

An Exploration of the Learning Experiences of Low-Attainers in Primary Mathematics in Sri Lanka

Thesis submitted for the degree of

Doctor of Education

At the University of Leicester

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School of Education

University of Leicester

2018

ABSTRACT

The curriculum for primary mathematics in Sri Lankan schools was revised recently with the aim of introducing constructivist approaches to the teaching and learning process. When initiating these changes, only minimal attention was given to the learning experiences of young pupils, especially for the low-attainers in primary mathematics. Recent studies also have shown that low attainment is still a major problem in Sri Lankan primary schools. Thus, this study aims to fulfill the major requirements by giving attention to the learning experiences of low-attainers in primary mathematics. The intention is to gain a better understanding of the practical experiences of low-attaining students and their teachers.

Therefore, the main objective of this study was to explore the learning experiences of low-attaining pupils in mathematics in primary grades in order to recommend a set of suitable remedial measures to overcome the problem. Under the qualitative research approach, the embedded multi-case study design was used to explore the learning experiences of low-attainers in primary grades. The data collection instruments used in the study included a lesson observation schedule and semi-structured interview schedules for teachers and students. The study investigated four Sri Lankan primary teachers' lessons pertaining to the following fields: (i) The teaching process (ii) The learning process (iii) teachers' perception in teaching mathematics (iv) students' experience in learning mathematics.

The qualitative analysis of the data revealed an insight into the teaching and learning process in primary schools in Sri Lanka. The important themes identified within the case were: teachers under pressure in teaching, problems of time management and emotional reactions of students in learning mathematics. Under those main themes the following crucial sub themes were also identified: poor physical environment of the schools, lack of resources, lack of expertise in teaching mathematics, poor support system, pressure of examinations, parents' attitudes and gender issues. Under these themes and sub themes, the findings clearly showed that the negative attitude towards mathematics among the low-attaining students. Most of the low-attaining pupils believed that mathematics is a hard subject to understand and it is devoted only to more able students. They believe that teachers also neglect them. Lack of leisure activities, the workload, nobody helping them at homes to solve mathematical tasks and they were beaten by teachers or humiliated by peers due to failure in the subject were the common learning experiences of low-attaining pupils.

The findings of this study have several implications for further investigations into classroom practices and classroom learning environment, re-designing the curriculum implementation,

modifying the policy and decision making process to overcome the existing problem of low-attainment in primary mathematics within the Sri Lankan school context.

Acknowledgment

This thesis is a product of the strenuous support and guidance of many people who in their own unique ways, were directly or indirectly involved with me in this endeavour to its completion. So, I wish to extend my sincere gratitude and deep respect to each and every one of them.

First of all, it has been a special privilege for me to have Professor Janet Ainley as my Principal Supervisor for this study. Without her selfless effort and provision of valuable time, the completion of this study could not have been possible. I particularly appreciate her patience in clarifying things in the simplest of terms and for giving feedback about my writings on time. Without her generosity and vision I wouldn't have been where I am today.

In line with this I would like to thank the academic and administrative staff of the School of Education, University of Leicester for their constant professional guidance and their patience and encouragement in pursuance of my goal.

Next, all my research participants – students and teachers deserve special gratitude. This is because without their cooperation and support, my research would have remained incomplete. They have all been really wonderful participants. I thank them for their time, patience and willingness to share their stories and experiences with me.

I would like to thank my place of work the University of Peradeniya for giving me permission to study at the University of Leicester in the UK. In line with this, thanks should go to the National Centre for Advance Studies in Humanities and Social Sciences (NCAS) in Sri Lanka and Higher Education for the 21st Century project (HETC) in Sri Lanka for providing funds for me to pursue this study. Without their support I wouldn't have completed this research.

Finally I would like to thank my family for the hardships they had to go through in my absence.

To those I have not mentioned here I say many thanks.

Dedication

To my loving Grandmother (Kiri Amma) who rests in peace now,
with deepest gratitude and veneration.

If not her, I would be nothing.

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Abbreviations

ADHD:	Attention-Deficit/Hyperactivity Disorder
DOE:	Department of Education
ISA:	In Service Adviser
CRM:	Curriculum Relational Model
MOE:	Ministry of Education
NBMS:	National Baseline Mathematics Survey
NEREC:	National Educational Research and Evaluation Centre
NEC:	National Education Commission
NIE:	National Institute of Education
PD:	Professional Development
PMP:	Primary Mathematics Project
SEN:	Students with special Educational Needs
SL:	Sri Lanka
UK:	United Kingdom
ZDE:	Zonal Director of Education
ZPD:	The Zone of Proximal Development

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CHAPTER 1: INTRODUCTION

1.1 Background of the study

After independence from Britain in 1948, the Sri Lankan government made education one of its highest priorities and made several initiatives to improve the education system in the country. The number of schools in Sri Lanka has increased by over 50 percent and the number of students has increased more than 300 percent within the period of last sixty years. Additionally the number of teachers has also increased by more than 400 percent during this period (MOE, 2013). Teachers make up the largest government work force outside the plantation industry. The literate population has grown correspondingly. Over 90 percent of the population was officially literate by the mid-1980s, with near universal literacy among the younger population. This is the most impressive progress in South Asia and places Sri Lanka close to countries labeled as developed nations (MOE, 2013).

According to the education policy in Sri Lanka, basic education is seen as a necessary condition for the development of the country. In addition, it is recognized as a right for every child. However the introduction of free education in 1945 resulted in increased enrollments without proper parallel improvements in the quality of education. The Sri Lankan Ministry of Education (MOE) has been working to develop the educational structure. However, the main criticism is that the quality of education is being addressed in a piecemeal way and in an uncoordinated manner. One of the crucial drawbacks is that a large number of students fail to reach the expected level of their curriculum. This is more common in learning mathematics than in literacy in all ages of students. This problem has been considered from many perspectives and is still considered as one of the burning problems of school education in Sri Lanka.

The curriculum revisions were introduced from 1997 under the support of the Department for International Development (DFID) in the United Kingdom to primary pupils (aged 5-10) for mathematics education. The purpose of the reform was to modify the content and focus of the entire primary mathematics curriculum. It was expected to replace the previous content-based and teacher-centered curriculum by introducing student-centered classrooms based on the constructivist view of learning and reflective teaching philosophies (PMP, 2003). The main hypothesis of the reforms was that knowledge is not passively received from an outside source but is actively constructed by the individual learner. Children construct their own knowledge as they interact with their environment. Therefore, Children must be offered

relevant learning experiences to achieve the expected learning outcomes. According to the new reforms the factors indicated in the figure 1.1 need to be considered when providing a positive learning experience to the young learners.



Figure 1.1: factors affected to a successful learning experience

According to the Sri Lankan primary mathematics curriculum, awareness of the learner experiences during mathematics lessons is a crucial factor in order to implement the effective measures to overcome the problem of low-attainment. However, despite the expectation of new reforms, the actual situation of classroom practices in mathematics education still remains the same as under the previous curriculum. One crucial criticism is that a large number of teachers are failed to embrace the constructivist approach and reflective teaching philosophies which are expected by the new curriculum (National Education Commission, 2012). Most of the primary teachers still employ a whole-class lecturing style of teaching. They concentrate on routine activities and procedures to introduce techniques for determining facts. Consequently, as mentioned by Handal (2003) many teachers preferred to rely on familiar and traditional methods of teaching, because they have confidence in these types of teaching rather than reflective methods of teaching. Students are encouraged to solve mathematics problems according to same procedure and algorithms (NEREC, 2012). Teachers believe that repetition and rote learning are the basis of effective skill acquisition. Thus, students were not encouraged to participate actively in the classroom and mathematics teachers do not diversify their activities when they are teaching in the classroom (NEREC, 2012). As mentioned by Skemp (1976), this approach encourages learners to learn mathematics by achieving instrumental understanding. It emphasises students' successful memorisation of mathematical facts, procedures and their application. The main aim of

primary education has turned into preparing the students for the Grade 5 scholarship examination to secure a place in a popular school. The examination-oriented teaching and learning process encourages memorisation practice and this does not allow students to construct their own methods of understanding. As a result of this situation a large number of the students in primary grades reported low-attainment in mathematics. Most of them show negative attitudes towards learning mathematics.

The main findings of two recent studies show that the majority of the pupils in Sri Lankan primary schools are performing below minimum and desirable levels of mathematical skills. When compared to pupils at similar levels in the different regions of the country, pupils' achievement has been remarkably low in most primary schools in disadvantaged areas. The study conducted by NIE (2011) in 4 districts in Sri Lanka shows that learner achievement in mathematics at the primary school level was below the expected levels. The study clearly mentioned that less than 30% of the learners were adequately prepared for the next higher class they were to move into. NEREC study (2012) showed that there was notable low performance in mathematics and language among the pupils of low income and disadvantaged village schools. Additionally the class teachers of those schools had problems in identifying the needs of low-attaining students and setting appropriate tasks for those pupils. NEREC (2012) indicated that nearly 70% of students reported below 40% of marks for the given test and recommended immediate actions to overcome the situation. These low-attaining students are categorized based on their performance on standardized tests conducted by the schools. According to these findings it can be concluded that despite the expectation of the mathematics curriculum, a large number of students remains without adequate performance when they move on to the next stage of their learning.

In line with this situation my study aims to identify the learning experiences of these low-attaining students in order to suggest the suitable remedial measures to address the causes of low-attainment of young pupils. In order to do this, there should be a bench mark to identify the low attaining students in primary mathematics within Sri Lankan context. The primary curriculum in Sri Lanka, sets a minimum performance indicator as 40% marks range at the end of primary level for each subject to enter into secondary school. Therefore, pupils who do not reach this 40% marks range for the primary mathematics at Grade 4 are categorized as low-attainers within this study. The significance of my study is discussed in detail in the following section.

1.2 Significance of the present study

In this section I will discuss the complex challenges faced by the Sri Lankan mathematics education as presented in the local literature and the importance of the present study. Such a literature informed discussion will help in the understanding of the extent of the difficulties and challenges facing local numeracy classes and how this hinders the effective teaching and learning of primary mathematics especially for the low attaining students. Furthermore, it will discuss how the present study addresses such challenges in the field of mathematics education in primary schools.

The Longman dictionary (1995) defines research as “the studious study of a subject, that is intended to discover new facts or test new ideas; the activity of finding information about something that one is interested in or needs to know about” (p. 1205). Based on this definition my study can also be considered as an activity of finding information about a selected phenomenon in the field of mathematics education. First, it will explore the nature of low-attaining students’ experiences in learning mathematics which elaborates the relationships existing between the teaching and the student’s learning process. The study hopes to uncover salient features of the teaching and learning process in primary mathematics that affect students’ attainment through classroom observation and in-depth interviews with teachers and students. Therefore, this study will provide thick descriptions of how the teaching and learning environment is organised in relation to maintain the quality of mathematics education for low-attaining students in primary grades. Mainly the study will help in the development of the primary mathematics curriculum which can be linked to quality improvements with respect to the learning needs of such students. This is a long term requirement of the system of education in Sri Lanka.

One of the main reasons that motivated me to undertake this research project is my personal interest and experience as a primary teacher in Sri Lankan schools. The main negative aspect was concerned with the examination-oriented learning activities based on memorisation and practice. This type of environment did not allow students to produce their own methods of learning and construct their own understanding. Most of the students in primary grades reported low-attainment and have a fear of failure and negative attitudes about mathematics (NEREC, 2012). According to my personal experiences, low-attainers in mathematics basically;

- have often been taught using the same method over and over again
- have different learning styles from those of higher-attainers

- have under-developed communication skills
- have poor short term memory
- have preconceived, negative ideas from parents

Drawing on research evidence from international and national studies a number of factors can be identified for the low attainment in mathematics. Those reasons can be listed as the quality of instructions, teacher expectations, and relevance of work set, classroom environment and pupils' rapport with teacher. I realized that those are the crucial fields which further research need to be carried out in order to remedy the situation. These issues had a negative effect on the pupils' academic attainment. Therefore as mentioned by Cristina et al (2012) awareness of the learning experience of low-attainers in mathematics in Sri Lanka would help to develop an appropriate intervention programme to the long lasting problem of mathematics education.

It can be expected that a study on exploration of the learning experiences of low-attainers in mathematics at primary circle will inform the current practices of the mathematics education in primary grades in Sri Lanka especially for the low-attaining pupils. I hope, the results of the study can also be used to strengthen teaching and learning through a programme of professional development in mathematics education for the low-attainers. Finally, this will improve the quality of the primary mathematics curriculum as well as the teacher education in Sri Lanka.

The First National Assessment of Learning Achievement (NEREC, 2005) also emphasises the importance of addressing the requirement of the low-attaining students in primary grades. According to the study, the following curriculum and methodological factors were identified as crucial to the students' attainment: class teacher interaction, learning process, teaching method, assessment procedures, monitoring and supervision practices and facilities provided. Based on the above mentioned findings the following recommendations were made:

- Further investigation into students' learning experiences,
- The students with low-attainment need a 'high quality of teaching' to prevent them failing in the initial acquisition of mathematics skills.
- An action plan for diagnostic and remedial intervention,
- A national level project on diagnostic and remedial teaching,
- Strengthening School Based Assessment,
- Implementation of a quality improvement programme.

As mentioned by the study it is crucial to understand and introduce possible remedies to overcome the existing drawbacks in mathematics education at primary grades in Sri Lanka. Investigation into the learning experiences of students and a ‘high quality of teaching’ to prevent them failing in the initial acquisition of mathematics skills are two of the main recommendations of the NEREC (2012) study to fulfill the requirement of quality mathematics education in Sri Lanka. My study focuses on these identified crucial fields in mathematics education. Therefore, the study can be viewed as a case of numeracy practice and inquiry informed professional teacher development with a focus on learning experiences of low-attainers. This can contribute to the growing body of literature that highlights learning as changing identity.

In addition to that, the study will show the appropriateness of the teaching learning process in mathematics at primary circle in the Sri Lankan context. The primary education in Sri Lanka has divided into three stages: Key stage 1 (Grade 1 and 2), Key stage 2 (Grade 3 and 4) and Key stage 3 (grade 5). The new curriculum reforms were introduced during last few years to cover the entire primary education. Some curriculum changes seem to be brought into Sri Lankan schools without the benefit of prior testing or verification. For example some mathematical tasks may not be appropriate to different classroom contexts and to the students with different attainment levels. Then it would be interesting to study how such curriculum materials affect learning mathematics hence the attainment of students.

Furthermore, this study complements the efforts made so far to find an effective teaching learning process in mathematics education in Sri Lanka by using rigorous qualitative analytical technique which has not been extensively used in previous studies. These are all in consonance with the national learning objectives of primary education in Sri Lanka which aim at creating a conducive learning environment for young learners. Additionally, it is expected that the results of the study could be used to promote higher achievement levels especially in low-attainers, improving the availability of teaching and learning materials and promoting effective monitoring and evaluation of quality mathematics education in primary grades. The main aim and the objectives of the study are given below.

1.3 Aim and objectives of the study

The main aim of the research is to explore the learning experiences of low-attainers in primary mathematics in Sri Lanka.

1.3.1 Objectives

To achieve the above-mentioned aim the following objectives have been set within the proposed study.

1. To explore how the classroom learning environment is organized to support the needs of low-attainers in primary mathematics.
2. To understand the instructional sequence and mathematical tasks used in the lessons.
3. To investigate how the teacher attempts to tailor instruction to meet the needs of low-attainers.
4. To explore the strategies used by low-attainers to cope during lessons.
5. To explore the reasons that students themselves find learning mathematics difficult.

In order to achieve above mentioned objectives the study needs to be built on a good foundation. Ruxton and Colegrave (2006) assert that a good research strategy requires careful planning and a pilot study will often be a part of this strategy. Therefore, I carried out a pilot study prior to the main study during the months of January and February 2014. This pilot study helped me to find a clear focus to the main study. Further, the pilot study helped me to get a clear idea of a number of important issues. I have identified some weaknesses in my pilot approach so I could take measures to minimize those explained effects. For instance, in the pilot study I selected one school as a case and the analysis was done based on the school. However, I realized that the classroom teacher is the core of the each case and that he/she affects students' learning directly. Therefore, I selected four teachers for the lesson observation and for the interview based on Sri Lankan school categories. Data were analyzed based on those four profiles. Moreover, I have checked the correct operation of the equipment (For instance Audio recorder and camera was properly checked and pre tested) and understood the necessity of changing them in order to get the reliability and the validity of results. In short, I have slightly changed the research design and the research instruments according to the experience of the pilot study to achieve the main aim and the objectives of the study. The purpose of the study is given below.

1.3.2 Purpose statement

The purpose of this study is to explore the nature of learning experiences of low-attaining students in primary mathematics with the expectation of introducing a set of recommendations towards effective numeracy teaching learning process at primary grades in Sri Lanka.

Low-attainers' classroom experiences on learning mathematics have not been considered in improving mathematics instructions in Sri Lankan schools during recent years. Therefore, this study seeks to explore the nature of learning experiences of low-attainers in primary mathematics in Sri Lankan schools in order to meet the requirement of the field. Developing an understanding of how low-attainers view mathematics learning is an important step in helping students experience quality mathematics education. Further, Students' views about mathematics teaching and learning can be taken into consideration when designing a mathematics curriculum that addresses their concerns about mathematics learning. Understanding the students' concerns could also influence the use of a variety of instructional practices in mathematics classes. Therefore I believe that this study contributes the requirement of the education system in Sri Lanka. In order to meet this expectation, the following main research question and sub-research questions have been formulated to carry out the proposed study.

1.4 Research questions

Central question

The central question in the present study is: What are the learning experiences of low-attainers in mathematics in primary grades in Sri Lanka? This question can be subdivided as follows:

Sub- questions

1. How is the classroom learning environment organised to support the needs of low-attainers in primary mathematics in Grade Four?
2. What are the characteristics of the instructional sequence and mathematical tasks used in the lesson?
3. How does the teacher attempt to tailor instruction to meet the needs of students with low-attainment?
4. What strategies do low-attainers use to cope during lessons?
5. What do the students themselves think are the reasons that they find learning mathematics difficult?

These were the original research questions set at the beginning of the study, but the data also revealed much more about the experiences of the teachers while implementing it.

1.5 Organisation of the thesis

I have organised this thesis into six chapters. Chapter one gives an overall introduction to the study. This includes background of the study, the importance of the study, rationale and its

general focus and the research questions. Chapter two introduces a review of literature which is relevant to the study. It includes constructivism and its influence on mathematics education; definition and labeling low-attainment in mathematics and practical intervention strategies to overcome the problem of low-attainment based on the theoretical perspectives. Chapter three provides a detailed sketch of methodological concerns relevant to the research design of the study. The data collection instruments, data analysis, trustworthiness and the ethical considerations of the study are given here. Chapters four and five include the findings of the study about learning experiences of low-attainers in primary mathematics in Sri Lankan classrooms. Chapter four introduces four mini profiles of observed teachers' lessons and describing the typical characteristics of each teacher's lesson. Additionally this chapter includes the interview results of both teachers and the students. Chapter five presents a report on the learning experiences of low-attainers under the emerged themes. The identified themes relevant to all four profiles are given through cross-case analysis. Chapter six focuses on the discussion of the findings and conclusion and research implications are also included based on the research findings. As a structural basis for the discussion, this chapter examines the research findings in reference to the research questions. The conclusion, which includes the summary as well as some suggestions and directions for further research and educational implications are given in this chapter.

CHAPTER 2: LITERATURE REVIEW AND CONCEPTUAL FRAMEWORK OF THE STUDY

2.1 Introduction

At the beginning of this chapter I define the term of low-attainment based on the existing literature on mathematics education. The actual definition to be adopted for this study is also formulated based on the literature and the context of Sri Lankan schools. Then I discuss the empirical evidence especially related to characteristics associated with low attainment in mathematics. The kinds of difficulties low attaining children may have when learning mathematics in the classroom are also included. Additionally, the evidence about the pedagogical approaches that have been found to be effective in the supporting children with low-attainment also discussed in detail. Furthermore, the theoretical ideas that underpin the pedagogical approaches have been discussed with special emphasis on the current curriculum in Sri Lanka which has been developed based on socio-constructivist theory. Finally, I have concluded the chapter by giving a brief introduction to the conceptual framework to the present study that was developed based on the constructivism.

2.2 The characteristics associated with the low-attainment and the operational definition

The term low-attainment in mathematics has been discussed under two important aspects by the previous empirical studies (Baker et al, 2002). Some studies identified the low-attainment on the basis of students' performance on standardized or informal tests in terms of percentages and pass rates or by their placement in the remedial classes. Separately, some researchers consider the cognitive development is the crucial factor affect to the low levels of mathematical attainment of the students. I think these two arguments are both important aspects to further investigate in order to identify the characteristics associated with the low attainment. The identification of these characteristics would help to formulate the operational definition of the low-attainment used for this study.

Causes for the low-attainment in mathematics may be seen as school related or beyond the control of the school. According to Boaler (1997) most teachers believe that children in low-attaining groups are similar. However, this suggestion has criticized by Foong (1999) and Houssart (2004) by giving idea that the low-attainers in mathematics are heterogeneous. Descriptions and explanations of low-attaining pupils have tended to emphasise their diversity. For example, Haylock (1991) talks about a broad range of differences related to children with low-attainment in mathematics. He used case studies of individuals in order to

demonstrate complex combinations of difficulties in understanding and engagement with mathematics by low-attainers. Further, Denvir et al (1982) also gives examples to clarify the diversity of low-attainers. Both Haylock (1991) and Denvir et al (1982) assert that these children will not form a homogenous group (Berinderjeet et al, 2012).

Haylock (1991) suggested that a “deficit model” of low attainment which emphasized the diagnosis of the child’s difficulties in understanding and mastering mathematics was an inadequate way of analyzing the problem. Further, he proposed the “ecological model” which attempts to describe the relationships between the child and the whole learning environment. I think this model clearly produced useful insights into the problem. According to Haylock (1991), at least three factors may be related to low attainment in primary mathematics. These factors can be listed as follows:

1. Some significant characteristics of school mathematics, such as - accuracy and concentration, - a symbolic language, - abstract concepts and relationships, etc.
2. Some specific intellectual or behavioural characteristics frequently associated with low attainers, such as - reading and language problems, - perceptual problems (spatial orientation, etc.), - social problems, - mathematics anxiety, etc.
3. Some of the shortcomings in the way the subject is often taught and assessed such as - the preoccupation of “completing the syllabuses”, - meaningless routines, - the teacher’s way is the only way, - practice and yet more practice, - assessment tasks are complex and tedious, correlate negatively with motivating for pupils.

Further, Mercer and Mercer (2005) stated that pupils failing in mathematics have one or more of the following main difficulties (Berinderjeet et al, 2011):

- Intellectual problems on the part of the pupil, such as short attention span, low retention (forgets facts and skills), cognitive immaturity, slow in grasping concepts, problem in organising knowledge and experience, inaccurate computation/procedure, lack of verbal, spatial ability.
- Affective, such as negative attitude and low motivation, anxiety/panic, low self concept.
- Pupil’s educational experience in mathematics, such as lack of appropriate background knowledge, inadequate concrete practical experience, symbols too abstract, lack of pre-requisite knowledge, poor mathematical language, use of rules without understanding.

Therefore, it can be said that any combinations of the above mentioned reasons may result in low attainment in primary mathematics. The NEREC (2012) study on variables associated with mathematics achievement of Primary Grade 4 pupils in Sri Lanka found that although both mathematical and psychological factors were related to mathematics achievement, mathematical factors contributed a higher variance to mathematics achievement than psychological factors. In NEREC (2012) study mathematical factors comprised logical thinking ability, computational skills, mathematical language, and mathematical concept. Further the NEREC (2012) study gave the psychological factors such as attitude towards mathematics, interest in mathematics and memory. Pupils' experiences within the learning processes and classroom practices are highly significant to their learner identities, their expectations, aspirations and motivations.

Piaget (1991) describes two processes used by individuals whilst they are developing. These are assimilation and accommodation. In the assimilation process, individual uses or transforms the environment in order for it to fit within the pre-existing cognitive structures. In the accommodation process, the cognitive structures are changed in order to accommodate something new from the environment. An example of an assimilation scheme would be adding two single digits together and then changing the scheme to add two double digit numbers together. An accommodation process could be where the adding scheme is changed when the pupil multiplies two single digits together. Schemes become more complicated and are then called structures. As these become increasingly complicated, they are arranged in a hierarchical format, as follows:

- Sensorimotor stage: At this stage there is no language (symbol) ability and knowledge is demonstrated through physical interaction and experiences.
- Pre-operational stage: Here language matures and memory and imagination are developed. However, egocentric thinking predominates.
- Concrete operational stage: Language is used in a systematic logical way. Operational thinking develops the ability to reverse mental actions and egocentric thought lessons.
- Formal operational stage: At this stage, individuals can use language related to abstract concepts. There is a return to egocentric thought in the early part of this stage.

Piaget believed that biological developments moved an individual from one stage to another. According to Piaget, the prime motivator of developmental change in a child is “dis-equilibrium”; i.e. a state of conflict in the child due to the difference in what they expect to

happen as an outcome to a situation and what actually happens. According to this a teacher can facilitate cognitive change in a pupil. The teacher can help a pupil discover implicit contradictions in their own thinking as long as these contradictions are latent in the pupil's knowledge base. Wadsworth (1971) also agrees with this when he describes how learners go through a process of assimilation and accommodation of new knowledge. It is then integrated into existing schemas. However, the case of a pupil not having some latent knowledge that could be activated needs to be considered. They would not have had developmental changes, therefore, they could not progress to the next stage. This could use to indentifying of a low-attainer, i.e. a pupil who does not progress to the next stage. However, it is impossible to ascertain whether a pupil does not have the required latent innate knowledge to progress from one stage to another or if it has not yet been activated. It is important to consider that Piaget's theories are about child (pupil) development and not learning. He does not believe that development can be accelerated. It depends on developmental stages. He says that it may be possible to accelerate learning but this would depend on the stage that the child (pupil) is on at the time and the topic being studied. However, pupils may be at different stages in different topics or different stages within a single topic. In algebra they may understand formulae and sequences but not integers, powers and roots. Here, pupils may be categorized as low-attainers in one topic but not in the other.

This idea of pupils being on different levels in different topics is reiterated by Herscovics and Lnychski (1994). They argue that there is a cognitive gap between arithmetic and algebra. This gap can be characterised as the students' inability to operate simultaneously with or without the unknown. They say that the low-attainer does not have the ability to generalise the skill to fit a new situation or adapt the skill to fit a new situation without the intervention of the teacher. The achievement in algebra of the pupils could be used to determine whether they are low-attainers. However, this would also be problematic in the identification of low-attainers. This is only a same topic that is taught several times during one academic year. This is further complicated when considering the mathematics education in Sri Lanka. Pupils in Sri Lankan schools need to study five strands. These are: numbers and the number system, algebra, shape, space and measurement, handling data and using and applying mathematics to solve problems (NBMS, 2005). Pupils will achieve different levels of understanding in different strands and in different topics within these strands as the year progresses. Most of the Sri Lankan pupils attend different tuition classes and they are learning same topic several times from different teachers. Hence this does not provide a clear clarification of the

characteristics of low-attainers that could be applied equally to all pupils throughout the Sri Lankan school context.

Haylock (1991) says that mathematical learning can be analysed in a hierarchical way. Each learning step leads to another in a sequential manner so if mathematics objectives are set and assessments of the understanding of those objectives are made, then it would be appropriate to apply this form of assessment to low-attainers. The pupils who do not achieve the objectives of the hierarchy could be considered as low-attainers (Haylock, 1991). Haring et al (1978) state that there are 4 levels of performance:

- Acquiring the behaviour (e.g. adding two single digits together)
- Performing the required behaviour fluently (e.g. being able to perform the calculation with only a few errors unaided)
- The ability to generalise the skill to fit a new situation (e.g. being able to add numbers together)
- Adapt the skill to fit a new situation. (being able to add two 2 digit numbers together)

According to them these levels of performance form a learning hierarchy. This could be used to identify the low-attainers. If pupils are at the first level of performance, they are acquiring the behaviour. However Haring and Eaton (1978) does not state a time frame in which these performance levels should take place. If we consider a pupil in Grade 2 then they may be able to add the two single digit numbers together but not achieve any of the other levels of performance. However by the time the same pupil is in Grade 5 they would be able to add two 2 digit numbers together. This identifies a low-attainer in Grade 2 but not in Grade 5. It is not clear if the pupil has to demonstrate all 4 levels of performance in one lesson, over a series of lessons or over a year. It is unclear how these performance levels can be applied with any consistency over a topic or time span. As with Piaget's stages, it would also be difficult to use these levels of performance to describe the performance hierarchy of pupils. They may be on one level in algebra, but on another in shape and space. Given all of the above it is impossible to think that a definitive description of low-attainers can be elicited from Haring and Eaton's (1978) learning hierarchy with the addition of a timeframe.

Bloom's taxonomy of educational objectives (Bloom et al, 1956) suggests categories of objectives that are arranged in a hierarchy. I will discuss the possibility of identifying a low-attainer according to which level of learning objectives they attain. In Bloom's taxonomy there are two domains that have pre-requisite levels within them. These are:

Cognitive

- Knowledge
- Comprehension
- Application
- Analysis
- Synthesis
- Evaluation

Affective

- Characterising
- Organising
- Valuing
- Responding
- Receiving

Bloom suggests that pupils should not move onto the next level before they have an understanding of the previous level. In cognitive levels, knowledge is the lowest level and evaluation is the highest. Objectives in the affective domain are about emotions, interests, attitudes and values and so are long term objectives (Haylock, 1991). Pupils develop these over a period of time, they are not attained through a specific programme of learning. I will only consider the levels in the cognitive domain, as only possible hierarchical models that could be used to identify low-attainers. Although this domain gives teachers a basis to judge attainment, it should be noted that different disciplines require different kinds of thinking. In one subject a pupil may be on one level and a different level in another subject. If we were to compare mathematics with physical education, for example, different skills and techniques would be needed to attain the next level. This principle could also apply to topics within subjects. In conclusion, hierarchical levels cannot be applied consistently to all pupils over all topics hence this cannot provide us with a usable definition of low-attainers, so I think it is important to consider the normative attainment test to identify the low-attainers in mathematics.

As mentioned by Baker et al (2002) several studies have attempted to define the term low-attainment in terms of percentages and pass rates of pupils. Heller and Fantuzzo (1993) define low-achieving pupils as (a) scores below the 50th percentile on standardized mathematical achievement (based on the school district of Philadelphia's citywide norms) and poor performance in mathematics as rated by classroom teachers. In this case teacher

nominations were used to identify the students' performance and the definition was developed based on this performance. However, it can be argued that this definition would not be applicable equally to pupils in all schools because different schools have different backgrounds.

Barnes (2005) considers low-attainers as pupils who do not reach the standard of mathematics performance as set out by the school. This is also a normative-based assessment that is specific to an individual school. He does not go on to state a percentage of the population of a school who would fall short of reaching this attainment and so could be identified as low-attainers. In many Sri Lankan schools targets are set for the percentage of pupils who obtain 40% or above in public and end-of-year examinations giving a normative-based attainment. The implication here is that in some schools all pupils achieve above the level of 40%, thus they would have no low-attainers when measured using the benchmark of a 40% mark or above. In other schools, only 25% of the pupils achieve the standard set by the school 40% and hence they would consist of 75% low-attainers. However, schools often set a second target for examinations of 15% A or above. In this case there may be low-attainers in both schools. Schools often set many internal standards that they hope pupils would attain. This is the problem with Barnes' idea of low-attainment on which of the schools' standards that he is referring to. This cannot be applied to the whole Island. However, the Cockcroft Committee stated that low-attainers in mathematics were deemed to be pupils in the lowest 40% nationally in terms of achievement in mathematics (Backhouse, 1989). Watson et al (2003) also says that a level 4 is the ideal minimum level for entry to secondary schools. This indicator can be used to identify pupils who have not reached this standard.

According to the above mentioned arguments, it is clear that most of the early research studies describe the characteristics associated with low-attainment in mathematics based on the observable performance of pupils. They did not consider the cause behind the situation. They describe low-attainers in mathematics as pupils who are in the bottom set of mathematical attainment in their age group in national assessment (Denvir et al, 1982). Other labels attached to such performing students are slow learners, at risk students, special needs children, less able children and so on. The EU benchmark identifies low-attainment in mathematics on the basis of the definitions used by the PISA survey in which scores range from level 1 to level 6 (the highest level). The European benchmark, low-attainers in mathematics are students who do not reach the level 2 of PISA in mathematics. This level is considered to reflect the necessary basic skills. It is measured at 15 years of age. "Students

whose proficiency in mathematics is limited to Level 1 or below can, at best, perform simple mathematical tasks in familiar contexts. They will find it difficult to think mathematically. They have limited ability to make sense of a complex world. Students at level 1 “can answer questions involving familiar contexts where all relevant information is present and the questions are clearly defined. They are able to identify information and to carry out routine procedures according to direct instructions in explicit situations. They can perform actions that are obvious and follow immediately from the given stimuli” (PISA 2009). Not reaching level 2 means that students are not able to perform at least 50% of tasks at PISA level 2. Some of those not reaching level 2 will be at level 1, which means that they succeeded in at least 50% of tasks at this level, while others will be below level 1. The great variability among countries shows that something can be done to improve the achievement in mathematics (PISA 2009).

In order to carry-out my research, a clearer definition of what constitutes low-attainment in mathematics was required. In particular, it was felt necessary to distinguish between low-attainers in mathematics and a number of closely related groups of students such as students with special education needs (SEN), students from disadvantaged socio-economic backgrounds, early school leavers, etc. I believe that the PISA definition can be considered as the foundation for identifying the low attaining students for my study. One of the limits of a definition based on PISA is that low attainment is only measured at age 15. Therefore I decided to study low-attainment from the early years of education as there was a consensus that effective policy had to tackle the roots of low-attainment early in a student’s formal education. This is where education policy is most likely to have a significant impact. While social, economic and health issues have an impact on educational attainment, and as such must be addressed by education policy. The decision to concentrate on low-attainment had the advantage of allowing me to focus on the teaching and learning processes alone.

National numeracy strategy for Sri Lanka (2003) has identified a minimum pass mark of 40% from the end-of-year test. This is the minimal performance indicator as 40% marks at the end of primary level to enter into secondary school. Hence based on these bench marks the low-attainers adopted for this study will be: Pupils who have not achieved a minimum pass mark of 40% in the end-of-year assessment conducted by the department of education at the end of Grade Level. The students selected based on this definition would be appropriate for my study. Therefore, I consider researching on the low-attainers is more important in order to meet the expectations of the current primary mathematics curriculum in Sri Lanka.

2.3 Pedagogical approaches that have been found to be effective in the supporting children with low-attainment

Baker et al (2002) emphasize that a careful observation and understanding about low-attainment is needed in order to design and implement a suitable pedagogical approaches to overcome the problem. Some researchers failed to do so and they tend to suggest some recommendations without considering the actual learning experiences of low-attaining students. Therefore, as mentioned by Baker et al (2002) it is important to consider the above mentioned characteristics of the low-attainment in mathematics when design a supportive pedagogical approaches to low-attainers.

Kutnick et al (2006) says that teachers' pedagogical approaches inevitably play a significant influence with low-attainment groups. In this sense, the organisational structures and processes in schools are highly applicable to the pedagogical context for low-attaining pupils and their teachers. Attainment grouping in practice appears to advantage some pupils while disadvantage others. Ireson et al (2002) found that pupils with high attainment in mathematics benefitted from homogeneous attainment groups while those with low-attainment in mathematics benefited from mixed attainment groups. Hallam and Ireson (2007) found that teachers preferred homogenous attainment groups as it allowed pupils to learn at the appropriate level and pace for the group. Slavin (1990) suggested that grouping by attainment increases the motivation of the lower attaining pupils by removing any competition or intimidation from working alongside higher attainers. However, later research by Boaler et al (2000) does not support this suggestion. The lack of clear evidence to support one form of grouping may reflect the greater influence that other factors have on outcomes such as effectiveness of teaching (Day et al 2006) and curriculum offered (Kutnick et al, 2002, Blatchford et al 2003). It is well known that pupils learn more when the school and classroom environments are positive and supportive (Christenson et al 1989). The teacher is key, as she/he arranges the physical (seating) and academic (e.g. scheduling, method of lesson presentation, nature of assessment, homework, etc.) variables and establishes the affective nature (e.g. encouragement, competitiveness, and cooperation) of the classroom. Teacher expectations, encouragements, evaluations, attentiveness, and attitudes greatly influence pupils' perceptions of themselves as learners (Mercer and Mercer, 2005). Because many low-attainers in primary mathematics have negative perceptions of their ability, teachers must create and maintain a supportive environment. Lee (1999) notes that one way to help low-attainers is by enhancing their mathematics specific self-esteem through creative

and varied teaching strategies. Sprick (1985) notes that learning is greater and behaviour is more appropriate in classrooms where teachers attend to positive events more than to negative events. Borich (1992) and Brigham et al (1992) maintain that teacher enthusiasm is an important and NEREC (2012) study also reinforces the teacher encouragements, expectations and attitudes greatly influence pupils' perceptions as learners. Alderman (1990) noted that a positive learning environment and pupil learning are enhanced when teachers believe that all pupils can learn and that teachers can make a difference. It is also equally important to provide the right kinds of learning experiences considering pupil preference for learning styles. Lim (1999) in her study on preferred learning styles of low achieving and high achieving pupils in a Singapore primary school found that low achievers preferred formally designed learning environments. Christenson et al (1989) state that a positive learning environment is built upon the use of realistic expectations of pupil learning, the development of instructional plans that consider pupil characteristics and needs, the use of reinforcement for pupil productivity, the use of active monitoring of pupil progress, and the belief that all pupils will experience academic success. Pupils need to be motivated and engaged in the learning process. Often low-attainers in mathematics lose their motivation for learning due to repeated failure at mathematics tests. Setting realistic instructional goals and determining mastery criteria are important to pupil motivation. To experience success and link it to one's own effort are critical for the development of motivation in pupils (Alderman, 1990). Hence, opportunities to experience such successes must be available for low-attainers in primary mathematics. From the factors that may be related to low-attainment in primary mathematics (Haylock, 1991) and the difficulties that may be experienced by low-attainers in mathematics (Mercer and Mercer, 2005) it is apparent that teachers working with low-attainers would need customised approaches to help their pupils (Berinderjeet et al, 2011).

Furthermore, Cockburn (1999) notes that difficulties with mathematics may stem from three perspectives:

1. child (experience, expertise, mathematical knowledge and understanding, imagination and creativity, mood, attitude and confidence)
2. task (mathematical complexity, presentational complexity, and translational complexity), and
3. teacher (attitude and confidence, mood, imagination and creativity, knowledge, expertise and experience).

There is a plentiful of research on how specific causes of low-attainment and the possible way of addressing low-attainers in primary mathematics (Haylock, 1991; Houssart, 2004;

Mercer and Mercer, 2005; and Cockburn, 1999). The literature highlights that there are a myriad of factors associated with low-attainment in primary mathematics and possible way of addressing the issue.

Vygotsky (1978) believes that if pupils were taught using only a recommended syllabus pedagogy which does not allow for abstract thinking that would not only fail to address students' needs but also would re-inforce their innate handicaps. The teacher, who focuses only on the knowledge that was pre-decided, suppresses the pupils' ability to form abstract thoughts. According to the national mathematic curriculum in Sri Lanka (2003), pupils are required to:

- Pose problems
- Predict Outcomes
- Decide on data to be used
- Choose appropriate methods and resources
- Interpret, discuss and justify results
- Identify further information required to pursue a supplementary enquiry.

Teaching pedagogy needs to promote active thinking in order to meet these objectives. It is suggested by Hokanson et al (2000) that there has been a change in education from instructivism to constructivism and from teacher-centred to learner-centred education. According to Cohen et al (1997), this change to constructivism has led to effective teaching and learning being based on: higher order thinking skills, deep and superficial learning, metacognition and cooperative learning. The primary mathematic curriculum in Sri Lanka (2003) emphasizes the using and applying of mathematics to solve problems. This includes thinking, problem-solving, communication and reasoning skills. It could be argued that pupils could be at a disadvantage if a constructivist approach is not applied to the teaching of mathematics within the given curriculum. This could cause low-attainment because of the use of an inappropriate teaching pedagogy. Furthermore, not being taught by a specialist in mathematics or the teacher having a limited knowledge of teaching methods can also be a cause of low attainment (Watson et al (2003). I believe that it would not be acceptable for a pupil to be taught by a non-specialist in any grade. However, considering the Sri Lankan context, low-attainers are often taught by non-specialists or teachers with inadequate training. Therefore it could be argued that teachers of low-attainers need an adequate understanding of the subject in order to transfer this understanding to their pupils. They need to have many different methods of approaching a topic. Further, they need to know many ways to explain

how to get to a solution for a mathematical problem. Therefore the teaching pedagogies that do not promote active thinking skill in young learners can be a cause of low-attainment. Therefore, the effective pedagogical approaches were suggested by various studies to overcome the problem of low-attainment. These recommendations are discussed below in depth.

