS AND CONTENTS OF CURRENT LESSON

In this lesson the pupils will be taught the following mathematical idea:

.....

At the end of the lesson they are expected to: (meaning understanding of the mathematical idea will be evident if they can:

.....

Take some minutes to tell the pupils what they would be doing and what they expect to be learning

3C LESSON VARIATION/STRATEGY

INVESTIGATIONAL PROBLEM SOLVING PRACTICAL EXPOSITORY

4 DEVELOPING PUPILS' CONCEPTUAL UNDERSTANDING (14th – 25th min)

Plan your activities in such a way that they will a) encourage pupils to use their prior knowledge; this is achieved by establishing some lesson sequencing principles, b) allow the pupils to see how the mathematical idea is used in real life context; it is wise to remain within the child's experience, c) provide good examples of the mathematical ideas in problems. It is very important to use learning aids to make abstract ideas real and concrete.

Predominant Classroom organization Whole Class Individual
 Pairs Small groups

5 MANIPULATIVE OR LEARNING AIDS *What provision have you made for manipulative or learning aids?*

6 PUPILS' CONSOLIDATION ACTIVITIES (26th – 35th) ***Write the tasks that will make the pupils use and interact with the mathematical idea***

Predominant Classroom organization Whole Class Individual
Pairs Small groups

7 CONCLUSION (36th – 40th) *The teacher or the pupils or both should bring out the gist of the le*

8 POST LESSON REFLECTION

APPENDIX 7. SACMEQ LEVEL DESCRIPTORS

COMPETENCY LEVELS	
1	PRE NUMERACY Applies single-step addition or subtraction operations; Recognizes simple shapes; Matches numbers and pictures; Counts in whole numbers
2	EMERGENT NUMERACY Applies a two-step additive operation involving carrying, checking (through very basic estimation), or conversion of pictures to numbers; Estimates the length of familiar objects; Recognises common two-dimensional shapes
3	BASIC NUMERACY Translates verbal information (presented in a sentence, simple graph or table) using one arithmetic operation in several repeated steps; Translates graphic information into fractions; Interprets place value of whole numbers up to thousands; Interprets simple common everyday units of measurement
4	BEGINNING NUMERACY Translates verbal or graphic information into simple arithmetic problems; Uses multiple different arithmetic operations (in the correct order) on whole numbers, fractions, and/or decimals
5	COMPETENT NUMERACY Translates verbal, graphic, or tabular information into an arithmetic form in order to solve a given problem; Solves multiple-operation problems (using the correct order of arithmetic operations) involving everyday units of measurement and or whole and mixed numbers; Converts basic units of measurement from one level of measurement to another (for example m to cm)
6	MATHEMATICALLY SKILLED Solves multiple-operation problems (using the correct order of arithmetic operations) involving fractions, ratios, and decimals; Translates verbal and graphic representation of information into symbolic, algebraic, and equation form in order to solve a given mathematical problem; Checks and estimates answers using external knowledge (not provided within the problem)
7	PROBLEM SOLVING Extracts and converts (for example, with respect to measurement units) info from tables, charts, visual and symbolic presentations in order to identify, and then solve multi-step problems
8	ABSTRACT PROBLEM SOLVING Identifies the nature of an unstated mathematical problem embedded within verbal or graphic information, and then translates this into symbolic, algebraic, or equation form in order to solve them

APPENDIX 8. TEACHER QUESTIONNAIRE

NOTES TO TEACHERS

Please read this note before you complete this questionnaire

Dear teachers,

This questionnaire is part of my PhD research which I am doing at King's College London. The research seeks to ascertain the impact (if any) of MLS. In this questionnaire, I ask you question about the way you: a) teach mathematics, b) manage the pupils' learning, and c) handle the day to day demands of the subject. Moreover, I ask you questions about: i) your views of the advantages and drawbacks of MLS, ii) your impression of what MLS is or is not achieving, and iii) your impression of its impact (if any) on teaching and learning of mathematics in your school. In order to gain more insight in your perception and actual practice about the teaching of mathematics, I ask you questions in relation to your training, qualifications and mathematics teaching experience.

Data which I will collect from this questionnaire will be used to develop my thesis. Being a participant in this activity your integrity will be preserved; your names and your school will remain anonymous. However, I need your names and schools on this cover for administration purposes.

