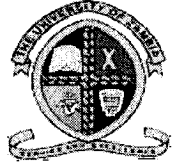


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REFLECTIVE PRACTICE: STUDYING CHANGES IN A MATHEMATICS TEACHER'S
CLASSROOM PRACTICE

By
CHIKUBA MUNAKASAKA

A dissertation submitted in fulfilment of the requirements for the degree of
Master of Education in Mathematics Education

The University of Zambia
(2010)



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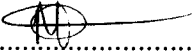
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DECLARATION

I, Chikuba Munakasaka, do hereby declare that this work is the result of my own research and it has neither in part nor in whole been presented elsewhere for another degree or any other qualification.

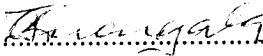
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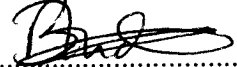
CERTIFICATE OF APPROVAL

This dissertation of Chikuba Munakasaka is approved as a fulfilling requirement for the award of the Master of Education in Mathematics Education of the University of Zambia

Examiners' signatures

Signed:  Date: 02-03 / 12 / 2011

Signed:  Date: 02-03 / 12 / 2011

Signed:  Date: 23rd / 04 / 2012

DEDICATION

I dedicate this work to my children, Kali, Namwinga and Chipu, as well as the Chikuba family; they stood by me during my study period.

ACKNOWLEDGEMENTS

For this task of compiling my work to be accomplished, many people supported and encouraged me. My sincere gratitude goes to my supervisors, Mr Christopher Haambokoma of the University of Zambia and Professor Onstad Torgeir of Oslo University, Norway, for their tireless efforts in getting me grounded in my work. I also want to give special thanks to Dr Muhau Tabakamulamu of the University of Zambia, Ms Sigrid Gjotterud of The University of Life Sciences in As – Norway and Professor Dorothy Nampota of University of Malawi – Malawi, for their support throughout my work on this study. To the teacher I worked with in this research, I say many thanks, for he made my work possible.

Gratitude untold goes to my sponsor Project SUSTAIN, who made it possible for me to complete my studies and exposed me to forums where I met other researchers, experienced and beginners, such as SAARMSTE conferences and SUSTAIN weeks.

My sons, daughter and indeed the whole family cannot be left out as I express my gratitude, for they were so tolerant and understanding through my study journey. My colleagues in this study programme, George and Foster - it was indeed rewarding to have you around as you helped me get by through all times, smooth or rough.

Finally, I wish to express my gratitude to all friends who encouraged me, gave me support and contributed towards making my study a reality in one way or the other.

ABSTRACT

This study investigated a mathematics school teacher changing his classroom practice through reflective practice. The study, which was in the form of action research, was conducted in Livingstone District of the Southern Province of Zambia, targeting teachers of mathematics in upper basic schools. The action research method was used to conduct this study and data were solicited from one teacher of mathematics at upper basic school level who was purposively selected. The instruments used to collect data were recording sheets and audiotape recordings for semi-structured interviews, lesson observations and reflection sessions, as well as lesson plans. Data were manually coded, emerging data were arranged in phases and data were analysed descriptively.

The main objective of the study was to examine the changes, if any, which took place in the teacher's classroom practice through reflective practice. The findings of this research were such that: (i) the teacher initially spoke well about issues to do with classroom practice and reflection - which was not the case during the first phase lesson observations; and (ii) collaboration with the teacher brought about some deeper reflections on classroom practices which, in the final analysis, brought about some changes in his teaching practice and also made me realise areas where I needed to put more effort as a teacher educator.

The report concludes with recommendations for reflective practice for teachers of mathematics and mathematics teacher educators who are directly involved in issues of quality delivery of the subject. While this study was a single case study, it would still be of great help especially for teachers of mathematics and teacher educators if they would take note of the results of this study and the changes that took place through reflective practice, and strive to see how such would work in their own setups. There are also some suggestions for further research in related areas of reflective practice and teachers' classroom practice.

The implication of the findings is that it is possible for mathematics teachers to become reflective practitioners and be made to think about what they are doing. This suggests that the reflective practice of many mathematics teachers could be enhanced if the inspectorate and advisory services departments in the education ministries take their role of encouraging teachers to be reflective practitioners seriously.