2.3.1 Conducive learning environment

The importance of a conducive learning environment is emphasized by Papert (1980) who indicates that the students learn naturally when they interact with their environment and Mounoud (1981) who says that the environment is an important factor in learning a new concept. Hay McBer, (2000) also advocates that a positive learning environment would lead to effective communication among the students and would finally provide an effective teaching and learning process. Pimm (1987) further suggests that teachers should facilitate students by providing an appropriate learning environment so, students get involved in more discussions amongst themselves in the classroom. Moreover, Reusser (2000) considers the learning environment an important factor for student attainment level and asserts that low-attainment in mathematics in most of the students is due to problems in the teaching and learning environment rather than genetic factors. He further believes that an effective teaching and learning environment positively impacts students' mathematics attainment levels regardless of grade or mathematical ability of the students. Adaptation and empathy must be the central characteristics of an effective classroom environment in order to meet the expectation of the different levels of attainers in mathematics. Russer (2000) further suggests that according to the learning style of a child, the teacher needs to make decisions every moment, with a micro-level approach in teaching.

In addition to that, studies show how the supportive learning environment positively affects the development of students' communication skills. Brown (1982) indicates that pupils in general are fluent in listener-oriented speech but teachers need to practice them for the message-oriented speech. When pupils are trying to be listener-oriented, they find it difficult to change the historical belief that a teacher does not want the pupils to talk in the classroom (Luria, 1976). This can be ameliorated if a supportive environment is facilitated. Additionally, teachers should also promote pupils' listening skills so that more pupil-to-pupil discussions can take place (Pimm, 1987). Therefore, as mentioned by Brown (1982), teachers need to enhance a supportive learning environment in order to facilitate communication among students. This idea of a supportive environment for the students' communication has

confirmed by Boaler et al (2010) who say that an environment which facilitates positive communication is important. He says that this can be achieved via group work. Pupils who took part in the group work enjoyed themselves as it allowed them to discuss problems. This gave them a better understanding of how the solution had been figured out. The discussion allowed students to understand different ways of solving problems. Here the pedagogy consist of facilitating collaboration, discussion, and peer scaffolding needed a supportive environment if they were to be used effectively (Boaler et al, 2010).

Watson et al (2003) also suggest that the pedagogical approaches have an impact on students' attainment such as allowing and facilitating pupil participation. They say that pupils will achieve more than their counterparts if learning strategies are facilitated. These interventions should take place in an environment in which pupils are challenged but supported. This could address some of the difficulties in mathematics for low-attainers.

The low-attaining students are also able to shifts their thinking from the superficial features of mathematical tasks to forms of mathematical thought if they are provided with the required helpful learning environment which facilitates to their levels of understanding (Watson, 2001). For example, in her study, students were able to shift from seeing fractions as congruent shapes to seeing fractions as quantities using the idea of area to make the link. Therefore, Watson asserts that low-attainment in mathematics is not the result of an inability to think but the lack of structured work to promote higher order thinking in those students. The evidence from the study of Zohar and Dori (2003) also confirm that the low-attaining students can benefit from teaching and learning processes which were designed to foster higher order thinking skills. They recommend that teachers encourage students of primary grades to engage in tasks that involve higher order thinking skills in suitable learning environment.

Research findings of Adedayo (1999) and Boaler (2000) confirm that students who actively engaged in learning mathematics with stimulating classroom environments were successful in improving their confidence and attainment. Schools that used a student-centered teaching/ learning process had an increased confidence and enjoyment of learning mathematics and those students attained statistically significant higher grades than students in a school with a similar population using a textbook-based traditional approach (Kerridge, 2012).

2.3.2. Teacher competency

Teaching has to be changed from instructivism to constructivism and from a teacher-centered to a learner-centred approach in order to implement a child friendly teaching and learning

environment within the schools (Hokanson et al, 2000). Constructivism has led to effective teaching and learning being based on: higher order thinking skills, deep and superficial learning, metacognition and cooperative learning (Cohen et al (1997). The primary mathematic curriculum in Sri Lanka (2003) also emphasizes the use and application of constructivism as the foundation for primary education. In addition to that, facilitating scaffolding (Vygotsky, 1978) is also emphasized by the new mathematics curriculum in Sri Lanka as an intervention strategy that addresses some of the causes of low-attainment. Therefore, the importance of having teachers with relevant competencies in schools has been recognized and the teacher development programmes are developed based on these innovative concepts (MOE, 2013).

The literature shows the importance of the teacher development programmes by providing examples from different studies. For instance, teachers' lack of conceptual knowledge in mathematics has proved to be problematic for professional developers in several studies (Akers et al 1997; Barrett et al 2002; Cohen, 1990; Olson and Barrett, 2004; Simon et al 1999). Teacher professional development must focus not only on subject matter knowledge (Horsley et al 2003) but also on pedagogical content knowledge and the different learning styles of their students (Schulman, 1987). In Sri Lanka the focus on pedagogical practices in mathematics in teacher professional development has been considered crucial for several years. However, for the successful implementation of curriculum reforms, teachers must not only broaden their mathematical knowledge and competencies (Battista, 1994) but also must challenge the attitudes, beliefs and behavior of their students' nature of learning mathematics (Sirotnik, 1999; Soder, 1999).

In addition to that, studies have considered the teacher's classroom behavior to be a factor associated with students' learning problems in mathematics. Fisher and Rickards (1998) have found out that students' attitudes towards mathematics tend to be more positive in classrooms where students perceive greater leadership and helpful/friendly behavior from their teachers. More negative attitudes have shown by the students who perceive their teachers as admonishing and enforcing strict behavior. Therefore the teacher's behavior in the classroom is a crucial factor associated with the students' attainment in mathematics. Therefore it is reasonable to argue that development of teacher competencies is a crucial factor in order to find a successful solution for the problem of low-attainment in mathematics among young students.

2.3.3 Prior learning experiences

Haylock (1991) says that there should be a shift of emphasis for low-attainers from routines and procedures to developing an understanding of mathematics. He says that tasks should be meaningful to the low-attainers in order for them to be engaged in the lessons and this could be achieved by using prior learning experiences. This is also in line with Driver et al (1986) who suggest that understanding is dependent on the pupils' prior experience and knowledge. A mathematical concept can be gradually introduced to the pupil by using their past experience regarding the topic. Furthermore, Kischner et al (2006) also believe that examples of prior experiences in real life are important for learning. They argue that these prior experiences need to be planned carefully and unguided experiences could leave the pupil less competent than when they started. Moreover, empirical research on prior learning experiences indicates that students learn mathematics better when they find it relevant to their prior experiences (e.g. Heibert and Carpenter, 1992; Visnovska and Cobb, 2009). Students' prior experiences in learning mathematics affect their role in the classroom. For instance, active involvement could be seen when doing designated works in the classroom (Yackel and Cobb, 1996). Some other studies have shown that prior learning experiences affect the perceptions of students about learning of mathematics which affect their classroom practices and performances (e.g. Even and Tirosh, 2008, Nickson, 1992). Therefore, it can be concluded that prior learning experience may have an effect on the whole of the student's behavior and attainment and this could be used as an intervention strategy to overcome the problem of low-attainment in mathematics among young learners.

Watson et al (2003) re-iterate the intervention strategy of putting mathematics into context with pupil participation to address some of the difficulties low-attainers face in mathematics and provide opportunities for their cognitive development. Vygotsky (1978) believes that a teaching pedagogy should allow for abstract thinking. Dowker et al (2000) state that writing symbols for numbers proves difficult for some pupils. These pupils cannot translate problems written in concrete (kinesthetic problems), verbal (word problems) and numerical (written problems) formats. However, teaching mathematics at primary grades in Sri Lanka requires abstract thinking from pupils and an intervention strategy that could address this. Vygotsky and Dowker et al suggest that teachers should provide practical tasks encompassing real concepts.

Driver et al (1986) say that understanding is dependent on the pupils' prior experiences and knowledge. They also suggest that much teaching is performed in a teacher-lead way and the

pupils are passive learners. In my experience low-attainer pupils tend to be passive and do not willingly share their experiences or knowledge. This was evident in the pilot study. Here, if a teacher can address the problems posed by socio-historical development then pupils would be more willing to use pupil-to-teacher communication (Luria, 1976). An intervention strategy that could be used would be more effective for the teacher to enable communication, such as listener- and message-oriented speech (Brown 1982), talking to others (Pimm 1987), peer-to-peer and pupil-to-teacher communication (Watson 2003), as described in the communication section above. This would mean that pupils become less passive and more willing to contribute their experiences and knowledge.

However it is important to consider Kirschner et al (2006) who say that in order for learning to be meaningful, experience is important. They also say that although the activities could be motivating for the pupils, if they are unguided, they can leave the pupil less competent than before they started the activity. However pupils must be given the chance to practice and gain feedback that will equip them to complete the problem at the time it is encountered.

Ryan and Pintrich (1997) mention that confidence in mathematics is associated with its attainment. Students who perceived themselves as cognitively competent were less likely to avoid seeking help. On the other hand, students who were unsure of themselves were more likely to feel threatened when asking their peers for help and more likely to avoid seeking help. Hart (1989) has found that the mean for teacher-student interaction was higher for high confidence students than the mean for low confidence students. Ryan and Pintrich (1997) explains that students with higher confidence in mathematics do not attribute their need for help to lack of ability and thus are more likely to seek help when they need it. Hart has further found out that students with more confidence engage in mathematics a greater percentage of the time than students with less confidence (Kerridge, 2012).

Haylock (1991) further says that there should be a shift of emphasis for low-attainers from routines and procedures to developing an understanding of mathematics. In order for low-attainers to engage in learning tasks, they should be meaningful. An intervention that could achieve this is the use of examples from real life. This needs to be presented in a way that low-attainers can understand. For example, he describes how the school day can be used when learning how to tell the time. All pupils understand that the school day starts, has lunch and ends at a specific time. This is an opportunity to use real life to teach a difficult topic to low-attainers and could be used to prompt pupils through the cognitive conflict and help them with further development

As mentioned in the previous section of this report, different characteristics were identified associated with the low-attainment in mathematics. These characteristics are categorized under the topic of special needs, lack of cognitive development, poor memory, and problems with communication and teaching pedagogies. The low-attaining pupil perceives mathematics as a difficult subject and is anxious about mathematics due to these different reasons (Casey et al, 2001; Hyde et al, 1990; Ma, and Kishor, 1997; Sayers, 1994; Vermeer et al, 2000). Therefore the students' attitude towards the subject is a crucial factor in attainment and the students having a positive perception of learning mathematics is crucial. (Papanastasiou, 2000; Wong, 1992; Fisher and Rickards, 1998; Forgasz and Leder, 1996). According to the literature the pedagogical approaches which are given below have been found to be effective in supporting the children with low-attainment.

2.3.4 The facilitation of group work

Vygotsky (1978) says that an essential feature of learning is that it awakens a variety of internal development processes that are able to operate only when the child is in the action of interacting with people in its environment and in cooperation with its peers. Piaget (1991) also believed that biological developments moved an individual from one stage to another and that concrete experiences facilitated through group work could be used to help children learn. The facilitation of group work is also an intervention strategy suggested by Haylock (1991), Watson et al (2003) and Boaler et al (2010). Haylock (1991) advocates small group work and competition as a means of pupils practicing and consolidating their mathematics. He cites examples of scaffolding being used as a teaching strategy within these groups. The prompts are used extensively at first, before gradually being taken away in order for the pupils to eventually solve a greater problem unaided. This is an example of peer scaffolding and the problems and benefits of this teaching pedagogy is discussed above. Further, Zakaria (2010) showed that cooperative learning such as group works improve students' achievement in mathematics and attitude towards mathematics. Therefore he recommends that teachers need to incorporate cooperative learning methods in their teaching. Therefore, organizing and facilitating of group works can be used as an important intervention strategy to overcome the problem of low-attainment among pupils.

2.3.5 Strategies for memorization

As mentioned by Wood (1991) and Wertsch (1978), low-attainers may have immature strategies for memorization. Furthermore, they explain the importance of remembering the

new knowledge in order to be able to apply it in subsequent lessons or situations. Therefore, according to those studies, it is reasonable to say that poor memory can be a cause of low attainment. To overcome this difficulty, various strategies have been suggested. For example, Bruner (1961) suggests that pupils are more likely to remember materials when they are actively engaged. Mayer (2004) suggests that pupils need to be cognitively active during learning. An intervention strategy that puts learning in context can also address poor memory as a cause of low attainment (Biggs, 1985; Ginsberg, 1977; Haylock, 1991; Piaget, 1991; Watson et al, 2003). Wood (1991) explains that putting things in context (the use of real life experiences) is a practical intervention that promotes factual recall by low-attainers. All those studies emphasize the need of practical activities for the improvement of memory of the students. Therefore, teachers and parents can use practical activities and provide real life experiences which a child can actively engage with peers. This will help pupils develop their own thinking and apply the experience in the new context. In line with this argument Ginsberg (1977) and Dowker et al (2007) explain that memory can play an important part in the understanding of mathematics. They say that one of the key theoretical principles is that pupils must be able to derive and predict unknown mathematical facts. In order to do this, pupils need to locate the appropriate arithmetical principle they need in their memory. An intervention strategy suggested by Dowker et al (2007) to address this is giving opportunities to play games that promote memory skills.

In addition to that, Warburton (2003) indicates the importance of surface learning to address the problem of poor memory, especially for the difficulties in learning mathematics. This is a type of learning where the emphasis is put on the memorisation of details without attempting to gain understanding and to provide deeper meaning, for example rote learning, or the kind of learning many students do for their exams. Dowker et al (2000) also suggest rote learning to address the principles and procedures related to counting. An example of an intervention strategy that addresses rote learning is chanting tables or pupils repeating correct answers to questions (Dowker 2004). However, rote learning must be underpinned by understanding (Biggs, 1985) and different approaches should be used when using rote learning to understand the role of place value (Dowker et al, 2000). Examples of this could be the use of money, number lines or using fingers and thumbs when considering multiples of 10s. However pupils may still memorise answers to a question without any real understanding (Dunn et al, 2010). However, rote learning does have its advantages in memorising facts, since that is a prerequisite for some summative examination questions such as year-end tests in schools. I think both rote learning and learning with understanding would enable a child to

do well in the test, but the test does not distinguish between the two. Thus it is tempting for children and teachers to focus on rote learning, which appears to give faster results. This situation leads to a possible conflict between the aims of the curriculum and the ways in which it is assessed. Besides these drawbacks the memorization strategies can be used to overcome the problem of low-attainment in mathematics.

2.3.6 Develop communication skills

Haylock (1991) and Watson (2003) mentioned that one of the causes of low-attainment is poor communication skills in pupils and it is important to provide opportunities to develop their communication skills. According to Vygotsky (1978) the facilitation of social scaffolding is a practical intervention strategy that can be used to enhance communication among the pupils. According to him the social scaffolding takes place if pupil-to-pupil communication is allowed in the classroom. Here, pupils need some form of aid when they cannot go beyond their capacity and in order to meet this requirement, the teacher can allow pupils to work on activities in groups. They can explain the solution to peers. These pupils are in the actual development level. They are in the zone of proximal development when benefiting from the aid of other pupils. Vygotsky (1978) says that this can only take place when the pupil is interacting with their environment and in co-operation with their peers. Cohen et al (2004) also state that peer-provided scaffolding is motivating and meaningful. They say that collaboration enhances learning. For instance, students may talk about the issues involved with each other as well as with the teacher.

The facilitation of collaboration as a practical intervention strategy addresses the causes of low attainment identified by Luria (1976) (Socio-historical beliefs) and Brown (1982) (Message-oriented speech). However, Chin (2006) says that teachers would have to be aware of the scaffolding taking place and guide pupils where appropriate to enable understanding. Therefore, the key principle of communication should be facilitated in the classroom in order to address low-attainers' poor language and communication skills. Pimm (1987) and Biggs (1985) agree with this stating that teachers should facilitate more pupil-to-pupil discussion. This facilitation of communication would provide an effective teaching and learning environment. (Dowker et al, 2000).

Watson et al (1998) also discuss communication as a key theoretical principle in mathematics and suggest that both closed and open questions should be used in the classroom as intervention strategies. The use of open questions does not rely on the pupil being able to remember how to do a question. This makes the pupils willing to share their reasoning and

methods. Thom (1973) says that there are only right and wrong answers in mathematics. However, all contributions to the solution of a problem are regarded unequally in this context. Knowing where a mistake in calculations has been made and being able to explain this to peers or hearing it from peers can lead to a greater understanding of the topic. This is an example of the use of both message and listener-oriented speech (Brown, 1982). The lack of facilitation for this explanation can be a cause of low-attainment. The intervention strategy which uses open questions, facilitates collaboration and discussion. This, as mentioned by Boaler et al (2010), allows teachers to formatively assess students' progress. Therefore, it can be concluded that the facilitation of many forms of communication is an important intervention in addressing the causes of low-attainment.

2.3.7 Use of assessment

Haylock (1991) mentions that low-attainers experience repeated failure and he suggests that clear and relevant objectives should be used within the teaching pedagogy in order to address this situation. The pupil's knowledge, what stage they are at and how they can get to the next stage need to be understood by the teachers. This is particularly important when we consider the recommended mathematics curriculum in Sri Lanka. Watson et al (1998) and (Baker et al, 2002) also suggest the awareness of this key theoretical principle of progress. Watson et al. (2003) suggest that the use of assessment for learning would be an intervention strategy that addresses this situation. For instance, the use of small white boards in a lesson could be used effectively to address the issue. Here, pupils can write the answers and hold up their white boards for the teacher's comments. The teacher can assess their answers and give the next question, gradually moving the pupils towards the desired outcomes. As suggested by Watson et al (1998), this type of assessment would be particularly useful when open questions are used as a teaching pedagogy. This is an example of formative assessment.

As mentioned by Piaget (1991), teachers could also use assessment to determine which resources and activities are likely to have the greatest effect on pupil developmental stages. Ginsberg (1977), Dowker (2004) and Boaler et al (2010) also suggest assessment as an intervention strategy to address the causes of difficulties in mathematics for low-attainers.

To conclude, different pedagogical approaches have been used and suggested to overcome the problem of low-attainment in mathematics. As mentioned above, these approaches were developed based on the theoretical perspectives of several psychologist, theorists and researchers. Primary mathematics curriculum in Sri Lanka also recommends and encourages the pedagogical approach which is developed based on the constructivism theory. The next

sexton of this chapter will discuss the conceptual framework of the study developed based on the constructivism.

2.4 Theoretical approaches to address the problem of low-attainment

Existing Sri Lankan primary mathematics curriculum emphasizes the constructivist approach in education and teachers guide and text books were developed accordingly. Cognitive constructivism and social constructivism provided the theoretical base for the pedagogical approaches for teaching and learning of mathematics in primary grades. Therefore, I will discuss the theoretical basis of constructivism and related theoretical approaches which underpin the above mentioned pedagogical approaches to remedy the problem of low-attainment.

2.4.1 Constructivism

Generally, constructivism is a theory in which learning is seen as an active process. There are two types of constructivism; cognitive constructivism, which is based largely on Piaget's theories, and social constructivism, based mainly on Vygotsky (Hokanson et al, 2000). Cognitive and social constructivism shares some common characteristics. According to Crowther (1995) pupils construct knowledge rather than receive it. Knowledge is constructed through reflective abstraction where the pupil actively participates. Here, they cognitively process information. The pupil, rather than being passively accepting, actively constructs meaning (Crowther, 1995). The theory of cognitive constructivism indicates that;

- pupils construct their own knowledge of the world
- pupils use experiences to derive learning
- learning takes time
- pupils continually organize and reorganize, structure and restructure new experiences to fit them into existing schemata.
- knowledge and understanding are constructed by the pupil rather than imparted by the teacher. (Cohen et al 2007).

2.4.1.1 Social constructivism

Social constructivism advocates learning strategies that are interactive, social and cooperative (Cohen et al, 2007). The environment plays an important role, placing topics in context. Here the teacher facilitates learning, setting up situations and prompts. This enables pupils to become independent learners, as they learn to think for themselves, and could be seen as

active learning (Bonwell et al, 1991). The responsibility for learning is on the pupils themselves. They also state that pupils are encouraged to use communication by working in pairs, using role-plays or taking part in debates. The teacher provides guidance for the pupil. This varies according to the situation and the individual pupil. The primary mathematics curriculum in Sri Lanka also emphasizes the using and applying of social constructivism in primary grades. This strand includes thinking skills, problem solving, communication and reasoning. Hence, it would be reasonable to say that pupils whose mathematics education is based on the national curriculum would be at a disadvantage if a social constructivist approach is not applied to their teaching. Therefore, social constructivism recommends pedagogical approaches that have been discussed earlier can be used at the level of the child to help them overcome their difficulties in learning mathematics.

2.4.1.2 Cognitive constructivism

A key principle from Piaget's theory of cognitive development (1991) says that children need to be encouraged to discover things for themselves by teachers without trying to overstretch them. The learning takes place by people building on their existing ideas to construct new knowledge. This is not a choice by the teacher or the learner, this is how learning happens. This does not mean that the teacher has no role or cannot support learning, but instead mean that we cannot assume that just telling a child something means that they have learnt it.

He also states that the prime motivator of developmental change in a child is "dis-equilibrium"; i.e. a state of conflict in the child due to the difference in what they expect to happen as an outcome to a situation and what actually happens. Wadsworth (1971) also describes how learners go through a process of assimilation and accommodation of new knowledge. This can be viewed as pupils having to look at previous knowledge in order to accommodate new knowledge. They may think that they know the answer based on previous knowledge, but they may draw the wrong conclusion. They are in the stage of dis-equilibrium. A pedagogic approach that facilitates activities enabling dis-equilibrium to occur provides opportunities for pupils' cognitive development. Wood (1991) also suggests that the facilitation of students learning through the appropriate intervention strategy is a vital basis for the cognitive development of a pupil. This is reflected when a child is in their proximal development zone. They can have a partial understanding of what an adult or peer has done or said and learn from it. This can be facilitated where there is a cognitive conflict. The pupil knows the "facts" but they do not fit the explanation. They can use bridging techniques whereby they know the ideas and methods from other activities. Pupils need to transfer these

to the current problem. However, as discussed earlier low-attainers have poor memory skills and hence an intervention strategy would be needed for them to be able to remember the methods they were previously been taught. The pedagogical approaches which are developed based on this idea could be used to prompt pupils through the cognitive conflict and help them whilst they are in the zone of proximal development. Here, scaffolding can be used to help pupils with difficulties in learning mathematical concepts.

2.4.1.3 Scaffolding

Wood et al (1976) defined scaffolding as “the process that enables a child or novice to solve a problem, carry out a task, or achieve a goal which would be beyond his unassisted efforts” (p.90) Further they distinguished scaffolding as an interactive system of exchange in which the tutor operates with an implicit theory of the learner’s acts. Here, the emphasis is given to get pupils attention, reduces degrees of freedom in the task to manageable limits, maintains ‘routes’ in the problem solving, marks significant features, controls disappointment and demonstrates solutions when the learner can recognize them. (p. 99). The study of this process originates in research on how mothers help children learn language and play games such as peekaboo (Bruner, 1975a, b; Bruner & Sherwood, 1976). The metaphor hints at a temporary construction that is used to put up or support a building. It can be changed or removed when the building is finished. Here, what is supported is a student’s construction of knowledge or skill. Another way to interpret the metaphor is that the temporary scaffolding structure helps people to do work they would not be able to do without that support structure.

The concept of scaffolding has gained popularity over the past decades within educational research. For example, the questions of: What is considered as good teaching? and how teacher involves sensitively in students’ learning? were considered in many researchers (Mercer and Littleton, 2007). Further, the concept has been broadened to include collaborative learning (Rojas-Drummond and Mercer, 2003), peer scaffolding (Ferna´ndez et al, 2001) and whole-class settings (Cazden, 1979; Puntambekar and Hu¨bscher, 2005; Smit et al, 2013). The importances of design and supporting artifacts have become conceptualized as scaffolds (Davis and Miyake, 2004).

Different studies have shown the scaffolding can be used in different ways to overcome the problem of low-attainment. According to Vygotsky (1978) there is a difference between a child’s capacity to solve problems on their own. A child can perform tasks unaided to some extent but needs some form of aid to go beyond their capacity. This is called the zone of

proximal development. The aid-provider can be anyone who already has the knowledge to perform the task, e.g. parent, teacher, etc.

Further, Staver et al, (1988) says that poor working memory is a cause of low-attainment as pupils find it difficult to manipulate and link pieces of information together. According to them, this linking of information promotes understanding. The intervention that can address this cause is the facilitation of scaffolding, where the pupil manipulates pieces of information in their minds depending on the prompts given by the teacher.

Additionally, Dowker et al (2000) also suggest that scaffolding can be used as a pedagogical strategy to address word problem-solving questions. During scaffolding, teachers must give pupils enough time to think about their answers and an intervention strategy that addresses this to allow waiting, or thinking time. (Wellington et al, 2001; Pimm, 1987; Cohen et al, 1996). This gives pupils time to manipulate the information and their thoughts. The teacher should facilitate peer discussion before answering. This improves the quality of teacher-pupil dialogue and allows time for understanding and assimilation by the student (Boaler et al, 2009, Dunn 2010). This is also a suggested intervention by Baker et al (2002) in their synthesised report. They state that when peers are used as guides or tutors, achievement is enhanced. Dowker (2004) agrees with this premise, stating that this cannot be used as a substitution for teacher-pupil interaction. However, peer discussion may not always be effective because pupils may use deflecting questions to lead the teacher from a topic with which they are uncomfortable or they may reinforce misconceptions (Pimm, 1987). Furthermore, Smit et al (2013) argue that the importance of using the whole-class scaffolding when addressing the problem of low-attainment in mathematics. As they mentioned this approach allows teachers to diagnosis students' levels of attainment, their responsiveness and handover independence to the students while they are learning. Most of the Sri Lankan teachers tend to use whole class approach in their teaching and obtain help of the more able children to support low-attaining students. Therefore, within the Sri Lankan context the whole-class scaffolding can be used as an effective pedagogical approach to help students' long-term learning.

As mentioned above, a pedagogical approach developed based on the theory of constructivism addresses some of the causes of low-attainment. However, Kirschner et al (2006) argue that it needs to be planned without its potential drawbacks, saying that if it is not done efficiently, it can lead to incorrect reasoning being reinforced. Therefore, a constructive

learning environment is important when planning suitable intervention strategies to overcome the problem.

2.4.2 Ecological system theory

The ecological system theory (Bronfenbrenner, 1979) explains how the conducive learning environment has an impact of attitudes on the mathematical performance of the child. Family members, peers, school, neighbours, and caregivers within the environment have a greater impact on the child's performance. In addition to that, culture, attitudes, morals, belief, and ideologies of the culture have a great impact on the learner's attitude and this could be either positive or negative. According to this theory, there is a very big connection between a child's teacher and her or his parents. The parent's negative attitudes towards the subject of mathematics lead to an unhealthy rapport between teachers and parents among children with low mathematical skills. This could lead to poor cooperation between teachers and parents. Low-attaining students develop a fear for mathematics due to the negative attitudes of the parents and other family members towards the subject. Therefore, the above-mentioned environmental factors need to be considered when designing an effective pedagogy to overcome the problem of low-attainment in mathematics.

Bronfenbrenner's (1979) Ecological System theory explains how culture, attitudes, morals, beliefs and ideologies of the culture impact a learner's attitude. This could be either positive or negative. Basically, Sri Lanka has single sex and co-educational school systems. Therefore, it is important to consider the research evidence on the effects of single-sex and co-educational classroom backgrounds upon students' attitudes and performance in mathematics when finding a solution to the problem of low-attainment. Forgasz and Leder (1996) and Norton and Rennie (1998) have found that both male and female students in single-sex schools have shown higher attainment in mathematics than students in co-educational schools. For example, Norton and Rennie's (1998) study of grades 4 to 6 in four primary schools in Queensland, Australia has found that the single-sex schools showed higher attainment. The co-educational schools reported lower performance in the subject. These results suggest that instructional methods may have an effect on students' attitudes towards mathematics. Therefore pedagogical approaches need careful planning considering these gender issues.

Furthermore, Ho et al (2000) show that gender issues have consistently emerged as an important component of mathematics education. The debate on gender and mathematics achievement has a long history and some studies have reported statistically significant effects

of gender and learning of mathematics (Casey et al, 2001; Ho et al, 2000; Ma and Kishor, 1997). However, some others have indicated that there is no relationship between gender and mathematics achievement (Papanastasiou, 2000). Even among studies that suggest a significant relationship, there is still a controversy regarding the educational implications of the results (Ma and Kishor, 1997). Some researchers (Hyde et al, 1990 and Norton and Rennie, 1998) argue that the effect of gender differences in mathematics is little. However, as shown by Casey et al, (1997) and Ma (1999) such a relationship could only exist in particular areas of mathematics content.

However, studies on self-confidence in mathematics have mostly reported that girls had lower self-confidence in mathematics than boys (Case et al, 1997; Norton and Rennie, 1998). In some cases, boys were more confident than girls even when their mathematics achievement was similar to that of the girls (Casey et al, 1997). Vermeer et al (2000) have further shown that the gender differences in self-confidence were markedly more for application problems than computation problems, with girls showing significantly lower confidence for application problems. Despite such consistent findings of girls' low confidence in mathematics, Boaler (2000 and 1997), Rennie and Parker (1997) s' studies of classroom environment have shown that the girls' confidence in mathematics improved greatly in classes where girls became actively involved in learning mathematics with structured guidance. Therefore, it is important to keep this situation in mind when planning and implementing suitable pedagogical approaches for pupils with low-attainment. According to the literature, the pedagogical approaches discussed here would not be efficiently implemented if a teacher competency is not developed.

The above-mentioned studies did not consider the effect of the socio-demographic settings of the children on their levels of mathematical performance. Conversely, Krajewski and Schneider (2009) show the influence of socio-economic status of the pupils is important factor which influence in learning. They came to this conclusion by using questionnaires to ascertain the educational status, training, and current profession of the parent(s). These variables were then compared with number naming speed in a 4-year longitudinal study of children in Germany from kindergarten to grade 4 (5–9 years old). A study conducted a few years earlier by Aunio et al (2006) on children aged 4–7 in Finland explored the influence of demographic variables, such as hand preference, education of the parent(s), number of children in the family, birth order, and family model. They found that the mother's level of education had a statistically significant effect on the child's score in the Early Numeracy Test (ENT) (Van de Rijt et al, 1999). The higher level of the mother's education influenced on the

higher the child's score. Further, the number of children in the family was shown to have an effect on the children's numeracy scores. The families with two or three children did better than the families with one child or more than three children. Additionally, the study found that girls performed better than boys in ENT test.

The programme for International Student Assessment (PISA) report from the Organization for Economic Co-operation and Development (OECD, 2006) also considered the importance of socio-demographic variables on achievement in mathematics. The study conducted in Spanish secondary schools and considered the education of the parent(s), job of the parent(s), and number of books at home. This study found that the above-mentioned variables affected achievement in mathematics. In addition to that, Navarro et al (2012) emphasize the socio demographic variables such as the number of hours watching television, number of computers at home, parental supervision, and frequency of teaching visits were related to mathematics performance. Features such as the education and professional qualifications of the mother were also thought to be of potential importance.

2.5 Conceptual framework of the study

Pupils being good at mathematical thinking, being hard-working and applying effective learning skills can be considered as the main factors that contribute to good performances when learning mathematics. However, as mentioned in the previous sections, many reasons could cause pupils to fail when learning mathematics. For example, pupils showing poor performance may fail in mathematical learning not only because they are not making any sense out of what they are learning but also due to poor teaching methodology and deprived learning environment. Therefore, considering all sides of mathematical learning, I think it is necessary to apply relevant strategies to improve students' learning. As mentioned earlier, my study aims to explore the learning experiences of low-attainers in mathematics which, I hope, may contribute to overcome the problem of failure in learning mathematics, in Sri Lankan context.

After a lengthy study of the existing theories and practical intervention strategies on student learning, I have selected constructivism and ecological system theory as the crucial guiding principle for my study. Constructivism believes that knowledge is constructed through reflective abstraction where the pupil participates and is active (Crowther, 1995). Furthermore, social constructivism advocates learning strategies that are interactive, social and cooperative (Cohen et al, 2007). The theory explains that the learning environment plays

an important role in student learning. Here the teacher facilitates learning by setting up situations and prompts for learning through scaffolding. This enables pupils to become independent learners, to think for themselves and could be seen as actively learning (Bonwell and Eison, 1991), where the responsibility for learning is on the pupils themselves. I believe that this theoretical principle provides the required foundation for my study. Additionally, ecological system theory (Bronfenbrenner, 1979) shows the impact of culture, attitudes, morals, beliefs and ideologies of the culture on attitude of a learner. These factors could be either positive or negative impact on student's learning. Therefore, as mentioned by Forgasz and Leder (1996) and Norton and Rennie (1998) it is important to consider the effects of backgrounds upon students' attitudes and performance in mathematics when finding a solution to the problem of low-attainment.

The conceptual framework, which I believe would represent the above-mentioned theoretical perspectives, has been graphically designed and is shown in figure 2.1.

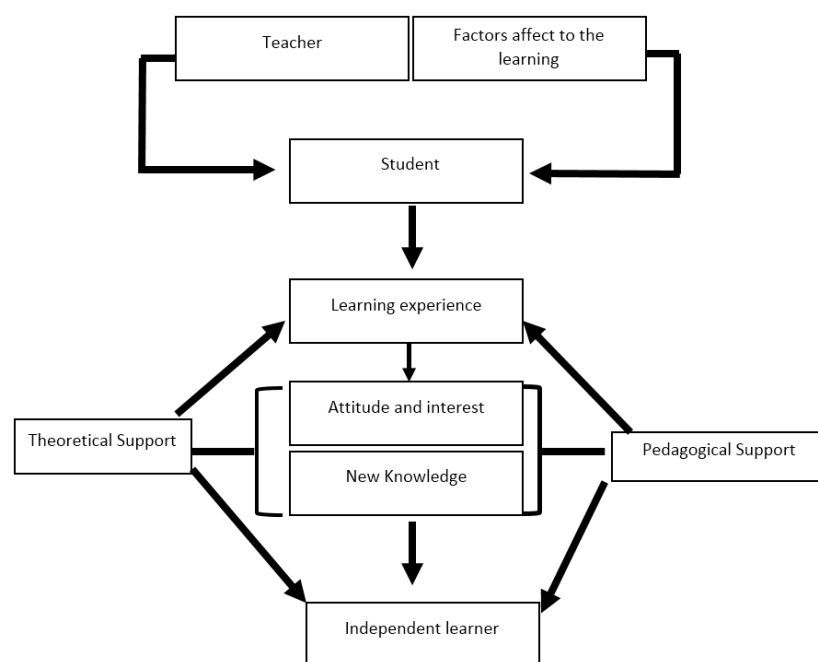


Figure 2.1: Conceptual framework of the study

Above mentioned theoretical perspectives explain that learning experiences are gained through successful collaboration of the different factors of learning. In particular, the above mentioned framework has different interrelated and reinforcing elements affect to the student and his/her learning. The factors such as cognitive development and physical or psychological problems directly affect the learning experiences of the students. It has given in

the diagram by directing two arrows leading towards the student. Furthermore, it is hoped that the suitable pedagogical approach developed based on the theoretical perspectives will also contribute to the positive learning experiences of student. In the same way, these two reinforced factors will contribute to the development of positive attitudes and interest in learning mathematics. This may lead to produce new knowledge and finally may create an independent learner which ultimate expectation of the curriculum. The arrows of the diagram represent this interrelation between those factors.

The above mentioned process of making an independent learner has supported by many previous researchers. According to Crowther (1995), knowledge is constructed through reflective abstraction where the pupil actively participates rather than being passively accepting. Social constructivism advocates for learning strategies that are interactive, social and cooperative. Additionally, teacher competency and other factors both affect the students' learning experiences (Crowther, 1995). Borasi (1990) and Shoenfeld (1985) say that the learning experiences of the students regarding mathematics and mathematics teaching have been considered very significant factors underlying their achievement. Here the teacher needs to facilitate learning by setting up situations and prompt learning through scaffolding. Pimm (1987) suggests that teachers should facilitate students by providing an appropriate learning environment and Boaler et al (2010) also confirm this suggestion by emphasizing the importance of environments which facilitate positive communication. Watson et al (2003) also suggest that the teacher needs to facilitate students' participation and Haylock (1991) emphasizes the examples from real life experiences. These methods of teaching enable pupils to have positive learning experiences. The supportive pedagogical approaches developed based on the solid theoretical foundation may positively impact on the students attitudes and develop the new knowledge. Finally, the student may become independent learners with positive attitudes towards learning mathematics (Bonwell et al, 1991). The process of constructing new knowledge is given in the above-mentioned framework.

Furthermore, the primary mathematics curriculum in Sri Lanka also emphasizes the using and applying of constructivism approach in primary grades and emphasizes the teachers' role as the facilitators of learning. Additionally, it is hoped that based on the findings of my study, mathematics teachers and the teacher education programmes would receive positive feedback and could suggest a positive combination of the above-mentioned factors which would affect students' learning. Serow and Callingham (2008)'s study reinforces the idea that unless teachers carefully plan their lessons and teaching approaches according to the students' attainment levels, there will be a negative impact on the achievement of deeper understanding

of mathematical concepts. Therefore, awareness of the learner experiences during mathematics lessons and pedagogical approach which support to the students learning are the crucial factors to implement effective measures for the low-attaining students. The interrelations between all those factors are crucial in developing a positive learning experience to the low-attaining students and help them to become as indigent learners. It is hoped that this would finally help to develop a positive teacher experience. This idea links with the work of Fuson and Mills (1997) who argue that the teacher has to consider the experiences provided by the pupils, since these experiences will reflect the direction in which the pupils are thinking. The role of the teacher will be to explore and broaden the understanding behind the experiences and to help the pupils adapt their knowledge base as advocated by the theory of constructivism.

Within this chapter, I have discussed the relevant literature for the study. First, I have given different characteristics associated with the low-attaining students in mathematics. Based on those characteristics I have developed the operational definition of low-attainment which has used for my study. When developing the operational definition of low-attainment in mathematics, the primary school classroom context in Sri Lanka was considered. Then I discussed the pedagogical approaches that have been found to be effective in the supporting students with the low-attainment in mathematics. Then, I have explored the theoretical ideas that underpin the pedagogic approach I have discussed earlier. Finally, I have concluded the chapter by introducing the conceptual framework to the present study. It gives a detailed justification for the selection of constructivism approach to the study. The next section of this report will give the research design developed based on the above mentioned literature and school context of Sri Lanka.

CHAPTER 3: RESEARCH DESIGN AND METHODOLOGY

3.1 Introduction

The main aim of this chapter is to present a systematic flow of the entire design of the research process. I present a case study of learning experiences of the low-attaining students in primary mathematics in Sri Lankan schools. Here, four schools were selected as the cases in order to understand how teaching and learning process was occurring. The ultimate expectation of the study is to introduce a set of recommendations towards an effective numeracy teaching and learning process at primary grades. This chapter therefore seeks to clarify the research design, justify the methods selected for data collection, describe the manner in which the data was analyzed and the ethical issues that have been considered.

3.2 Philosophical perspectives of the study

I begin by justifying my distinctive theoretical affiliation to the constructivist and interpretivist paradigm and the research methodology that guided and underpinned this case study. The aim is to make explicit the ontological and epistemological positions that are used and justified within the research.