I am aware that the length of this questionnaire will require you to spend some of your precious time reading and completing it. I apologize. Your contribution is so invaluable. I thank you for being part of this research.

Thank you.

Justin Valentin

NAME	<input type="text"/>	SCHOOL	<input type="text"/>								
<i>Tick the class in which you teach mathematics</i>											
P1	<input type="checkbox"/>	P2	<input type="checkbox"/>	P3	<input type="checkbox"/>	P4	<input type="checkbox"/>	P5	<input type="checkbox"/>	P6	<input type="checkbox"/>

PLEASE ANSWER ALL QUESTIONS WITHOUT DISCUSSING YOUR ANSWERS TO OTHERS!!!

SOME BACKGROUND INFORMATION ABOUT YOURSELF

Put a tick (✓) in the appropriate box. The numbers in the boxes are for data entry. Ignore them.

1. Indicate your sex

Female 0

Male 1

2. Indicate your age-group (yrs)

< 25 1

25 – 35 2

36 - 46 3

47 - 55 4

> 55 5

3. How long have you been teaching mathematics **in this school**?

Less than one year 1

Between 1 to 5 years 2

Between 6 to 10 years 3

More than 10 years 4

4. How long have you been teaching mathematics altogether?

Less than one year 1

Between 1 to 5 years 2

Between 6 to 10 years 3

More than 10 years 4

5. What is your highest teaching qualification?

I'm an untrained teacher 1

Certificate Level 2

Diploma Level 3

Bachelor Level or higher 4

6. About how many pupils do you teach mathematics at the moment?

0 – 30 1

31 - 60 2

61 – 90 3

Above 90 4

10. How often do you ask your pupils to do each of the following as part of the mathematics instruction, homework, or assessment? **(Please tick one response for each item.)**

	Rarely	Sometimes	Most of the time	Always
a) Justify their answer or explain their reasoning	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4
b) Practice computational procedures	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4
c) Memorize facts, rules, definitions or formulae	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4
d) Read or work out problems from a textbook	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4
e) Discuss different ways to solve a particular problem	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4
f) Complete worksheets	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4
g) Work on non-routine problems	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4
h) Use manipulative materials to solve problems	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4
i) Work on problem or exercise on the front board	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4
j) Recite lesson notes	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4

11. Indicate your level of confidence to handle each of the following aspects of the mathematics teaching.

	Very Confident	Confident	Not too confident	
a) Teach the different topics in the primary mathematics syllabus	<input type="checkbox"/> 4	<input type="checkbox"/> 3	<input type="checkbox"/> 2	<input type="checkbox"/> 1
b) Assess pupils' learning of mathematics	<input type="checkbox"/> 4	<input type="checkbox"/> 3	<input type="checkbox"/> 2	<input type="checkbox"/> 1
c) Construct mathematics assessment instruments	<input type="checkbox"/> 4	<input type="checkbox"/> 3	<input type="checkbox"/> 2	<input type="checkbox"/> 1
d) Manage pupils' learning tasks	<input type="checkbox"/> 4	<input type="checkbox"/> 3	<input type="checkbox"/> 2	<input type="checkbox"/> 1
e) Devise pupils' learning tasks	<input type="checkbox"/> 4	<input type="checkbox"/> 3	<input type="checkbox"/> 2	<input type="checkbox"/> 1
f) Manage pupils on task	<input type="checkbox"/> 4	<input type="checkbox"/> 3	<input type="checkbox"/> 2	<input type="checkbox"/> 1
g) Extract instructional objectives from the curriculum	<input type="checkbox"/> 4	<input type="checkbox"/> 3	<input type="checkbox"/> 2	<input type="checkbox"/> 1
h) Devise effective Mathematics lesson	<input type="checkbox"/> 4	<input type="checkbox"/> 3	<input type="checkbox"/> 2	<input type="checkbox"/> 1
i) Manage mixed ability teaching	<input type="checkbox"/> 4	<input type="checkbox"/> 3	<input type="checkbox"/> 2	<input type="checkbox"/> 1
j) Manage group works	<input type="checkbox"/> 4	<input type="checkbox"/> 3	<input type="checkbox"/> 2	<input type="checkbox"/> 1

REFLECTING ON THE SUPPORT YOU RECEIVE AT YOUR SCHOOL

12. Please, indicate your response to the following questions about the school-based support in your school in terms of collaboration with your colleagues.