TABLE OF CONTENTS

Declaration	i
Certificate of Approval	ii
Dedication	iii
Acknowledgements	iv
Abbreviations	v
Table of Contents.....	vi
Abstract.....	x
CHAPTER ONE: INTRODUCTION	1
1.1 Background.....	1
1.2 Statement of the problem	5
1.3 Purpose of the study.....	5
1.4 Objectives of the study.....	6
1.5 Research questions	6
1.6 Significance of the study.....	6
CHAPTER TWO: REVIEW OF RELATED LITERATURE	8
2.1 Introduction.....	8
2.2 Social constructivism.....	8
2.3 Reflective practice/teaching	11
2.4 Classroom practice.....	14
2.5 Quality teaching/good teacher	18

2.6	Summary	22
CHAPTER THREE: RESEARCH METHODOLOGY		24
3.1	Introduction.....	24
3.2	Research design	24
3.3	Target population	26
3.4	Sample and sample selection	26
3.5	Research instruments	28
3.6	Data collection procedure	29
3.7	Validity and reliability	31
3.8	Data analysis	32
3.9	Summary	32
CHAPTER FOUR: PRESENTATION OF FINDINGS.....		33
4.1	Introduction.....	33
4.2	Collaborator	33
4.3	Phase one: pre-lesson interview and first classroom observations	33
4.3.1	What are a basic school teacher's views about reflective practice?	33
4.3.1.1	Semi-structured interview	34
4.3.1.1.1	Classroom practice	34
4.3.1.1.2	Reflective practice/teaching	36
4.3.2	How do basic school teachers' classroom practices exemplify reflective teaching?.....	37
4.3.2.1	Lesson observations.....	37

4.3.2.1.1 Lesson 1	37
4.3.2.1.2 Lesson 2	43
4.3.3 Phase Two: Reflections	49
4.3.3.1 How can changes in classroom practice through reflective practice be facilitated?	49
4.4 Phase three: scaffolding on reflective practice.....	54
4.4.1 Lesson observations	54
4.4.1.1 Lesson 1	55
4.4.1.2 Lesson 2	58
4.5 More Reflections.....	65
4.6 Lesson plans.....	68
4.7 Summary	68
CHAPTER FIVE: DISCUSSION OF FINDINGS.....	70
5.1 Introduction.....	70
5.2 Phase one	70
5.3 Phase two	84
5.4 Phase three	86
5.4 Summary	97
CHAPTER SIX: CONCLUSIONS AND RECOMMENDATIONS	99
6.1 Introduction.....	99
6.2 Conclusions.....	99
6.3 Recommendations	102

6.4	Limitation of the study.....	103
REFERENCES		104
LIST OF APPENDICES		113
	Appendix One: Informed Consent Form for Teachers.....	113
	Appendix Two: Ministry of Education: Southern Province 2006 JSSLE Results Analysis for Districts.....	114
	Appendix Three: Lesson on ‘Congruent triangles’.....	115
	Appendix Four: Data recording sheet.....	125
	Appendix Five: A reflection session in phase one.....	133
TABLES AND FIGURES		
	Figure 1: Action research process.....	25
	Figure 2: Seating arrangement in the classroom.....	38
	Table 1: Homework question.....	63

ABBREVIATIONS

ACME	Austin Collaborative for Mathematics Education
ECZ	Examinations Council of Zambia
JSSLE	Junior Secondary Schools Leaving Examinations
LTA	Learning and teaching aids
MoE	Ministry of Education
NCAC	National Centre on Accessing the General Curriculum
NCTM	National Council of Teachers of Mathematics
UNESCO	United Nations Educational, Scientific and Cultural Organisation
UNZA	University of Zambia
ZNBC	Zambia National Broadcasting Services

CHAPTER ONE: INTRODUCTION

1.1 BACKGROUND

This study investigated a teacher's reflective practice and how this helped him change his classroom practice. The research was conducted in Livingstone District of the Southern Province of Zambia at a basic school, with a focus on upper basic school level. Since I am both a teacher of mathematics and a teacher educator for the upper basic level, I found it appealing to study the way mathematics is taught at this level. This was a way of evaluating my own contributions to teaching as well as those of others in the mathematics department at college level. I wanted to examine the current practices and see if, through reflections and collaborations, there could be some changes in the classroom practice of an upper basic school teacher of mathematics. The main objective of this study was to examine the changes, if any, which take place in a teacher's views and classroom practice through reflective practice.