3.2.1 Paradigm

The approach adapted to my study is a constructivist and interpretivist paradigm. Before discussing the adopted approach in detail, the term “paradigm” needs to be defined. Bryman (2008) defines this term as belief clusters which guide researchers to choose what discipline they explore and the way in which they need to study this discipline. Furthermore, he explains how they approach the interpretation of the evidence. Johnson and Christensen (2010) define the term as the researcher’s view point that is based on a set of beliefs, assumptions and values. According to these definitions the paradigm of a particular field of inquiry has an influence on almost every decision that researchers make throughout the study such as; the nature of the chosen topic of interest, data collection and analysis. Bogdan and Biklen (2007) have said that, there should be a consistency between methods and “the logic embodied in the methodology” (p.35). As mentioned earlier the approach adopted for my study is a constructivist and interpretivist paradigm. This follows the foundations of “relativism”, the notion which suggests that reality is subject to change from one individual to another depending on their unique perceptions and conceptualisations (Guba and Lincoln, 2005, Cohen et al. 2007). Interpretivist social scientists intend to capture “the subjective

meaning of social action” (Bryman, 2004, p. 13). This paradigm understands the “world of human experience” in which the participants’ view of the world is privileged (Cohen, et al. 2007). The interpretive paradigm emphasizes that there are a number of factors which affect the way things are in the social world. Studies adopting the interpretivist paradigm often aim to explore individuals’ characteristics, different human behaviors, opinions, and attitudes and to understand them from within (Cohen, et al., 2007). My study explores the learning experiences of low attaining pupils in primary mathematics within the context of Sri Lankan schools. This enabled me as the researcher and participating teachers and students to enter into the research frame and collaborate in sharing the perceptions on the teaching and learning process within the primary school context in Sri Lanka. Within this context, the actual classroom practices and the learning experiences of low-attaining pupils are collected and perception of teachers and students who are failing continuously in mathematics are discussed. This led to a form of qualitative data relating to the experience of the participants within this specific context.

3.2.2 Ontology

Gray (2004) asserts that ontology is concerned with the nature of the phenomenon being studied. According to the ontological perspective of interpretivist paradigm, “reality is socially and discursively constructed by human actors” (Grix, 2004, p.61). Individuals differ in the way they make sense of the world and the way they construct meanings from objects through their interaction and engagement with them (Bryman, 2004). Interpretivist ontology postulates the idea that research pursues multiple realities since individuals construe realities subjectively in different ways (Creswell and Clark, 2007). Robson (2011) mentioned that these multiple realities are shaped by the knowledge of people as participants in social world. Interpretivist researchers often attempt to interpret reality by extrapolating abstract statements from concrete evidence, rather than the other way around (Punch, 2009). That is why a set of hypotheses are not simply confirmed or disconfirmed in a linear way within my study. The evidence of my study is based on the informants’ views on the topic under exploration (the learning and teaching of mathematics in primary classrooms) and also on my observations. Since the study aims to explore a phenomenon associated primarily with pupils’ learning experiences within an educational context, the diversity in the participating pupils’ realities needs to be recognised. My role as a researcher is to understand the existing teaching and learning practices in primary mathematics classrooms with special reference to learning experiences of low-attaining pupils within the Sri Lankan school context. The conception of

“low-attainment in mathematics and learning experience” could be largely different depending on the teachers’ and students’ beliefs and practices.

3.2.3 Epistemology

Bryman, (2008) shows that epistemology refers to the manner in which knowledge is acquired in a particular discipline. Epistemology is concerned with how the reality of the research subjects can be known and their personally, culturally and socially “situated interpretations of the social life-world” (Crotty, 1998: p.67). What needs to be recognised is that the researchers’ epistemological stance has an influence on how they approach the phenomenon of their interest. In interpretivism, the notion of knowledge is considered to be constructed as a result of people’s interactions with each other as they rely on unique experience with the world (Bassey, 1999). It is their individual experience and different quality and degree of knowledge that perceive the same phenomenon differently. As Bryman (2008) explains, since human beings tend to “act on the basis of the meanings that they attribute to their acts and the acts of actors”, it is necessary to construe their thoughts and actions from their viewpoint. Otherwise the “social reality” that has a particular relevance to them cannot be grasped. In the case of my study, knowledge is generated about the learning experiences of low-attaining students in primary mathematics in the Sri Lankan school context and about the experiences of teachers. This reflects my epistemological position that knowledge exists through human interactions and negotiations with other peers and their learning environment. It is assumed that knowledge is dependent on and an outcome of social construction to a large extent. Accordingly, a classroom observation protocol and interview protocol were used to investigate the current situation in classrooms. Through these protocols, this study primarily concentrates on the process of the social phenomena, as it is the case with the majority of qualitative studies (Robson, 2011). More specifically, in this study, an attempt was made to gain insights into learning experiences of low-attaining pupils in primary mathematics. Since the current study seeks to understand the existing practices of the teaching and learning process of primary mathematics within the Sri Lankan school context, the teachers are given the potential opportunity to understand the actual function of their classroom practices.

The research epistemology, theoretical perspective, research methodology and the methods that are used for my study can be presented graphically as follows.

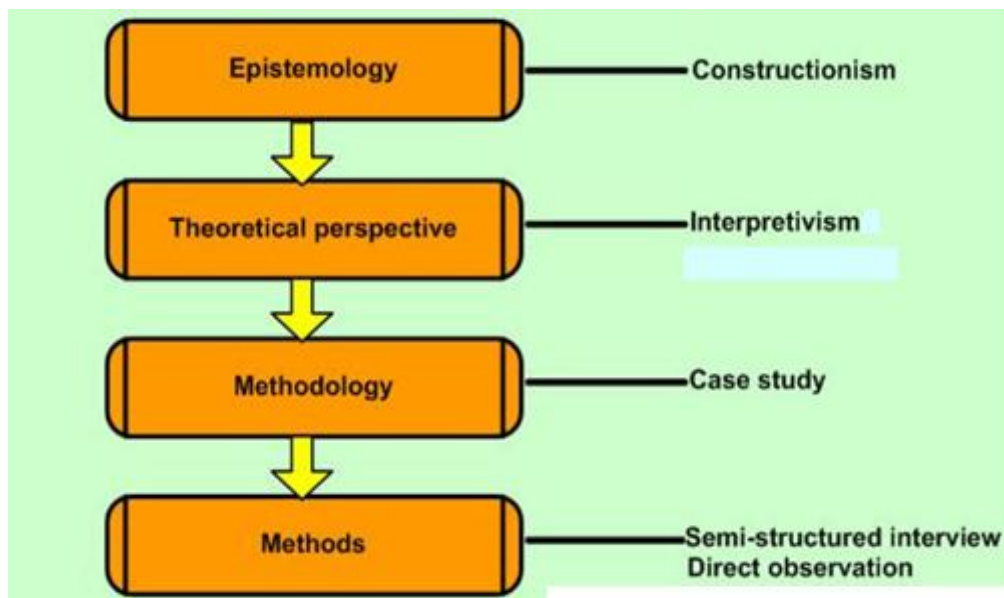


Figure 3.1: Research epistemology, theoretical perspective and methodology,
(Adopted from: Crotty, 1998)

3.3 Research methodology

Generally, research methodology means the way of doing research. Webster's New International Dictionary of the English Language defines research methodology as the system of collecting data for a research project. Yin (1989) suggests that a research methodology is “the logical sequence that connects the empirical data to a study’s initial research questions and ultimately, to its conclusion” (p.28 – 29). Thus the main purpose of the research design is to assist in collecting data and avoiding situations where data does not address the research questions. Howell (2013) defines and elaborates further giving full description to the research methodology. He claims that research methodology is the general research strategy that outlines the way in which a research project is to be undertaken and, among other things, identifies the methods to be used in it. Furthermore, this is a science of understanding what method of conducting research is best applicable in a certain situation. Some important factors in research methodology include validity of research data, ethics and the reliability of measures. Therefore, as mentioned by Fraenkel and Wallen (2003) a research methodology can be defined as the logic that links the data to be collected and the conclusions to be drawn to the initial questions of a study.

The qualitative approach has been used to accomplish the overall aim of the study. Most of the Sri Lankan literature on mathematics education has largely focused on quantitative studies that lack deeper theoretical analyses (NEREC, 2014). It was expected that a

qualitative approach could help me to get a deeper understanding of the issues being investigated. It is an approach which would enable the research questions to be answered by providing a rich picture on the actual conditions surrounding teaching and learning practices in Sri Lankan primary classrooms. I prefer qualitative design because in this design the natural setting is the direct source of the data (Fraenkel and Wallen, 2003). My study observed research participants and collected data in their natural setting without controlling any aspect of the research situation. As this research study was intending to find out students' and teachers' experiences on learning and teaching mathematics, effects of those experiences on their learning and teaching exploring the reasons of their experiences were best answered through qualitative paradigm.

3.3.1 Case study design

Under the qualitative design I selected case study as the research methodology. Robson (2002) defined case study as: *A strategy for doing research which involves an empirical investigation of a particular contemporary phenomenon within its real life context using multiple sources of evidence* (p.178). Morris and Wood (1991) summarise that the case study strategy is best for gaining a deeper understanding of the research being investigated. Case study has a distinctive advantage over other research strategies when “how” or “why” questions are being posed to discover a current phenomenon and when the researcher has little or no control over the events (Yin, 2003). Yin (2009), further points to the technically critical features of the case study strategy, stating that it is an empirical inquiry that:

Investigates a contemporary phenomenon within its real-life context especially when...the boundaries between phenomenon and context are not clearly evident; and in which multiple sources of evidence are used (p.18).

Denscombe (1998) summarizes that case study offers the opportunity to *explain why certain outcomes may happen – more than just find out what those outcomes are* (p.31). The case study's unique strength is in its ability to deal with a full variety of evidence (Stake, 1995; Rowley, 2002; Gomm et al., 2008). Eisenhardt (1989) and Yin (2009), assert that a case study strategy offers the use of different methods of data collection such as interviews, observations and documentations, provides the researcher with the opportunity to gain different perspectives from a range of sources and increases the likelihood of generating theory. Gray (2004) suggests that a case study approach is particularly useful in revealing the casual relationships between the phenomenon and the context in which it takes place. This leads to the validation of data through triangulation (Denscombe, 1998). Thus, any findings or

conclusions are likely to be more compelling and accurate (Yin, 2003). This supports the purpose of this study, to identify the causes for the low-attainment of the students. As mentioned earlier in this section, case study is particularistic because it focuses on a specific phenomenon such as a program, event, process, person, institution or group. I believed that this methodology would allow me to get in-depth understanding of the perceptions of students about the mathematics learning and in exploring the factors which affect students' perceptions.

Yin (2009) suggests that when designing a case study a choice needs to be made between conducting the study as a single case or a multiple case investigation (Stake, 1995; Rowley, 2002; Yin, 2009). Four types of case design were identified by Yin (2009) and described as follows:

Type 1: single case holistic design, is justifiable where the case represents a critical case and we want to use it for testing an existing theory. Other situations where a single case design is appropriate are longitudinal studies. The case serves a revelatory purpose.

Type 2: single case embedded design, requires one single case with multiple units of analysis. This design can be used when investigating a large education programme that involves a number of projects. Each of the projects would then be the embedded units. These embedded units can be selected through sampling or cluster techniques.

Type 3: multiple case holistic designs, refers to the study of multiple cases, each constituting a unit of analysis. This is where no logical subunits can be identified or the relevant theory underlying the case study is itself of a holistic nature.

Type 4: multiple case embedded designs refer to the study, of more than one case, each case consisting of one unit of analysis (Yin, 2009).

Yin presents four different designs in the following matrix:

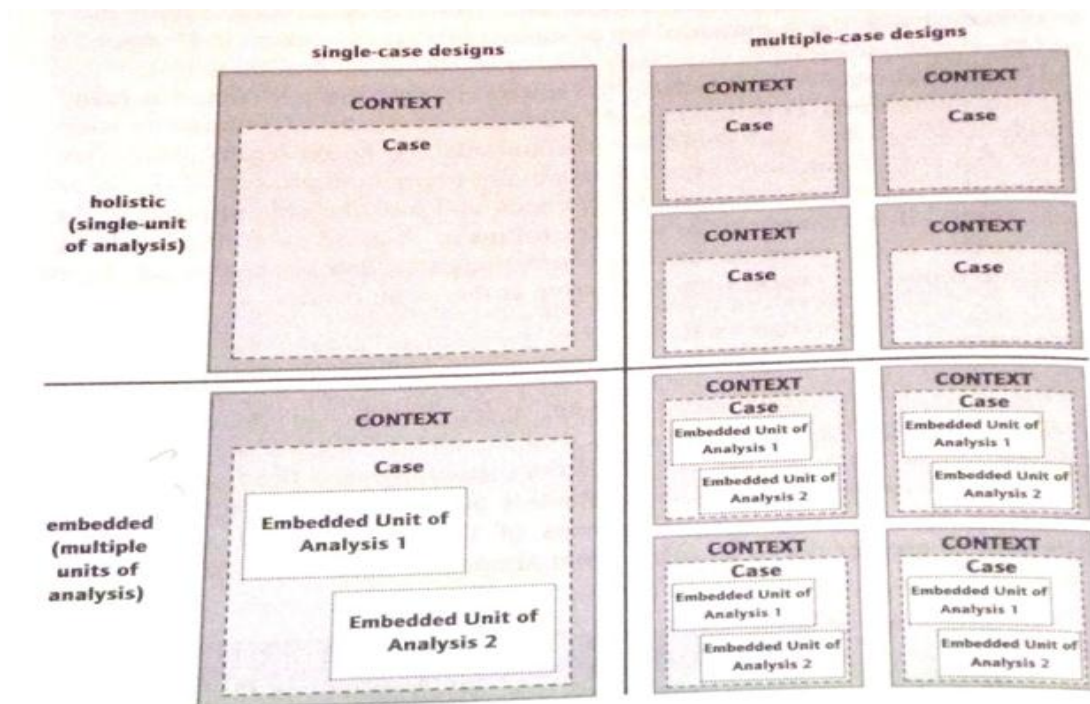


Figure 3.2: Case study research: design and methods. (Yin, 2009, p.46)

The matrix first shows that every type of design will include the desire to analyze contextual conditions in relation to the 'case,' with the dotted lines between the two signaling that the boundaries between the case and the context are not likely to be sharp. The matrix then shows that single- and multiple-case studies reflect different design situations and that, within these two variants, there also can be unitary or multiple units of analysis. The resulting four types of designs for case studies are (Type 1) single-case (holistic) designs, (Type 2) single-case (embedded) designs, (Type 3) multiple-case (holistic) designs, and (Type 4) multiple-case (embedded) designs (Yin, 2009, p.46).

Type 1 and Type 2 are not considered to be appropriate for my study, because this study does not fit into the definition of a “critical” case. The phenomenon being studied is not a unique one and could not give rise to the investigation of an extreme or unique case. Also this study is not considered a revelatory investigation. Type 3 is also not considered appropriate, because employing a multiple holistic approach for this study will require the unit of analysis to include all aspects of the Sri Lankan education system’s functions, structures and activities. This study might run the risk of focusing more on classroom environment and processes rather than on individual school settings. Therefore, this study employed the embedded multi-case study design (Type 4). The embedded multi-case design allows the researcher to follow a ‘replication’ logic approach aimed at achieving analytical rather than statistical generalizations. The evidence and conclusions coming out from multiple-designs

are more reliable and convincing than those based on single-case designs. Thus the findings are more likely to be generalized (Yin, 2003).

Yin (2009) suggests that the advantages of a multi-case study is that the analytic results concluded independently from two or three cases are more compelling than the results concluded from a single case. Confidence in generalisability of the embedded multi-case study findings increases with the number of cases included. Miles and Huberman (1985) observe that: “by comparing cases, one can establish the generality of a finding and, at the same time, pin down the conditions under which that finding will occur. Therefore there is much potential for both greater explanatory power and greater generalisability” (p.151). Also, confidence in the overall strength of the research findings has the ability to explain the causal links in real life interventions that are too complex for experimental approaches (Eisenhardt, 1989; Stake, 1995; Yin, 2009).

Furthermore, assumption is that there are different types of conditions that exist in different types of Sri Lankan schools and there is a need for sub-units of cases to cover all diversity conditions and practices of the school system.

3.3.2 The selection of cases/ unit of analysis

The target population of the study was teachers who are working in the Grade four classes and their low-attaining pupils in primary mathematics in government schools in Sri Lanka. The Sri Lankan schools were divided into four categories by the Ministry of Education based on the facilities and availability of academic fields. Under these categories, 1AB schools comprise all study streams in Advanced Level while 1C schools having only the Arts and Commerce streams. These schools comprise of Grade 1 to 13 while Type two schools contain up to grade 11 and Type three contains up to grade 5 or 8. However, almost all the schools comprise a primary section (Grade 1 to 5) regardless the existing categorization. Stake (1994) mentions that “in case studies, nothing is more important than making a proper selection of cases” (p. 243). Therefore, in order to represent the existing school categorization, the purposive sampling procedure was adopted in selecting the cases and included all the existing school categories when selecting the cases for my study. Maxwell (1996) emphasizes the importance of using purposeful sampling when persons are "selected deliberately in order to provide important information that cannot be gotten as well from other choices" (p. 70). My study focused on the best way to understand the participants by describing and interpreting the meaning of their classroom learning experiences in primary mathematics. Therefore, identifying and understanding about the case from the target

population is important. Stake (1995) describes the best rationale for using a case study methodology and importance of understanding the uniqueness of a case:

The real business of case study is particularization, not generalization. We take a particular case and come to know it well, not primarily as to how it is different from others but what it is, what it does. There is emphasis on uniqueness, and that implies knowledge of others that the case is different from, but the first emphasis is on understanding the case itself (p.8).

According to this explanation, in order to meet the aims and objectives of the study, selection of an appropriate case is crucial. According to Brewer and Hunter (1989), there are six types of units, which could be applied in educational research: persons; attributes of persons; activities and interactions; residues and artefacts of behaviour; settings, incidents and occasions; and collectives. Any of these may constitute the core of case study research. Furthermore, unit of analysis is defined by Sekaran (2000) as “the level of aggregation of the data collected during the subsequent data analysis stage” (p.135). The embedded multi-case design allowed me to maintain a chain of evidence from the primary unit of analysis.

A formal method of sampling was required under the multiple case study design because it may yield a representative selection of cases (Stake, 2005). I wanted to select four government schools with primary sections to represent all the government school categories in Sri Lanka in order to make use of maximum variation sampling (Patton, 1990; Lincoln & Guba, 1985). The rationale for using different school categories for sampling was that it would enhance the value of this study by capturing common patterns from variation that may emerge. I acknowledge that a limitation of maximum variation sampling as a method for small samples is that high heterogeneity can be a problem because individual cases may be significantly different from each other. I also note that while balance and variety in a case study approach is important, ‘opportunity to learn is often more important’ (Stake, 2005, p. 451). Accordingly, I identified four research sites based on the categorization of the schools. A well resourced 1AB public school, a poorly resourced semi-urban 1C public school, Type 2 and type 3 schools were selected. I excluded rural schools from the sampling criteria based on my assumption that rural schools have many other significant challenges to basic educational needs. These challenges range from the lack of basic services such as water and electricity supply to substandard classroom infrastructure. I assume that the use of additional resources in teaching and learning would be far removed from the agenda of teachers due to disadvantaged background. I used Stake’s (2005) view that the selection of cases should offer

‘opportunity to learn’, and proceeded to select cases from which I could learn the most. I based the purposeful selection (Berg, 2007) of possible information-rich research sites based on the following criteria which were determined to accommodate local circumstances within the context of this study.

1. Selected schools had to adhere to and implement education policy on the National Curriculum Statement in Sri Lanka.
2. Schools had to have followed the new primary mathematics curriculum during recent years. This implies that the school administration and teachers should take actions effectively for optimum use of the curriculum recommendations.
3. Selected schools that had three levels of primary education (Level 1, 2, and 3) in the general education within the Sri Lankan schooling system.
4. The selected schools need to have primary sections including Grade 4 classes. Experienced teachers must be available for teaching in these classes. The lack of qualified teachers should not compromise day-to-day curriculum delivery.
5. Teachers who are selected to the study should teach primary mathematics in the government primary schools at grade 4 level and they need to have at least five years teaching experience.
6. Low attaining students from the selected teachers’ classrooms and they attained below 40% marks for mathematics from the year end examination conducted by the school.
7. For the purpose of volunteering, teachers and students who are willing to participate for the study were selected.

The rationale for selecting government schools with primary sections as research sites was two-fold. First, government schools have been in the process of implementing the revised National Curriculum (Department of Education, 2004) fundamental policy for more than ten years (from 2004). Secondly, government primary schools are expected to use the same national curriculum throughout the Island. The government primary schools cannot implement their own intention to change the existing primary mathematics curriculum. This method of sampling would obtain a more realistic understanding of the existing practices of primary mathematics teaching and learning process in government schools in Sri Lanka.

The cases were selected based on above mentioned criteria. Therefore, the unit analysis for this research was four individual primary mathematics teachers who were working in Grade

four classes in four government schools in Sri Lanka and their low-attaining students (who have reached below 40% of final marks in mathematics for the year-end term test conducted by the school in the year 2014). Each individual teacher represented one case in which convergent evidence was sought regarding the facts and conclusions for each case. The low-attaining students were considered as sub units of each case to get the evidence. It was expected that those students would provide me with real evidence of the teaching and learning process and factors influencing their learning experiences. The analysis the findings of each case were done separately and all findings were cross compared finally. The teachers are treated both as individuals and as a group. In other words, I treated each of the four teachers as individual participants who may have distinct belief systems separately and at the same time I treated them collectively where they act as a group (Yin, 2009). The unit of analysis of my study developed base on the multiple-case (embedded) designs is given in figure 3.3.

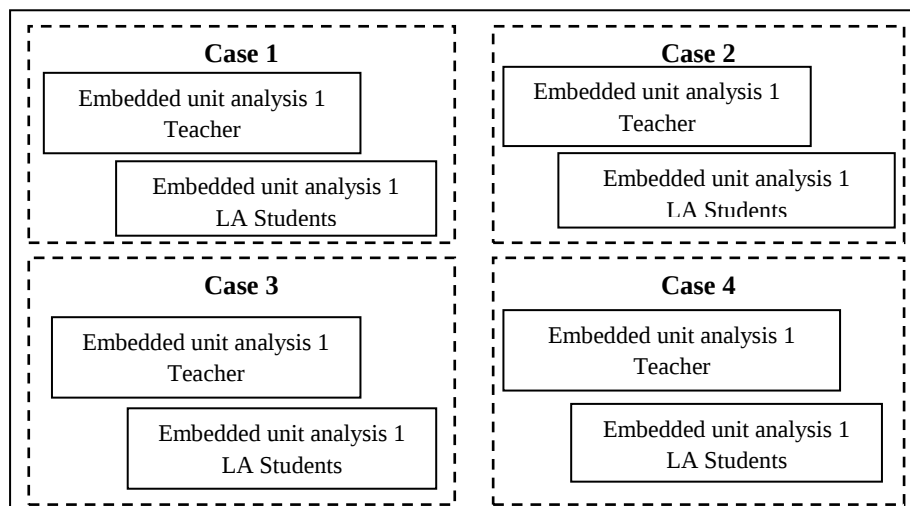


Figure 3.3: Unit of analysis of the study

3.3.3 Identification and selection of participants

The participants of my study needed to be able to provide an actual situation of the teaching and learning mathematics in the primary classrooms within Sri Lankan school context. It can be said that, my study explored a human issue in its multiple complexities such as: teaching, learning, mathematics, knowledge of students, and specialized knowledge needed to teach for the low-attaining students. In addition to that, the dimensions of my study were mathematical, psychological, theoretical, pedagogical, social, and personal. Therefore, these complexities and dimensions were considered when selecting the participants. As stated previously, the case constituted schools with grade four teachers and their low-attaining students in primary

mathematics. I purposefully (Glesne, 2006; Berg, 2007) selected the participants at the schools according to preset criteria. First, the teachers had to be professionally qualified. I qualify this criterion because many schools tend to appoint newly requited teachers without attending formal training on primary education. This information was determined from my initial visit to the schools and after discussion with the principals and sectional heads. Second, the identified teachers were selected by their willingness to participate in the study and not forced them to take part in my research. Third, the participant teachers had to be teaching the primary mathematics curriculum provided by the MoE. Forth, selections of low-attaining students were done with the help of class teacher based on their performance on the year-end test held in 2014. Fifth, selection of participants was not based on race or gender as these criteria were irrelevant to the study.

I had initially decided on one teacher and his/her low-attaining students at each research site as my unit of analysis. Drawing on my personal experience, most of the Sri Lankan primary teachers teach all the recommended subjects to their students. School management did not use subject specific teachers to deliver the primary mathematics curriculum. Thus, I expected to find a qualified trained teacher at each school. However, at selected four schools a different scenario played out. It reflected in the following extract from my field notes:

I requested a grade four male teacher who was introduced by the deputy head of the school to help me to carry out the research. I explained, if he would be willing to be observed and interviewed in his mathematics classroom it will help to meet the aims and objectives of the research. However, that teacher was reluctant to be part of the study, although he did not say this openly, he referred my intention as an 'lesson evaluation' in his informal talk to other teachers in my presence. His expression gave me an opportunity to understand his concerns about the object of my research (Case1/ Field notes/ 09/01/ 2015).

At the 1 AB (Case A) school, there were four parallel grade 4 classes and two teachers were shown their willingness to take part in the research. Sectional head of the school said that both of them actively engaged with teaching and other administrative activities in the school. The first teacher had more experience and I selected her and all the low-attaining students in her class for my study. At the second research site, 1C School (Case B) which is situated in a middle socio-economic sector of the semi-urban area in Kandy district, both teacher and low-attainng students were identified by the primary sectional head and the identified teacher

enthusiastically agreed to participate in the study. The type 2 (Case C) and type 3 schools (Case D), the schools within a low socio-economic community, there were one teacher for each primary class. The principals of both schools asked grade four teachers to take part in my research. A detailed summary of the research sites, the location of schools, the demographics of the participants is given in Table 3.1.

Table 3.1: Pupil and teacher participants in the study

School type	School location Kandy Edu. District	Number of pupils nominated	Number of pupils interviewed	Teachers		
				Qualifications	Years of experience	Code
1AB	Kandy	16	14	Diploma in primary teaching	15	Mr.Ananda
1C	Pilimatalawa	9	9	Diploma in primary teaching	14	Mrs.Bandara
Type 2	Katugastota	9	8	Diploma in primary teaching	19	Mrs.Chandra
Type 3	Gampola	10	9	Diploma in primary teaching	17	Mrs. Damayanthi
Total		44	40			

3.4 Data collection methods

Yin (2006) asserts that “case study research is not limited to a single source of data in collecting case study data” (p.115). In line with this, a qualitative researcher is expected to draw upon multiple (at least two) sources of evidence; that is, to seek convergence and corroboration through the use of different data sources and methods. Such sources include

interviews, participant or non-participant observation, documents and physical artifacts. The idea behind this argument is to strengthen the evidence and findings as much as possible.

Robson (2002) indicated that the purpose of the enquiry may change over time. This reflects that the research project may have more than one purpose at the same time. An exploratory study intends to explore “*what is happening; to seek new insights; to ask questions and to assess the phenomena in a new light*” (Robson, 2002, p.59). It is valuable particularly when there is very little information known about the phenomenon. On the other hand, explanatory study aims to find out the causal relationships between variables (Saunders *et al.*, 2007). Additionally, descriptive study seeks to provide a clear picture about the phenomenon as it already occurs (Hedrick *et al.*, 1993). This research was based on multiple exploratory case studies and therefore I used direct observations and semi-structured interviews as the methods of collecting data. Figure 3.4 indicates these sources of evidence used for the study.

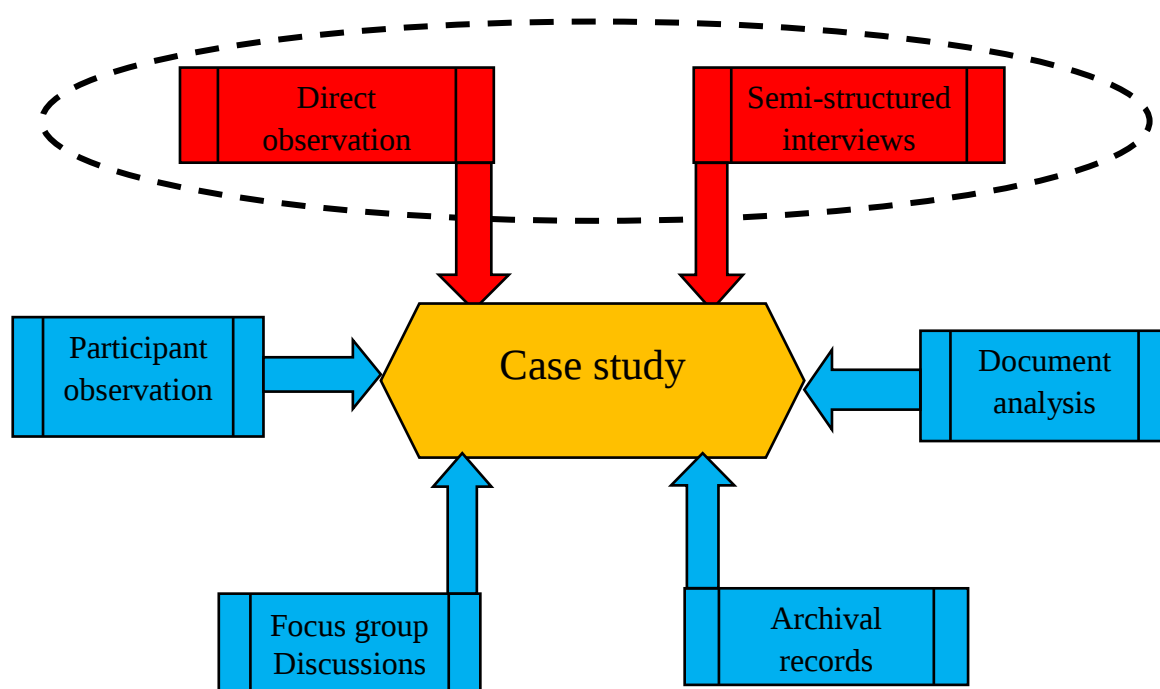


Figure 3.4: Sources of evidences for the study (Adopted from Yin, 2003)

As mentioned by Stake (1995) the context of each case is important. “The context of the case involves situating the case within its setting, which may be a physical setting or the social, historical, and/or economic setting for the case” (Creswell, 1998, p. 61) In this study the researcher was the main instrument of data collecting and analysis. I was immersed in the natural setting, observed and conducted the interviews the observations with my own eyes. In

this way, I become an “insider” in the system. My intent was to be a “noninterventionist” (Stake, 1995) seeking naturalistic observation. I did not participate in the day to day operation of the teaching of mathematics. My role was to describe and experience the real life operation of mathematics teaching to understand what it is and what it looks like. I used an observation schedule and video recordings for each observation, conducted individual audio-taped interviews with each teacher and with low-attaining students. Table 3.2 gives a summary of the research questions, data sources and the corresponding instruments which were used in this study.

Table 3.2: A summary of the research questions, the data sources and instruments

Research questions	Data sources	Instruments
How is the classroom learning environment organised to support the needs of low attainers?	Physical arrangement of the classroom Social and emotional interaction between teacher and pupils Availability of the teaching and learning resources Teachers’ responses	Field notes, Observation schedule, Semi-structured interviews with teachers
What are the characteristics of the instructional sequence and mathematical tasks used in the lesson?	Documents (Text book and Teachers Guide) Lesson plan Teachers’ responses	Field notes, Observation schedule, Semi-structured interview schedule for teachers
How does the teacher attempt to tailor Instructions to meet the needs of low attainers?	Methods of teaching, Teaching aids and activities, Motivational strategies	Field notes, Observation schedule, Semi-structured interview schedules for teachers and students
What strategies do low-attainers use to cope during lessons?	Different learning strategies Student behavior Students’ responses	Field notes, Observation schedule, Semi-structured interview schedule with pictures for students
What do the students themselves think are the reasons that they find learning mathematics is difficult?	Students’ responses	Field notes, Observation schedule, Semi-structured interview schedule with pictures for students

A detailed description of the data collection methods that I have used is given below.

3.4.1 Classroom observation

As mentioned by Mulhall, (2003) I used structured classroom observation developed based on the constructivist paradigm to foreground the importance of context and the co-construction of knowledge between the researcher and the researched. The reason for using classroom observational methods in this study was to make a decision whether what participants' say they do is the same as what they actually do in practice. I think, as mentioned by Mulhall, (2003) this method allowed me to capture not only the process of policy implementation but also the context. Leahy et al (2005) assert that observation is the most appropriate strategy for getting information on the situation in numeracy classes. Therefore, the classroom observation was adopted for the study and it was divided into three parts:

- Observation of the teachers who were conducting lessons.
- Observation of the students during the lesson.
- General observation of the classroom settings/arrangements

My goal of the observations was to see what mathematics teaching and learning process looked like in each participant's classroom. I used the data from observations to describe what each participant did in his/her teaching including verbatim classroom interactions of mathematics teaching and learning. This component of data collection helped me understand and see actual learning experiences of low-attaining students in primary mathematics.

The observation schedule used for data collection (see appendix 2) was adapted from models of Stake (1995) and Schumacker and McMillan (1993) and recorded information that was both descriptive and reflective (Creswell and Miller, 1994). Generally, field notes taken during the observations were descriptive and entries after observations were reflective. The classroom observation schedule was included the contextual description of the classroom learning environments, participants' approaches in teaching and learning mathematics, procedures and physical arrangements of the selected cases. The observations sought data that focused on answering the study questions and to "reveal the unique complexities of the case" (Stake, 1995). The naturalistic setting provided experiential data that can only be obtained from real life experience. I sought to conduct observations that Stake (1995) states;

“keeps a good record of events to provide a relatively incontestable description for further analysis and ultimate reporting. The researcher lets the occasion tell its story, the situation, the problem, resolution, or irresolution of the problem (or issue)” (p. 62).

In order to meet the expectations of the study, four themes which previously been utilised in former research and validated (Barkatsas and Malone, 2005; Barlow & Cates, 2006; Goos and Bennison, 2002) were included in the observation schedule. They are;

1. The arrangement of classroom learning environment,
2. The characteristics of the instructional sequence and mathematical tasks used in the lesson,
3. Teacher attempt to tailor instruction to meet the needs of low-attainers,
4. The strategies used by low-attainers to cope during lessons.

These four themes were divided into fifteen characteristics under the five research questions. Then, each characteristic was marked under three different sections (Teacher, Student and General) and data were recorded accordingly. This is considered a useful means to enhance the tool with a solid theoretical foundation which have discussed in the literature review section, and to explore whether the data reflects the theoretical underpinning of mathematical acquisition of young learners. Barlow and Cates, (2006, p.32) mention “good classroom observation progress step-by-step in a planned sequence towards the research objectives”. Therefore these important characteristics were included in a sequential manner into the observation schedule. Furthermore, additional comments were also added in each section of the protocol in order to obtain more information about classroom observations.

As mentioned earlier, the observational data gathered was for the purpose of giving a description of the socio-cultural settings, classroom activities, teaching and learning process, and most importantly the teaching and learning experiences of the participants (Silverman, 2006). Classroom observations not only provided me an opportunity for deeper understanding of the actual happening inside the classroom but also provided knowledge of the context in which the implementation of the curriculum (Schumacker and McMillan, 1993).

Though there are several observational strategies are available in the literature, I chose to locate myself as a silent observer and was not interfere with the social setting under study. It

might help teachers to avoid misunderstanding between my observation and the traditional evaluation of a lesson by the educational authorities (Giacomini and Cook, 2000). I think this method give me an opportunity to understand and witnessed about ‘what is really going on in’ their lessons. I made the provision to enter the classroom before about five minutes earlier the actual lesson was started. This allowed me to record all observations from the beginning of the lesson. I usually positioned myself at the back of the classroom so that I could be as unobtrusive as possible. My aim was to observe the total scenario of the teaching and learning process. This observation position also presented the opportunity to collect data that satisfied ethical issues of data collection, as I could capture the images of children without compromising their identity. As I took the time-table of each school, lesson plan and curriculum guides I collected a complexity of teachers and students and their teaching and learning process. However, I am not position to guarantee the potential bias that may occur due to my presence in the classroom. Although, a non-reactive observer role creates opportunities for observation, same time, it also brings challenges about the physical present of the observer among other participants. This situation is not natural.

I pursued more than one mode of documenting my observations in order to capture more detail from the observed classrooms. I used observation schedule, field notes, video recording and digital photographs. Angrosino (2005, p. 74) suggests that ‘technology makes it possible for the ethnographer to record and analyse people and events with a degree of particularity that would have been impossible a decade ago’. I structured my observations by using three procedures as delineated by Angrosino (2005, p. 733) inherent in observational research. In terms of descriptive observation (Angrosino, 2005) I tried to noted detailed descriptions of everything that was taking place (field notes). Then, I employed focused observation (Angrosino, 2005) in which I chronologically documented based on the pre-designed observation schedule. This has focused on the policy and the pedagogy, Additionally, I carried out selective observation (Angrosino, 2005) on the issues that; teacher involvement, student involvement, specific activities use in the classroom, classroom layout, discipline, teacher control and classroom management. The reflection below indicates some aspects relative to the design of the observation schedule.

Today, I observed the following aspects; grade, topic of the lesson, time, duration and lesson progression; the use of resources; its effectiveness and student involvement. Classroom management issues and teacher attention in order to support low-attaining students when they are learning also considered.

Problems and participation of low-attaining students also observed (Case1/
Field notes/ 09/01/ 2015).

I conducted the interviews after the commencement of the classroom observations as soon as with the respective teachers and their low-attaining students. The period of observations at the schools began in January 2015 and ended in May 2015. However, there are periods when public schools were not accessible to me as the researcher due to Sinhala and Tamil New Year in April and schools were closed for the vacation. I refrained from data collection during this period and did not impose on the hectic schedule of teachers during the vacation.

As mentioned above, I used the observation as a data collection technique with the hope of understanding and experiencing the classroom life over a period of time. However, apart from above mentioned strengths, the observation method posed some challenges also. Observational data is subject to interpretation by the researcher (Mulhall, 2003). In an attempt to minimize investigator bias and ‘maximize observational efficacy’ I used standardized observational procedures as summarized above (Schumacker and McMillan, 1993). I also attempted to reduce observer bias by extracting feedback from participants whose behaviours were being reported. I believe, this process had two distinct benefits. Firstly, I could establish a ‘self correcting investigative process’ by showing the participants my observation notes (Angrisino, 2005). Secondly, the disclosure of my observational notes to the participants improved ‘rapport’ (Glesne, 2006). It is expected that distance-reducing, anxiety-quieting and trust-building mechanism with this effort. Another limitation of concentrated observations at a small number of schools is that it could be seen as instructive and illustrative, and not as representative of all schools.

3.4.1.2 Documenting observations: field notes, observation schedule and audiovisual data

Bodgan and Taylor (1998) indicate that field notes are a primary source of recording observations and interviews. I adopted the field notes and observation schedule in accordance with using their suggestions for collecting important data. Here, I addressed two significant issues that had implications for the credibility of the study. First, I had to make certain that my note-taking was thorough and detailed in describing the research context. Furthermore, I had to reflect and differentiate between what was actually said or observed as opposed to my interpretations of what was said or observed. This difference is evident from an excerpt from my field notes.

The principal of school c showed his enthusiasm to assist me in my research and suggested me 'why don't you prepare the model lesson for primary teachers and I will get my teachers to deliver the lessons'. I said him that it is my intention to observe the way of teaching and learning process in its natural setting and not through my facilitation or control. It was evident that most of the teachers do not follow the guidance and recommendation of the primary mathematics curriculum. Later, principal said me he will invite me after the research to demonstrate a model lesson to primary teachers in the school (Case3/ Field notes/ 05/02/ 2015).

As advocate by Giacomini and Cook (2000) I used the two basic approaches to field observation namely direct and indirect observations. I spent satisfactory time in the context of the social setting under study for direct observation and to record direct observations in the form of observation schedule or detailed field notes. During indirect observation I used audiotape, video recording and still photography to capture data. I relied on the use of mental notes while interacting with participants and when the situation did not allow for full note taking (Glesne, 2006), later I transformed these mental notes into jotted notes (Glesne, 2006; Berg, 2007) as a reminder to write more complete field notes. The rationale for jotted or cryptic notes was to capture events as they experienced during in-classroom and out-of-classroom activities. This method served me as a memory aid for constructing more substantial field notes (Glesne, 2006).

I used the pre-designed observation protocol (Mulhall, 2003) to make notes and record my observations of both verbal and non-verbal cues (See Appendix 2). The rationale of the using observation protocol was to guide or make the observation more focused. The classroom observation protocol looked at several aspects as indicated previously.

I also used the field notes during classroom observations of anything that was noteworthy, interesting, unusual, or 'most telling' (Wolfinger, 2002). I made temporal notes to track the teaching processes of: introduction, content, use of resources, assessment and conclusion of lesson. Angrosino (2005) posits that true objectivity emerges from observational research when there is agreement between the participant and the observer 'as to what is really going on in a given situation'. In order to achieve this, I made detailed notes on discussions with teachers immediately after each lesson to validate my observations and perceptions.