	Almost Never	Rarely	Most of the time	Always
a) Teachers share mathematics learning materials	<input type="text" value="1"/>	<input type="text" value="2"/>	<input type="text" value="3"/>	<input type="text" value="4"/>
b) I am on my own with my mathematics works	<input type="text" value="1"/>	<input type="text" value="2"/>	<input type="text" value="3"/>	<input type="text" value="4"/>
c) Teachers tutor one another about mathematics	<input type="text" value="1"/>	<input type="text" value="2"/>	<input type="text" value="3"/>	<input type="text" value="4"/>
d) Teachers help one another about maths work	<input type="text" value="1"/>	<input type="text" value="2"/>	<input type="text" value="3"/>	<input type="text" value="4"/>
e) I initiate discussion about the mathematics with colleagues	<input type="text" value="1"/>	<input type="text" value="2"/>	<input type="text" value="3"/>	<input type="text" value="4"/>
f) I can count on my colleagues for help on my maths teaching	<input type="text" value="1"/>	<input type="text" value="2"/>	<input type="text" value="3"/>	<input type="text" value="4"/>
g) Teachers discuss their work with colleagues	<input type="text" value="1"/>	<input type="text" value="2"/>	<input type="text" value="3"/>	<input type="text" value="4"/>
h) Teachers create time to work with others	<input type="text" value="1"/>	<input type="text" value="2"/>	<input type="text" value="3"/>	<input type="text" value="4"/>

13. Please, indicate your response to the following questions about school-based support in your school in relation to support obtained from your leaders

	Strongly disagree	Disagree	Agree	Strongly Agree
a) They value our mathematics teaching work	<input type="text" value="1"/>	<input type="text" value="2"/>	<input type="text" value="3"/>	<input type="text" value="4"/>
b) They closely monitor pupils progress	<input type="text" value="1"/>	<input type="text" value="2"/>	<input type="text" value="3"/>	<input type="text" value="4"/>
c) They support teachers with instructional-related problems	<input type="text" value="1"/>	<input type="text" value="2"/>	<input type="text" value="3"/>	<input type="text" value="4"/>
d) They do not show interest to what teachers are doing	<input type="text" value="1"/>	<input type="text" value="2"/>	<input type="text" value="3"/>	<input type="text" value="4"/>
e) They create ways for teachers to discuss maths teaching ideas	<input type="text" value="1"/>	<input type="text" value="2"/>	<input type="text" value="3"/>	<input type="text" value="4"/>
f) They give supportive feedback to teaching about their teaching	<input type="text" value="1"/>	<input type="text" value="2"/>	<input type="text" value="3"/>	<input type="text" value="4"/>
g) Teachers cannot rely on them for mathematics teaching advice	<input type="text" value="1"/>	<input type="text" value="2"/>	<input type="text" value="3"/>	<input type="text" value="4"/>
h) They welcome new teachers ideas about maths teaching	<input type="text" value="1"/>	<input type="text" value="2"/>	<input type="text" value="3"/>	<input type="text" value="4"/>
i) They do their best to support the development of mathematics	<input type="text" value="1"/>	<input type="text" value="2"/>	<input type="text" value="3"/>	<input type="text" value="4"/>
j) They do not encourage new teacher initiatives	<input type="text" value="1"/>	<input type="text" value="2"/>	<input type="text" value="3"/>	<input type="text" value="4"/>