3.4.2 Semi-structured interviews

As reiterated by Merriam (1998) interviews are important in situations when we cannot observe behaviour or when we do not know how participants experience their world. Face-to-face semi-structured interviews afforded me an opportunity to explore the meaning participants attach to their learning experiences (Ponterotto, 2005). Face-to-face situation allowed me to observe non-verbal events and appropriately react or modify my inquiry in response to those non-verbal events of participants (Holbrook et al, 2003; Lee 2003). I can intervene appropriately to the situations particularly when they showed confusion, uncertainty, or lower motivation. In this regard I was able to constructively react to these situations by reducing task difficulty and reinforce interest by using selected questions. I could modify my line of inquiry by probing into unanticipated, interesting or unique participant responses (Lee, 2003; Suchman and Jordan, 1990).

Semi-structured interviews were regarded to be valuable for my study as some wording of opening questions could be defined previously (Patton, 1990). The advantage of taking these steps was that detailed verbal commentary was elicited which afforded some insights into the participating teachers' and low-attaining students' beliefs about mathematics education. This was important because it was perhaps the first time for the participants to articulate their views about the subject matter, its teaching and learning process (Creswell and Miller, 1994).

Two interview protocols were used for the study and the questions of the both interview protocols were formulated in an open-ended way. The expectation was that the participant teachers and students could take part in-depth way. The conversational questions helped me to learn as much as I could from the participants and allowed their own language and perceptions to emerge (Creswell and Miller, 1994). These open-ended questions used a semi structured format. Some of the questions were pre-determined but other questions evolved and changed throughout an interview and between participants throughout the study to best understand the case. Additionally, both clarification and elaboration probes were used to understand the participants. "Qualitative case study seldom proceeds as a survey with the same questions asked of each respondent; rather, each interviewee is expected to have had unique experiences, special stories to tell" (Stake, 1995, p. 65).

One of the concerns about primary mathematics teaching in the profession is the content knowledge or subject matter knowledge of the teacher (Ball, 1990; Ma, 1999; Stigler and Heibert, 1999). Evidence suggests that Sri Lankan primary teachers have poor critical knowledge for teaching topics in mathematics, negative attitudes on support services and

poor concern on students with low-attainment (PMP 2003, NEREC 2012 and NIE 2013). Therefore, teacher interview protocol's questions developed an in-depth rich understanding of each participant's beliefs and experiences about teaching and learning mathematics including above mentioned aspects. Therefore, the interview protocol was consisted four important characteristics which represented the previous empirical research evidences and my research questions. (Haylock,1991; Baker et al ,2002; Day et al, 2006; Kutnick et al, 2002; Blatchford et al, 2003; Lim, 1999 and Christenson et al, 1989). These characteristics are;

1. Participants' experience on the process of teaching and learning mathematics. Their beliefs about the function of mathematics education especially for low-attaining students.
2. The arrangement of classroom learning environment and its relevance to the needs of low-attainers.
3. The characteristics of the instructional sequence and mathematical tasks used in the lessons and the teacher attempt to tailor instruction to meet the needs of low-attainers.
4. Availability of resources, support services and the expectations from the authority.

It was expected that this would provide the participants with an opportunity to analyse the existing situation of mathematics education within the Sri Lankan primary school context and to reveal their actual experience with me. Interviews with teachers were conducted after each observed lesson. In order to get to know the teachers, I maintained a friendly relationship with them before the proper interview. I did not show any authoritative behavior. After the lesson observations the interviews were conducted and the whole time was spent in smooth conversation.

Furthermore, interview protocol which were used for the low-attaining students was developed based on the previous research evidences (Mercer and Mercer, 2005; Cockburn, 1999; Hay McBer, 2000; Boaler et al, 2010; Casey et al, 2001; Hyde et al, 1990; Ma, and Kishor, 1997; Sayers, 1994; Vermeer et al, 2000) and my research questions.

1. Students' perception on learning mathematics.
2. The strategies used by low-attaining students in learning mathematics.
3. The possible reasons that the low-attaining students find learning mathematics is difficult.

Angold (1976) explains that some students may feel uncomfortable when they are in new environment or a classroom setting. Therefore, to increase the opportunity to respond about

their learning experiences, I adopted two methods. First, I divided the students into groups if there were more than five low-attaining students in one observed classroom. If the number of students was less than five, I considered them as one group for the interview. I assumed that students would feel more comfortable when they are in groups than in individual setting. Secondly, I used photos of their classroom and some activities of the lesson that they have been experienced by themselves, as stimuli to facilitate pupils' talk.

According to my experience as a primary teacher for more than fifteen years I have noticed that the pupils rather reserve in their oral communication when they are in a one-to-one interview setting. This observation led me to adopt a group interview format for the study. During the interviews I used pictures of their mathematics lessons to stimulate talking among themselves about how their mathematics teachers usually teach them in classes and what their preferences for learning mathematics are. I took different photographs from their own classroom settings during the lesson observation and different classroom settings in the school. (I have obtained permission from the parents, teachers and the head teacher of the school to include these photographs in my thesis). A sample of the selected photographs is as follows;



Figure 3.5: Teacher-led whole class instruction



Figure 3.6: Lesson starter (sharp start to the lesson, engaging pupils' attention)



Figure 3.7: Group work (pupils working on tasks without manipulatives)



Figure 3.8: Individual working on task with manipulatives



Figure 3.9: Group work (pupils working on tasks with manipulatives)

After showing the pictures one by one, the questions indicated in appendix 3 were asked for further building of the conversation. I believed that it was important to build a friendly and stimulating environment with students before the interview. Therefore, at the very beginning, I introduced myself and had a short discussion with them about themselves and their family and school back-ground. After assuring the friendly relationship with me and pupils, the scheduled questions were asked to understand their experiences on learning mathematics. The students' responses were analyzed under the emerging themes and sub themes from their responses during the interview. The following section will give detailed description of the process of data capturing and recording while using the interview method.

Although I designed the interview protocols as a set of open-ended questions, I was free to modify and change the sequence of the questions according to the manner, appropriateness and context in which conversation flowed (Fontana and Frey, 2005). The design of the interview protocol ensured that I make effective use of the limited interview time. I tried to keep focus when interview teachers and students in the same systematic and comprehensive manner. As mentioned by McCracken, (1988) in designing the interview protocols, I created an opportunity to change the way the questions were worded. I included additional prompts or rephrased the question(s) when the need arose (often evident when interviewees are silent after a question is posed). "Qualitative case study seldom proceeds as a survey with the same questions asked of each respondent; rather, each interviewee is expected to have had unique experiences, special stories to tell" (Stake, 1995, p. 65). Furthermore, I kept a resource of planned prompts and additional questions that could be included as follow-up to probe into particular responses or to supplement the interview (McCracken, 1988). Interviews were

scheduled for a period of approximately 45 to 60 minutes. The interview protocols used for the study are attached to the appendix 3 and 4 of this report.

3.4.2.1 Data capturing and recording

As mentioned by Merriam (1998) the semi-structured interviews allowed me for generated data to be used to compare and obtain common issues and experiences of the participants. The interview responses help to identify the codes and themes for data analysis. The semi-structured interviews were used as one of the principal data collection instruments as a means to cross check my observations and field-notes.

I relied on digital recording equipment to preserve the answers of the interviewees, which proved to be useful during the subsequent categorising and data analysis. Patton (1990) suggests that a tape recorder is an essential tool for capturing data, However, Lincoln and Guba (1985) do not recommend it because of intrusiveness and technical failure reasons. Immediately after the interviews, I downloaded each voice recording and converted it to particular file formats for ease of playback during transcription. These interviews were transcribed and the transcriptions became the data source for analysis.

3.4.2.2 Limitation of face-to-face interviews

Glesne (2006) indicates that there is possible limitation of this face-to-face interview method of data collection. Participants may tend to provide responses that they presume the researcher wants to hear. This can be identified from an extract given by a participant of my study:

You know Mr. Ekanayake, I feel uncomfortable and not very good at interviews (Case1/Teacher interview/ 09/01/2015).

According to this comment, I understood that Mr. Ananda felt that the purpose of my interview was to determine correct or incorrect responses from him. In an attempt to reduce the Hawthorn effect, I made two visits before the formal data collection to the schools to engage with the participants in their natural setting. I had informal friendly conversations with the participant in order to gain their trust and confidence before formal interviews were started. I also used various communication modes such as e-mails, sms's, and telephonic in order to develop a relationship of trust with the participants, before scheduling the classroom observation and interviews.

The students and teachers were interviewed to collect data just after the lesson before they engage in other work to avoid the possibility of forgetting the activities of the lesson. This

data were recorded in the given sections of the interview schedules. Schatzman and Strauss (1973) suggest that an interview is a special mode of inquiry which is particularly suited to the study of human beings and necessary where the actions of people are either unfamiliar or complex. The teachers and students in this study were required to describe their interest, needs and experiences which the literature search shows to be an under researched area (Parry et al., 2005; Moxham and Boaden, 2007). Therefore, it was considered that semi-structured interviews provided the best opportunity for in depth discussion to achieve a full understanding of the learning experiences of low-attainers' and to obtain answers to the research questions. Thus, the interview questions were designed to address each specific research question and to link what is asked at each individual and group interview to the overall research design. All interviews were audio taped and then transcribed. The interview protocols are attached to Appendix 3 and 4.

The findings of the teacher interviews were also analyzed according to the emerging themes and sub-themes. Four pseudonyms were used (Ananda, Bandara, Chandra and Damayanthi) when the teachers' responses were extracted for the analysis the findings. Interviews were recorded (with the permission of the participants) and notes also were taken down at the interview by me. After each interview a contact summary form was completed to summarise the main themes, concepts or issues arising from the interview. Use of the contact summary form helped adjustments to be made to the interview protocol, as new themes emerged from the interviews.

Despite the strengths of using semi-structured interviews to gather data, there are weaknesses too. Yin (2009), suggests that weaknesses of semi-structured interviews include: response bias; bias due to poorly constructed questions; and inaccuracies due to poor recall. In order for the researcher to overcome these difficulties; I made a conscious effort to avoid bias during the interview process by establishing rapport with the participants. In addition to that to avoid or minimise the potential bias I kept questions and body language neutral and was rigorous and systematic in organising and analysing the data. Each interview started with general (getting to know you) conversation, by explaining the purpose of the study and how it will benefit the individual and the education sector as a whole. In an effort to minimise inaccuracies in the interview data; the interviews were recorded and transcribed verbatim by me. To validate the picture emerging during the interview; I checked the transcripts and sent the transcription to the participants' and invited them to check the transcripts as an accurate representation of what he/she has said at the interview. This was done before commencing data analysis.

As research participants and researcher are not native English users, in order to verify the accuracy of the translation of interview schedules and the responses of the students and the teachers of the research sample I used the back translation process. This helped to assure the accuracy of the translation. Thus, the interview schedules and the responses of the teachers and the students were translated from the original language (Sinhala) into English language and translated back to the original language (Sinhala). After the back-translation, the original and back-translated documents were compared and points of divergence were noted and edited. I got assistance from a qualified English language instructor from the English Language Teaching Unit at the University of Peradeniya, Sri Lanka as an independent translator within this process. The translation was then corrected to more accurately reflect the intent of the wording in the original language. It was expected that as mentioned by Scott (2004) back translation can improve the reliability and validity of my research which was conducted in two different languages; English and Sinhala.

3.5 Data analysis

This section outlines analytic methods used to make sense of the mass of qualitative data that was collected from the four cases. I attempted to provide comprehensive explanation of the analysis process in order to bring meaning, structure and order to the data. The main focus of data analysis will be to build a proper connection between the reality of the phenomena studied and the emergent themes. This study is carried-out within a qualitative paradigm which embeds the concept that the form of data capture, is ultimately in the form of text. The converted text was the primary model for the object of interpretation (Schwandt, 1999). As indicated in a previous section, the data was collected through a variety of methods (semi-structured interviews, classroom observation and field notes). In the final analysis, the data sources for analysis included observational reports, field notes and interview transcripts. Photographs were also used when audiovisual data was not being adequate. Each of these data sources were analyzed separately and then integrated according to the emergent themes. These forms of data formed part of ‘a procedure involving the simultaneous and sequential collection and analysis of data’ (Creswell, 2002, p.449). Figure 3.5 indicates the entire research process in a one diagram.

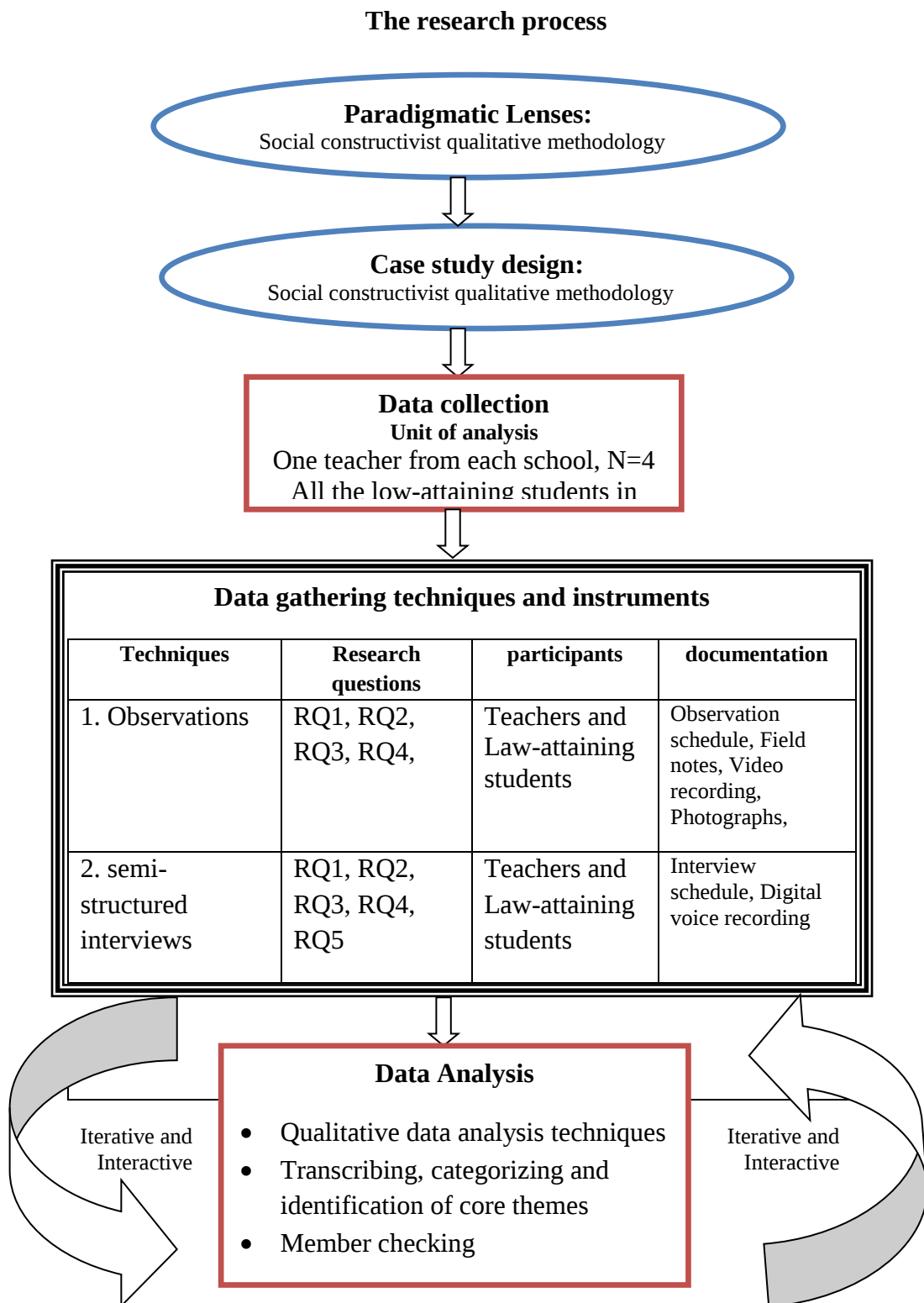


Figure 3.10: Research process

Now I explain the data analysis methods employed for each of the above mentioned documented data sources.

3.5.1 Data analysis: Classroom observation

I personally involved for the data collection within this method and observation schedule, field notes and video recording were used to gather the relevant data from the four selected cases. The rich images of the classrooms provided an opportunity to analyze teaching and learning issues with particular attention to the learning experiences of low-attainers in primary mathematics. In my observations video recordings and still photographs were used to capture the classroom events and activity. This included visuals such as the writing on the blackboard and verbal communication during the lesson. While I am observing the lessons using observational schedule, a research assistant helped me for the video recordings of the lessons. The analysis of video material that was collected in this study included watching, analysing and coding it. My observational notes were used for the clarification of the recorded events. As Jacobs et al (1999) suggest a major advantage of a qualitative approach to video recordings is that it more easily allows for the discovery of new ideas and unanticipated occurrences. I applied Jacobs et al's (1999) qualitative video analysis approach to my observation data. As the first step of the analysis, the video data were watched, critiqued and analyzed. Secondly, supplementary observational notes were made. Then, I used my classroom observational notes for the comparison and searched for any additional codes or categories that may have emerged. I then watched the particular video again and applied the open coding scheme that was developed and applied to the interview transcripts.

3.5.2 Data analysis: Interview data

As mentioned by Charmaz (2005) the interview data needed to be processed before analysis could begin. This was achieved through typing, editing and transcription. At last, the interview data emerged as words or text. I used the method of data preparation and transcription as explicated by McLellan et al (2003). I also followed their guidelines and instructions on how to prepare a transcript as well as track and store the digital audio recordings. There were eight interviews in total; four with teachers and four with low-attaining students. The number of pages of the written down document of the interviews was 173.

I listened to the voice of the participant and I personally transcribe each interview with the aim of reflecting on my experience of the interview. When I listened the voice of the participant, I could immediately reflect on the conversation and make contextual notes in the transcription. As mentioned by Fontana and Frey (2005) this allowed me to place text emphasis on the experiences of the participant. Miles and Huberman (1994) show the

advantage of transcribing the interviews personally. When progressing through the transcription, researcher can immediately take note of possible codes that emerged as units of meaning. I considered the anonymity of the participant while preparing the document. A printed document was hand delivered to the participant for member checking in order to completion of each interview transcript (Creswell and Miller, 2000). The participants were requested to make amendments to the text if the interview transcript was not correctly captured. I requested them to make additions to the text if they felt that their ideas were not appropriately captured. I utilized Miles and Huberman's (1994) data-reduction methodology as a means to reduce the mass of raw data into a manageable form ready for analysis. Drawing on their "components of data analysis" (p. 23), I subjected raw text data to refinement as a distinct process in the data analysis process. During the data reduction phase the qualitative data was reduced by selection, summary and paraphrasing of text. The main purpose of data reduction was to reduce the data into a form that could be examined for patterns and relationships. As a novice researcher to qualitative data analysis, I analyzed the collected data manually.

3.5.3 Data analysis: Field notes

As indicated by Spradley (1980) the observations that are only descriptive are both time-consuming and ineffective. Documented field notes were immediately followed by a period of analysis within my study. I think that led me to more focused fieldwork. According to Mulhall (2003) any writing in the field or thereafter is a construction of events by the researcher. I often attempted to make notes at the research site before leaving. In order to remind me the key events and dialogues during the observation of the schools, the jotted phrases or words were used in the field notes. The field notes were then written up in more detail as personal document. I understood that although this technique relies on an accurate memory and a recall of events, it does avoid some of the problems of confidentiality. I notice that participants being sceptical about the note-taking in their presence. However, I used field notes as an analytic approach to re-construct the accounts of participants or salient events within context (Ellis and Phelps, 2002). Although the experience of the researcher in the field is subjective, the field notes were not set aside as irrelevant information (Ellis and Phelps, 2002). One practical issue of concern was how the data were recalled and whether the field notes would inform the study. Specific critical incidents or exchanges were related to other similar or contrasting events during the writing up of notes. Moreover, I wrote up events as they happened in real time. I distinguished between descriptions that represented the

participants, other people, physical environment, and actions which make up a setting. I also noted dialogue which was a written representation of what was said (Mulhall, 2003).

3.5.4 Coding and categorizing the data

According to Stake (1995), analysis refers to a continuing process of “giving meaning” to impressions about data. Denscombe (2007) states that qualitative data analysts generate data by interpreting what they see or hear from the participants throughout the field work. Bryman (2004) describe this as an “iterative” process which suggests an interrelationship between collecting and analysing data.

The approach for the data analysis of this research was inductive. According to Bryman and Bell (2007) an inductive approach has its roots in social science and seeks to interpret data in order to address a problem or answer questions that are raised at the outset of the research. The inductive approach supports the philosophical approach (interpretivism) adopted for this research. There are two types of textual data in this study:

- 1) Observational field notes,
- 2) Interview transcripts,

The subsequent steps were taken to analyse the data collected from these two sources:

- Preparing the whole data set for analysis
- Coding and Categorising
- Identifying broader themes

The data analysis process began during the period of data collection. I took notes on how things happened in the classroom. Additionally the notes were taken on how participants responded to the research questions. I transcribed each interview within 24 hours of conducting the interview. During transcription a preliminary analysis was completed. It was expected to explore how each participant responded to the given interview questions. This was compared with the evidence of the observation. An example of the coding/categorization process is given in appendix 5A and 5B.

At the beginning of the analysing process, I tried to become familiar with each data set by re-reading the whole transcribed data. This was done in Sinhala. By doing this, I became more immersed in the data. This provided me with an overall picture to obtain a gradually deeper understanding of each participant’s perspective and standpoint on teaching and learning process of mathematics in primary grades. Then I started to translate each slice of data which

became significant into English. While translating data, forward and backward translation approach was used with the help of a Sri Lankan colleague who was qualified in both English and Sinhala languages.

I adopted two main phases for coding and categorising the data, namely initial and focussed coding (Charmaz, 2001, p. 46). The initial phase involved the coding of the data. According to Charmaz (2001) coding is the first step of progressing beyond the interview transcripts and towards making analytical interpretations. The coding scheme was accomplished through a combination of a priori and open coding (Weitzman, 1999). The main themes were determined through interaction with the data and developed inductively through open-coding (Freeman and Richards, 1996). Coding was done by labeling segments of the data in order to simultaneously categories, summaries and account for each piece of data (Charmaz, 2001). According to Merriam (1998), Glesne (2006) and Patton (1990), categorization of the data begins with the first transcript of the first set of transcribed data; observational field notes and interview transcripts. Through several reading iterations of each transcript I began with open coding of the data. The initial coding was done by gradually reading through the entire transcript of all the interviews. New codes were added by open coding. This method of constant comparing of transcripts was strictly adhered to, in order to yield a master list of all codes reflecting ‘recurring regularities’ Merriam (1998, p. 181).

In the second iteration of the data, focus coding was done to synthesize and refine the data. I compared the data within categories and between categories. In other words “constant comparative analysis” was utilized in this study to compare data with data, to identify similarities and differences and categories findings (Charmaz, 2005). In this process, some categories were merged and some categories were eliminated because of irrelevance in response to the research question. According to Peräkylä (2005, p. 870), analysis of text takes place through a number of reading iterations of the empirical data. Then “try to pin down their key themes and, thereby, to draw a picture of the presuppositions and meanings that constitute the cultural world of which textual material is the specimen.”

The axial coding was done to relate categories to subcategories during the third iteration of the data. I specified the properties and dimensions of a category within this phase. This process brought the data analysis to a level of interpretation. The categories that emerged had some congruence with the reality of the phenomenon under study. Underlying patterns that form theoretical constructs about how low-attaining students learn mathematics could now be investigated. I subjected the emergent codes and culminating themes to a hierarchy scheme in

order to maintain conceptual congruence and to make sense of the emergent categories (Merriam, 1998).

To conclude, the study does not set out to test pre-existing theories, for example through the use of hypothesis or experiments and rely instead upon qualitative data. Information gathered from classroom observations and interviews with teachers and low-attaining students were used to reach the objectives of the research. I was interested in the factors that affect the different interpretations from informants. The emphasis was given to understand the individual experiences of teachers and their low-attaining students in teaching and learning mathematics. Teachers' comments and classroom observations were used to explain the complex and nuanced mechanisms of the teaching and learning process. Therefore, this study was inductive, rather than deductive and theory building. I did not try to test a theory and it can be considered as highly contextual in general. I understood that there would be a limited opportunity to generalize the findings due to these limitations.

3.6 The trustworthiness of the study

Floden (2007) explains that issues of rigour are those that the study employs to guard against many threats of trustworthiness of the study. I attempted to clarify and provide a clear justification for the methods used for my study in order to ensure the trustworthiness of the findings. It is my intention to provide adequate evidence in order to give trustworthiness to this qualitative research.

3.6.1 Audit trail

As mentioned by Tobin and Begly, (2004) the detailed audit trail enhances qualitative issues of credibility, transferability, dependability and conformability and places the study firmly beyond verisimilitude perceptions. My research design also attempted to follow the above mentioned audit trail by providing detailed, transparent and reliable methodological processes. I provided extensive access to all processes of documenting the study. The research methods, data-collection instruments, process of data analysis were given. The consent letters from the participants, permission letters from the educational authorities were also included in the appendices (Sandelowski, 2000).

3.6.2 Case-to-case transferability

The focus on selected sites could raise validity issues with respect to the transferability of the findings. To overcome this threat, I adopted the strategy of selecting four schools for in-depth study from different school categories in different location in the Central province in Sri

Lanka. I also made a concerted attempt to use different data collection methods and instruments that would strengthen the notion of triangulation. In the previous sections I made an in-depth account of the various methods of data collection which, coupled with elaborate and detailed reflections. I tried to provide sufficient description of the context of each site and the description of the units of analysis. The maximum variation of sampling may facilitate and promote case to case transferability (Yin, 2003).

3.6.3 Credibility

Yin (2003) refers to credibility as the extent to which the researcher captures and represents the reality of how things really are from others' (informants and fellow researchers) standpoints. Credibility through triangulation of the descriptions and interpretations was continuously accomplished throughout the study. Credibility of the findings was also accomplished through in-depth data collection. That was sought from a wide range of different and independent methods such as interviews, observations and field notes. The extended engagement in the research field allowed for data to be captured in the natural settings of the participants. Most important thing is the level of consistency at the research sites over a period of time. Value judgments are made on this process. This allowed for observed similarities and differences. The judgements that are made remained the same over time and thus supporting the notion of dependability of findings.

3.6.4 Confirmability

The trustworthiness construct of confirmability was achieved by employing a strategy in which the interview transcripts and the findings were fed back to participants. The process of member checking was to ensure that the findings represent a reasonable account of the participant's experience (Graneheim and Lundman, 2004). As mentioned earlier, because of the interviews were conducted in Sinhala language the translation of wording might have created problems about reliability. As mentioned by Cohen et al. (2007) similar wording in interview questions was used to increase the comparability of responses. At the point where language issues arise in the translation process, they were re-checked by a Sri Lankan colleague who is working as an English language instructor in the University of Peradeniya, Sri Lanka.

Participant feedback was also used to make the study more valid. Participant feedback was received by asking the participants to review the summarised data (Creswell, 2007; Johnson and Christensen, 2010). Participant validation was used to ensure the information

dependability. Primary mathematics teachers from the selected schools reviewed and checked the synthesized information that I collected during the observations and from the interviews.

3.6.5 Width and depth of the study

Hoepfl (1997) and Patton (1990) state that sampling errors may occur due to distortions caused by insufficient depth, lack of breadth, and changes over time in the data collection process. I attempted to address these issues of distortion (Mouton, 2001), first through the triangulation of various sources of data whereby greater research depth was achieved; second, greater breadth of the research was achieved through a variety of sampling sites and the inclusion of an appropriate number of participants at each site in the study; third, as participant observer, I attempted to conduct my observation within the natural classroom settings.

According to Gerring (2004), “a single unit observed at a single point in time without the addition of within-unit cases offers no evidence whatsoever for causal proposition”. I also understand that my observations as a single researcher are limited to my own perceptions and introspection. My presence in the research field may influence the behaviour and speech of the participant. However, the extended engagement at each research site may help to reduce this effect (Mays and Pope, 1995).

3.6.6 Retest reliability

To promote retest reliability, I thoroughly maintained records of interviews, observations, field notes and a detailed explication of the process data analysis (Tobin and Begly, 2004). I also indicated above that my role as a researcher is to produce a plausible and coherent explanation of the phenomenon under focus. The use of qualitative data analysis methods, digital video and audio recording enhanced the accuracy with which the analysis of data was achieved. More significant is that the interview transcripts, digital formats of video observations and audio recordings are available for subsequent analysis by independent observers.

3.6.7 My role as the researcher

I turn to the work of Multerud (2001), who describes a criterion for validity as researcher self-disclosing their basic biases, beliefs and assumptions. I also understand that in trying to understand the ‘other’ we learn about ‘ourselves’ (Fontana and Frey, 2005). My role as a researcher is described most succinctly by Glesne (2006), as that of a researcher as learner. Having this view in the research field culminated in my ability to reflect on all aspects of research procedures and findings. Glesne (2006, p. 46) posits that ‘as a learner you are

expected to listen'. This is supported by Ponterotto (2005, p. 131) as he refers to the researcher as a "would-be knower". Often there were days in the research field when I was unsure that my reflections of what I was observing or hearing would lead to anything significant. However, there were more days that I felt optimistic of my reflections but not certain of how they would all fit together - (data collection; audio; video; transcripts; coding; reflections; analysis). Getting mixed messages about my progress from my supervisor accompanied by feelings of guilt about family neglect all create immense anxiety in my role as a researcher (Glesne, 2006). I took comfort in understanding that this is "normal" and my supervisor's words that "things do get confused".

3.7 Ethical issues and concerns

Ethical considerations in social science research are paramount in order to avoid any risk to the physical, psychological, health and social well being of the participants (Saunders et al, 2007). Therefore, when designing the methodology of the study it is important to consider the potential ethical issues. This can be identified as informed consent, confidentiality, data generation and analysis, researcher/ participant relationships and reporting of final outcomes. As mentioned by Dresser (1998) the research process creates tension between the aims of research to make generalizations for the good of others, and the rights of participants to maintain privacy. Ethics pertain to doing good and avoiding harm. Harm can be prevented or reduced through the application of appropriate ethical principles. Therefore the protection of human subjects or participants in any research study is very important (Dresser, 1998).

As mentioned by McMillan and Schumacher (2001) ethical issues in research concern beliefs about what is wrong and what is right from a moral perspective in the conduct of research. Research ethics therefore imply compliance with acceptable research norms, morals, standards and principles. Dresser (1998) asserts that researchers are ultimately responsible for protecting the participants. She suggests close monitoring of high-risk studies. Ramos (1989) describes three types of problems that may affect a research study: the researcher/participant relationship, the researcher's subjective interpretations of data and the design itself. I have understood that the nature of ethical problems in case study methodology needs to be anticipated in advance. Furthermore, it is important to always respect the mandate of maintaining ethical principles as an issue of protection of human rights, important in both participant and myself. Consequently, Mohr (1996) offers a very interesting and relevant perspective on research ethics. According to him, in order to formulate the principles of

research ethics one needs to be aware of both research and teaching ethical principles, and properly formulate the relationship between them.

I depended heavily on collecting data through interviews, observations, written materials, video and audio-visual material. It was important to negotiate access to participants to collect data. The quality of social interactions between me and the participants may facilitate access to information. Therefore In my study, I considered the following key ethical principles:

- a) Informed and voluntary consent;
- b) Confidentiality of information;
- c) Anonymity of research participants;
- d) Beneficence or no harm to participants; and
- e) Reciprocity.

In line with the principle of “informed consent” I explained honestly and openly to all participants about the nature, aims, purpose and educational benefits of my study and further elaborated to participants that participation in this research is voluntary and that participants can withdraw from the study at any time. The teacher participants signed the Participant Information and Informed Consent, the Interview Consent and the Recording Consent forms. All these forms were translated into appropriate languages of the participants. The forms included my contact telephone numbers as well as those of my university. I secured prior voluntary consent before video and audio recording and interviewing the participants. I got the permission in writing from the parents of the low-attaining students and also did not force the students to participate in the interview. The information obtained from the low-attainers was used only for the research and I did not share that information with the teachers, principals or with their parents. During the identification of low-attainers from the classrooms, I did not let them aware that they selected to the study based on their levels of performance. During the interview I maintain a friendly and supportive relationship with them and did not give even a hint regarding their low-attainment.

Furthermore, teachers may perhaps show an uncertainty of their own practices to deal with the existing problem of low-attainment in mathematics due to various reasons such as lack of training and/or other commitments to the school. These types of uncertainty of teachers are normally criticized by other evaluators such as ISA or Director of education during their visit to the classroom. Generally, Sri Lankan teachers are likely to keep quiet without involving constructive dialogue with the observer and have a tendency to maintain a distance between them and the officer. This can be seen as a traditional way of respecting to the hierarchy of

Sri Lankan Education. In order to avoid this type of ambiguity of teachers, I openly discussed the purpose of my study with them and explained the significance of their constructive ideas. My aim at this point was increase their confidence as teachers and to make sure they are the crucial decision makers in the classroom. As mentioned by Dresser (1998) as a researcher, I am the person who is responsible for protecting the participants of my study with acceptable morals, standards and principles.

Furthermore, I also needed to comply with ethical issues of confidentiality, anonymity and privacy. To ensure confidentiality, names of the interviewees did not disclosed; the name of the schools, teachers, learners, principals (heads) remained anonymous and not appeared in the thesis. Instead, fictitious names were used throughout the study. Pseudonyms were used when the students' responses extracted for the analysis of findings. Data gathered in this exercise solely and strictly used for the purpose of this research project. During and after completion of the study the raw research data appropriately stored by me under lock and key. Such confidentiality initiatives and data storage measures are all in the interest of ensuring and protecting the privacy and anonymity of participants. McMillan and Schumacher (2001) and Neuman (2006) agree that guaranteeing privacy, anonymity and confidentiality means that access to participants' responses, behaviour and information is restricted to the researcher and kept secret from the public. I made all the necessary effort and commitment to ensure and uphold both the informants' privacy and research ethics principles during the fieldwork and in the compilation of my thesis. I believe that if I maintain the above-mentioned ethical standard it would lead to an exploration of the learning experiences of low-attainers and at the same time satisfy the ethical principle.

To conform and comply with the University's research ethical codes, guidelines, protocols and practices, the research proposal has been approved by the Ethics and the Higher Degrees Committee of the University of Leicester. I have also obtained authorization to conduct my research from the Central Province Education Department in Sri Lanka. Before entry into the research sites (primary school classrooms) I have obtained the permission to carry out my research from the School Heads and teachers. The request letters for obtaining permission is attached to Appendixes 6 to 9. In addition to that as a teacher educator, I have understood the potential conflicts between my official duty and as the researcher. In order to avoid this possible conflict I refrained from any official support from my work place and from the officers of the system. I always requested permission from the parents and the teachers to carry out the research. I put on my 'researcher hat' and forgot the official mentality. I always maintained friendly approach with the participants.

3.8 Chapter summary

Within this chapter, I illustrated the theoretical and methodological foundation that guide and underpin this study. The constructivism theory and the qualitative paradigm were considered respectively. I describe the qualitative methods and instruments that I employed to gather data. The reason for choosing a qualitative approach (case study) for conducting the study was explained; as enabling the study to gain an understanding of the learning experiences of low-attainers in mathematics. It provides a detailed account of the research sequence and this addresses the procedures that were followed during data collection. Furthermore, the way the data was organized for analysis and the procedures of the analyses of the data were discussed. In addition to that, I submitted the criteria that attempt to enhance the trustworthiness of the study. Finally, ethical issues that have been considered during the study also included. In the next chapter, I will focus my attention to the findings of the study.

CHAPTER 4: FINDINGS

4.1 Introduction

This chapter presents the findings of the current research on the exploration of the learning experiences of low-attaining students in primary mathematics in Sri Lanka. The findings of the study are given in two main ways. In this chapter, the four case studies of the primary mathematics lessons done by the teachers who were observed during their classroom teaching are presented. Interview data with teachers and their low-attaining students are also included in this section. The second section of the analysis (Chapter 5) addresses the cross-case findings of the study. The cross-case analysis is given under the themes and sub themes that emerged from the four cases.

The cases described here are of four Sri Lankan primary mathematics lessons. Analysing individual teachers might help to better understand the existing situation of the teaching learning process in Sri Lankan primary schools. The four cases served as background for the cross-case findings. In this section, I provide some important aspects that I have observed during their lessons and during the interviews with the teachers and the students. I used pseudonyms for each teacher and present the findings with a brief description of each school at the beginning of the case.

4.2 The case One

4.2.1 Background of the school

Mr. Ananda's School was in Kandy educational district, Central province, Sri Lanka and student population was 1300 students with grade levels ranging from 1 to 13. The school was categorized as 1AB and serving in disadvantaged town area that has experienced economic decline. Its intake was predominantly Sinhalese and all of them are eligible for free school meals, textbooks and uniforms based on their parents' income. The attainment of national examinations such as Gr.5 scholarship, G.C.E. O/L and A/L were very low during last few years according to the school examination reports. Additionally, as indicated in the reports, the proportion of low-attaining students in mathematics was high when compared to the same category schools in the region. The following table shows the number of low-attaining students in primary grades, who got below 40 marks for the test held in December, 2014.

Table 4.1: Low-attaining students in primary grades (case 1)

Grade	Number of students	Number of low-attaining students
Gr.1	41	Not evaluated
Gr.2	43	23
Gr.3	36	18
Gr.4	34	16
Gr.5	31	13

Source: School census 2014

There were 65 government appointed teachers in the school and six of them were primary teachers. All of them had gained professional trainings which were designed for primary teachers from various teacher training institutes such as universities, Colleges of Education and the NIE in Sri Lanka.

There were four main buildings and two temporary buildings in the school. All the buildings were in adjacent and as a result of that the students' noise disturbed the teaching and learning process of the school. The head teacher's office was separated from other buildings and it was located in the centre of the school. The observed classroom was in the old building of the school with a cement floor and the brick walls. Ceiling-to-floor was painted in same faded color. It looked like an old store room for goods rather than a school building. Mr. Ananda mentioned that a lot of problems affect the teaching and learning process and that it cannot be done in an active and interesting way under this situation.

4.2.2 The case of Mr. Ananda

Mr. Ananda has taught for 15 years in primary grades. He has completed his first Bachelor of Arts degree from a leading university in Sri Lanka and has joined the teaching career without pre-service training. He currently teaches all the primary subjects for his grade and has participated in two in-service teacher training programmes conducted by the Ministry of Education in Sri Lanka. Before the formal observation and the interview I talked with him to understand his process for building a relationship with his students and to share any anecdotal evidence he had to support what he was saying.

Mr. Ananda gave me the lesson plan before starting his lesson but he had not followed the standard structure provided by the MoE. According to his lesson structure, the duration of

the lesson was 40 minutes but he had not included his time division between each activity in his plan. However, his lesson basically had the following phases;

1. Introduction
2. Demonstration on the blackboard
3. Individual work
4. Evaluation of the students' work
5. Conclusion

The lesson was on money handling and at the introductory phase of the lesson Mr. Ananda recalled the previous day's activity which had been completed by the students. They were encouraged to complete the previous day's task immediately. After a few minutes, two students showed their answers to Mr. Ananda and he praised those two students while others were remaining silent. Then he gave an additional set of problems from Grade four mathematics workbook. He demonstrated an example on the blackboard and explained the way of solving the given problems. Then, he wrote the page number on the blackboard and students were asked to follow the same pattern to find the answers. The students were encouraged to complete the task immediately. After about 10 minutes four students completed the entire task within the given time while some of them were engaging in the task. I noticed that a few students were struggling to understand the task and it appeared that Mr. Ananda made no attempt to engage with pupils who had difficulties in answering the given tasks. After the lesson observation I inquired about the first activity and he explained his difficulty in planning and implementing the lesson for the benefit of all students. He said;

Each student is important and teacher needs to pay attention for individual differences of each and every student. However practically it is difficult to do due to many backwards students. I agree that there are few lapses in my lesson. I cannot manage the whole class with different levels of students and poor supply of necessary resources. I cannot cover the whole aspect of the lesson within 40 minutes period. (Teacher interview 09/01/2015)

Mr. Ananda marked the workbooks of four students and appreciated them as clever students. The rest of the students were asked to follow them and get an example of good practices from them. While most of the students were engaging in the assigned task he wrote the correct answers on the blackboard with the help of those four students. Low-attaining students sat silently and they appeared to be pretending that they understood the procedure demonstrated on the blackboard. Then, he turned to page number 82 of the workbook and assigned the

students a new task which included five word problems. The facial expressions of the majority of the students were miserable and one or two students verbally expressed their dislike to have too many calculations.

I realized that Mr. Ananda attempted to cover the entire content of the lesson within the allocated forty minutes period. He did not consider giving sufficient time for the students to take the opportunity to step back and reflect on what they had learned from the previous task. Finally, the lesson ended with the bell that signified the change of classes, rather than with any planned discussion or questioning about the important features of the lesson. Mr. Ananda did not assign any additional activity after the lesson. In the conclusion of the lesson he mentioned that the lesson will be continued the next day and students who could not complete the given word problems were asked to complete it by the next day. Students who had shown difficulties in solving the given tasks were not provided with additional support. Throughout the lesson, most of the low-attaining students appeared to be off-task and confused about what they were supposed to do. The following comments made by the low-attaining students of the class elaborated their frustration;

Case1/St.03: When teacher explained the calculation, I didn't really understand it.

Case1/St.04: I don't know how to answer the given problems. No one helps me. I don't like mathematics.

Case1/St.06: Teacher punishes us when we made wrong calculations. Today he did not punish us just because you came to our class.

Case1/St.13: I like to work with others but they were not really cooperative. They didn't really help me. Teacher also helps only the able students.

Generally, Mr. Ananda did not consider the mistakes made by some of the students and did not use motivational techniques for praising pupils' good effort. He did not encourage pupils to ask questions and engage in peer evaluation. The main focus was given to the use of correct procedures to solve mathematical tasks. Errors made by pupils were not used for reflection. Mr. Ananda gave the following reasons;

I need to finish the lesson within the given time. I cannot concentrate on each and every child and their difficulties within 40 minutes. First, I concentrate on able students then I can look at weaker ones. . I correct them at the afterschool classes but most of the students don't need to learn and they are not even coming to the class. I have no extra support to meet the problem of low-

attainers. No school or educational authorities support us to facilitate those students. The problem is inherent. Finally we are the victims. We need to get the entire burden without any appreciation.

(Teacher interview 09/01/2015)

At the interview, Mr. Ananda expressed his personal experiences on teaching in those grades. He did not consider himself as a successful teacher for low-attaining students. He said that he has no sound mathematics knowledge and was not satisfied with his experiences on the teaching methods that are relevant to the low-attaining students. Further, he insisted on more support from the relevant authorities of the education system.

I'm an arts graduate teacher. I work as a primary teacher from the beginning of my career and I have to teach all the subjects including mathematics for these young kids. However, my mathematics background is very poor. I did mathematics for GCE (O/L). That's it. I followed arts subjects for the G.C.E. (A/L). I have participated in two in-service workshops during my career. Those workshops were designed especially for primary teaching, not for mathematics. Therefore, I tried to follow the textbook and the teachers' guide without adequate support from the experts in the field. I am trying but I feel that I cannot deal with children with different abilities using different types of teaching and learning strategies. I think I need more support from the relevant authorities to become a successful teacher. (Teacher interview 09/01/2015)

According to Mr. Ananda's comment he had distinctly negative beliefs about current school practices on low-attaining students. He considered that if the school or the educational authorities provide adequate support and training he could have actively engaged by using remedial actions for the pupils with difficulties. He further mentioned that the home background of the students does not support them to overcome their inborn problem of low-attainment;

Some children in my class have learning needs. More than 10 students haven't got at least 40 marks for the mathematics paper given for the last term test. They're not motivated. They like to play all the time but do not like to study. Management of the classroom is very difficult. These children need many supports in different ways and as I think I am not qualified to give necessary support for them. As I know, there is no one at home either to help them.

Parents of low-attaining students insist that there is no time to support their children because they have to do their jobs. Almost all of them don't have mathematic skills to teach their children. Even if they have such skills, they don't have time to do so. As the class teacher I need to do everything for the betterment of these pupils. They have many expectations from the school and from me. (Teacher interview 09/01/2015)

Additionally, Mr. Ananda showed another important aspect which affected his teaching, at the interview. The school has been poorly resourced by the relevant authorities and this has negatively affected the teaching and learning process, especially for the low-attainers. He explained the situation like this;

It is required by the curriculum to use teaching and learning aids during the lessons especially for the low-attainers. They can grasp the idea easily, if the teacher uses the correct material at the correct time. But we do not have required materials to help those students. (Teacher interview 09/01/2015)

Mr. Ananda explained the effectiveness of cooperative learning for the improvement of the low-attaining pupils. He said that he did not use this type of method due to time restrictions.

I think learning mathematics by doing is important, especially for those students with learning difficulties. It is necessary to plan activities for cooperative learning. I think that if we put children who have difficulties with mathematics together with those who are good at mathematics, they can help each other. In my lesson I did not use this because of limited time allocation for a mathematics lesson. (Teacher interview 09/01/2015)

However, at the classroom observation, I clearly noticed Mr. Amanda's uncertainty with mathematics concepts. He did not give children space to think, and mainly followed the order and the instructions of the mathematics books. Always he appreciated the right answers rather than solution procedures.

Teacher used the blackboard for solving the mathematical problems. He underlined the correct answers in each time and asked students who got correct answers to raise their hands. Without even checking their work book teacher appreciated those students. He never used group activities or math games during the lesson. Extract from the field notes (09/01/2015)

Generally, Mr. Ananda did not play roles that helped students become active learners in the classroom. During the lesson, he tended to intervene with students' work without a pre-decided task. In general, he did not encourage students to reflect on their work. At the interview students said that they are afraid of their teacher;

Case1/St.03: If I don't understand teacher will punish me.

Case1/ St.05: Sometimes I feel scared. I try to copy correct answers from others.

Mr. Ananda never encouraged students to think that learning mathematics is not as difficult as they perceived. Mr. Ananda used only a few selected interactive activities, such as teacher to whole class interaction and teacher to individual interaction. He did not use any pair work and group work in the class for developing a friendly relationship between the learners. This was clearly evident from the students' interview data. All the pupils of the low-attaining group agreed that their teacher always uses teacher-led whole class instruction during mathematics lessons.

Case1/St.02: It is boring and lonely when doing by ourselves using text book and work book.

Case1/St.05: I like working with my friends and sometimes they help me. Our sir gives us more individual work.

In addition to that, Mr. Ananda explained his difficulty like this;

Some of the content of the present curriculum is impractical and unrelated to life. For example: Lesson number 4, handling money contained impractical activities. The curriculum put too much emphasis on mechanical computation (e.g., multiplication and division involving decimal numbers) and that there was not enough emphasis on thinking skills. The curricula for these grade levels fail to match students' cognitive development. As a result, students, especially those of average and low attaining standards, had great difficulty in understanding the content and this had great impact on their confidence and interest in learning mathematics. (Teacher interview 09/01/2015)

He further explained that the lengthy curriculum and tight teaching schedule allow teachers very little time to focus on some important topics or to use activities in teaching on a regular basis. In general, he found it important to spend more time with students to help them build a

solid foundation in mathematics. Mr. Ananda said that present curriculum offered very little help in alleviating the problems imposed by a tight teaching schedule.

Parents expect everything in the curriculum to be covered. It is very hard to complete the whole expectations of the curriculum.

(Teacher interview 09/01/2015)

Therefore, he suggested that he is looking for a more manageable curriculum in terms of length and degree of relevance. In terms of length, he was in favor of trimming down the current primary mathematics curriculum to make time for better teaching and learning. He was in need of more time to do lesson preparation and to provide guidance to students. Students were in need of more time to digest materials and understand important concepts.

Based on the data I can conclude that the practice of the observed lesson was far behind the expectation of the Ministry of Educations' aims and objectives of teaching and learning process of primary mathematics. There were several reasons behind the existing situation and teacher tried to explain those difficulties in his point of view. Furthermore, low-attaining students in the observed class experienced a teacher-led whole class instruction rather than a child-friendly approach. There were apparent mismatches with the way that he thought he should teach.

4.3 The case Two

4.3.1 Background of the school

The selected school for the second case study was in the Kandy educational district, Central province in Sri Lanka. The school is categorized as 1C by the Ministry of Education. The student population was 962 with grade levels ranging from 1 to 13. The school serves in a town area and its intake was Sinhalese and all the pupils were eligible for free school meals, school uniforms and textbooks based on their parents' income. Attainment of the national examination such as Gr.5 scholarship and G.C.E. (O/L, A/L) was very low and none of the students were qualified from the Grade 5 scholarship examination during last five years (2010-2015, School examination reports). According to the school census, the proportion of low-attaining students in mathematics was high when compared to the other subjects. The following table shows the number of students who recorded low marks for mathematics in primary grades for the year-end test in 2014.

Table 4.2: Low-attaining students in primary grades (case 2)

Grade	Total number of students in the class	Number of low-attaining students
Gr.1	38	Not evaluated
Gr.2	27	16
Gr.3	33	13
Gr.4	31	09
Gr.5	26	11

Source: School census 2014

There were 37 teachers (29 female and 08 male) including head teacher with a teacher-pupil ratio of 1:26 in the school. Nine of them were primary teachers and all of them had received their professional training especially for teaching in primary grades from various teacher training institutes such as universities, Colleges of Education and NIE in Sri Lanka. There were two trainee teachers from the college of education, Peradeniya. There were five permanent buildings in the school and those buildings had windowpanes, doors with lockers and good roofing. The primary classes of the selected school were in good condition in terms of teacher allocation, classrooms, desks, teachers' tables and chairs. Primary teachers had chairs and tables and space for their activities. The observed Grade four class was equipped adequately. Students' desks and chairs were supplied by the MoE. There were extra books and note books for students and they were allowed to take books home at the weekends. The teacher had few homemade types of equipments. There were few pictures and posters on the walls but none of them were relevant to learning mathematics.

4.3.2 The case of Mrs. Bandara

Mrs. Bandara is a General Certificate of Advanced Level in social sciences (GCE A/L) holder and a trained teacher currently teaching all the primary subjects except English in the school. She has gone through a three-year conventional teacher education program conducted by a College of Education in Sri Lanka. Her teaching experience was 14 years. Mrs. Bandara said that she prefers teaching in primary grades and helping students in their learning.

I like to work with primary pupils and see their development. I also have two kids and these pupils are also same as mine. I know that it is my responsibility to help them to put a firm foundation for their future life.

(Teacher interview 27/01/2015)

Further, she explained the difficulties she faces as a teacher within this school;

Although the learner-centered approach was recommended by the new curriculum, there are so many factors that are barriers for its success. Time, resources, space and lack of commitment of the students are those barriers. I cannot change these factors alone. I need more resources to use a learner-centered approach, but the problem is preparation and maintaining cost. I have to bear all the expenses from my salary. Main problem is the difficulty of getting support from the school or from the poor parents. I prepared few teaching aids and use them when necessary. (Teacher interview 27/01/2015)

According to her comment, it was clear that Mrs. Bandara is committed to the profession but she has a negative attitude regarding the current situation in the system.

Mrs. Bandara did not use a prepared lesson plan for her lesson and she used the teachers' guidebook to carry out the lesson. She derived all the activities from the guidebook without changing those suggested activities, or the sequence of the activities as necessarily. She tried to stick to the time suggested by the Teachers' Guidebook. The way Mrs. Bandara used the Teachers' Guidebook was more than a guide. It was perhaps close to a rulebook where every suggestion in the guidebook was followed to the letter. During the interview she explained why she preferred to follow the teachers' guidebook than a prepared lesson plan.

I used the teachers' guide and the textbook because we are supposed to do so. Those materials and suggested activities are prepared by the experts in the field and I think I am not qualified to change them. If I change them I'm not sure about the validity of my activity to the pupils. However, I believe that I need further support from the people responsible to achieve the goals of teaching mathematics, especially for helping low-attainers.

(Teacher interview 27/01/2015)

Mrs. Bandars' lesson was on word problems on handling money and she developed her lesson according to the following phases using the guide book;

1. Mental mathematics as for the lesson starter
2. Demonstration on the blackboard
3. Individual work
4. Group activity
5. Conclusion

Mrs. Bandara used mental mathematics at the beginning of the lesson. She asked number bonds and word problems from whole class and that activity took about 5 minutes. Mrs. Bandara asked direct questions from a few selected students and they gave answers correctly. The low attaining pupils remained silent while other students were raising their hands and popping up to give answers. Mrs. Bandara explained the importance of mental mathematics at the beginning of each lesson;

As suggested by the teachers' guide book, I use mental mathematics before starting the actual lesson. I use this technique to warm up and motivate students to learn mathematics. (Teacher interview 27/01/2015)

After the mental mathematics, Mrs. Bandara read a word problem based on a price list and students were asked to listen and think about the procedure to solve the problem. Then she demonstrated the procedure to find the answer of the given problem on the blackboard. Students were asked to copy the steps. Then, Mrs. Bandara read another word problem and students were asked to solve the problem and show the procedure on the blackboard. One able student from the first row of the classroom came forward and demonstrated the procedure correctly on the blackboard and Mrs. Bandara appreciated him and asked other students to applaud him. Mrs. Bandara expressed the reasons why she used this type of mediating effort as follows;

Always I tend to use child-centered methods in my class and I can easily understand those students having problems and how to sort the problems out. Students also know their standing in the class and they could be able to know their understanding on a particular lesson. Furthermore, if we plan the activities in a child-friendly way it helps them to improve their understanding and applying whatever they learned. (Teacher interview 27/01/2015)

However, few able students participated in the given activities and most of the low-attaining students were silent throughout the lesson. At the interview students said why they remained quiet and did not go forward;

Case2/St. 04: I don't like to go to front of the class and give wrong answer to a question. I feel scared to see the gloomy faces of others.

Case2/St.05: When doing by ourselves it is boring and lonely.

Case2/ St.07: I don't know what to do so I keep silence.

Case2/St.08: I feel shy to ask questions, I feel uncomfortable when my friends laugh at me and our madam also helps only the able students.

Mrs. Bandara used an individual work as the next step of her lesson and students were given five word problems on handling money from their workbook (page 80). Students were warned and not allowed to talk or discuss during the allocated 10 minutes time. I noticed that students followed the instruction and they tended to cover their writings from others. Mrs. Bandara said that “it was part of the classroom rules and students should not talk to each other during individual work”. Most of the able students were engaging in the assigned activity while most of the low-attaining students were off task or kept silent. Five able students completed the task within the given time. Interestingly, throughout the activity not a single student asked a question for any clarifications from the teacher. Sometimes Mrs. Bandara walked around the classroom to make sure that everyone was busy working and that students were not sharing ideas. Mrs. Bandara said;

Students are same. I know that, some of them have learning difficulties. I don't want them to label as weaker students. If you consider them as weaker students they become lazy. Some students just copy work from their friends without understanding. They must learn to work hard. I support them overcoming their difficulties by giving suitable activities and doing extra classes. (Teacher interview 27/01/2015)

Without completing the assigned individual work, Mrs. Bandara divided students into five groups for the next step of the lesson. There were five or six students in a group and both able and low attaining pupils seated together to find the answers to assigned word problems. I was surprised to see the way the students were engaged in the given activity. The groups or individual students did not ask any questions from the teacher to make sure they were on the right track. Most of the students were unable to make connections and solve the problems. Many low attaining students were quiet and did not engage with each other throughout the given time. More able students engaged in the task without asking others for support. The low attaining pupils expressed their mentality as follows;

Case2/St.03: Most of the friends in our group are weak. I cannot ask help from anybody about the activity.

Case2/St.06: Some friends in our class are very selfish. They don't like to help others.

Case2/St.07: When we work alone we might do it incorrectly. We need help from our madam.

Case2/St.08: Scared if I don't understand what our madam wants. My group members did not help me. I don't like to work with them

There were five groups in the class but only two of them completed the given task. Mrs. Bandara criticized the other three groups and praised the two groups who completed. She discussed the procedure for solving the given problems while students were remaining silent. Then, the students were asked to turn to page number 82 and 83 in the text book while she was writing a price list of selected items on the chalkboard. Students were then asked to copy and complete the invoice. At this time she went around to check students' work. I noticed that two students could not write the numbers properly and they were among the low-attainers. Mrs. Bandara did not help those students and they were neglected by other students also by not allowing them to contribute to group activities. Furthermore, lots of students showed problems of spacing between numbers. Apart from not being able to space the numbers properly, writing numbers according to place value was a major problem. One student wrote rupees and cents in the same line. The following three photographs show the situation of those weaker students in writing language and numbers.

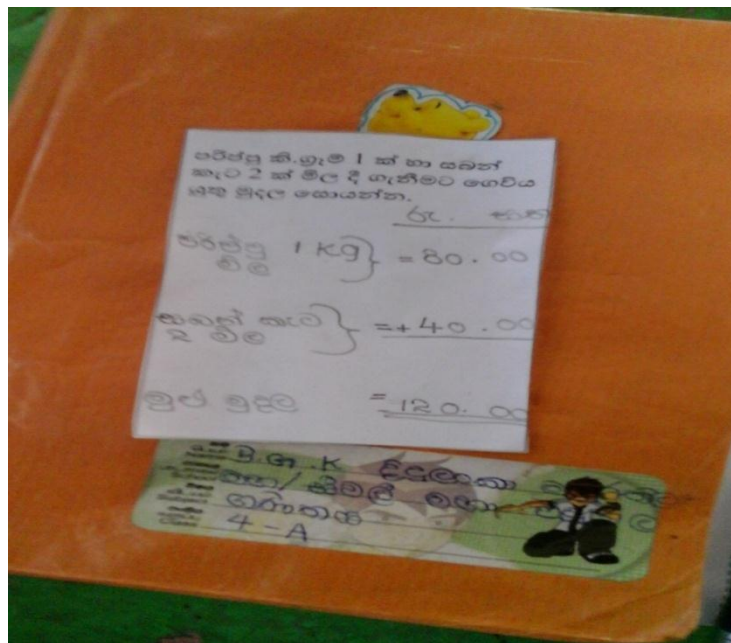


Figure 4.1: Sample of more able students' work

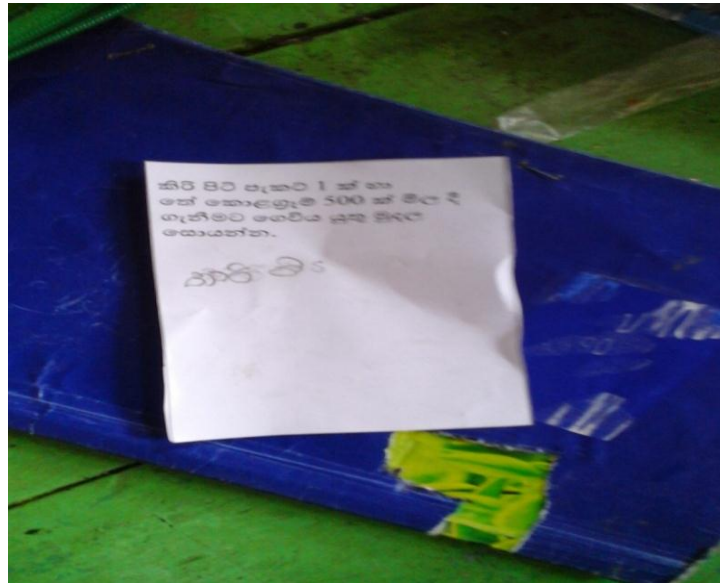


Figure 4.2: Problems of writing basic letters

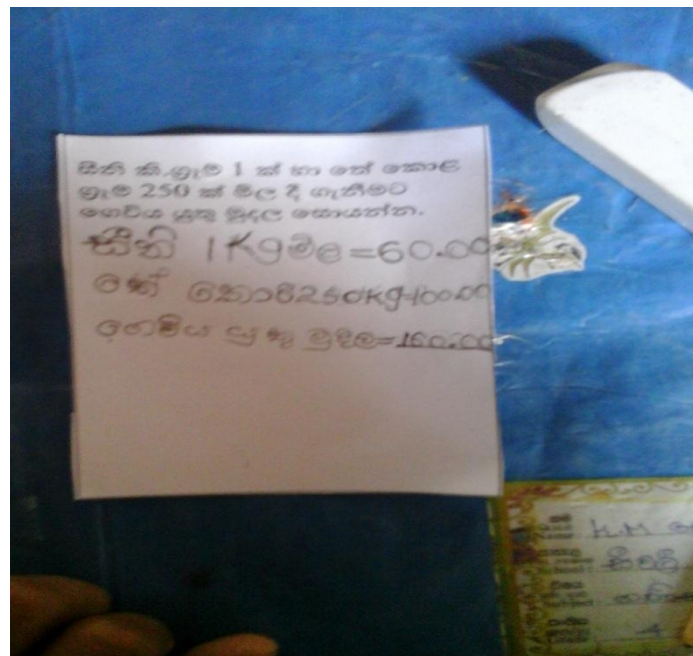


Figure 4.3: Problems of place value

Mrs. Bandara expressed her plan to develop these students as follows;

There are more than ten low attaining students in my class. I think there are different reasons behind their low-attainment; home background, brain capacity and failures at the early grades may be the causes. I give extra attention to these students. For instance; conducting afterschool classes for two days per week and paying extra attention in regular classes.

(Teacher interview 27/01/2015)

Mrs. Bandara asked direct questions from individual students rarely. Most of the questions she asked required students to give choral responses. Sometimes she asked questions seeking an explanation, but she waited only for a few seconds and answered the question herself. Students were not allowed to talk to each other when the teacher was working out an example or when they were doing individual work. She explains;

I think it is my responsibility to develop the students who do not like mathematics. I believe that we all need to work as a group. Some students do not ask questions because they are shy and they do not want to expose their ignorance. Some students do not ask questions, not that they have understood but because they have no courage to ask questions. My responsibility is bringing them to the required level of attainment. That is why I used different activities to bring them and keep them together.

(Teacher interview 27/01/2015)

However, Mrs. Bandara expressed her disappointment with her lesson because the lesson did not go as planned. She gave the reasons as follows.

I planned the lesson carefully but you possibly saw most of the students did not understand the lesson. This is a normal situation of this type of a class. Some pupils still need to learn spelling and language. I need to train them to write the numbers in correct way and I'm giving more practice in my extra classes for low-attainers. (Teacher interview 27/01/2015)

As she mentioned, I noticed that there was very limited student-teacher interaction during the lesson. Students were not allowed to speak to each other most of the time. Students were encouraged to hide their work after they had finished during the group activity. The lesson was predominantly teacher-centered and students were not given time to reflect on or share ideas. Low-attaining students gave the following responses about the lesson;

Case2/St.01: oh very difficult.

Case2/St.03: I didn't understand the lesson.

Case2/St.04: Very hard. Not enough time to complete the given activities.

Case2/St.07: I didn't like the lesson. There were too many calculations.

According to the above mentioned responses it is apparent that all of the low-attaining students of the class do not prefer the teacher-dominant classroom experience. Students

further said that they like a classroom where they can be actively engaged and have a supportive environment.

Case2/St.03: I like working with others. I like to ask help from others. But most of them don't support me.

Case2/St.05: I like group activities very much if friends are supportive. I did not enjoy today because our team members did not work collaboratively. I don't like home work.

Case2/St.07: Our madam asked me to write on the blackboard but I don't like to go to write on it, I feel very nervous at that time, but I feel comfortable when working individually and with friends.

It can be concluded that, Mrs. Bandara had tried her best to bring her students to the expected level of attainment during the 40 minutes period. She used different activities and tasks within her lesson according to the lesson objectives. However, her lesson generally focused on the able or average students and it was rare to see her commitment towards the low-attaining pupils. As mentioned above, the result of the lesson observation and the interview responses of the low-attaining pupils have proved this situation.

4.4 The case Three

4.4.1 Background of the school

The third teacher who was selected for the case study was Mrs. Chandra and her school was located in the Kandy educational district, Central province in Sri Lanka. The distance from the Kandy city centre to the school was about six miles and the area can be considered as disadvantaged semi urban. Normally it takes approximately 45 minutes to travel from Kandy to the school by general transport service. The school was categorized as type 2 by the Ministry of Education and student population was 756 with grades ranging from 1 to 11. All the pupils are eligible for free school meals based on their parents' income. Free textbooks and uniforms are provided by the government. The school had 31 teachers (21 female and 10 male) including the head teacher. There were seven primary trained teachers in the school.

The school was nestled into a neighborhood with different types of homes which had been constructed over several years ago. Each house had its own architectural design and did not follow a common pattern. Some homes indicated the poverty levels of the residents. The school was located on the both side of a main road and the main entrance to the school was on the opposite side of the bus stop. Teachers and the students need to cross the main road to

go to the other section of the school. There was no marked pedestrian crossing or a stop light system designed to help students and teachers to cross the busy narrow road. Honking always disturbs the classroom activities. The school was surrounded by a brick wall and here were four permanent buildings including the science lab. There were few old trees in front of the school buildings that yielded a mostly shaded area. There was a large sand area where primary students could play under a large shady tree. There were small areas of flowers and plants to bring natural color and beauty to the area.

According to the reports, the attainment of the national examination such as Gr.5 scholarship and G.C.E. (O/L) was low. Only five students qualified from the Grade 5 scholarship examination during the last two years (2013-2014 School examination reports). The proportion of low-attaining students in mathematics was comparably higher than the other subjects. The following table shows the number of students who recorded low marks for mathematics in primary grades for the year-end test in 2014.

Table 4.3: Low-attaining students in primary grades (case 3)

Grade	Total Number of students	Number of low-attaining students
Gr.1	44	Not evaluated
Gr.2	41	11
Gr.3	36	14
Gr.4	43	09
Gr.5	37	15

Source: School census 2014

Mrs. Chandra's class was in the main building of the school. The building was about 150 ft long and 40ft in width. The roof was covered by asbestos. There were four primary classes in the building. Mrs. Chandra's class was on the right side of the hallway. As I walked into the classroom I noticed that the walls and bulletin boards on each side of the classroom were filled with students' posters especially including mathematical information. There were two bulletin boards in front of the classroom. One was used for displaying the multiplication tables and the other was used for English language. There were hundreds chart, money charts, an interactive clock on the front wall. There was a cabinet, and a wooden closet on the side of the room. Teacher stored all the teaching and learning aids inside the cabinet. It was clear that the teacher organized the shelves properly and she was able to find materials instantly when needed. There were two wooden windows on the other side of the classroom and direct

sun light comes through these two windows. The blackboard was kept in front of the classroom. The teacher's desk was in the back of the classroom. A small semi-circular wooden stage was next to the blackboard where the students can use it for their activities. The classroom was very colorful. There were many boxes, books, folders all around the classroom. There were six groups of students and small desks were used for their writings. There were square containers on each table which filled with students' writing materials. The size of the desks and chairs were appropriate for students. The desks were arranged vertically in the back two-thirds of the classroom. It gives plenty of space in the front for the whole class for activities.

4.4.2 The case of Mrs. Chandra

Mrs. Chandra has taught for the last 19 years in primary grades and 8 years at the present school. She had graduated with a Bachelor of Education degree from the University of Colombo and had participated in several training programmes designed for primary teachers conducted by the National Institute of Education, Sri Lanka. She currently teaches all the primary subjects except English language. Mrs. Chandra said that she prefers teaching in primary grades.

Education is in our family and something I wanted to do. My parents are also teachers. I have noticed how they dedicated their lives for students' progress. I believe that I got this experience from them. I really like watching kids learn, especially primary graders. (Teacher 3/Sc 3/ 05.02.2015)

Mrs. Chandra said that there were nine low attaining students in mathematics in her class who got below 40 marks for the term test and she claimed at the interview;

It is a natural thing. Every child is not in the same levels of attainment. Those pupils struggle not only in mathematics but also in all the other subjects. Therefore, we need to help them. I have planned several activities for them with the support of their parents and the school. (Teacher 3/Sc 3/ 05.02.2015)

The observed lesson was on adding milliliters and liters. Mrs. Chandra gave me a copy of her lesson plan written according to the standard structure given by the MOE. The lesson basically had six phases;

1. Introduction and engagement (Mental Mathematics)
2. Demonstration and calculation on the blackboard
3. Group activity

4. Individual work
5. Evaluation of the students' work
6. Conclusion

The first activity of the lesson was a kind of a meditation about two minutes. According to Mrs. Chandra the expectation of the activity was that this would help to keep students calm and quiet during the rest of the lesson. Immediately after the meditation, she used mental maths for about 5 minutes and she said that it is important to use the mental awakening methods in order to help young students to understand mathematical concepts. The mental maths activity was based on a role play and teacher and two students were participated. Students watched the play with joyful faces and soon after the play they asked several questions from Mrs. Chandra. She explained the importance of using this type of activity to motivate students to learn as follows;

I don't choose an activity just because they need it. I think it needs to have a purpose. Based on my experience as a primary teacher for about 19 years, I have understood that just teaching the facts every day isn't effective. So what I do is that I include fun filled important activities. When using fun activities students don't know what they are learning their mathematics concepts. They just are doing those activities. I know that some of them are good and some of them are not good.The noise level went up during today's activity as students would discuss with each other. I am trying to keep students on the track using whatever activity is good for them.

(Teacher 3/Sc 3/ 05.02.2015)

According to her comment, she believed that it is important to have a clear purpose and effectiveness when including fun games and activities in a lesson which is aimed to teach a mathematical concept. The students also said that they like these types of activities in the classroom. Their responses are given below;

Case3/St.04: I like activities rather than sitting and writing. Our madam uses these activities to teach us. It is interesting and very fun. We can enjoy a lot.

Case3/St.06: I like role play activity. I can't perform like others but there are clever friends for dramas. I like to watch and learn from them. I do not like to turn the workbook, look at the pages and copy the mathematics problems. It is boring to me.

The following extract from my field notes also shows the students engagement and their happiness to do these types of activities in the classroom.

Most of the students of the class raised their hands and jumped up to give the answers. Mrs. Chandra asked the students' answers and took one student to the front of the class. Then, she wrote the amounts on the blackboard. The student was asked to add those amounts together. She helped and explained the steps clearly to the classroom.

The next step of the lesson was drinking fruit juice by students. The students' faces were very pleased and eager to see what is going on. Mrs. Chandra asked two students from back rows (One girl and one boy) to come forward and drink the given fruit juice slowly. At the beginning they felt shy to drink but Chandra encouraged them and they slowly started drinking. Students of the class delighted to see the event and one student shouted "madam, I can drink. May I come? Please". (Field notes/Case3/ 05.02.2015)

Mrs. Chandra continuously helped students by giving multiple strategies for solving problems conceptually. She used the blackboard to explain the concepts after each activity. She gave opportunities to students to come forward and do the math sums on the blackboard. She asked one student from each group to come forward and demonstrate the procedure on the blackboard. At this point most able students came forward while low-attainers were silent. Mrs. Chandra did not ask those low-attainers to come forward to do the demonstrations. In the interview students said how they feel when writing on the blackboard in front of the others.

Case3/St.03: I feel shy and afraid if teacher asks me to write on the blackboard. I feel that if I give wrong answers others may laugh at me.

Case3/St.08: Teacher asked us to write on the blackboard but I don't like to go to write on the blackboard, I feel nervous when working individually.

Mrs. Chandra used discussion methods and questioning to develop her lesson. She started the discussion by asking questions individually and from the whole class. She explained the necessity of these methods like this.

I'm always thinking what I can do for them. I try to understand what they're thinking. It helps me to find what other examples that I can give them or what other things that I can do to maximize their understanding. Furthermore, it

helps me to identify the possible ways to address their learning using different methods. (Teacher 3/Sc 3/ 05.02.2015)

Mrs. Chandra asked a series of questions from the students to teach the process and modeled the steps they needed to accomplish the task. For example, she asked students the strategies they can use to find the sum of the given problem. She first asked what the sum was, next she asked for the strategy. Mrs. Chandra used the blackboard in her lesson and generally students also had the opportunity to work on the blackboard. She watched students work on the blackboard and helped them as necessary. The following picture shows a student working on the blackboard.

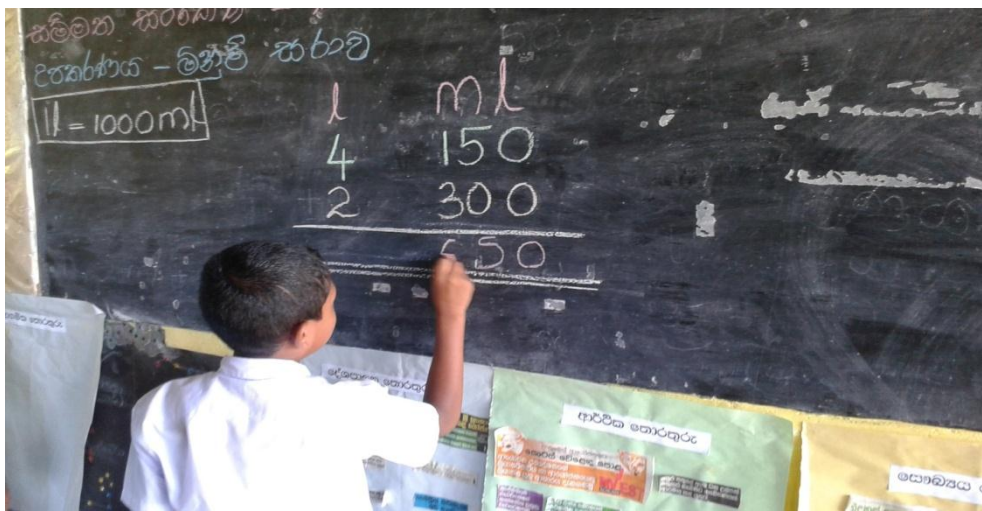


Figure 4.4: A student working on the blackboard

During her lesson, Mrs. Chandra continuously asked questions from the students in all activities she conducted. One of the problems of the day was that she asked students to do the following sum using their work book.

Red bucket contains 5l and 300ml water and 3l and 480l is poured into the blue bucket from that amount. Calculate the remaining amount in the Red bucket.

Chandra walked around the classroom looking at students work. “I want to check whether you are using your brains properly” she said. Students were solving the problem in different ways. Some drew words and numbers while others discussed with the group. Some of them used the table displayed on the wall on the calculation of liter and milliliter. Mrs. Chandra encouraged students to solve problems with group discussion and find their own way. She explained that;

There are several ways to solve a problem. As you see students are using different ways when solving a math problem. So I try to find the best way for them. They probably don't get it the way I show them. I want them to always figure out a way that they could be successful in mathematics. It's just a good thing to have lots of ways to get that right answer. (Teacher 3/Sc 3/ 05.02.2015)

In her lesson Mrs. Chandra was adamant that students could effectively articulate the mathematics that they were doing. She verbally asked students to tell her what they did or what strategy they used to get the answer. She appreciated students' attempts giving positive comments. She asked questions to clarify and develop concepts and procedures. In addition, Mrs. Chandra was also in the opinion that her students were doing well in terms of collaboration and supporting each other in their activity in the classroom. This is the way she practiced the learner-centered approach in her class. For instance, she commented:

I can say they are doing very good in group activities. I try to give my support for a while, and then give some activities to their groups. I encourage them to work in their groups, and with their friends. (Teacher 3/Sc 3/ 05.02.2015)

Mrs. Chandra used guided instruction activities. Most of the guided instruction activities occurred with a given problem. Students needed to use their work books to explore the given problems individually. Mrs. Chandra asked students to demonstrate their work on the blackboard. A few students did not pay attention and Mrs. Chandra got the students close together when she wanted them to pay attention to something that was important. Mrs. Chandra gathered the students with behavioral problems closely together to get their attention and discussed the directions of the task. She told me later in the interview,

If I see someone who is not reaching the expected level, it is better to understand his/her actual situation and talk with them to get them on the right track using suitable teaching method. If I don't then it is a waste of our important time. (Teacher 3/Sc 3/ 05.02.2015)

Mrs. Chandra believed that she could treat her students equally in terms of any kind of learning activity such as reading, writing, speaking, problem solving, and so on. She also believed that she could provide equal opportunities to each one of them, and an equal provision of time while doing activities in her class. This is exemplified by the following comment:

I am trying my best in terms of learner-centered approach. I have learnt something called student-oriented teaching. My students have different structures such as Round Table, and Rally Table. There are so many other structures. So, while using these structures, time is very important. Each child gets equal opportunity tosay, if it is a writing activity, they get equal time to write, and if it is an oral activity like a spoken activity, they get equal chances to speak as well. So, through using such structures, I think, I am trying my best to give them the equal opportunity and to be learner-centered.

(Teacher 3/Sc 3/ 05.02.2015)

Mrs. Chandra was careful to use the appropriate mathematical terminology in her teaching of mathematics and expected her students also to use those words. She corrected or developed student vocabulary continuously throughout the lesson. She defined mathematical terms for students, instead of plus she corrected the student to say addition and count on...., and when a student said count on for addition she rewarded the student with positive affirmation and used his terminology to reiterate adding two volumes of liquid. She often restated her question to distinctly use the proper vocabulary to make clear what was happening.

Mrs. Chandra checked each student's work by seeing how they worked out the problems. She noticed that some students were not able to reach the expected levels of understanding and specific skills that were lacking. She tried to help those students to develop needed concepts and procedures. Mrs. Chandra mentioned to me that it was important to know what the students are thinking. This technique allowed her to determine what was understood and what needed attention for the students to be successful in the lesson. Mrs. Chandra said that she wanted students to actively interact with mathematics that they were learning. The students had to work with other students' to learn.

Each activity must have a mathematical purpose. Different teaching techniques helped me to meet the learning needs of pupils to some extent. This is because the number of pupils with low mathematical skills was large in the classes. (Teacher 3/Sc 3/ 05.02.2015)

She further commented that;

We need to think about the Sri Lankan culture and traditions when we plan a lesson. Extended family is our nature. We inherit the concepts of 'peer

support' and 'mutual coexistence'. Generally by nature we are willing, supportive, and helpful to one another. Thus, the peer support system among students may owe its origin to their family and neighborhood systems. I think when we teach our students we need to provide opportunities for students to further strengthen such cultural values and norms of the society.

(Teacher 3/Sc 3/ 05.02.2015)

Mrs. Chandra had a clear idea of what she wanted to teach in the lesson. The lesson was determined by what she saw and heard from her students as they interacted with mathematics. She had her students work individually, in groups, on the blackboard, and used manipulatives to see what students were doing and what they were thinking. Mrs. Chandra also asked questions continually throughout all the sections of the lesson. I tried to count the number of questions she asked in the lesson and it was more than 80. Mrs. Chandra was careful about how students were processing and using what she was teaching in the lesson. She asked questions from the same student until she was confident that she understood what the student knew about the concept or procedure of the problem. Mrs. Chandra compared what she was seeing with what she was hearing to analyze deeper what the student's understanding was.

The student interview data suggest that the students had opportunities to engage themselves in group discussion and other classroom activities. Both boys and girls believed that they had the opportunity to clarify their doubts as and when required from both the teacher and their friends. This point is supplemented by the following comments made by the students during the interview:

Case3/ St.05: Whenever we do not understand the task or the process, we always ask from our madam, and also from our most able friends and then we get support and cooperation to understand the task.

Case3/St.08: Our madam is always with us and she helps us very much. If we have doubt, if we ask, she will explain it to us.

Mrs. Chandra appreciated students' attempts and used very friendly behavior with students and she explains;

I use motivational strategies as appropriate. Children are very much interested in such encouragements. They look for such appreciations; they express their positivism, when they are given positive feedback. But what is important in carrying those strategies in proper management. Otherwise, there can be

children who get misguided and do not achieve what they are supposed to achieve. (Teacher 3/Sc 3/ 05.02.2015)

Furthermore, she explained her plan to develop the low-attainers using different methods as below.

I'm always thinking about what I can do for them. I try to understand them and see what they're thinking. It helps me to understand some other ways to teach them. Furthermore, it helps me to identify the possible way to address their learning using different methods. (Teacher 3/Sc 3/ 05.02.2015)

According to Mrs. Chandra, her plan was on the understanding of those students and selection of relevant activities based on their requirements. In the observed lesson she tried to motivate those students by asking questions, explaining the procedure and giving opportunities to write on the blackboard. Additionally, Mrs. Chandra used manipulatives in her lesson. These objects were: beakers, bottles, water, fruit juice, blackboard, work books and exercise book which could be easily found in the school. She explained the reasons why manipulatives are an important part of her teaching of mathematics.

I think manipulatives help students understand what mathematics is. I prefer to teach mathematics where they develop their own learning. If we give them the tools they need and let them explore and try to solve a problem it is the base for constructing that learning. It helps the basic understanding. Some teachers think students don't need those things and just do the teaching in a traditional way. I know most kids do not learn that way. They'll learn it and it will stay forever with them if they use their hands and their eyes to do it.

(Teacher 3/Sc 3/ 05.02.2015)

The comment reveals that Mrs. Chandra had understood the importance of the manipulative in the teaching and learning process. However, lack of resources and classroom materials acted as one of the major constraints in her classroom. Those materials are provided only in limited quantities. In the absence of these basic required materials, there is little opportunity for her to make her mathematics learning motivating, enjoyable, and authentic to their learners. Most of the students agreed that working with friends and doing fun activities were the most attractive activities during their lesson. The following individual responses help to understand their preferences for the activities,

Case 3/St.01: it was very fun to work with friends. I can see what others are doing.