REFLECTING ON THE MATHEMATICS LESSON STRUCTURE AS THE REFORM INITIATIVE

14. How often do you use MLS as the basis for your lesson organisation and structure?

Always Most of the time Rarely Almost never

15. How often do you incorporate each of the components of MLS in your teaching?

	Always	Most of the time	Rarely	Almost Never
a) Begin lesson with a mental activity	<input type="text" value="4"/>	<input type="text" value="3"/>	<input type="text" value="2"/>	<input type="text" value="1"/>
b) Review the content of the last lesson	<input type="text" value="4"/>	<input type="text" value="3"/>	<input type="text" value="2"/>	<input type="text" value="1"/>
c) Tell student the focus of current lesson	<input type="text" value="4"/>	<input type="text" value="3"/>	<input type="text" value="2"/>	<input type="text" value="1"/>
d) Incorporate real life example in explanation	<input type="text" value="4"/>	<input type="text" value="3"/>	<input type="text" value="2"/>	<input type="text" value="1"/>
e) Give out key examples for pupils to follow	<input type="text" value="4"/>	<input type="text" value="3"/>	<input type="text" value="2"/>	<input type="text" value="1"/>
f) Use pupils' prior knowledge in your teaching	<input type="text" value="4"/>	<input type="text" value="3"/>	<input type="text" value="2"/>	<input type="text" value="1"/>
g) Create space for pupils consolidation task	<input type="text" value="4"/>	<input type="text" value="3"/>	<input type="text" value="2"/>	<input type="text" value="1"/>
h) Conclude lesson with some kind of activity	<input type="text" value="4"/>	<input type="text" value="3"/>	<input type="text" value="2"/>	<input type="text" value="1"/>

16. To what extent do you agree or disagree with each of the following statements?

	Strongly disagree	Disagree	Agree	Strongly Agree
a) MLS is having a positive impact on my teaching	<input type="text" value="1"/>	<input type="text" value="2"/>	<input type="text" value="3"/>	<input type="text" value="4"/>
b) It was a good idea to introduce MLS in schools	<input type="text" value="1"/>	<input type="text" value="2"/>	<input type="text" value="3"/>	<input type="text" value="4"/>
c) MLS is not applicable at all levels	<input type="text" value="1"/>	<input type="text" value="2"/>	<input type="text" value="3"/>	<input type="text" value="4"/>
d) MLS restricts teachers' creativity	<input type="text" value="1"/>	<input type="text" value="2"/>	<input type="text" value="3"/>	<input type="text" value="4"/>
e) MLS limits what I can do in class	<input type="text" value="1"/>	<input type="text" value="2"/>	<input type="text" value="3"/>	<input type="text" value="4"/>
f) I find MLS not a useful tool	<input type="text" value="1"/>	<input type="text" value="2"/>	<input type="text" value="3"/>	<input type="text" value="4"/>
g) Maths teaching has improved with the introduction of MLS	<input type="text" value="1"/>	<input type="text" value="2"/>	<input type="text" value="3"/>	<input type="text" value="4"/>
h) MLS has motivated me to like the teaching of mathematics	<input type="text" value="1"/>	<input type="text" value="2"/>	<input type="text" value="3"/>	<input type="text" value="4"/>
i) MLS offers scope to deal with mixed ability teaching	<input type="text" value="1"/>	<input type="text" value="2"/>	<input type="text" value="3"/>	<input type="text" value="4"/>

17. Using your personal evaluation of teaching mathematics with the MLS, to what extent do you agree or disagree with each of the following statements?

	Strongly disagree	Disagree	Agree	Strongly Agree
a) Pupils interact better with the teacher	<input type="text" value="1"/>	<input type="text" value="2"/>	<input type="text" value="3"/>	<input type="text" value="4"/>
b) Pupils in this school seem to like mathematics	<input type="text" value="1"/>	<input type="text" value="2"/>	<input type="text" value="3"/>	<input type="text" value="4"/>
c) Pupils understand mathematics lesson better	<input type="text" value="1"/>	<input type="text" value="2"/>	<input type="text" value="3"/>	<input type="text" value="4"/>
d) Pupils are generally scoring more in mathematics	<input type="text" value="1"/>	<input type="text" value="2"/>	<input type="text" value="3"/>	<input type="text" value="4"/>
e) Pupils are doing mathematics at a higher level	<input type="text" value="1"/>	<input type="text" value="2"/>	<input type="text" value="3"/>	<input type="text" value="4"/>
f) Pupils show more motivation towards learning maths	<input type="text" value="1"/>	<input type="text" value="2"/>	<input type="text" value="3"/>	<input type="text" value="4"/>
g) Pupils are better controlled in MLS lessons	<input type="text" value="1"/>	<input type="text" value="2"/>	<input type="text" value="3"/>	<input type="text" value="4"/>
h) There has been no change in pupils' ability even with MLS	<input type="text" value="1"/>	<input type="text" value="2"/>	<input type="text" value="3"/>	<input type="text" value="4"/>