Case3/St.04: I like group work. I can work with others. I can ask help from friends.

Case3/St.05: I like group activity much more than the individual assignments, because when I work with others we can talk to each other and ask for help.

In addition, Mrs. Chandra was also in the opinion that her students were doing well in terms of collaboration and supporting each other in their activities in the classroom. This is the way she conducted the learner-centered approach in her class. For instance, she commented:

I can say they are doing very good in group activities. I try to give my support a while, and then give some activities to their groups. I encourage them to work in their groups, and with their friends. (Teacher 3/Sc 3/ 05.02.2015)

Mrs. Chandra was also in the view that the amount of material supplied to classes does not match the class size and she finds it difficult to give correct mathematical concepts such as different shapes. This point is further supplemented by the comments made by her;

This curriculum demands a lot of teaching-learning materials. There are so many activities which are to be taught through games. To carry out these activities, when teachers do not have enough materials, is very difficult. It was asking me to give printouts and handouts, and all. I have a real challenge in getting these things. I have to spend my own money. Thus, the lack of resources and materials can restrict the teachers' use of those new teaching strategies proposed in the new mathematics curriculum, as well as inhibit group-focused learning activities in the process of teaching and learning mathematics. (Teacher 3/Sc 3/ 05.02.2015)

According to Mrs. Chandra the support system does not provide adequate help to understand the instructional sequence of her mathematics teaching. Additionally she expressed her experiences that may be helpful to make sense of the participant's view of learning and teaching of mathematics.

..... I have been teaching for 19 years, and I have attended several training programmes on teaching for primary kids but never any workshop or training designed especially for low-attainers. So we are just using manuals, and we are just going through textbooks, and just teaching. So, we never got any training or seminar for coping with low-attainers! I know that today's lesson was not a perfect lesson. I learn every day.

.....Though the new reforms were introduced recently, I think the present mathematics curriculum does not offer enough opportunities for pupils to engage in critical thinking process, including problem solving, communication, and making connections. Still we consider the teacher as the centre of the teaching and learning process. In particular, the teacher was characterised as the knowledge provider who was to transfer information directly to the students without understanding. This is because of the exam-oriented education system.....

.....The implementation of new ideas in the current classroom is not possible for various factors such as overcrowded classrooms, lack of infrastructure of schools, examinations and time.

(Teacher 3/Sc 3/ 05.02.2015)

Here, the argument is that the current classroom environment limits the teachers' opportunity to take full advantage of the newly introduced curriculum in Sri Lankan schools. It is so intense and there is not enough time to teach the whole curriculum in one year; therefore it is tempting for teachers to load students' heads with readymade mathematical information that they are expected to remember and use in the exams. The present examination system forces teachers to use drill and practice methods for teaching and learning mathematics while expecting a learner-centered approach in the curriculum as Mrs. Chandra said:

The present curriculum encourages play and fun activities when we are teaching. Teachers' guides and workshops encourage us to carry out those child-centered approaches. But as you know we have to train these kids for the Gr. five scholarship examination. This is the expectation of the school and the parents. I have to satisfy parents and school authorities rather than my pupils.

(Teacher 3/Sc 3/ 05.02.2015)

Mrs. Chandra further mentioned that there are some other aspects that need to be considered when she plans the lessons. For instance gender difference is also an influential factor in Sri Lankan schools. She commented that:

In my class, most of the girls are cleverer than boys in classroom tests. I arrange boys and girls in a same group when doing an activity and ask them to help each other; some of the boys do not like sitting and working with girls. They tend to avoid sitting with them and start talking only with boys.

(Teacher 3/Sc 3/ 05.02.2015)

To conclude, Mrs. Chandra had tried her best to introduce the mathematical concepts by using different approaches in teaching during her lesson. She used different activities and tasks within her lesson according to the objectives of the lesson. Generally, her lesson was focused on the whole class approach and individual attention. She understood the importance of helping low-attaining students with different approaches. She mentioned the existing difficulties which affected to her teaching and those barriers are beyond her control. However, I have noticed that, most of the low-attaining students engaged in the assigned activities in lively manner.

4.5 The case Four

4.5.1 Background of the school

The selected school for the fourth case study was also in Kandy educational district, Central province in Sri Lanka. The distance to the school is about 2 miles from the Kandy city centre. It was established in British colonial period in 1913 by the Christian missionaries. The area can be considered as urban. It took approximately 30 minutes for me to go to the school by community transport service. The school was nestled into a neighborhood with business centers and small shops. The school was on the right side of the main road which leads to north western province, Sri Lanka. Heavy traffic jam and the noise of the vicinity were the main disturbing factors which affect the smooth functioning of the school. The main entrance to the school was directly through the small shops and homes. The school land was surrounded by a brick wall. There were small areas of flowers and plants from the entrance to the main building. There were two permanent and one temporary building in the school. The office of the principal was a small room about 200 square feet which was arranged in the main building of the school. There were four primary grades in the same building including the grade four classroom. The school did not have a play ground or area where students could play or carry out their extra activities. There was an open air theater which student could use for aesthetic activities.

The school was categorized as type 3 by the Ministry of Education and student population was 227 with grade levels ranging from 1 to 5. All the pupils are eligible for free school meals based on their parents' income. Free textbooks and uniforms are provided by the government. The school had 17 teachers (15 females and 2 males) including the principal. Teacher-pupil ratio of the school was 1:13. All the teachers were qualified and trained. There were five graduate teachers and ten primary trained teachers among them.

The attainment of the students in the Gr.5 scholarship was very low. Only one student has qualified from the Grade 5 scholarship examination in the last year. However, six students have reached above the average mark of 100 from the examination. The proportion of low-attaining students in mathematics was comparably higher than the other subjects. The following table shows the number of students who recorded below 40% for mathematics in primary grades for the year end test in 2014 conducted by the Department of Education Central Province.

Table 4.4: Low attaining students in primary grades (Case 4)

Grade	Nu ,of Students	Number of low -attaining students
Gr.1	43	Not evaluated
Gr.2	38	17
Gr.3	33	16
Gr.4	27	10
Gr.5	23	13

Source: School census 2014

The primary classes were in good condition in terms of separated classrooms, desks and chairs and other relevant equipments. The observed Grade 4 class was in the middle of the building and is provided with most of the facilities needed for a primary classroom such as water, electricity, desk and chairs. The students were divided into five groups and some of them were seated opposite to the blackboard and teacher's table. There were few pictures and posters on the walls.

4.5.2 The case of Mrs. Damayanthi

Mrs. Damayanthi has taught for last 17 years in primary grades and 4 years in this school. She has completed her diploma in teaching from a College of Education in Sri Lanka and has attended several in-service teacher training programmes designed for primary teachers conducted by various educational institutes in Sri Lanka. She currently teaches all the primary subjects except English. Mrs. Damayanthi said that she is not satisfied with the condition in the present school. Before the formal interview she made the following comment on the present situation of the school;

I have experience about 17 years and I am working with several difficulties in this school. Nobody wants to develop these types of schools. All the facilities

and supports are provided for prestigious town schools, this is the sad situation of our system. Sometimes, I feel fed up with this situation. It's very difficult to work with these students. They don't want to learn. I have no enough space in this classroom either. (Teacher 4/Sc 4/ 027.02.2015)

Mrs. Damayanthi had not prepared a detailed lesson plan for the observed lesson and she gave the reason like this,

Everything is given in the text book and the workbook. Teachers' guide provides a comprehensive path to carry out a lesson. Therefore, I think it is not necessary to write these things again and again.

(Teacher 4/Sc 4/ 027.02.2015)

The topic of the observed lesson was word problems on multiplication and the lesson had three phases basically. They were as follows;

- Introduction to the lesson
- Activities on the blackboard
- Individual work

At the beginning of the lesson Mrs. Damayanthi asked few random multiplication problems from the whole class. 8×4 , 6×7 , 7×8 , 4×8 were the problems she asked from the students. While low-attaining students were remained in silence few able students provided all the answers to the given problems. Mrs. Damayanthi appreciated them. Then, Mrs. Damayanthi moved to the second phase of the lesson and she wrote down two word problems on the blackboard and quickly worked out those two examples. Students were asked to copy them down in their books. I noted that one low-attaining student was very confused and whispered to his desk mate telling him that he did not understand the way the teacher solved the two problems on the chalkboard. The desk mate told the teacher, but the student who complained denied having said anything to that effect. Mrs. Damayanthi just proceeded as if nothing had happened. She asked them to be silent and look carefully how she works out the tasks. Mrs. Damayanthi did most of the work without explaining to the students.

For the next step of the lesson, Mrs. Damayanthi wrote down a word problem on the blackboard and asked one students to come forward and solve it. One able student came very quickly to the blackboard and solved the problem correctly. After the student had finished working out the problem she appreciated him but did not comment on the procedure he applied to solve the problem. The student was also not given a chance to explain his work.

Then, Mrs. Damayanthi wrote a new word problem on the blackboard and finished working out the problem by herself. She asked students to copy the example. Then, she asked students to turn to page number 53 of the workbook and solve the given four word problems as soon as possible. She advised not to talk or copy from others. Some able students have shown very confident about the given task while low-attainees were in gloomy faces. Mrs. Damayanthi talked to the students with difficulties. "I gave you enough examples. I did few examples yesterday also. Today is your turn to multiply and find the correct answers. I will not give you another example. Now it is your turn to show your skills". However, all the low-attaining students were quiet, but some students exchanged glances as if they did not agree with what the teacher said. Most of the low-attaining students in the class looked confused and frustrated. They did not seem to know what they were supposed to do.

Fifteen minutes before the end of the lesson, Mrs. Damayanthi stopped the students from working-out the given word problems and told everybody to pay attention as she worked out the problems on the blackboard explaining step by step to the students. "Look here, is this difficult? This is what I told you yesterday. It is because you do not pay attention when I was explaining. Is it clear now?" asked Mrs. Damayanthi, looking disappointed. "Yes madam," all students responded in chorus as if they wanted to please their teacher. However, in the interview low attaining students responded as follows;

Case4/St.04: When our madam starts the math lesson it is boring. She always uses the blackboard and asks us to do the calculations. I don't like it.

Case4/St.05: I didn't understand today's lesson. I don't like to sit and do the math. I like to do activities with my friends but in our class we didn't do activities.

Case4/St.06: Our madam is very strict. She beats us when we do a wrong calculation.

Case4/St.09: She asks us to go up to the blackboard and do some of the problems. I was always scared of doing that.

According to the above mentioned responses, most of the low-attaining students of the observed classroom did not like the way of conducting the lesson. They feel frustrated or scared when Mrs. Damayanthi asked them to come forward and do some work on the blackboard. The lesson was over before 10 minutes of the expected time. There was no evidence of written feedback or comments from Mrs. Damayanthi in the students' notebooks. She used a red pen either to cross off wrong answers or to mark correct answers. Crossed off

work seemed to mean nothing to the students. There was no credit given for good effort. I raised the questions regarding her method of teaching and her answers were as follows;

Me: I noticed that most of your students were not able to understand the multiplication of the given word problems correctly. What could be the reason?

Mrs. Damayanthi: Most of these students are lazy and playful. They do not study at home.

Me: Were problems 2 and 3 related to the examples you gave yesterday?

Mrs. Damayanthi: Yes, they are. These students already know multiplication table. It is not necessary to show them how to multiply numbers again. I put a multiplication table on the wall and I have also asked them several times to keep it in mind. (Teacher 4/Sc 4/ 27.02.2015)

Mrs. Damayanthi did not use different techniques of classroom management as recommended by the Grade four teachers' guide. According to grade four teachers' guide teachers need to connect their teaching of mathematics with good classroom management techniques. Mrs. Damayanthi explained her classroom management techniques in the interview as follows;

As you see in my lessons I use the whole class instruction most of the time, then group activities and individual work. I used different methods, whatever is good for them. I think that students are more accountable to mathematics if they discover it on their own. Therefore, I am trying my best to keep students working on the task. I support them as necessary. I do not believe these so-called classroom management techniques can be effectively used for these students. (Teacher 4/Sc 4/ 27.02.2015)

According to her comment, she believes that it is not important to include different management methods in her classroom. However, in her class most of the students were confused or did not understand what they are supposed to do. Mrs. Damayanthi tried to complete the task without getting feedback from the students. Students were silent and the teacher did not pay attention to their individual needs. She did not use adequate methods of classroom management techniques suitable for her students, as she mentioned. However, she further commented that;

I have learnt how important the organization of classroom environment is when we are teaching. I used these methods in my previous schools also.

However, I noticed that some students are not interested in listening to what I'm teaching in the class. Therefore, naturally I tend to act as a traditional teacher. (Teacher 4/Sc 4/ 27.02.2015)

I observed two low-attaining pupils were playing with pen clips instead of listening to the teacher. Mrs. Damayanthi ignored those students and showed dislike to talk to them and give instructions to them. However, she explained further her strategy for developing low-attainers;

Besides these problems faced, I took several measures to improve them. For instance, discussing with their parents, conducting after school classes and getting support from the able students are used. (Teacher 4/Sc 4/ 27.02.2015)

I have seen that the shortage of teaching and learning materials and not paying special attention while teaching were the main problems in coping with low-attaining students. No adequate attention was paid to those students during the observed lesson. Additionally, I noticed that teacher did not use manipulatives to motivate her students. She used verbal explanations and questioning only. At the interview Mrs. Damayanthi responded like this;

I know learning aids are important to understand a mathematical concept. However it is very difficult to use those materials for each and every lesson. The government does not provide these materials adequately, so how can the teachers use them? I cannot buy these things spending my own money or ask poor parents to buy those for me. (Teacher 4/Sc 4/ 27.02.2015)

According to this comment, it is reasonable to assume that Mrs. Damayanthi has understood the importance of using teaching and learning aids in the lessons. However, as she mentioned the lack of resources acts as one of the major constraints in her classroom. Those materials are provided by the authorities only in limited quantities. In the absence of these basic required materials, she faces lots of difficulties in teaching. Furthermore, she claimed lack of support given to develop her understanding about the mathematical concepts and teaching methods as follows;

Director and In-service Advisor (ISA) provided two one day training sessions during the last school term for the primary teachers in our Zone. Those two day programmes covered all the subjects in the primary grades. We did not get anything on developing low-attainers. Textbook and the teachers' guide are

the main sources I used in planning my mathematics lessons. Not only that, we don't have internal observation or peer evaluation system in this school.

Teacher 4/Sc 4/ 27.02.2015)

Mrs. Damayanthi felt that she was not provided with adequate help to understand the instructional sequence of her mathematics teaching. She used the students' textbook and the work book for her lessons. Additionally she mentioned that her school did not use internal observation or peer observation to improve the teaching and learning process. Furthermore, she commented that the current examination-oriented education system of the country hinders the enjoyment of learning mathematics. She explained;

Pupils do not have time to engage in extra leisure activities. It is expected that teachers need to complete the entire syllabus before the examination date. The teacher is considered as the knowledge provider who needs to get all the responsibility to pass the students in these competitive examinations. The present system forces teachers to use drill and practice methods for teaching and learning mathematics. (Teacher 4/Sc 4/ 27.02.2015)

It was observed that some of the pupils with low mathematical skills did not know how to read and write numbers correctly. Mrs. Damayanthi said that she was conducting remedial classes for these pupils.

Streaming and remedial classes can be one way of helping these pupils because the time that should be spent for helping pupils with low mathematical skills during mathematical lessons is not sufficient. (40 minutes). Thus, if they attend remedial classes they can get enough opportunities to learn. (Teacher 4/Sc 4/ 27.02.2015)

However, within the observed lesson Mrs. Damayanthi did not guide the students as necessary. She spoke several times to the students with behavioral problems and who disturbed others. She told me later in the interview,

There is no enough time for helping each pupil with low mathematical skills during my normal mathematical lesson. I can't use a variety of teaching methods such as group discussion and games. I use the lecture method mostly. However, as I told earlier I use extra after-school classes one or two times for a week for these low attainers.

(Teacher 4/Sc 4/ 27.02.2015)

I observed Mrs. Damayanthi using some motivational techniques during her lesson. For instance she appreciated the whole class while demonstrating on the blackboard. Furthermore, she marked the students' work randomly and praised the students who wrote correct answers. Some of the pupils with low mathematical skills did not make corrections while some others corrected their wrong answers although she did not mark corrections made by them. She always highlighted that lack of resources caused the poor level of teaching in her classroom. I did not see that different teaching and learning materials were used during the lesson. The teacher always used verbal expression during her lesson. In contrast, students explained the ways that they like to learn;

Case4/St.02: I like to work with manipulatives. But we do not use much in our classroom.

Case4/St.09: In my early grades we did activities with manipulatives. Now we are not using much.

Case4/St.06: Very funny working with instruments. I can use them with friends. I can learn how to work with them. But we don't have a chance to use them in our classroom.

According to the interview responses of students it is clear that they like to be in a class which is more supportive and helpful for them. They feel shy or scared when they are alone where they are assigned to complete a task without teacher or peer assistance. Furthermore, they said that they like doing group activities with learning aids but their teacher did not use those instruments as they want.

Case4/St.03: I need help to do math activities, if I'm alone I feel very distressed. We don't have a chance to use different games or activities for learning. We only use our work book always.

Case4/St.06: Our madam asks us to complete the problems in our workbook. We don't go outside our classroom or use such other activities to learn mathematics.

To conclude, Mrs. Damayanthi gave little support and interaction to the low-attainers during her lesson. Generally, there was a negative interaction between teacher and pupils with low mathematical skills while interaction between teacher and pupils with higher mathematical skills was positive. Furthermore, I noticed that the students demonstrated a large degree of non-involvement to the lesson. Students quietly copied down procedures without showing

any desire to learn the lesson. Mrs. Damayanthi frequently cautioned students who were seen whispering or moving around the classroom. Therefore, it is reasonable to say that the teaching and learning process of the observed lesson was not in accordance with the way required and prescribed in the new primary mathematics curriculum in Sri Lanka.

4.6 Conclusion

The purpose of this chapter has been to offer a general picture of four primary mathematics classes in Sri Lankan primary schools and provide the important comments on the teaching and learning process made by the teachers regarding their lessons and particularly on low-attaining students during the interview. The low-attaining students' experiences in learning mathematics were also highlighted when analyzing each observed lesson. It is recognized that the existing classroom practices of mathematics education in observed primary schools were different from school to school and from teacher to teacher. Teachers have shown different abilities and attitudes regarding the teaching and learning process. The selected teachers showed the importance of having different approaches in teaching low attaining students, but they added that they are not able to put the expectations of the curriculum into practice due to varied reasons (including institutional constraints). These difficulties emerged externally and internally. Additionally, most of the low attaining students mentioned that their experiences of learning mathematics were negative and they felt learning mathematics is very difficult.

Based on these evidences from the classroom observations and the interviews, I have understood that several barriers affect the smooth running of teaching and learning process of selected schools. As a result of this situation low-attaining students were neglected or not provided with adequate support to overcome their problem of low mathematical skills. Within the next chapter of this report, I will give a cross-case analysis under the emerged themes from the above-mentioned four cases.

CHAPTER 5: CROSS-CASE ANALYSIS

This chapter gives an overall picture of the findings of this study by bringing together the major findings from the individual case studies. I tried to understand context and issues with regard to particular cases. I explored the meaning of the cases through “categorical aggregation” and “direct interpretation” (Stake, 1995). I used these strategies to reach new meanings about the cases through the aggregation of instances until something could be said about the present situation of learning mathematics of low-attainers in primary grades in Sri Lanka. To meet the expectation, this chapter includes the results of the cross-case analysis under the emerged themes and sub themes from the classroom observations and the interview results. The main themes identified from the four cases are as follows:

- Teachers under pressure in teaching
- Problem of time management
- Emotional reactions of students in learning mathematics

Under those main themes the following crucial sub themes were also identified.

- Physical environment of the schools
- The lack of resources
- Lack of expertise in teaching mathematics
- Poor support system
- Pressure of examinations
- Parents’ attitudes
- Gender issues
- Problem of time management

The cross-case analysis is done under the identified main themes and sub themes.

5.1 The teachers under pressure in teaching

According to the data gathered from the cases, I noticed that teachers were under pressure in teaching due to many reasons. Locations of the schools, lack of resources, lack of expertise in mathematics education, poor support systems from the respective authorities, pressure of examinations, parents’ attitudes and gender disparities were the main reasons given by the interviewed teachers. The findings are given under these sub themes.

5.1.1 Physical environment of the schools

According to teachers' comments, the school location was a main difficulty faced by some of them in the teaching and learning process. The selected schools represent different areas in Kandy educational district in urban, sub -urban and rural settings in Sri Lanka. The intake of these schools is predominantly Sinhalese and all the pupils are eligible for free mid day meals, textbooks and uniforms provided by the government, based on their parents' income. Water, electricity and building facilities are provided by the Ministry of Education for these schools. However, as one teacher made clear,

It is difficult to get maintenance costs of those facilities from the government funds so school authorities need to generate that money from the parents as school fees or as donations. The Ministry of Education encourages these types of fund raising activities. We need to do all these extra things while teaching

(Case1/Teacher interview/ 09/01/2015)

On my visits to schools I noticed a number of examples of facilities and levels of maintenance which seem to have an impact on students and teachers. In one school, I noticed a bad smell from toilets that were not cleaned regularly. I noted these situations in my field notes as follows;

The schools did not have separated classrooms even for primary classes. The noise was very high. In addition to that, the school was located between a railway line and the Kandy Colombo main road (A1) and noise of the trains and the vehicles disturbed the smooth running of the school. Gas exhaust from hundreds of thousands of vehicles may cause health problems in the school population. (Case1/ Field notes/ 09/01/ 2015)

The school had buildings on either side of a main road, with no pedestrian crossing for students and teachers. The school had a playground area, including a large sandy area in the shade of a tree. However, the area was not well maintained: Five dogs slept on the sand and I noticed that they were moving around the school during the interval looking for some food from students. (Case3/ Field notes/ 05/02/ 2015)

The teachers of those schools expressed their unhappiness about the existing situation and facilities provided by the respective authorities as follows;

I am very much upset by the school location. Noise level is very high and it is difficult to do a good lesson. Students do not have basic facilities in this school. Students are packed within this small room. All other classes are the same in this school. (Case1/Teacher interview 09/01/2015)

I don't like to work in this type of a school. This is our fate. Government neglects these kids. (Case 2/ Teacher interview 27/01/2015)

I have to travel a long distance to come to the school. I have to spend about two hours in three busses and feel very tired when I come to the school. It is difficult for me and I made several request for a transfer to a convenient school, but no vacancies are available in those schools.

(Case 4/ Teacher interview/ 27/02/2015)

Teachers felt that they were neglected by the respective people in authority and they cannot make a positive impact on students' learning under these difficulties. Students also commented negatively on my question regarding the school environment: *How do you feel about your school and classroom environment?*

Case1/ St.04: Our sir does not use many activities in the classroom. We need to go outside if we need to do such activities because our classroom is too small.

Case1/St.04: Noise of the train and the vehicles is very high. It is difficult to work inside the classroom when train is honking.

Case 4/St.03: We don't have a space to play. Our madam doesn't allow us even to talk inside the classroom.

Case4/St.03: I am walking about four kilometers to come to the school. There is only one bus to and from the Kandy town. It is very difficult to get into the bus due to heavy crowds in peak hours.

Therefore it can be said that the physical environment of the school has affected the teaching and learning process of the selected schools. Most of the the teachers and the students of the selected schools felt that they were under pressure due to the existing poor physical conditions of the schools.

5.1.2 The lack of resources

According to the data gathered from the selected cases, lack of resources was a main factor to increase the teachers' pressure in teaching and this was noticed in two respects, namely physical arrangement of the classrooms and the availability of required materials.

It was clear that the physical arrangement of the observed classes were not supportive for successful learning. Lack of basic facilities "space for movement for the activities", empty walls and shelves without displayings, classrooms without separation and poor classroom arrangement were the main problems I have noticed from those classrooms. The situation of the observed four classrooms and other classrooms of the schools were shown in the following photographs.



Figure 5.1: Lack of space for the students' work



Figure 5.2: Lack of space for students' movement



Figure 5.3: Lack of basic facilities



Figure 5.4: Walls and shelves without displayings



Figure 5.5: Walls and shelves without displayings



Figure 5. 6: Walls and shelves without displayings



Figure 5. 7: Poor classroom arrangement



Figure 5.8: Classes without separation

There were a few visual posters on walls, windows, or around cupboards in the observed classrooms but I noticed that it was uncommon to see any displayings relevant to the concepts of mathematics. The following extract from my field notes is an evidence for the classroom arrangements which are not supporting students' learning.

Some students were seated facing away from the blackboard. They turned back when they were expected to look at and copy the displayed material on the blackboard. Students could not move when they need to do activities. Smaller desks and chairs did not fit with some students and they were seated uncomfortably. (Case1/Field notes/ 09/01/ 2015)

Students also commented negatively on the existing classroom situation of their school.

Case1/ St.04: I like to play and do activities with my friends while learning. Our sir does not use many activities in the classroom. We need to go outside if we need to do such activities because our classroom is too small.

Case 1/st.13: We need to jump over the tables to go to the blackboard or go to the toilet. One day he (pointed to one student) fell down from a desk (all were laughing together).

In terms of other materials, textbooks, workbooks, blackboards, teachers' tables and chairs, students' desks and chairs and a few posters on the wall were the main resources available in the observed classrooms. Though they suffered from lack of basic resources, teachers of the study agreed on the importance of using learning aids during their lessons, especially for low-attainers. However in practice, most of them used only mathematics textbook in their lessons. At interview they gave the reasons for the question: *What are the barriers to carry out instructional sequence and relevant tasks of your lessons?*

We don't have enough resources for quality mathematics lessons. However I tried to manage with existing resources. Here, I tried to use the teachers' guide and work book during the lesson. I am not in a position to use pre prepared learning aids for students. The problem is beyond my capacity

(Cas1/Teacher interview/09/01/2015)

Teaching and learning resources are important, but the problem is preparing and maintaining cost. I have to bear all the expenses from my salary. Main

problem is the difficulty in getting support from the school or from the poor parents. (Case2/Teacher interview/27/01/2015)

However, low attaining students of the sample showed their enthusiasm to work with extra resources and expressed how those manipulatives affected their learning.

Case1/ St.02: I like to work with manipulatives. But we do not use them much in our classroom.

Case 3/St.08: I like to use resources to learn. I can get support from others to solve the math problems. Some students grab them and do not like to give me. We need more of them for group works.

Case 4/ St. 05: I like to do activities with resources but our madam does not give us. She always asks us to use the textbook and solve the given problems in our work book.

I noticed that in one case, when students had to share the available resources it tended to be a silent conflict between able students and the low-attainers. This mostly happened when boys and girls were in the same group. For instance Mrs. Chandra (Case3) used a few materials for the lesson development and students were asked to share the materials within their groups. There were occasions, when some pupils had to share the equipment, they tried to grab the materials and did not give them to other group members. This most commonly happened when boys and girls were in the same groups. Always boys dominated in using materials. Some of the low attaining pupils gave up the activity and started chatting pointlessly with others. However Mrs. Chandra showed awareness of the need for low-attaining pupils to be able to focus on the task in hand. Chandra pointed out that:

I know the importance of having resources and using different teaching strategies for different learners. We do not have enough resources and Ministry of Education does not give us in sufficient numbers. However, I spent my own money and parents helped me to prepare some materials for my lessons. I always encourage pupils to work together using those materials..... This is a very good practice for them to learn mathematics and also to learn to work collaboratively with others.

(Case2/Teacher interview/ 27/01/2015)

Based on the above-mentioned evidence it seemed reasonable to conclude that the teachers of the selected sample were under pressure due to lack of required resources and that situation had directly affected students learning.

5.1.3. Lack of expertise in teaching mathematics

Basically, all teachers selected for the study were qualified and they had more than ten years' experience of teaching in primary classes. The educational and professional backgrounds of the selected four teachers are as follows:

Table 5.1: The educational and professional background of the selected teachers

Name	Years of service	Educational qualifications	Professional qualifications
Mr. Ananda	15	B.A general	Diploma in Teaching
Mrs. Bandara	14	GCE (A/L)	Diploma in Teaching
Mrs. Chandra	19	B. Ed.	B. Ed.
Mrs. Damayanthi	17	GCE (A/L)	Diploma in Teaching

Furthermore, some of the teachers of the sample said that they were satisfied with the teaching profession and helping young children.

Education is in our family and something I wanted to do. My parents are also teachers. I have noticed how they dedicated their lives for students' progress. I believe that I got this experience from them. I really like watching kids learn, especially primary graders. (Case 3/Teacher interview/ 05/02/2015)

I like to work with primary pupils and see their development. I also have two kids and these pupils are same as mine. I know that it is my responsibility to help them form a firm foundation for their future life.

(Case 2/ Teacher interview/ 27/01/2015)

However, most of the teachers of the sample did not consider themselves as successful teachers due to their lack of specialism regarding the problem of low-attainment. They thought that the training programmes did not provide adequate training to support low-attaining students. The following comment revealed their thinking.

..... I have to teach all the subjects including mathematics for these young kids. However, my mathematics background is very poor. I did mathematics for GCE (O/L). That's it. I followed arts subjects for the G.C.E. (A/L). I have participated in two in-service workshops during my career. Those workshops were designed especially for the primary teachers, not for teaching mathematics. Therefore, I tried to follow the text book and the teachers' guide without adequate support from the experts in the field. I am trying but I feel like I cannot deal with children with different ability levels though I use different types of teaching and learning strategies.

(Case1/Teacher interview/09/01/2015)

According to this comment the teacher does not consider himself as successful in the profession and had no sound mathematics knowledge. Furthermore, the process of gaining knowledge about the problem of low-attainment is also not up to a satisfactory level. Therefore most of the teachers had depended on textbooks rather than using manipulatives to deal with the problem of low attainment. Sometimes they did not show understanding of the importance of using extra materials in the teaching and learning process. The following comment shows how one teacher felt about the additional materials;

Mostly I depend on the teachers' guide and the textbook which was recommended to us. The lesson needs to be completed within the given time. I don't want to use so many materials or books for helping my students. It is an extra burden for me and a waste of time.

(Case 2/ Teacher interview/27/01/2015)

However, the following comment elaborates a different aspect of the problem and it shows how the lack of opportunities has caused the teachers' poor knowledge to address the problem of low-attainment.

..... I have been teaching for 19 years, and I have never attended any workshop or seminars or training designed especially on learning difficulties of young learners. So we are just using manuals, and we are just going through textbooks, and just teaching. We never had any training for coping with low-attainers! I know that today's lesson was not a perfect lesson. I learn every day. (Case3/Teacher interview/ 05.02.2015)

One teacher claimed that the behavior of the students forced them to act as a traditional teacher though they were aware of some techniques to cope with low-attaining students. She thought that it was students' fault that did not allow her to do a good lesson for them.

.....I noticed that some students were not interested in listening to what I was teaching in the class. Therefore, naturally I tend to act as a traditional teacher. (Case4/Teacher interview/ 27.2015)

Additionally, the existing opportunities to gain knowledge and skills were also criticized by the teachers based on the content and the school practice.

Director and In-service Advisor (ISA) provided two one day training sessions during the last school term for primary teachers in the Zone. Those two day programmes covered the whole range of subjects in the primary grades. We were not given instructions on developing low-attainers. we don't have internal observation or peer evaluation systems in this school.

(Case4/Teacher interview/ 27.02.2015)

According to the above-mentioned evidence it seemed that although the selected teachers had much experience in teaching, they are not feeling satisfied about their knowledge to deal with low-attainment of the students and have not received an adequate specialty on the problem of low-attainment from relevant authorities.

5.1.4 Poor support system

The observed teachers believed that they cannot solve the problem of low-attainment alone because it needs to be organized as a collective effort. The educational authorities and school communities need to work collaboratively to overcome the situation. Observed teachers made it clear that they had identified the problem and tried to help those students with the help of their parents. Furthermore, according to Mrs. Chandra's comment, other teachers of the school also need to consider the problem when they teach those students. This is not only the responsibility of mathematics teacher.

It is a natural thing that every child is not in the same levels of attainment. I have planned several activities for them with the support of their parents. Those pupils have struggled not only with mathematics but also with all the other subjects. Therefore, I need support from other staff members to help these students. (Case3/ Teacher interview/ 05.02.2015)

In contrast, the following comment shows the difficulty of asking for parental help to overcome the problem. It makes clear why parents are unable to support their children and to the teacher. My question was: *How do you get support from the parents to help students who are not performing as expected?*

They need more attention and need a lot of support in different ways. I think I have not enough time and training to give the support necessary for them. I talked several times to their parents. Unfortunately they don't know how to support their children. (Case 4/Teacher interview/ 27.02.2015)

Parents of low-attaining students insist that there is no time to support their children because they have to do their jobs. Almost all of them don't have mathematical skills to teach their children. Even if they have such skills, they don't have time to do so. As the class teacher I need to do everything for the betterment of these pupils. There are too many expectations from the school and from me. (Case1/ Teacher interview/ 09/01/2015)

Even though a learner-centered approach in the teaching and learning process was recommended by the new curriculum for the primary pupils most of the teachers felt that the respective authorities do not provide required support to carry out the recommended activities. Teachers spend their own money for the preparation of resources for teaching. The situation was explained by a teacher like this;

Although the learner-centered approach was recommended by the new curriculum, there are so many factors acting as barriers for its successful use. Training opportunities, time restrictions, resources, space and lack of commitment of the students are those barriers. I cannot change these factors alone. I need more resources to use the learner-centered approach, but the problem is preparing and maintaining cost. I have to bear all the expenses from my salary. The main difficulty is that it is difficult to get support from the school or from the poor parents. I prepared a few of them and use those appropriately. (Case2/ Teacher interview/ 27/01/2015)

I know learning aids are very important to understand a mathematical concept. However it is very difficult to use those materials for each and every lesson. The government does not provide these materials adequately, so how can the

teacher use them? I cannot buy these things spending my own money or ask poor parents to buy those for me. (Case 4/Teacher interview/ 27.02.2015)

Teachers said that they knew the importance and relevance of materials for supporting students' learning but shortage of those materials hindered their capability of teaching. One teacher commented on the issue as follows;

.....it was asking me to give printouts and handouts and all. I have a real challenge in getting these things. I need to spend my own money. Thus, the lack of resources and materials can restrict the teachers' use of those new teaching strategies proposed in the new mathematics curriculum.....

(Case3/Teacher interview/ 05.02.2015)

In addition to that, the following comment clearly shows how the teachers feel about the actions of higher authorities and their support to address the issue.

.....The implementation of the new ideas in the current class room is not possible for various factors such as crowded classrooms, lack of infrastructure of schools, examinations and poor support from the respective people such as DoEs, ISAs and school level authorities.....

(Case3/ Teacher interview/ 05.02.2015)

The interviewed teachers felt that in order to overcome the problem of low-attainment there needs to be a collective effort by all the relevant people. They further raised another important aspect for the consideration of developing a valid support system to schools. According to them, Sri Lankan tradition and culture needs to be considered when designing a curriculum rather than copying from elsewhere.

We need to think about the Sri Lankan culture and traditions when we plan a support system for the teachers and the students. Extended family is the nature of our country. We inherit the concepts of 'peer support' and 'mutual coexistence'. Generally by nature we are willing, supportive, and helpful to one another. Thus, the peer support system among students may owe its origin to their family and neighborhood systems. I think when we teach our students we need to provide opportunities for them to further strengthen such cultural values and norms of society. (Case3/ Teacher interview/ 05.02.2015)

However, the teachers felt that finally they get the burden and that they become the victims of this poor support system. The isolation of the teachers may cause them to neglect the students and their levels of learning. The following comments revealed the feeling and distress of the interviewed teachers.

I have no extra support to meet the problem of low-attainers. No school or educational authorities support us to facilitate those students. The problem is inherent. Finally we are the victims. We have to carry the entire burden without any appreciation. (Case1/ Teacher interview /09/01/2015)

However, although they faced several difficulties, another teacher explained her strategy for the development of low-attainers besides these problems she faced. My question was: *What is your plan to overcome those barriers?*

It is our responsibility to support students in learning, no matter the difficulties we face. I arrange after-school classes for them and help them with the support of donors to purchase some stationery such as books, pens and pencils. (Case4/Teacher interview/ 27.02.2015)

5.1.5 Pressure of examinations

The education system in Sri Lanka is recognized as examination-oriented and those examinations are highly competitive in general. Students are trained to show their cognitive skills by answering written papers and there is very little or no provision to measure their attitudes and skills such as social and behavioral. Teachers are encouraged to complete the syllabus as soon as possible and forced to prepare students to get higher marks from these competitive examinations. This situation appears to badly affect the successful implementation of the child-friendly activities which have been recommended by the new curriculum because teachers also tend to complete the recommended activities in an adhoc manner. This was noticed in the classroom observation and one teacher expressed her sorrow when I asked the question: *The syllabus recommends a learner-centered approach. Do you follow these recommendations?*

I think the present mathematics curriculum does not offer enough opportunities for pupils to engage in critical thinking process, including problem solving, communication and making connections. Still we consider the teacher as the centre of the teaching and learning process. In particular, the teacher was characterised as the knowledge provider who was to transfer

information directly to the students without understanding. This is because of exam-oriented education system.....

.....The implementation of new ideas in the current classroom is not possible for various factors such as crowded classrooms, lack of infrastructure of schools, examinations and time.

(Case3/Teacher interview/ 05.02.2015)

The argument is that the current exam-oriented education system limits the teachers' opportunity to take full advantage of the newly introduced curriculum in Sri Lankan schools. It is so intense and there is not enough time to teach the whole curriculum in one year; therefore it is tempting for teachers to try to load students' heads with readymade mathematical information that they are expected to remember and use them in the examinations. Additionally, the present examination system forces teachers to use drill and practice methods for teaching and learning mathematics though a learner-centered approach is expected in the curriculum. A teacher of the sample commented that;

The present curriculum encourages play and fun activities when we are teaching. Teachers' guides and workshops encourage us to carry out those child-centered approaches. But as you know we have to train these kids for the Gr. five scholarship examination. That is the expectation of the school and the parents. I have to satisfy parents and school authorities rather than my pupils.

(Case 3/Teacher interview/ 05.02.2015)

Another teacher commented on how the existing system negatively affects teaching and learning process and the students' enjoyment of learning;

Pupils do not have time to engage in extra leisure activities. It is expected that the teacher needs to complete the entire syllabus before the examination date. The teacher is considered as the knowledge provider who gets all the responsibility to pass the students in these competitive examinations. The present system forces teachers to use drill and practice methods for teaching and learning mathematics. (Case4/Teacher interview/ 27.02.2015)

In the interviews with the students, they also agreed that they have no extra time for fun activities with their friends or family members. Parents send them to private tuition classes after the school and on holidays. Students and teachers have become the victims of this confused situation. Students expressed their unhappiness in the interview;

Case4/St.4: My mum always asks me to get higher marks for mathematics. She sends me to a tuition class in Kandy town on every Saturday. I don't like to go to the class.

Case4/St.5: I like to play with my friends. But in our class we do not have time and in the evening I have to do homework assigned by our madam or my mother.

Case4/St.09: My father is always saying that if I want to go to a good school I must pass the scholarship examination. But I don't like to go to another school.

5.1.6 Parents' attitudes

The parents' attitude of low-attaining pupils was very poor according to the interviewed teachers and that has affected to increase the teachers' workload. Teachers believe that remedial actions need to take as a collective effort and this was clearly stated at the interview. My question was: *What do you suggest to improve the existing support system in schools in order to overcome the problem of low-attainment?*

I need adequate training on methods and techniques to help these students. Support from the mathematics adviser is important and need it in a regular basis. The school and parents need to have a collective effort to achieve the goals. I think parents need to get much responsibility to help their children and support us in our effort. (Case2/ Teacher interview 27/01/2015)

Parents' lack of commitment and the poor mathematical knowledge to support their children was also criticized by the teachers stating that their workload had increased as a result of this situation.

I need to teach all the subjects including mathematics for these pupils. There are too many things to do within a limited period of time. School does not give me any assistance in solving these difficulties. Parents do not have time to help their children or they don't know how to help them.

(Case1/ Teacher interview 09/01/2015)

Although parents do not support their children at home, teachers feel that they expect everything needs to be done by the teachers to improve learning of their children. This situation was explained with negative feelings;

Parents expected everything in the curriculum to be covered by teachers. It was very hard to tailor to the curriculum without the support from them.

(Case1/Teacher interview/ 09/01/2015)

Finally, how the teachers and their students became the victims of poor planning of the existing mathematics education was mentioned at the interview like this;

.....as you know we have to train these kids for the Gr. five scholarship examination. That is the expectation of the parents as well as the school. I have to satisfy parents and school authorities rather than my pupils.

(Case3/Teacher interview/ 05.02.2015)

5.1.7 Gender issues

Gender issues among the students were a common problem among the observed classrooms. The teachers mentioned this issue at the interviews as a disturbing factor for their classroom activities. According to the evidence most of the boys do not like to work with girls and if they were in the same group, they noticeably neglected girls. Therefore, girls always tried to work with the same-sex and if they were with the opposite sex they tended to be silent or did not engage in the assigned activities. Therefore, teachers had to take extra actions to bridge the gap between them. One interviewee explained the situation as follows;

I arranged boys and girls in the same group when doing an activity and asked them to help each other. Some of the boys did not like to work with girls. I noticed that boys tend to avoid sitting next to a girls or work as a team. They talk only with boys and do not like to talk to or help girls.

.....Some students do not like to work with the opposite sex. I encourage them to do work within their groups, and with their friends but some students do not like to work with the opposite sex.

(Case3/Teacher interview/ 05.02.2015)

The discrimination of the boys in the classroom activities was evident and pupils also claimed their experience as follows;

Case3/St.05: I do not like to work with girls. Our madam puts us in the same group. I feel shy to work with them.

Case2/St.06: Some male friends in our class are very selfish. They don't like to help others.

Case1/St.07: I don't like to work with a group. Most of them are boys. They are not helping me.

According to the comments made by interviewed teachers, they were aware of the situation and had tried to take remedial actions to overcome the situation. The teacher of case number three explained the way she avoided the gender discriminations in her classroom and how she gives pupils the equal opportunities.

I treat students equally without their gender or differences. So, by using such structures, I think, I am trying my best to give them the equal opportunity and a learner-centered atmosphere. (Case3/Teacher interview/ 05.02.2015)

Some teachers believe that the situation is linked to a social problem and managing those issues is beyond their capacity. Teachers need to complete the syllabus within the allocated time and they neglect the other issues and force students to work cooperatively to complete the task.

Some pupils don't have social skills. They don't know how to work with others. I need to complete the syllabus without additional support to solve these social and mental problems. Sometimes I force pupils to work together and punish them if not. It is a sad situation.

(Case1/Teacher interview/ 09.01.2015)

According to this, it emerged that the teachers and some female students of the sample believe that gender issues amongst the students also negatively affect the teaching and learning process.

5.2 Problem of time management

Time management is an important aspect that needs to be considered in planning and implementing a lesson. During my observations and the interviews with teachers and students, they said that the allocated time for a lesson (40 minutes) was inadequate. Teachers need to complete the syllabus during the allocated time and they believe that this badly affects a successful teaching and learning process. In most of my observations I noted that teachers rushed to complete the lessons rather than paying individual attention to low-attainers and helping them to understand the tasks. My field notes include the situation like this;

Four students completed the entire task within the given time while a few students were struggling to understand the task. It appears that teacher made no attempt to engage with pupils' levels of understanding.

(Case1/Field notes/ 09/01/2015)

The teacher explained the difficulty in planning and implementing the lesson for the benefit of all students as follows;

I feel that there were few lapses in my lesson. I cannot manage the whole class with different levels of students and limited resources. Furthermore, within 40 minutes I cannot cover the whole aspect of the lesson. I need more time to rethink and help students.

(Case1/Teacher interview 09/01/2015)

Most of the observed teachers did not consider the mistakes made by low-attaining students. They completed their lessons without considering low-attainers' difficulties in completing the assigned activities. Additionally, teachers failed to complete the important aspect of a lesson such as motivational techniques, extra attention for low-attainers, waiting for the completion of the tasks, encouraging pupils to ask questions and engaging in a proper evaluation process during each stage of the lesson. Errors made by pupils were not used for reflection. The main focus was given to more able or average students. An interviewed teacher explained;

I think learning mathematics by doing is important, especially for those students with learning difficulties. It is necessary to plan suitable activities and also to encourage cooperative learning. I think that if we put children who have difficulties with mathematics together with those who are good at mathematics, they can help each other. In my lesson I did not use this because of the limited time allocated for the mathematics lesson.

(Case1/Teacher interview/ 09/01/2015)

Low-attaining students also said that they need more time to complete the assigned activities and need a clear explanation from their teacher. If teacher goes fast they felt uncomfortable in the class.

Case2/St.09: learning mathematics is very hard. No enough time to complete the activities.

Case3/St.05: If teacher explains slowly I can understand. When she goes fast I feel uncomfortable.

Furthermore, the observed teachers said that the current examination-oriented education system forced them to complete the lessons quickly and this situation affects the enjoyment of learning mathematics.

When we were students we engaged in a lot of activities and fun games. We spent our younger days freely. I feel sorry for these kids today. They do not have fun time due to this competition. I think they are also victims of this unnecessary race. (Case 4/Teacher interview/ 27.02.2015)

It was observed that some of the low-attaining pupils did not have basic skills, such as reading and writing numbers correctly. In three of the observed lessons the teacher did not guide these students as necessary. And also two teachers did not pay any special attention to the students with behavioral problems. Those teachers said that they do not have enough time to help those students during the allocated 40 minutes time. One teacher told me later in the interview;

There is not enough time for helping each pupil with low mathematical skills during my normal mathematics lesson. I can't use a variety of teaching methods such as group discussions and games. I normally use lecture method mostly... (Case4/Teacher interview/ 27.02.2015)

However, in the interview students showed their enthusiasm to do activities with their friends using manipulatives. However, they have felt that their teacher does not give an adequate amount of time for the completion of the tasks. They commented like this;

Case4/St.02: I like group activities. Our madam doesn't use much of those activities. She always gives us very short time to finish work.

Case4/St.06: It's very fun working with instruments. I can use them with friends. I can learn how to work with them. But we do not have time to use those materials. We need to do calculations within given time.

Based on the above-mentioned evidences it appears that teachers and the students of the sample were not satisfied with the existing time allocation for the recommended mathematics lessons. Both of them expressed the difficulties they face during the teaching and learning process. Therefore it is reasonable to contend that the problem of low-attainment in mathematics was not addressed properly due to the pressures of the time allocation in the syllabus.

5.3 Emotional reactions of students in learning mathematics

The consideration of the emotional reactions of the students is a crucial factor for the teachers to plan and implement the lessons according to the students' needs and levels of understanding. This was considered within this study and I gave my attention to investigate the students' feelings about the classroom experiences they received. During classrooms observations, I noticed that most of the low attaining students were off task or confused during the lessons and most of the teachers neglected them or gave poor attention to them. Therefore, I tried to find out the reasons behind the students' low participation in the lessons.

First, I tried to understand the students' feelings about learning mathematics by using the interview schedule attached to appendix 3. Some low-attaining students of the sample released their pressure as follows for the question; *Do you like leaning mathematics?*

Case1/St.07: I don' like. Learning mathematics is very difficult. I am afraid of the teacher.

Case2/St.09: Scared if I don't understand what teacher wants. Mathematics is very difficult. I don't like it.

Case4/St.07: I don't like mathematics because it is very hard. I cannot understand when teacher goes fast. Nobody is at home either to help me.

Case4/St.01: I feel bored and sleepy when our teacher explains the things without a break.

Case4/St.04: I'm very weak in mathematics. I can't understand when our teacher goes fast. I need more time to understand what she is explaining.

Furthermore, some of the students talked about their teachers' reactions when they failed to complete a given task. They expect kindness and help from the teacher but the teacher behaves differently. According to some students, physical punishment, strictness and blame are the common methods used by the teacher to control students during the lessons so, students feel unhappy about the situation and commented on the question of *what is your feeling about your madam's/sir's teaching style?*

Case1/St.04: We have a very strict Sir. He punishes us when we do wrong things.

Case2/St.06: We get blamed or physically punished in the classroom. I don't like to be beaten by a cane.

Case3/St.03: If I don't understand madam will punish me.

Case1/St.05: Sometimes I feel scared. I try to copy the correct answer from others.

Case1/St.06: Our sir punishes us when we do wrong calculations. Today he did not punish us because you came to our class.

Students' poor concentration was experienced by the teachers as a common problem during the lessons. I noticed that some of the observed teachers seemed unable to control the students during the lesson and some of the students shouted and did other things that they want. Teachers made attempts to bring them back to the lesson but they disturbed others after a very short silence. Both teachers and low-attaining students talked about the difficulties they faced during the lesson. These are the low-attaining students' comments on their peers' negative behavior;

Case1/St.04: I don't like when my friends are shouting and misbehaving. I cannot do my work and it is bad for our class also.

Case1/St.06: Some friends are always talking with others and doing other things in the classroom. Our sir punishes them sometimes.

Case4/.St. 04: I can't work sometimes. One of our team members (mentioned a name) always shouts and disturbs us.

Furthermore, they told how they feel alone during the lesson;

Case1/St.04: I don't know how to answer the given problems. No one helps me.

Case1/St.05: I like to work with others but they don't really cooperative. They don't help me. Teacher also helps only the able students.

In contrast, some students of the sample said that they had opportunities to engage themselves in discussion and other class activities with their able friends and that they always had helped them. This point is supplemented by the following comments made by the students during the interview to the question: *Which class do you want to be in and why?*

Case3/ St.05: I like my classroom because whenever we do not understand the task or the process, we always ask from our madam, and also from our most able friends and we get support and cooperation to understand the task.

Case3/St.09: Our madam is always with us and she helps us very much. If we have a doubt, if we ask, she would explain it to us. I like this way of learning.

Most of the teachers of the sample did not allow students to think learning mathematics is not as difficult as they have perceived. They commonly used only a few selected interactive activities, such as, teacher to the whole class interaction and teacher to individual interaction. Pair work and group work were used rarely in the class for developing a friendly relationship among the pupils. Pupils of the low-attaining group expressed their feelings on teachers' way of instruction for the question: *Which class don't you want to be in?*

Case1/St.02: It is boring and lonely when doing by ourselves using textbook and workbook.

Case1/St.05: I like working with my friends because sometimes they help me but our sir gives us more individual work.

Case2/St.05: When doing by ourselves it is boring and lonely.

Case2/St.07: When we work alone it may cause us to do the wrong things. We need help from our teacher.

Additionally, when students were assigned to complete activities in groups, I noticed that a few more able students dominated all the observed classes and most of the low-attaining students were silent. They did not ask any questions from the teacher to clarify the activity or the given task. It was clear that most of the low-attaining students were unable to participate in the given activity with other students. Many of the low-attaining students were quiet and did not engage with others throughout the time. At the interview they made the following responses for the question: *If you could not understand the lesson, what would you do?*

Case2/ St.09: I don't know what to do so I keep silent.

Case2/St.07: I feel shy to ask questions, my friends laugh at me and teacher helps only able students.

Case1/St.03: Sometimes it is difficult to understand the activities. I feel shy to ask help from able students. They cover the books and they do not like to help me.

Case4/St.06: Some classmates are very selfish. They don't like to help others. I do not like to talk to them.

However, some low attaining students said that they like to do activities with their peers and these types of activities helped them to understand the mathematical concepts. They further said that they like a classroom where they can actively engaged with their friends. They gave their comments as follows to the question: *Which class do you want to be in?*

Case2/St.08: I like to work with my friends. If I'm alone I cannot study well.

Case3/St.03: Individual work is difficult, I like working with others because I can get support from others.

Case1/St.05: I like to do fun games with others because we can talk to each other. I don't like too much writings in the exercise book.

Low attaining students felt nervous when their teacher asked them to come in front of the classroom and do some activities alone. Sometimes they were asked to do the demonstration on the black board or express the way of solving the given problem. Almost all of them expressed their pressure when I asked this question: *Which activity do you not like much?*

Case2/St.07: When our madam asked me to write on the blackboard, I don't like to go forward, I felt nervous at that time, but I feel comfortable when working individually or with friends.

Case3/St.03: I feel shy and afraid when teacher asks me to write on the blackboard. I feel that the others may laugh at me if I give an incorrect answer.

Case3/St.08: Teacher asked us to write on the blackboard but I don't like to go to write on the blackboard. I felt I feel very nervous tension at when working alone.

Case4/St.09: She asked us to go up to the black board and do some of the problems. I was always scared of doing that.

According to the above-mentioned responses, most of low-attaining students of the observed classroom did not like the way of conducting the lessons and some activities. They feel frustrated or scared when the teacher asks them to come forward and do some work on the blackboard.

One observed teacher included fun activities for her lesson and she expressed her view on how important those activities to raise the students' levels of understanding. Low-attaining students of that classroom also expressed their motivation to engage in these types of activities. I asked a question regarding the most interesting activity for them in the lesson: *Which activities do you like much?*

Case3/St.04: I like fun activities. Our madam uses these activities to teach us.

Case3/St.06: I like role plays. I like to watch and learn from those activities. I do not like to look at the books and copy the mathematics problems. It is boring for me.

Case3/St.05: I like telling stories and role plays very much. Our madam uses these activities.

When teachers failed to get students attention for the lesson they expressed their unhappiness like this;

Case4/St.05: I did not want to sit and do the math. I like to do activities with my friends but in our class we didn't do activities.

Case4/St.04: When the teacher starts the math lesson it is boring for us. She always uses blackboard and asks us to do the calculations. I don't like it.

The following extract from my field notes shows the students engagement and their willingness to do these types of fun filled activities in the classroom.

Most of the students of the class raised their hands and jumped up to give the answers. Mrs Chandra got the answers from the students and asked one student to come forward and write the amount on the blackboard. Then she asked the students to add those amounts together. She helped and explained the steps clearly to the class. The second step of the lesson was drinking fruit juice by two students. The students' faces were very happy and keen to see what was going on. Chandra asked two students from back rows (One girl and one boy) to come forward and drink the given juice slowly. At the beginning they felt shy to drink but Mrs. Chandra encouraged them and they settled down. Students of the class were delighted to see the event and one student asked "madam, I can drink. May I come?" (Case 3/Field notes/ 05.02.2015)

According to the above-mentioned students' emotional expressions, it is clear that the low attaining students of the observed classroom had shown a negative attitude towards their classroom learning. Salomon (1991) says that a learning environment needs to be organized in a way that students are engaged in meaningful and purposeful activities. Therefore, when organizing a meaningful learning experience, teachers need to understand the students' emotional reactions while they are learning. I have understood this situation while I am observing the lessons and conducting interviews for low-attaining students. Therefore, it is reasonable to say that this was neglected by most of the observed teachers.

Within this chapter I presented the results of the cross-case analysis. As mentioned at the beginning of the chapter I reached new meanings about the cases through aggregation of instances of the learning of mathematics of low-attainers in primary grades in Sri Lanka. The chapter included the results of the cross-case analysis under the following emerged themes and sub themes. Those themes were: teachers under pressure in teaching, the problem of time management and the emotional reactions of students in learning mathematics. In addition to that the following sub themes were also identified and data were presented.

- Physical environment of the schools
- The lack of resources
- Lack of expertise in teaching mathematics
- Poor support system
- Pressure of examinations
- Parents' attitudes
- Gender issues
- Problem of time management

Within the next section of the report I will develop the critical discussion on above-mentioned findings. Here, I will use the research questions as the main topics to develop discussion and to suggest appropriate recommendations to overcome the existing problem of low-attainment among the primary students in Sri Lanka.

CHAPTER 6: DISCUSSION AND CONCLUSION

6.1 Introduction

As mentioned in chapter one of this report, low-attainment in mathematics is a significant problem in Sri Lankan schools and the situation starts from the early stages of learning. A new mathematics curriculum was introduced in 1997-2003 period and the teachers were requested to follow the instructions to overcome the situation of low-attainment. However, even after about 13 years from the introduction of new reforms, recent studies (NEREC 2014 and NBMS 2014) show that a considerable number of students with low-attainment still exist in the schools. Now, it is time to re-think about the situation carefully in order to take remedial actions to overcome the adverse effect of the low-attainment. Therefore, the main purpose of this study is to understand the actual factors which affect the students' learning and to suggest some possible recommendations to solve the circumstances.

Linda and Fraser (2010) argue that understanding the experiences of students and teachers in the direction of the teaching and learning process is important and their experiences can apply to the development of the learning outcomes of students in mathematics. Thus, the main focus of this study was to understand the learning experiences of low-attainers through identifying the affective barriers and emotional reactions to learning mathematics. The study also sought teachers' perspectives and identified challenges they face in teaching mathematics in primary grades in Sri Lanka with the aim of finding possible intervention strategies to increase the attainment levels of those pupils in mathematics in their early stage of learning. As indicated in the methodology chapter, four cases were purposefully selected for this study. Four schools in the same educational district in Sri Lanka were chosen for the four cases and Grade four classes were selected to the study from those schools. Reason for the selection of grade four classes for this study is explained in the research design chapter of this thesis. Four teachers who were teaching in selected grade four classes were chosen to observe their teaching strategies in the classrooms and investigated their different strategies of managing the pupils with low mathematical skills. Furthermore, low-attaining students were asked to explain their real experiences in classroom learning to identify their ideas about learning mathematics. As indicated in the research methodology in chapter 3, data was collected by using classroom observations and interviews with teachers and their low-attaining students. The instrument used for observation was the observation schedule and the instrument used for interviews was the interview guide. The presentation of the findings and analysis of the results was done in chapter four and five. In this chapter I will discuss the

findings; giving conclusions and recommendations based on the above-mentioned findings. In order to fulfill this task, the chapter six is divided into following sections:

- Discussions of the main findings (Section 6.2)
- Implications of research findings (Section 6.3)
- Contribution of the study (Section 6.4)
- Concluding remarks (Section 6.5)

6.2 Discussion of the main findings

The current study provides an insight into the learning experience of low-attainers in primary schools in Sri Lanka. It is hoped that such an understanding will make a positive contribution to raise awareness among the people responsible and implement large-scale researches on effective teaching and learning processes in primary grades. As reported in chapters four and five the data was presented and analysed under the emerged themes and sub themes. At the beginning of the data analysis process I focused on the research questions and tried to find evidence related to the field. However, I realised that the analysis of the collected data based on the teachers' and students' perceptions is more effective to protect validity and reliability. Based on that, the following themes were identified through classroom observations and interviews;

- Teachers under pressure in teaching
- Problem of time management
- Emotional reactions of students in learning mathematics

Under those main themes the following crucial sub themes were also identified.

- Physical environment of the schools
- The lack of resources
- Lack of expertise in teaching mathematics
- Poor support system
- Pressure of examinations
- Parents' attitudes
- Gender issues
- Problem of time management

The research questions, observation schedule and interview guides have been used for identifying the above-mentioned themes and those themes were used to analyze the data. Discussion and interpretation of the findings of the study was set in line with the process of analysing. Hence, the salient results of the study are discussed in relation to the five research questions and their implications. The study was guided by the following main questions:

1. How is the classroom learning environment organised to support the needs of low-attainers in primary mathematics?
2. What are the characteristics of the instructional sequence and mathematical tasks used in the lesson?
3. How does the teacher attempt to tailor instructions to meet the needs of different learners?
4. What strategies do low-attainers use to cope during lessons?
5. What do the students themselves think are the reasons that they find learning mathematics difficult?

6.2.1 How is the classroom learning environment organised to support the needs of low-attainers in primary mathematics?

As indicated in the literature review chapter of this report, Papert (1980), Mounoud (1981) and Hay McBer's (2000) studies have confirmed that a positive learning environment would provide an effective teaching and learning process. Pimm (1987) and Boaler et al (2010) also suggest that teachers should facilitate students by providing an appropriate learning environment where students get involved in more interaction among themselves. Boaler et al, (2010) also argue that the positive learning environment facilitates positive communication between students. Discussion allows students to understand different ways of solving problems. The intervention strategies that allow and facilitate pupil participation may have an impact on students' attainment. For instance, the intervention strategies of facilitating collaboration, discussion, and peer scaffolding need a supportive environment if they are to be used effectively. Watson et al (2003) also suggest that pupils will achieve more than their counterparts if these learning strategies are facilitated. These interventions should take place in an environment in which pupils are challenged but supported. They say that this could address some of the difficulties in mathematics for low-attainers.

However, poor arrangement of the physical learning environment of the observed schools had directly affected the teachers' effectiveness of teaching and therefore it was observed that the

teachers were not able to organize the learning environment appropriately when teaching pupils with low mathematical skills. This was revealed through observation and interview to the question of, “*Can you describe how you organize the learning environment to meet the needs of pupils with low mathematical skills?*” Teachers felt that they were neglected by the education authorities and that they cannot make a positive impact on students’ learning under these difficulties. The learning environment can be divided in to three main sections based on the available data; physical learning environment, social environment and pedagogic environment. Therefore the discussion is given under these three sub topics.

6.2.1.1 Physical learning environment

In the literature review section I have discussed the importance of the learning environment in the theoretical perspective and pedagogical approaches that have been found to be effective in the supporting children with low-attainment (Section 2.3). These theoretical foundations and practical intervention strategies emphasize the requirement of the appropriate physical environment and relevant materials in order to increase the students’ levels of understanding. These requirements need to be considered when organizing the learning environment.

Vygotsky (1978) says that a child can perform unaided to some extent and needs some form of aid to go beyond their capacity (the zone of proximal development). The aid provider can be anyone from the parents, teacher or a peer from the classroom who already has the knowledge to perform the task. As he mentions, the impact of this support process can be organised using appropriate physical objects and with real life experiences (Wood, 1991).

Further, Dowker et al (2007) suggest an intervention strategy which includes games that promote the memory skills of low-attainers using suitable objects and a supportive environment. Different materials should be used when using rote learning to understand the mathematical concepts, for instance; this could be the use of money, number lines or using fingers and thumbs when considering multiples of 10s. (Biggs, 1985 and Dowker et al, 2000). Kirschner et al (2006) also suggest that in order for learning to be meaningful, experience is important though relevant manipulatives and a suitable learning environment.

However, in my study, most of the observed classrooms did not have basic facilities, such as water and electricity. Scarcity of teaching and learning aids was common for them. According to the comments made by teachers they find it difficult to provide a supportive and challenging learning environment for the students without basic facilities and resources. This

led to neglect some students with low mathematical skills. Additionally, the physical learning environments of the observed four schools were far behind the expectations. The students were arranged in groups but they were unable to move around to do the activities assigned by the teacher or ask for support from a more able peer. As a result of this situation, most of the students remained seated during the whole lesson. In addition to that, the neighboring environment of the classrooms did not support the smooth function of the teaching and learning process. For instance, the noise and the smell of the uncleaned toilets badly affected students' learning. It was obvious that the lack of resources and the poor physical environment of the observed schools affected the teaching and learning process and in turn, had increased the teachers' disappointment on teaching.

6.2.1.2 Social learning environment

Cognitive Development theory (Vygotsky, 1978) emphasizes that every individual is unique and the teacher should identify each individual's social uniqueness in order to accommodate every learners' needs. Assistance should be offered to the low-attaining students at points in which performance requires assistance. Teacher can allow pupils to work on activities in groups. They can explain the solution to peers. Many studies (Haylock 1991, Watson et al 2003, and Boaler et al, 2010) show that the creation of this type of social learning environment can be used as an intervention strategy to overcome the problem of low-attainment. However, this was not evident from the observed classrooms due to several difficulties. Most of the observed teachers did not use able peers or group activities effectively to facilitate low-attainers. Almost all the teachers depended on the lecture method and the demonstration of mathematical calculations on the blackboard. The teachers complained that they are unable to use interaction and group activities due to existing constraints in the system.

Furthermore, some low-attaining students expressed their fear on mathematics. They did not have an accommodating background from their homes and classrooms. The nervous feeling and being neglected by friends were the main reasons they expressed at the interview as the causes for the negative feelings in mathematics. They further mentioned that their teacher did not provide assistance to them as they expected and that the teacher would penalize them if they make a mistake when doing an assigned task. This argument has confirmed by Watson et al (2003) stating that social and /or emotional problems can be causes for the low-attainment of the students. A child who has emotional difficulties – perhaps because of an uncooperative situation – is likely to be affected in ways that impact their ability to learn in

school. In addition to that, while low-attaining pupils are expecting a more caring social environment from the classroom they are forced to accept the existing social practice (Luria, 1976). The pupils are expected to maintain a suitable social contact with the teacher. They often need more attention in the topic which they really do not understand. However, as I have observed, the classroom practice was that the child should be silent and keep calm without disturbing their teacher as the lesson needs to proceed smoothly. This situation would not allow pupils to express their opinions or raise questions. This cause can be addressed if a teaching pedagogy in which pupils can break with socio-historical beliefs is adopted (Brown, 1982). The social interaction through effective communication can be used as an intervention strategy to overcome the problem of low-attainment. This idea has confirmed by many scholars such as talking for others (Pimm 1987), peer to peer and pupil to teacher communication (Watson 2003). This would mean that pupils become less passive and more willing to contribute their experiences and knowledge.

Observed teachers expressed the view that low-attaining pupils have poor memory and therefore they have tried to increase their levels of understanding by using different techniques. However, in general I was unable to see any effective methods they implemented during their lessons. This could be addressed through putting the learning in context (Biggs, 1985; Ginsberg, 1977; Haylock, 1991; Piaget, 1991; Watson et al, 2003). The use of real life experiences is a practical intervention that promotes factual recall by low-attainers. All those studies emphasize the need for an interactive environment that promotes practical activities for the improvement of memory of the low attaining students. The intervention strategies of facilitating collaboration, discussion, and peer scaffolding need a supportive environment if they are to be used effectively (Wood, 1991).

The interviewed low attaining students expressed their negative feelings with the people and factors which meet them every day and the poor support they get from them for learning mathematics. Ecological System theory (Bronfernbrenner, 1979) explains the environmental impact on the child's mathematics performance, such as family members, peers, school, neighbors, and caregivers. In addition to that, culture, attitudes, morals, beliefs and ideologies of the culture has a great impact on the learner's attitude and this could be either positive or negative. Most of the interviewed students' declared that they experienced negative support from their parents, teachers and peers. Additionally, it was noticed that the behaviors of the pupils in the classrooms were fashioned by the traditions and belief of the Sri Lankan society.

Furthermore, Tomlinson (1995) argues that the learning environment needs to accommodate inclusion of all the students in a classroom and it helps them regardless of their learning abilities. The differentiated instruction is a necessary component for students in different ability levels. There is a need for organizing a learning environment adapting mathematics instruction to respond the student's needs (Gersten, Jordan, & Flojo, 2005). So that students with low mathematical skills can benefit from a well-organized learning environment. The learning environment in observed classrooms were not organised to support the inclusion of the students due to several difficulties faced by the teachers and the school as a whole. Therefore, it is an urgent need to provide appropriate infrastructure facilities and resources in order to accommodate inclusion of all the students in the classrooms and address the problem of low-attainment.

6.2.1.3 Pedagogic learning environment

As suggested by Hokanson et al (2000) teaching pedagogy needs to promote active thinking in order to meet the objectives of the curriculum. Cohen et al (1997) explain that constructivism encourages effective teaching and learning based on: higher order thinking skills, deep and superficial learning, metacognition and cooperative learning. The effective pedagogy promotes instructivism to constructivism and teacher-centered to learner-centered education. The primary mathematics curriculum in Sri Lanka (2003) also followed the theory of constructivism and emphasizes the development of thinking skills, problem solving, communication and reasoning. Therefore, it is reasonable to argue that pupils could be disadvantaged if a constructivist approach is not applied to the teaching mathematics within the classrooms. This could be a cause for low-attainment and for the negative attitudes of learning mathematics.

As mentioned earlier, Sri Lankan primary mathematics curriculum aims to provide child-centered and active teaching and learning process in the classrooms. In order to achieve the aim, a set of different techniques of teaching were also introduced through teachers' guides and teachers were encouraged to use these indoor and outdoor activities in their lessons. However, most of the observed teachers of the sample seemed unable to use innovative methods of teaching in their lessons and they mostly depended on lecture method. The pupils who were taught using the traditional ways of teaching could fail to use abstract thinking. This is not only failing to address the students' needs but also enforces their innate handicaps. Teachers who focused only on pre-decided knowledge suppressed the pupils' ability to form abstract thoughts (Vygotsky, 1978).

Furthermore, Watson et al (2003) argue that the pupils not being taught by a mathematics specialist or the teacher having limited teaching methods is also a cause of low-attainment. It is an acceptable argument that a pupil should not have to be taught by a non-specialist at any grade. According to the existing evidence of the observed classrooms, low-attaining pupils are often taught by non-specialists or less trained teachers. The teachers of low-attainers need an adequate understanding of the subject in order to transfer this understanding to their pupils. They need to have many different methods of approaching a topic. Furthermore, they need to know many ways to explain how to get to a solution for a mathematical problem. Disappointingly, the situations of the observed classrooms were far behind the constructivism and the learner-centered approach of teaching. Therefore, it is reasonable to say that the organisation of the classroom learning environment in most of the observed schools did not support the needs of low-attainers in primary mathematics.

6.2.2 What are the characteristics of the instructional sequence and mathematical tasks used in the lesson?

To find a suitable answer for this research question I will develop the discussion on the instructional techniques used by the observed teachers at the beginning of this section and then, discuss the characteristics of mathematics tasks used by the observed teachers in their lessons.

The newly introduced primary mathematics curriculum in Sri Lanka encouraged the use of the constructivist approach to provide instruction to students. The classroom needs to be organized to have a dialog between students and teacher. The teacher needs to help the pupils to construct their own knowledge. As mentioned in the teachers' guides for primary classrooms, teachers should use learner-centered, child-friendly instructional approach to address the requirement of the pupils and the tasks which are used in the classroom need to be based on the pupils' levels of attainment. Teachers are encouraged to use scaffolding, mutual teaching, cooperative learning, motivation and self-determination to attend the students' needs. Therefore, it was expected that the teachers would be able to use different and appropriate instructional techniques such as guided participation, peer tutoring, problem solving based learning, and other such techniques. The observed teachers of my study also agreed on the importance of applying these instructional techniques to their teaching but they pointed out the potential barriers in using these techniques.

A child-friendly and interactive teaching and learning environment is encouraged by the primary curriculum in Sri Lanka. This has also been emphasized by various previous studies and has highlighted the instructional methods which allow interaction among pupils that are

important for the pupils with low mathematical skills (Vgotsky, 1978; Bruner, 1966 and Rogoff, 2003). They suggested that teachers can use the teaching methods which allow interaction among the pupils such as group discussion, demonstration, games, storytelling, question and answers to maintain successful learning. Carol et al., (1983) conclude that good instruction is well-balanced instruction. The things that we teach must include concepts, skills and applications. To teach these things effectively, teachers need to use a combination of developmental activities, practice activities and application activities. Generally, all teaching methods could be applied by the teachers.

The teachers of the sample also explained the importance of using many different instructional techniques to improve the mathematics skills of low-attainers. Through observation and interviews on the question of: *“Please tell me what kind of teaching methods do you normally use in order to improve performance of pupils with low mathematical skills?”*, teachers mentioned different teaching methods. These methods were: pupil participation, games, demonstration, problems and puzzles, oral and written testing, group discussion, questions and answers, and lecture method. They said that they use a mixture of these methods as necessary in the classroom. However, findings show that the lecture method was mostly used in the lessons I observed but the other instructional methods were rarely used. They used common lecture methods with a few questions for all the students without giving special attention to pupils with low mathematical skills. Osaki (2007) argues that learning problems of pupils may be the result of an inadequate design of instruction in curricular materials. In line with this, Chinn (2004) argues that mathematical difficulties of the pupils can emerge due to undifferentiated instruction between the ranges of learners. This also is supported by Donlan (1998) who argues that failure in using teaching techniques for making arithmetic meaningful is one of the causes of children’s lack of understanding in mathematics.

Furthermore, the interviewed teachers criticized the content of the primary mathematics syllabus and the recommended instructional activities. Their main criticism was that the allocated time is limited so that they are unable to complete the whole recommended activities within the given time. As a result of this, most of the teachers of the sample tended to follow similar methods of instruction within the allocated limited time period and they rushed to complete the lesson without employing methods relevant to the pupils with low mathematical skills. Ginsburg (1989) shows that one of the main causes of learning difficulties in mathematics is teaching that does not accommodate students’ individual needs and differences. Also, Westwood (2003) argues that pedagogical factors can be associated

with poor learning in mathematics. These pedagogical factors are: inappropriate instructional methods, insufficient total time devoted to teaching and learning, demonstrations that are too brief or unclear, insufficient guided participation, too little corrective feedback, and abstract symbols introduced too early in the absence of concrete materials or real life examples. Almost all of the observed lessons were in line with these findings and were completed without the assurance of students' understanding of the content of the lessons.

The constructivist theory puts emphasis on the importance of the teachers' role in mathematics classes. The teacher needs to change her/his role from instructor to facilitator of the children's own explorations and discoveries. In line with Constructivist theory, Vygotsky's Cognitive Development and the idea of ZDP insists upon giving assistance and help to the learner. Scaffolding (Brunner, 1990), guided participation and apprenticeship (Rogoff, 2003) all emphasize the concept of help given by the teacher to the failed child. Apart from these expectations, during my observations I noticed that pupils with low mathematical skills were not helped well during the mathematical lessons. The role of the teacher was more an instructor than a facilitator for them. Hanley (1994) says that there are many resources to learn and the teacher should not become the primary source of information for the student to learn. Realistic instruction confirms the learners' informal knowledge and the role of the teacher should change from directing to guiding (Milo, 2003).

Most children gain a vast knowledge and understanding as well as some number sense before they start schooling (Hughes, 1986; Hannell, 2013). Pupils can connect classroom learning with their real life experiences that are already familiar to them. Carol et al (1983) assert that mathematics is meaningful when the pupils' mental imagery links with personal experiences. Sri Lankan primary mathematics curriculum also encourages teachers to apply connectionism and transformation as an instructional technique during their mathematical lessons in order to raise the students' levels of understanding. It is expected that teachers taught mathematics by connecting the home environment by using pupils' experience and concrete objects. Teachers need to integrate different issues in mathematical concepts by using daily life situations as examples. In Sri Lankan context, children learn simple mathematics skills by counting animals like goats, cattle, pigs, chickens, ducks and other birds. They also count tins and sacks of crops such as maize, beans, wheat, sweet potatoes. Children count fruits like bananas, oranges, avocado, pears, papaws, and passion fruits to mention few. This working knowledge is what children take with them to school and teachers should build up the new knowledge on these previous experiences. In line with this, Alsopp et al (2007) argue that there are many different ways to build meaningful student connections and provide linkage.

These ways are: link the concept to be taught to students' previous knowledge and experience, and identify what students will learn and provide students with a meaning for learning the skill. Using real life experiences that are already familiar to the children helps them to connect what is being taught (Hannell, 2013). The earlier experiences of the learners have a great contribution in understanding mathematics. This can be considered when organizing a task for pupils with low mathematical skills. However, findings show that this did not happen in observed lessons and it is an urgent requirement to take remedial actions to emphasise the importance of connectionism and transformation as an instructional technique in the primary classrooms.

Furthermore, Constructivism Theory promotes active learning by doing and through the recognition of one's experience. The constructivists believe that people must build their knowledge on the basis of their experiences (Glaserfeld, 1996). For example, activities such as counting cattle and bananas can be used to facilitate understanding in the pupils with low mathematical skills. These types of activities can be used with a natural flow to understand the subject. Booker et al (1997) argue that, if the mathematics concepts do not relate to the child's experiences, it simply would not make sense. The child will be reduced to manipulating meaningless symbols. In line with this, Allsopp et al (2007) argue that helping students to make connectionism between ideas can help them gain a more lasting understanding of mathematics. Therefore, it is very important to use pupils' experiences and home environments when organizing mathematical activities in schools.

Findings show that the observed teachers were not able to provide suitable tasks to pupils with low mathematical skills to improve their levels of understanding. Teachers offered reasons like lack of expertise in teaching mathematics, lack of resources, exam-orientated competition and problem of time management. This was revealed through observation and interview on the question of, *"What kind of tasks do you give pupils with low mathematical skills?"* The kind of tasks which were used in the classrooms were: oral and written assignments, demonstration on the blackboard and homework based on the text book. Pupils with low mathematical skills were given the same tasks as other students to perform and these tasks were not prepared according to the students' levels of attainment. Allsopp et al (2007) argue that assigning relevant tasks and activities should be a regular part and those tasks need to match the students' attainment level. This type of classroom instruction would help students become critical thinkers and independent learners. In line with this, NCTM (2000) states that; *"without the ability to solve problems, the usefulness and power of mathematical ideas, knowledge, and skills are limited"* (P.182).

Additionally, most of the observed teachers provided very little or no assistance to the pupils who failed to perform the assigned tasks individually. They responded to the following interview question and gave their reason for the situation. *“May you briefly tell me how you differentiate the independent level of mastery to pupils with low mathematical skills?”* Teachers answered that they know the independent level of mastery of each pupil in their classrooms. The practical difficulties, such as time constraints and lack of resources prevented them from giving individual attention during the lesson and assigning individual tasks based on different levels of attainment. This was noticed when the pupils with low mathematical skills were solving some questions in their classrooms. Though the teacher realized that a certain pupil had failed to do the task alone, the teacher did not support her or him appropriately. This does not fit with the Vygotsky Cognitive Development Theory through the idea of Zone of Proximal Development and guided participation and apprenticeship of Rogoff (2003).

Teachers need to understand the expectations of Sri Lankan primary mathematics curriculum which was developed based on constructivism. As mentioned by Vygotsky (1978) each child is born into a cultural historical setting and develops through interaction with its surroundings, which includes family members, peers, school, neighbors, and caregivers. The interaction between the child and this environment may cause the child’s physical and cognitive structure to grow and mature. A child is interacting and constructs knowledge within the society and thus is learning and developing his or her mental and psychological functions. Therefore, the instructional techniques that encourage interaction between pupils, pupil and teacher and environment can motivate and enhance learning of pupils with low mathematical skills (Bronfenbrenner, 1979). However, it is reasonable to say that the existing instructional practices and tasks used in the Sri Lankan primary mathematics classrooms were far behind the expectations of constructivist approaches of learning.

6.2.3 How does the teacher attempt to tailor instruction to meet the needs of different learners?

There were more than forty low-attaining students in the observed four classes and teachers mentioned that they were aware about those pupils and their needs. During interviews, I raised the questions, *“Do you have low-attaining students in your classrooms? What are the reasons you think for the problem of low mathematical skills and why?”* Teachers mentioned different causes of low attainment of their students. These causes were: exam-oriented competition, shortage of teaching and learning materials, inability to follow instructions, large numbers of pupils in one classroom, lack of reading and writing skills of students, lack

of listening skills, poor teaching methods, unsuitable teaching and learning environment, parents' negative attitude towards mathematics, lack of support from the family members and teachers, lack of professional development (capacity building), gender differences and competition. According to teachers' comments, it is reasonable to assume that they have a clear understanding about the problem of low-attainment and possible reasons for the pupils' failure in mathematics. Therefore, I investigated the strategies which were used by the teachers to tailor instructions to meet the needs of different learners.

The teachers' guide, grade four text book and the pupils' workbook were the main sources used by most of the observed teachers as their instructional materials. In addition to that, mathematical tasks in the pupils' work book, demonstrations on the blackboard, questioning and marking students' answers were the common strategies used by teachers to tailor the instructions to the students' needs. Those techniques were common for all the students regardless of their ability level and verbal expressions like "good", "clever" and "attention please" were used for encouraging individual students. Almost all of these strategies were used for whole class teaching and did not apply specifically to the pupils with low mathematics skills. The common problem was that the observed teachers were unable to use the relevant instructional techniques to meet the needs of different learners.

According to the Grade four teachers' guide teachers are advised to prepare a daily lesson plan or scheme of work using given template and the signed approval for the lesson plan needs to be obtained from the head teacher or from the sectional head. Also they are expected to prepare the learning aids needed for their lessons. Johnsen (2001) also explains the importance of these two elements in the Curriculum Relational Model (CRM) in order to conduct a successful lesson. However, most of the observed teachers did not use the approved template for preparing their lesson plans and most of them showed a negative attitude or considered the process as an unnecessary trouble for them. Therefore, it was clear that most of the observed teachers were unable to give written evidence prior to their lessons indicating their map to tailor instructions to meet the needs of different learners.

Furthermore, findings showed that the observed teachers seldom used the variety of teaching and learning materials in their lessons especially for the pupils with low mathematical skills as the answer to the question, "*What kind of teaching materials do you use in teaching pupils with low mathematical skills?*" However, teaching materials such as notes and coins, bottles and bottle tops, sticks and water were used occasionally but the teachers were unable to get the maximum benefit from those materials. Teachers were unable to show their ability to use

materials effectively with the assigned tasks especially for the low-attainers. The situation does not fit according to Underhill et al. (1980)'s argument of meaningful mathematics learning experiences: concrete, semi-concrete and abstract. To the meaningful learning of basic computational skills, teachers need to understand the relationships between real- world experiences and the symbol system involved in computations. They need to design suitable activities based on this process which then could apply to their lessons. Hands-on learning is a more powerful way of learning than dry abstract instruction. Hannell (2013) says that young pupils need to touch and have real objects to work with as they begin to master the early formalities of mathematics.