END OF QUESTIONNAIRE

APPENDIX 9. TEACHER FOCUS GROUP INTERVIEW

Prompt questions

- What do you think were the major reasons for implementing MLS in the schools?
- Who is actually using MLS, and what are your reasons for using it?
- Who among you were incorporating the structure in your teaching practices but have now stopped using it? What are some reasons for stopping?
- Who have hardly used MLS and what are your reasons for using it sparingly?
- In your opinion has pupils' performance in mathematics changed over this 5 year period and in which direction?
- Has the teaching of mathematics changed and in what direction?
- What else do you think could have been the outcomes of MLS implementation?
- Does the MLS structure really facilitate your teaching of mathematics, or does it create more problems? In either case discuss how.
- Discuss the nature of the support you received to make the change possible? What did you like about the support you received?
- What were the major challenges (constraint/difficulties) about the support you encountered?

APPENDIX 10. SUBJECT LEADER FOCUS GROUP INTERVIEW

1. How is the MLS reform being addressed by the teachers?
2. To what extent is mathematics teaching consistent with the reform ideas?
3. Are there any initiatives being implemented or encouraged at school level other than the MLS reform or even within the MLS reform?
4. How satisfied are you in the teaching of mathematics in your school?
5. To what extent in your point of view as a leader can the MLS guidelines assist the teacher in developing a nice lesson?
6. What are the strengths with regards to teaching mathematics in school?
7. What are some potential challenges with regards to teaching mathematics?
8. What messages are teachers receiving with regards to MLS reforms? What are you advising teachers about MLS?
9. What are the things you put emphasis on?
10. What are the things that have been neglected in the teaching of mathematics?
11. How satisfied are you with the “school base support structure” with regards to the reform idea?
12. What are some potential outcomes of MLS?
13. In what way has teaching of mathematics in your school changed?
14. Discuss your capacity to lead the development of mathematics in line with the MLS reform.
15. What are your personal views of mathematics teaching in your school?
16. How consistent are what you value in mathematics with the MLS?

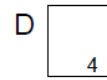
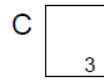
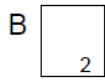
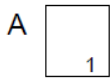
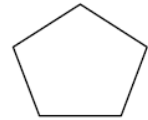
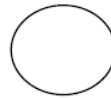
APPENDIX 11. KEY INFORMANT INTERVIEW

- Q1) Describe your roles(s) as a support provider to the teaching and learning of mathematics education in the schools.
- Q2) State 2 aspects of mathematics teaching that you place a lot of emphasis on
- Q3) State 2 aspects of mathematics teaching that you barely place emphasis on
- Q4) According to you what are the main ideas of the MLS reform?
- Q5) Explain any agreement or disagreement between your views of mathematics and the main ideas of MLS reform
- Q6) Do you think the MLS reform is achieving its purpose(s)? Justify your answer.
- Q7) What do you tell teachers about the application of MLS in their teaching?
- Q8) What do you consider as opportunity or strength to the teaching of mathematics in Seychelles?
- Q9) What do you consider as challenge or threat to the teaching of mathematics in Seychelles?

APPENDIX 12. ITEMS COMMON TO SACMEQ AND IPAM TESTS

(Difficulty indices in brackets)

6. Which of the following shapes is a rectangle?

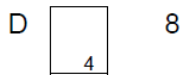
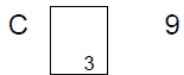
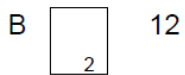
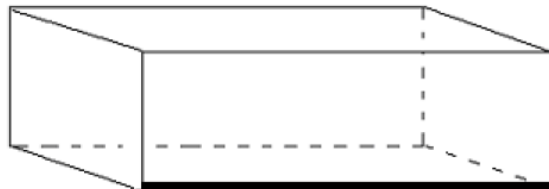


2000 (0.91)

2007 (0.91)

2009 (0.83)

13. This picture shows a cuboid with one edge marked. How many edges does the cuboid have altogether?



2000 (0.33)

2007 (0.35)

2009 (0.65)

14. Which symbol should be put in the box to make the sentence true?

$$23 \quad \square \quad 4 \quad = \quad 27$$

A \square $+$

B \square $-$

C \square \times

D \square \div

2000 (0.89)

2007 (0.88)

2009 (0.95)

28. Here is the beginning of a pattern of tiles.



Figure 1

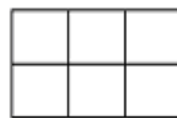


Figure 2

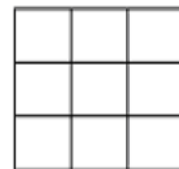


Figure 3

If the pattern continues, how many tiles will be in Figure 7?

A. 12

B. 15

C. 18

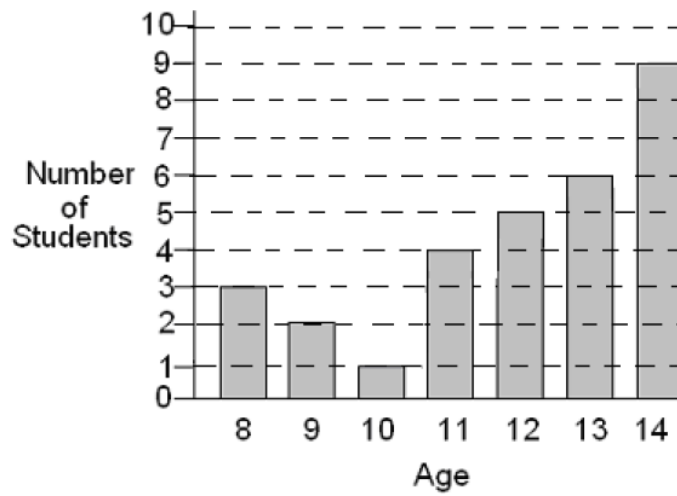
D. 21

2000 (0.60)

2007 (0.59)

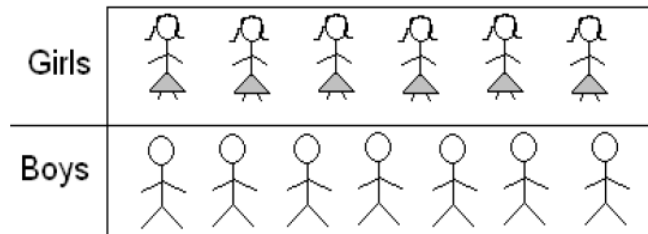
2009 (0.58)

36. The chart below shows the number of students at each age. How many students in the chart are more than 9 years old?



- [A] 27 [B] 20 [C] 24 [D] 25
- 2000 (0.30) 2007 (0.28) 2009 (0.34)
-

21. The diagram shows the number of girls and boys in a classroom. There are 11 chairs in the classroom. If only one child may sit on each chair, how many of the children will not have a chair to sit on?



- [A] 2 [B] 6 [C] 7 [D] 11
- 2000 (0.65) 2007 (0.71) 2009 (0.78)
-

APPENDIX 13. MLS EVALUATION LESSON OBSERVATION

SCHOOL		CLASS		TEACHER	
--------	--	-------	--	---------	--

No. Boys		No. Girls	
----------	--	-----------	--

Draw briefly a pupil sitting plan

BLACK BOARD

LESSON FLOW – DESCRIPTION OF THE LESSON

0 – 5 th mins
During 6 th – 10 th minute

During 11th – 15th minute

During 16th – 25th minute

During 26th – 36th minutes

During the last five minute

APPENDIX 14. POST LESSON OBSERVATION INTERVIEW

1. In what way was MLS useful in the planning and conduct of the lesson?
2. How has MLS hindered the planning and conduct of this lesson?
3. Values and espouse
 - a. What are the things (state 2) that you value most in mathematics teaching?
 - b. How have you manifested what you value and espouse in this lesson?
4. What makes the actual teaching of MLS lessons difficult?
5. What makes the teaching of MLS lessons easy?
6. What are some of your main concerns with regards to mathematics teaching in your classroom?
7. How were you supported to develop this lesson or what kind of support you would have like to receive in order to develop this lesson?
8. With respect to mathematics teaching and learning, what are your views on each of the issues below and how do you live your views in actual practice?
9. Any other business (with regards to teaching mathematics under the MLS regime).