The constructivism theory also emphasizes the importance of using concrete objects in teaching and learning mathematics. Constructivists argue that knowledge might not only be connected to problem solving with concrete objects, but also might be applied on semi-concrete and semi-symbolic. Finally this will establish the reflective level with the use of abstract symbols (Underhill et al., 1980). Pictures and drawings can be helpful to give meaning to the content of the mathematical task on the symbolic level (Hughes, 1986). Underhill et al., (1980) support the principle that teaching moves on a continuum from the concrete to the abstract level. The constructivist classroom materials include primary sources of materials where learning is interactive. Teachers need to build on what the pupils already know. Pupils with low mathematical skills could learn the mathematical concepts easily by using concrete materials developed based on the instructional sequence and mathematical tasks assigned for the students. I did not observe this was happening in most of the observed classrooms.

The interaction was also not obviously happening as a strategy to tailor instruction to meet the needs of different learners. It is important to build a proper interaction between pupils with low mathematical skills and teachers through given tasks. However, apart from the expectations, the interactions were highly negative in the observed classrooms when assigning the tasks to the pupils with low mathematical skills. They were isolated and they were forced to be silent or hang around without disturbing able peers. The positive interactions occurred only with the pupils who had no problem with the assigned tasks. Teachers allowed or liked to select more able pupils to answer questions and ignore those with low mathematical skills. Studies have suggested that a learning environment should be positive for the interactions of all pupils. Teachers are not supposed to ignore pupils with learning difficulties (Tomlison, 1995).

Moreover, the teacher's assistance for the pupils who fail to perform the task is very important in the teaching and learning process. As mentioned in the literature review section of this thesis, this is well supported in the Vygotsky's Cognitive Development Theory which insists that the parents or other adults in a child's world should provide assistance or guidance to the children while they are learning new information and developing more complex thinking abilities. If the pupil is not able to solve a certain mathematical question, he/she should be helped by giving him or her simple questions. According to Vygotsky's idea (1978) of Zone of Proximal Development, guided participation should be provided to the pupils with low mathematical skills. However, despite the fact that the teachers had enough knowledge towards the problem of low mathematical skills among pupils, they failed to take appropriate instructional techniques to meet the needs of them. This situation leads to an increase in the problem of low mathematical skills among them. Therefore, it can be said that the instructional methods used by the observed teachers were not directly linked to the need of the low-attaining students and therefore, appropriate remedial actions need to be taken in order to develop such skills among the teachers.

6.2.4 What strategies do low-attainers use to cope during lessons?

According to the present study the low-attaining students were not given adequate attention from their teachers and they did not use strategies to achieve the expectations of the lessons. Most of the low-attaining students were not engaged in the tasks and showed lack of understanding of the lesson. However some of them tried to do the assigned activities with their friends while some of them remained silent. The teachers worked out a problem on the chalkboard and then assigned individual seatwork most of the time. During individual seatwork students were not allowed to talk or discuss the problems. Teachers made sure that everyone was busy working and all students were on task. However this situation does not match with Brown et al. (1983)'s explanation of the importance of understanding the pupils' learning strategies. They show that learning strategies are the plans students select to achieve their goals and teachers need to use these distinguished strategies to regulate their learning. The observed teachers used their strategies to introduce the mathematical concepts rather than giving opportunities to express the pupils' way of learning. This situation affects negatively to the pupils with low mathematical skills.

It is a cultural fact that Sri Lankan students do not normally question their teachers' plan of instruction, activities and the pedagogical methods use to teach. The learning depends upon how the teachers are able to make the mathematical concepts and skills meaningful and

personally relevant to the students. Therefore, it is important how the teachers organize the classroom learning environment to have interactions to allow students for discussion and for different activities. However, it was common in most of the observed classroom that students were not allowed to talk to each other during the lessons. This was a part of the classroom rules and not a single low-attaining student asked a question throughout the three observations. They showed fear or shyness to ask questions from their teacher. At the interview most of them remained silent. When I asked questions also they felt shy to talk. This situation was common for all the observed cases. In two cases teachers used different motivational techniques, such as storytelling and singing to draw students' attention. However, almost all the low attaining students remained without paying attention properly or they were engaged in some other work on their own.

However, some of the students' showed more favourable perceptions about teacher support at the interview. Some of the possible reasons for this could be students' respect for their teachers, and other cultural inhibitions, which restrict them from evaluating or questioning their teachers' ways of doing things in the classrooms. At the interview most of the low-attaining students expressed their views on group work and use of manipulatives for learning. They talked positively when they are assigned to work with peers and complete activities using manipulatives or game.

Furthermore, low-attainers were disappointed when they were asked to do individual work or demonstrate their work in front of the class. They responded negatively when they were assigned too much extra work or lots of home work by their teacher. Most of them were fearful of the punishment from their teachers because of the incompleteness of the assigned homework. Therefore, it is important to understand the students' learning preferences before assigning tasks, especially for low-attainers.

6.2.5 What do the students themselves think are the reasons that they find learning mathematics difficult?

Emotional reaction of students in learning mathematics was a main theme that emerged from this study and this has confirmed the findings of several former studies. Mathematics is considered a difficult subject to learn by many individuals (Fennema & Sherman, 1976) and this is related directly to poor achievement. Children with negative attitudes develop anxiety towards mathematics and show performance problems (Hembree, 1990). Bronfenbrenner Ecological System theory explains clearly the impact of attitudes on a child's mathematics performance. According to the theory, family members, peers, school, neighbors, and caregivers within the environment have a great impact on the child's performance

(Bronfenbrenner, 1979). Also, in the macro-system, this includes culture, attitudes, morals, belief, and ideologies of the culture. According to this theory, there is a very big connection between a child's teacher and her or his teacher parents. The parent's negative attitudes or poor support towards the subject of mathematics leads to a lack of connection between teachers and parents among children with low mathematical skills. As shown by most of the observed teachers, the parents of low-attaining pupils did not support them and were unable to help to overcome the situation. The negative responses of the parents also have made the situation more challenging. Furthermore, Reisman (1972) argues that children may have heard parents talk about the difficulty of mathematics and through this experience a child may start to develop negative or unpleasant situation towards mathematics. Also, Bronfenbrenner Ecological System Theory emphasizes the importance of the relationship between the belief and culture of the family members and their children in order to raise child's development (Henderson, 1996). This is supported by (Westwood, 2004) who argues that the increasing interest in the impact of cultural influence and different teaching methods may increase achievement of most of the pupils.

The findings of the four selected cases also confirmed the above-mentioned arguments by providing evidences of the negative attitude towards mathematics among the low-attaining students. Most of the interviewed pupils believed that mathematics is a hard subject to understand and it is devoted only to more able students. They believe that teachers also neglect them and support only the able students. They try to avoid or hide among others when a difficult task is assigned. Lack of fun activities and the workload, especially too much after school work and a lack of the leisure activities, nobody helping them at homes to solve mathematical tasks and they were beaten by teachers or humiliated by peers due to failure in the subject were the common problems indicated by the interviewed pupils as the reasons why they think learning mathematics is difficult. In addition to that, teachers' and parents' pressure on them to get higher marks from the Grade five scholarship examination is the main challenge they have to face. They said that they have problems with numbers and mathematical operations. Finally, they felt that learning mathematics is difficult when compare to the other subjects.

6.3 Implications of the research findings

The research findings of this study have several implications for classroom practices research, classroom learning environment research, curriculum implementation, policy and decision making. Some of these implications can be explored as follows:

6.3.1 Implications for future research

This study aimed to address issues related to some major aspects of the learning experience of low-attaining students in primary mathematics in Sri Lanka. I think there are many other issues to be researched to understand the proper situation of the low-attaining students. This consequently leads to many implications for future research. The following few are areas which may be manageable, and more importantly useful, for Sri Lankan school contexts.

- An investigation of the learning experiences of low-attaining students in primary mathematics' needs to be carried out in more depth and on a larger scale than in this study. It would be useful to research a larger sample size, which may provide a better picture of the classroom situation in Sri Lanka. Hence, the study could be done using different geographic areas, grade level samples, school level samples, school types, school localities, and so on.
- Additionally, a longitudinal study of the learning experiences of low-attaining students at three stages of primary schools (Stage 1, stage 2. and stage 3 in primary schools in Sri Lanka) would give broader and better perception of the issue.
- Though this study I laid a foundation for understanding the learning experiences of low-attaining students in primary mathematics in Sri Lankan school context. It was focused only on the classroom teaching and learning environment. Therefore, it would be useful to identify additional areas for similar studies. For instance, it is important to understand the parental involvement in the students' learning and school management process regarding the low-attainment. In-depth case study of each of those fields would confirm positive and reliable views of the participants about their classroom learning experiences.
- The present study may perhaps not assess the present primary mathematics curriculum in Sri Lankan schools and its impact on student learning outcomes. For this reason, as shown by research in many other countries (e.g., Fraser, 1998) a study focusing on the relations between the curriculum practices and students learning outcomes or learning efficiency could be helpful.
- Moreover, the classroom learning experiences were studied in this study. There are possibly several other extracurricular areas of mathematics learning. The study of these additional experiences of mathematics learning could also provide a better picture of the classroom situation of the Sri Lankan primary schools.

- Additionally, a comparative study of learning experiences among different subjects and discipline areas would also provide better perspectives of the classrooms in Sri Lanka.

6.3.2 Implications for schools and classroom practices

The findings showed a notable difference between students' and teachers' perceptions of their classroom teaching and learning environments in terms of ability levels, peer supports, resources and teachers' classroom practices and so on. Within this context, as mentioned by Dorman (2008) and Fraser (1998), the teachers have a leadership role in classrooms by setting the learning environment and closing the gap between students' and their perceptions of the classroom learning environments. These findings of my study imply that classroom teachers need to consider their teaching in a student-centered way.

Additionally, Educational authorities should provide an adequate time for teachers to understand the situation of their students' learning capabilities and plan the teaching methods accordingly. It is a requirement for classroom teachers to reconceptualise their thinking, pedagogical beliefs and work practices. Time and space are needed for professional dialogue in order to develop an agreement of ideas (Liu, 2011; Zevenbergen, 1996).

6.3.3 Implications for curriculum development and implementation

This study explored the learning experiences of low-attainers in primary mathematics in Sri Lankan context. Based on the main aim, it explored the existing teaching and learning process with the belief that the quality of classroom learning environment affects students' learning considerably. Therefore, the classroom learning environment becomes an important field to understand the students' learning experiences in mathematics. The implication is that the curriculum specialists, curriculum planners and teachers as curriculum implementers should be aware of the practical requirements of curriculum implementation. The result of the study recommends to the policy makers and administrative levels those requirements, such as the supply of basic classroom materials, equipment, and so on. In addition to that, this will also help in empowering the curriculum planners and developers to improve the curriculum documents and materials for the benefit of low-attaining students.

6.3.4 Implications for policy and decision-making

Finally, there are implications for educational administrators and policy makers at both macro and micro levels. The research study provides evidence in learning experiences of low-

attaining students in 4th grade mathematics classes and their classroom learning environments. The findings suggest that differences in terms of students' expectations, teaching and learning environments exist in schools. This can be used as a point of reference for the improvement. The key issue is the need for an enlightened approach by teachers within the classroom. This must be supported by appropriate ideas and materials from the Ministry of Education and teacher training institutes (Dukpa, 2000). In order to bring change and make the implementation of the mathematics curriculum successful with a desired effect, policy makers and all professionals in the system must consider and respond constructively to the above findings.

This study recommends the importance of positive classroom learning environments in Sri Lankan school contexts. It is needed for policy considerations by the respective authorities. These policies need to be implemented formally. The teachers can gain a sense of awareness about the significance of a positive learning environment. In order to help teachers, the authority needs to provide teacher training and facilities in appropriate ways. The sufficient resources and materials also need to be supplied to all the classrooms. As a result of this endeavor, teachers will understand how to improve the classroom learning environment, especially for low-attaining students in mathematics.

6.4 Contributions of the study

As mentioned by Fraser et al. (2012) the classroom can be considered as a place where the actual business of learning takes place. In order to occur a meaningful learning, the classroom learning environment must be equally comfortable and enriching for both the student and the teacher (Peer, 2011). It is a clear cut fact that a primary school student spends completely five years in the classroom by the time they complete their primary education. Hence, it is not only reasonable but essential to find out about the learning situation as perceived by participants of the classroom teaching and learning process that includes both the students and the teacher. This study is an attempt to explore the actual teaching and learning process with special attention to low-attaining pupils within the Sri Lankan primary school context. Therefore, this study has theoretical and practical contributions.

6.4.1 Theoretical contributions

The present study is important because it expanded the field of classroom learning environment research by investigating learning experiences of low-attaining pupils and perception of their teachers in their mathematics classroom environment. Most of the

previous studies focused only either teachers' or students' perceptions. My study focused on both factors; low-attaining students and their teachers. Thus, it adds to the theoretical knowledge of the field of learning environment research.

In addition to that, this is the first study of its kind in Sri Lanka that investigated the learning experiences of low-attainers in primary mathematics. I think that made a common flat form for all the learning environment researches by adapting them into a single study and in a new context. This can contribute towards further investigations, development and validation of learning environment in primary Grades in the Sri Lankan school context.

Furthermore, this is the first study of its kind in Sri Lanka that investigated learning experiences of low-attainment in primary mathematics after the implementation of new educational reforms in 2003. This study can be considered as an attempt to bring together the two fields of the classroom learning experiences of low-attaining students and perceptions of their teachers in teaching, both of which are ultimately concerned with the students and their learning.

The new Sri Lankan primary school mathematics curriculum theoretically promotes a shift from traditional to constructivist teaching practices in order to make learning mathematics meaningful to the pupils. Hence, the classroom teaching and learning process is expected to reflect constructivist views under the framework of new mathematics curriculum. My study contributes towards the conceptual understanding of classroom teaching and learning practices from the constructivist perspective which emphasizes the student is at the center of the classroom context. The student learning can be always understood from the perspective of both the teachers and the students. They are the key participants in the classroom environment. Hence, this study contends that the students' and teachers' perceptions of their classroom learning environments are critically important.

As mentioned by Howard et al. (2009) the social constructivist perspective emphasizes the learner should be the focus of the teaching-learning process. The classroom environment should allow pupils to actively participate in the learning process. Learning can be attributed to individual cognition, which lies within the learner's mind. However, the student's learning processes and behaviors are always mediated by other participants in the classroom context. The teachers and other students are always involved and mediated in the classrooms. These types of constant interaction with the teacher and with the other students have a significant role in pupils' learning. The present Sri Lankan curriculum also encourages interaction with the teachers and other students. Thus, the current study proposes a theoretical model for

understanding the nature of social constructivist learning environments in Sri Lankan mathematics classrooms. This model is given in the conceptual framework of the study in the literature review chapter (Section 2.7). This theoretical model explains how the social constructivist classroom learning environment can be understood in Sri Lankan schools, based on the different dimensions of human environment, which comprises relationship, personal growth and system change and maintenance (Dorman, 2008).

6.4.2 Practical contribution

The practical contribution of this study is that it may enhance the ability of the classroom teachers to make mathematics learning enjoyable and meaningful to their learners. They can create a positive learning environment and change their pedagogical orientations towards student-centered instruction. The findings of the study indicated that the teachers themselves appeared to be a constraint inhibiting learning environments in the Sri Lankan contexts due to their lack of understanding about the concept and significance of low-attainment of students in mathematics. It is recommended that there should be a clear direction of how the teachers need to understand the concept of the constructivist learning environment and how it could be manifested at the classroom level especially for the low-attaining students in mathematics. The findings of the study indicated that almost all of the observed teachers lacked professional training and orientation with regard to the implementation of the new curriculum and take the remedial actions for pupils with low mathematical skills. They themselves recognize the need for workshops or trainings on the implementation of the new curriculum for their professional development. Hence, this could help the teachers improve their classroom practices to better understand the learning atmosphere in Sri Lankan educational contexts, and more specifically in the context of teaching and learning of mathematics for the students with low mathematical skills in primary grades.

The study may be valuable to educational authorities, teacher educators and school principals in Sri Lanka since it would provide them with insight into the impact of a positive perception of low-attainment in mathematics among young learners and promoting effective classroom practices for them. This should enable them to understand the benefits, values and impact of positive classroom learning environment, identify significant barriers in student learning and evaluate teaching practices within the Sri Lankan school context (National Education Commission, Sri Lanka, 2014).

6.5 The limitations of the study

This section explains the potential limitations of the study, such as time, and the size of the research sample and my role as the researcher. I understood that these limitations affected to the design of the study.

The time factor affected my research in two ways. First, the data collection was done in a short period of time in 2015 and there was no opportunity to follow up the extra activities done by the teachers to improve the low-attainers which they mentioned verbally at the interviews. I have to analyze the collected data within very short period of time in order to keep the records up to date. Secondly, the duration of an observed lesson was 40 minutes and most of the teachers who conducted the lessons felt that they could not address the issue of low-attainment within such a short allocated period of time. This has also emerged from the data as a key theme in this study. I insisted on 40 minutes period on my lesson observation and I also felt that the teachers may possibly complete their lessons if they had flexible time allocation for teaching mathematics. Furthermore, they need to have a confidence to integrate alternative approaches in teaching mathematics. As mentioned by Hoyles et al (1991) this situation showed me that the need for the understanding of the real challenges when designing a professional development programmes especially for Sri Lankan teachers.

Another limitation of this study was originated from the methodology. Findings of this study were based on data gathered from four schools in the Central province in Sri Lanka. Ministry of Education (1997) categorizes Sri Lankan schools into four categories as mentioned in the methodology section of this report. However, there are some other categories of schools also available within the system such as national, co-educational, single sex, specialist, sports, private and international, religious, rural and independent schools. In view of all this, I could not generalise the findings from the study to all the existing different schools in Sri Lanka. This was mainly because communities may respond differently to the same social phenomenon. However, I hoped that transferability of the findings to schools which are in similar socio-cultural contexts could be claimed. The study, therefore, left room for further research on how other communities and schools which differ from those selected for this study could perceive and handle problems that relate to the low-attainment in mathematics.

Additionally, this research only consisted of a small number of teachers and their low-attaining students who selected purposely by me. I feel that if more teachers and low-attaining students were involved in the study, this would not limit the generalizability of the

findings of the study. On the other hand, it is possible to make some modest claims about the generalizability of the results to all educators and settings due to this situation. The triangulation, description and rich verification of the findings were presented in the data in order to overcome these claims. These entire attempts contributed to the protection of the validity of the analysis, making it possible for others to judge the relevance and applicability of these findings in their own research contexts.

A further limitation of this study was my role as the researcher. As the Ed D student and a novice researcher with no authorised position from the Ministry of Education, this potentially created some problems from the participants' perspective about my role. Some teachers showed low degree of responses due to the participation of the research project was voluntary. This meant that it was important for me to build a good rapport with those who did participate with the study. Therefore, I engage with them by spending time getting to know them socially. The fact that I was not a figure of any authority in the Sri Lankan educational context helped me sustain a mutually respectful relationship with the participating-teachers and students. I can conclude that the ethical dilemmas concerning my attachment with the research came to be less of a concern ultimately.

6.6 Concluding remarks

This study was an exploration of learning experiences of low-attaining students in primary mathematics in Sri Lanka. According to my knowledge, it was the first study that investigated the learning experience of low-attaining students, particularly within the Sri Lankan school context. The low-attaining students' experiences of learning mathematics in primary classrooms were successfully investigated employing in class observations and semi structured interviews as the data sources, and whereby gathered data was sequentially analyzed (Jayasena, 2013). The study also discussed and analyzed the qualitative data to complement credibility of the findings altogether. Attempts were made to link them with the available literature to make meanings and to draw valid conclusions.

The study has contributed to the findings on how low-attaining students and their teachers perceived the mathematics classroom learning environments from the perspective of the existing practices in Sri Lankan context. I believe that this study provides base samples to see how important the classroom situation is in the teaching and learning of mathematics especially for the low-attaining pupils. The present study also informs how Sri Lankan low-attaining students and their teachers feel about their teaching and learning environment. I

believe that other research studies will follow to add to these samples and be able to have a holistic picture of the learning experiences of low-attainers across all schools in Sri Lanka. The result of these studies would contribute to improve the attainment levels of low-attaining students and finally would increase the quality of mathematics education in Sri Lankan primary schools.

The Sri Lankan primary mathematics curriculum was developed based on a social constructivist approach to the teaching and learning process. It was expected to offer considerable potentials for enhancement, engagement and motivation for quality student learning. This expectation would guarantee and sustain the improvement in the quality of mathematics education in the country if the findings of this study were positively addressed. However, for its greater success, it is important to address a number of contextual issues, which may not be quickly or easily overcome.

Lastly, I think, the present study has made a valuable contribution to the field of mathematics education research in Sri Lanka. It provides an in-depth understanding of students' and teachers' perceptions about mathematics learning environments and how their perceptions align with teaching practices in Sri Lankan primary schools. Its findings could be used by fellow mathematics teachers in Sri Lanka to guide the development of a more positive teaching and learning process for low-attaining students. On the whole, it is hoped that low-attaining students in mathematics will always be motivated and be happy to learn in a classroom where the teacher is supported, reliable, task-oriented, cooperative, and equitable in nature. A teaching and learning experience might contribute in its own little ways to Sri Lanka's national educational goal of 'total personality development.' Consequently, the study provides the way forward to improving low-attaining student in mathematics by contributing theoretically and practically towards a better understanding of the classroom situation in Sri Lankan schools.

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Appendixes

Appendix 1: Letter of ethical approval from the University of Leicester

To: **Prabath Ekanayake**

Subject: Ethical Application Ref: **pcse1-1d5e1**

(Please quote this ref on all correspondence)

12/05/2014 13:20:57

University Administration

Project Title: An exploration of the learning experiences of low attainers in primary mathematics in Sri Lanka

Thank you for submitting your application which has been considered.

This study has been given ethical approval, subject to any conditions quoted in the attached notes.

Any significant departure from the programme of research as outlined in the application for research ethics approval (such as changes in methodological approach, large delays in commencement of research, additional forms of data collection or major expansions in sample size) must be reported to your Departmental Research Ethics Officer.

Approval is given on the understanding that the University Research Ethics Code of Practice and other research ethics guidelines and protocols will be compiled with

- <http://www2.le.ac.uk/institution/committees/research-ethics/code-of-practice>
- <http://www.le.ac.uk/safety/>

Appendix 2: Classroom observation schedule

School:

Teacher:

Lesson:

Date:

Time:

Research question	Data source	Observations		
		Teacher	Pupil	General
How does the classroom learning environment organised to support the needs of low-attainers?	- Physical arrangement of the school/classroom. - Availability of usage of teaching and learning resources - Interaction - Student behavior			
What are the characteristics of the instructional sequence and mathematical tasks used in the lesson?	- Lesson plan - Method of Instructions - Mathematical tasks used in the classroom			
How does the teacher attempt to tailor instruction to meet the needs of low-attainers?	- Methods of teaching - Motivational strategies - Student attention - Other strategies			
What strategies low-attainers use to cope during lessons?	- Students behavior - Learning styles			
What the students' themselves think are the reasons that they find learning mathematics difficult?	- Work examples of students - Students' responses			

Appendix 3: Interview schedule with students

Research question	Main question	Probing questions
How does the classroom learning environment organised to support the needs of low-attainers?	How do you feel about your school and classroom environment? Do you like learning mathematics? (After showing the pictures taken from their classroom) Which class do you want to be in? Which class don't you want to be in? Which activity do you like much? Which activity you do not like much?	Explain (If yes) why? (If no) why? Why? explain Why? explain Why? Explain Why? Explain.
What strategies low-attainers use to cope during lessons?	After showing pictures (Students with and without manipulative) Which picture do you like most? If you feel you could not understand the lesson or an activity, what would you do? What is your feeling about your madam's/sir's way of teaching?	Why? explain Explain

What the students' themselves think are the reasons that they find learning mathematics difficult?	What would you tell to another child about today's lesson? Do you remember what did teacher do after the activity? Which picture shows the way your mathematics teacher usually teaches you in class? Discuss with the group and tell me what the most attractive event of your lesson is. What support you get from your parents to learn mathematics? Let me know your experiences about extra classes for learning mathematics	Do you like that method of teaching? Why? explain Is that activity so good? Why? explain <i>(If yes)</i> why it is attractive? <i>(If not)</i> Why those activities not are attractive? Explain Explain
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Appendix 4: Interview schedule with teachers

Research question	Main question/statement	Probing questions
How does the classroom learning environment organised to support the needs of low-attainers?	Please tell me your view on general situation of the school What are the reasons you think for the problem of low-attainment and why? Can you describe how you organize the learning environment to meet the needs of pupils with low mathematical skills? Do you think your lesson was a successful one? If you teach a lesson and your students don't seem to be "getting it," what do you do? How do you get support from the parents to help students who are not performing as expected? What are the main things need to be considered when developing a valid support system to overcome the problems?	explain May you briefly tell me how you differentiate the independent level of mastery to pupils with low mathematical skills? Explain <i>(If yes)</i> why do you think it was successful? <i>If no)</i> What are the reasons for your answer? Explain Explain Explain
What are the characteristics of the instructional sequence and mathematical tasks used in the lesson?	Please tell me what kind of teaching methods/ tasks do you normally use in order to improve performance of pupils with low mathematical skills? What kind of teaching materials do you use in teaching pupils with low mathematical skills? How often you are using those resources for helping low-attainers?	Explain Explain Explain

	What support did you receive to help you understand the instructional sequence of mathematics lessons? What are the barriers to carry out instructional sequence and relevant tasks of your lessons? What is your plan to overcome those barriers? What do you suggest to improve the existing support system in schools in order to overcome the problem of low-attainment?	Explain Explain Explain Explain
How does the teacher attempt to tailor instruction to meet the needs of low-attainers?	The syllabus recommends that a learner-centered approach should be used for teaching mathematics at primary grades. Do you think you are using a learner-centered approach? How do you provide support for students who are not performing as expected? Can you describe how you transform a concrete object into the abstract meaning to the pupils with low mathematical skills?	(If yes) What sort of things have you done that are “learner-centered”? (If no) What are the reasons for not using “learner-centered approach”? Explain Explain

Appendix 5A: An example of emerging themes, categories and sub-categories

Themes	Categories	Sub category	Textual data
Teachers under pressure in teaching	Learning environment	Organization of the classroom	It is required by the curriculum to use the teaching and learning aids during the lessons especially for the low-attainers. They can grasp the idea if the teacher uses the correct material at the correct time. But we do not have required materials to help those students.
Teachers under pressure in teaching	Poor support system	Lack of training opportunities	My mathematics background is very poor. I did mathematics for GCE (O/L). That's it. I followed arts subjects for the G.C.E. (A/L). I have participated in two in-service workshops during my career. Those workshops were design especially for the primary teachers, not for the mathematics. Therefore, I tried to follow the textbook and the teachers' guide without adequate support from the experts in the field. I am trying but I feel that I cannot deal with children with different ability using different type of teaching and learning strategies. I think I need more support from the relevant authorities to become a successful teacher.

		Support from the Educational authority	I have no extra support to meet the problem of low-attainers. No school or educational Authorities support us to facilitate those students. The problem is inherent. Finally we are the victims. We need to get the entire burden without any appreciation.
Problem of time management	Duration of a lesson	Planning an activity for low-attainers	I need to finish the lesson within the given time. I cannot concentrate on each and every child and their difficulties within 40 minutes. First, I concentrate on able students then I can look at weak students. I correct them at the afterschool class but most of the students don't need to learn and they are not coming to the class.
Emotional reactions of students in learning mathematics	Approaches of students in learning mathematics	Dislike/ hesitation	I don't like to go to front of the class and give wrong answer to a question. I feel scared to see others gloomy faces.
	The learning strategies of low attainers	Working with peers/Group activities	It is boring and lonely when doing by ourselves using text book and work book.

Appendix 5B: Extracts of coded data

Themes	Codes	Extract from the observational field notes and participants' interview
Teachers under pressure in teaching	Parents expectations	Present curriculum encourages play and fun activities when we are teaching. Teachers' guides and workshops encourage us to carry out those child centered approach. But as you know we have to train these kids for the Gr. five scholarship examination. School and parents expectation is that. I have to satisfy parents and school authorities rather than my pupils. (Teacher 3/Sc 3/ 05.02.2015)
Lack of resources/poor use of available resources	Poor supportive system	I know learning aids are most important to understand a mathematical concept. However it is very difficult to use those materials for the each and every lesson. Government did not provide these materials adequately, so how teacher can use these materials if not provide adequately. I cannot buy these things spending my own money or ask poor parents to buy those for me. (Teacher 4/Sc 4/ 27.02.2015)
Problem of time management	Lack of time	Pupils do not have time to engage in extra leisure activities. It is expected that teachers need to complete the entire syllabus before the examination date. The teacher is considered as the knowledge provider who needs to get all the responsibility to pass the students in these competitive examinations. The present system forces teachers to use drill and practice methods for teaching and learning mathematics.(Teacher 4/Sc 4/ 27.02.2015)
Emotional reactions of students in learning mathematics	Hesitation	Case2/St.1: oh very difficult. Case2/St.5: I didn't understand the lesson. Case2/St.7: I didn't like the lesson. There were too many calculations. Case2/St.10: Very hard. No enough time to complete the given activities.

Appendix 6: Request letter to obtain permission from the Director of Education, Kandy District to enter the research site.

E.M.P.Ekanayake
Department of Education
Faculty of Arts,
University of Peradeniya,
Peradeniya
Tel: 812392711/2704
Email: empcse@yahoo.co.uk
November 15, 2013

Director,
Department of Education,
Central Province,
Kandy.

Dear Sir,

Requesting permission to carry out research study leading to a Doctoral Degree

I am currently pursuing a course of studies leading to a Doctor of Education degree from the University of Leicester, United Kingdom.

As you know low-attainment of students in mathematics is one of the major problems which have long been a source of concern for educators and policy makers in Sri Lanka. This problem has been considered from many perspectives. Therefore, purpose of my study is to explore the nature of learning experiences of low-attainers in primary mathematics with a particular focus on teaching and learning process with the expectation of introducing a set of recommendations towards effective numeracy teaching learning process at primary grades in Sri Lanka.

The target population of the proposed study is pupils and teachers in government schools at Grade 4 level in Kandy Educational District in Sri Lanka. A purposive sampling procedure will be adopted in selecting the sample and eight schools have been selected from Kandy Educational District for the pilot study and the main study.

1. Denu/Kiribathkumbura National School
2. K/Getambe Mahanama College
3. Denu/Gampola Wicramabahu National School
4. Denu/ Wimaladharma College Peradeniya
5. Denu/ Dheerananda Maha Vidyalaya Pilimalalawa
6. Katu/ Sri Rahula College
7. K/Hindagala Sivali maha vidyalaya
8. Denu/Kadugannawa primary school

Plan for the main and the pilot study

Type of the study	Duration	Teachers	Students
Pilot study	January to May 2014	4	10
Main study	January 2015 to August 2015	4	40

My data collection method may include some or all of the following: Classroom observations, semi-structured interviews with teachers and pupils with low attainment in mathematics. I will seek permission from Principals, Teachers and Parents of the selected students of respective schools as appropriate.

I will guarantee confidentiality of information. I will only report information that is in the public domain and within the law. I will not reveal of a personal or comprising nature. If I intend to use information that is in any sensitive I will seek the permission of the originator before using it. There will also be total confidentiality of pupils' and teachers' names. I will not name the school without permission. I promise that, while carrying out this research, I will observe the highest possible ethical standards.

Therefore, I would be grateful if you could grant me permission to carry out the proposed study within the selected sample of government schools.

I have enclosed a copy of my registration information for the Ed D. programme from the University of Leicester. Should you have any questions or concerns regarding this letter or my research, please contact me at my email address or telephone number given. You may also want to contact my supervisor Professor Janet Ainley, University of Leicester at janet.ainley@le.ac.uk +44 (0116) 252 3690. Dr. S. Wijesundara, Head, Department of Education, University of Peradeniya at subhashiniew@yahoo.com, +94812392700

Thank you

Sincerely,

Prabath Ekanayake
Ed.D. Candidate
School of Education,
University of Leicester,
United Kingdom.

Enclosure
Department of Education
Faculty of Arts,
University of Peradeniya,
Peradeniya
Tel: 812392711/2704
Email: empcse@yahoo.co.uk

Director of
Education,
Central Province,
Provincial Office,
Kandy.
28/11/2013

TO WHOM IT MAY CONCERN

Mr. Prabath Ekanayake has the permission of this Department of Education, Central province, Kandy, Sri Lanka to carry out his research project within the selected sample of schools in Kandy educational District, as described above.

Signed

Director of Education,
Central Province,
Provincial Office,
Kandy.

+44 (0116) 252 3690. Dr. S. Wijesundara, Head, Department of Education, University of Peradeniya at subhashiniew@yahoo.com, +94812392700

Thank you

Sincerely,



Prabath Ekanayake
Ed.D. Candidate
School of Education,
University of Leicester,
United Kingdom.

Enclosure
Department of Education
Faculty of Arts,
University of Peradeniya,
Peradeniya
Tel: 812392711/2704
Email: empcse@yahoo.co.uk

Director of Education,
Central Province,
Provincial Office,
Kandy.
28/11/2013

TO WHOM IT MAY CONCERN

Mr. Prabath Ekanayake has the permission of this Department of Education, Central province, Kandy, Sri Lanka to carry out his research project within the selected sample of schools in Kandy educational District, as described above.

Signed



For Director of Education,
Central Province,
Provincial Office,
Kandy.

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මප/අධ්‍යා/සං/07

ඔබේ අංකය
உமது இல
Your No.

කාර්යාලය
கාරியாலம்
Office

081 - 2224041
081 - 2224042



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Education Department of Central Province

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மா.க. ப. அ. அ. அ.
P. D. E.

081 - 2225134

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உம. மா. க. ப.
Add. P. D. E.

081 - 2228535

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திகதி
Date.

2013.11. 29

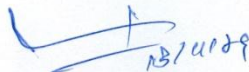
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පේරාදෙණිය.

**Requesting permission to carry out research study leading to a
Doctoral Degree**

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- ❖ මප/මහ/ මහානාම විද්‍යාලය, මහනුවර.
- ❖ මහ/ වික්‍රමහානු ජාතික පාසල, ගම්පොළ.
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- ❖ මප/දෙනු/විමලධර්ම විද්‍යාලය, පේරාදෙණිය.
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2. අදාළ විදුහල්පතිවරුන් වෙත - අදාළ සිසු සිසුවියන්ගේ අධ්‍යයන කටයුතු වලට බාධා නොවන පරිදි උක්ත පර්යේෂණ කටයුතු සඳහා සහය ලබාදීම සඳහා.

Appendix 7: Request letter to obtain permission from the principals of the selected schools

E.M.P.Ekanayake
Department of Education
Faculty of Arts,
University of Peradeniya,
Peradeniya
Tel: 812392711/2704
Email: empcse@yahoo.co.uk
November 15, 2013

Principal
.....College

Dear Madam/Sir,

Requesting permission to carry out research study leading to a Doctoral Degree

I am currently pursuing a course of studies leading to a Doctor of Education degree from the University of Leicester, United Kingdom. I am writing to request your permission to observe lessons and interview Grade Four teachers and students in your school for my doctoral dissertation.

The purpose of my study is to explore the nature of learning experiences of low-attainers in primary mathematics with a particular focus on teaching and learning process with the expectation of introducing a set of recommendations towards effective numeracy teaching learning process at primary grades in Sri Lanka.

I will be focusing my research on a targeted group of low-attainers in mathematics at fourth grade students and their teachers. I will observe classroom teaching and conduct interviews with both teachers and students during the pilot study and the main study. The duration will be from January 2014 to January 2016.

I will be collecting work samples, student surveys, and other data throughout the research project. The students and teachers will remain anonymous in my written report and any work samples used will not include their names. Students and teachers will be referred to as a letter or a number in the report. I will not name the school without permission.

I need your permission to take some pictures of the teachers' and students' while they are working in their classrooms. I will include these photographs in my thesis without the identity of school and the persons. I promise that, while carrying out this research, I will observe the highest possible ethical standards.

If you have any questions regarding my research project, feel free to contact me at above mentioned telephone number and email address.

Please see the attach permission letter from the director of Education, Kandy.

I would be grateful if you could grant me permission to carry out the proposed study within your school.

Thank you

Sincerely,

Prabath Ekanayake
Ed.D. Candidate
School of Education,
University of Leicester,
United Kingdom.

Enclosure

Department of Education
Faculty of Arts,
University of Peradeniya,
Peradeniya
Tel: 812392711/2704
Email: empcse@yahoo.co.uk

TO WHOM IT MAY CONCERN

Mr. Prabath Ekanayake has the permission of this school management to carry out his research project in this school, as described above.

Signed

Principal,

.....School

Appendix 8: Request letter of consent from the parents

E.M.P.Ekanayake
Department of Education
Faculty of Arts,
University of Peradeniya,
Peradeniya.
Tel: 812392711/2704
Email: empcse@yahoo.co.uk
November 15, 2013

Dear Parents,

Request consent to include your child in my research project

I am doing an a research project on the learning experiences of low-attainers in mathematics at primary grades with the aim of introducing a set of recommendations towards effective numeracy teaching learning process at primary grades in Sri Lanka.

I will be focusing my research on a targeted group of fourth grade students. I will meet with them two times, about one hour each, to discuss their learning experiences during next school term 2014. The same practice will be carrying out during January 2014 to January 2016.

I will be collecting work samples of students, their experiences in learning mathematics using small group interviews throughout the project. The students will remain anonymous in my written report and any work samples used will not include their names. Students will be referred to as a letter or a number in the report.

Furthermore, I need your permission to take some pictures of your child while he/she is studying in the classrooms. I will include these photographs in my thesis without their names. This would be extremely helpful to complete my research study.

If you have any questions regarding my research project, feel free to contact me at given phone and email. I have enclosed relevant permission letters from the respective authorities. If you do not wish your child to be included in my research project, I will still assist them in learning mathematics.

Thank you,

Sincerely,

Prabath Ekanayake
Ed.D. Candidate
School of Education,
University of Leicester,
United Kingdom.
Enclosure
Department of Education
Faculty of Arts,
University of Peradeniya,

Peradeniya
Tel: 812392711/2704
Email: empcse@yahoo.co.uk

Please complete the bottom portion of this letter and return it to me by (01 January 2014).

Student's name _____

Parent's signature _____

My child can participate in this research project.

YES ____ NO ____

Appendix 9: Request letter of consent from the teachers

E.M.P.Ekanayake
Department of Education
Faculty of Arts,
University of Peradeniya,
Peradeniya
Tel: 812392711/2704
Email: empcse@yahoo.co.uk
November 15, 2013

Dear Mr/Ms.....
.....School

Requesting consent to include for the research project

I am currently pursuing a course of studies leading to a Doctor of Education degree from the University of Leicester, United Kingdom. I am writing this letter to obtaining permission to include you as a key informant for my doctoral research.

The purpose of my study is to explore the nature of learning experiences of low-attainers in primary mathematics with a particular focus on teaching and learning process with the expectation of introducing a set of recommendations towards effective numeracy teaching and learning process at primary grades in Sri Lanka.

I will be focusing my research on a targeted group of low-attainers in mathematics at fourth grade students and their teachers. Therefore, in order to meet the aim and objectives of the research I will observe your classroom teaching and expect to conduct interviews with both you and your low attaining students in mathematics after the lesson observations. In addition to that I would be appreciated if you could help me to identify the low attainers in mathematics in your classroom. The duration for the study will be from January 2014 to January 2016.

The students and teachers will remain anonymous in my written report and any work samples used will not include their names. Students and teachers will be referred to as a letter or a number in the report. I will not name the school without permission. I promise that, while caring out this research, I will observe the highest possible ethical standards.

Furthermore, I need your permission to take some pictures of your classroom while you are teaching. I will include these photographs in my thesis without your name or school name. This would be extremely helpful to complete my research study.

If you have any questions regarding my research project, feel free to contact me at above mentioned telephone number and email address. I have enclosed relevant permission letters from the respective authorities.

I would be grateful if you could grant me permission to consider you as a key informant for the proposed study.

Thank you

Sincerely,

Prabath Ekanayake
Ed.D. Candidate
School of Education,
University of Leicester,
United Kingdom.

Enclosure

Department of Education
Faculty of Arts,
University of Peradeniya,
Peradeniya
Tel: 812392711/2704
Email: empcse@yahoo.co.uk

Please complete the bottom portion of this letter and return it to me by (01 January 2014).

Teacher's name _____

Signature _____

I can / cannot participate in this research project.

YES ____ NO ____