END OF INTERVIEW

APPENDIX 15. INDICATION OF CODING AND CATEGORIZING

		Codes: Preliminary concepts emerging
R What were you told were the major reasons for implementing MLS in the schools? And if there are new teachers around, what were the reasons that you were given to use MLS in Schools?		
T2	I was at NIE when MLS was introduced in school and we were told that it was for... to improve their performance, to see whether it has an impact – the way the teaching was going on.	Pre-teaching exposure (1) Formal authority (2) Awareness of expectation (3)
T1	In the same line with what T2 has said, I heard it was put in place to improve the teaching of mathematics in the classroom.	Informal authority (4) Awareness of expectation
T5	What we've been told, I mean, I was already in the profession when it was introduced, and we were told that, like they were saying to improve pupils' performance and also, so everybody would be doing the same. There would be a standard ok when they're preparing lesson plans.	Formal authority Awareness of expectation
T3	To add on, for the pupils also to upgrade their level maybe in this kind of standard used.	Awareness of expectation
R	I'm not going to comment on your answer. I want just to know your views about the issue.	
T4	It's a way to... for pupils to assess pupils. For teacher to assess the pupils to see if they have achieved the objectives.	Awareness of expectation
R	At the moment who is actually implementing MLS in the schools and if you are, what are your reasons for using it. If you have stopped using it, what are your reasons, if you are considering of stop using it what are your reasons? What's the situation?	
T1	Since I've joined the teaching profession, they have been using MLS. And I've been using MLS since I've started teaching. I have been using MLS since I began teaching. I was at NIE when it was introduced, I've learnt how to use it at the NIE then I am still using it. When I came to the school there were using it and this is why I am still using it.	Expected practice (5), compliance (6) Pre-teaching exposure Common practice (7)
R	So you have no choice. You have to use it?	
	(Group reaction suggesting that they are all using MLS as a basis of their planning and teaching of mathematics)	
R So there is nobody who was stopped using it or is considering or would like to consider, you know, abandoning MLS. OK. Let's move on. You are moving very fast. We've already covered Q2, Q3. Now we are at Q4.		
R How consistent is your teaching with the major requirements of the structure? So when you look at the structure and your teaching, how consistent are the two? Let's talk about this.		
	(No response)	
R Are you following exactly what the structure is advocating or are there instances when you are making changes to your teaching. I mean to the structure?		
T5	At times I change – because it depends on the group of pupils I am working. With some pupils it's easy to follow it. Other group not easy. This is why I change.	Adaptation (8), Learners' characteristics (9), Suitability (10)
R	How do you change? What are the changes that you make with the structure when you change?	
T5	Sometimes I don't use it straight as it is. Some pupils are so slow. So I tend to cut.	Learning pace/ability(11), Adaptation

Open coding	Categorization (1 st Level)
Expected practice (5)	Expected instructional practices
compliance (6)	
Given guidelines (43)	
Reason to use MLS (47)	
Common practice (7)	
Learning task (14)	Actual practice/accommodating the learners
Adaptation (8)/ Learners' characteristics (9)	
Direct application (15)/ Within class grouping (17)	
Suitability (10)/ Learning pace/ability(11)	
Mixed-ability teaching (20)	
Application of MLS (18) Manipulation (41)	
Re-teaching (23)/ Re-configuration (27)	
Definition of mental activities (40)	Requirements of the reform
Real life (12)	
Mental (16)	
Review last lesson (19)	
Definition of MLS (28)	
Unrealistic requirement (22)	
Lesson planning load (24)	Challenges
Morning & afternoon tasks (25)	
Two-lesson in a day (21)	
Demanding (59)	
No example	
Teacher identity issue (26)	Sense of professional identity
Critical assessment (34)	
Teacher competency	
Seeking alternative (38)	
Novelty (39)	
Materials (50)	Resources
Quality time (53)	Teaching support
Team planning (54)	
Teacher collaboration (55)	
On job training (56)	Reform Exposure
Pre-teaching exposure (1)	
Formal authority (2)	
Awareness of expectation (3)	
Informal authority (4)	
Given guidelines (43)*	Scope of the lesson structure
Commending MLS (44)	
MLS scopes (46)	
MLS advantage (48)	
Useful tool (60)	Perceived pedagogical improvement
Smoothness (32)	
Guideline (33)	
Improve focus (36)	
Assessment support (37)	
Sense of direction (52)	
Change in learning ethos (57)	
Variety of strategies (54)	
Additional teaching ideas (58)	
Teacher reported change (45)	

The numbers in brackets are simply written to label the code.