The Zambian education system operates within the framework of Education for All, and since 1996 has been informed by the 'Educating our Future' Policy. There are six levels in the Zambian system of education: pre-school; lower basic, (that is, Grades 1 to 4); middle basic, (that is, Grades 5 to 7); upper basic, (that is, Grades 8 to 9); high school, (that is, Grades 10 to 12) and tertiary education. The aim is that all pupils who start school in Grade 1 should go up to Grade 9 without impediments. However, there are 'selection' examinations at Grades 7, 9 and 12, and the higher one goes in education, the fewer the places there are for learners. For this reason, only high-scoring learners manage to get places and to progress to the next level of education, while the majority fall by the wayside and have to manage their lives as out of school people.

In the Zambian school curriculum, mathematics is one of the subjects that pupils are introduced to as soon as they enter the school system. It is taught from pre-school to tertiary education. It is one of the compulsory subjects for all learners from pre-school to high school level; that is, in most cases every school time-table will have mathematics appearing every school day. Additionally, mathematics is a prerequisite to entry into high school and most tertiary education institutions. The subject is taught by teachers with a Teacher's Certificate from pre-school to middle basic level. Starting from upper basic school level to tertiary education, teachers of mathematics are specialised in the subject at diploma and degree levels. To be specific, the upper basic level is supposed to be handled by diploma holders while the high school and tertiary levels are handled by teachers with degrees. However, in most cases diploma holders will also be found teaching at high school level.

Examination scores for the Junior Secondary Schools Leaving Examinations (JSSLE) in the Southern Region of Zambia have been poor. Data from the Provincial Examinations Office in Livingstone show evidence of this phenomenon of under-performance. For example, according to the Examinations Council of Zambia Southern Province, one of the best performing provinces in the country showed that in 2006 a total of 23, 453 Grade 9 pupils sat for Mathematics Paper 1 and 23, 478 sat for Paper 2; of these, 20, 653 and 22, 114 pupils failed the two papers respectively. A total of 3, 936 candidates were absent from the examinations, while 122 were recorded as missing. Pass percentages for the two papers were, 11.9 and 5.8 respectively (see Appendix One for details). One wonders what happens to the majority that fail and do not find high school places to continue with their education. The Zambian Education Policy, *Educating our Future*, (Ministry of Education, Republic of Zambia, 1996), lays emphasis on quality teaching

and high achievement. This study, therefore, could be seen as a response to this emphasis, since through its findings it sought to assist with improving classroom practices.

As seen above, there is poor performance by most learners in mathematics. Being a teacher educator in mathematics I became concerned with this trend. Most learners find themselves disadvantaged in going further with their 'educational dreams' because of failing mathematics. In view of this, I wondered how reflective teachers of mathematics were in their practice. I felt that it would be worthwhile to engage teachers in examining how reflective practices could in some way help to change classroom practice – and thus also potentially help change the gloomy picture in terms of attainment in mathematics.

Mathematics is one of the subjects believed to be very difficult and less enjoyed by most learners, and yet it is one subject that everyone has to learn. If taught meaningfully, it could be a perfect tool subject, in that everyone uses at least some basic principles of mathematics in everyday life. Mathematics gives a fuller understanding of the world around us, and this understanding can be applied to solve everyday problems. However, most people have developed a negative attitude towards mathematics and simply use its principles without being aware that they are doing so, for example when estimating quantities, calculating, negotiating prices and presenting ideas graphically. Such people need to be helped to develop a liking for the subject and to use it as profitably as possible (Swars, Smith, Smith & Hart, 2008; Austin Collaborative for Mathematics Education [ACME], 2008; National Council of Teachers of Mathematics [NCTM], 2000; Obanya, 1985; Scopes, 1973)

This negative attitude towards mathematics is not peculiar to Zambia; research has revealed similar findings in places like the USA, the UK and South Africa, to mention but a few (Vijay, 2006; NCTM, 2000; Cockcroft, 1982). There could possibly be several factors that are at play in this scenario of low achievement and negative attitudes towards mathematics. It could be that the problems of attitude and under-performance are caused by curriculum specialists, teachers, examinations, the pupils themselves, negative influences from the community or other factors, since all are role players in the subject. There could be combinations of factors that need to be tackled in a bid to improve the attitudes to and beliefs about mathematics, and probably achievement.

From discussions with school managers and teachers, one arrives at the assumption that teachers mostly teach learners to pass the examinations, rather than to help them fully understand the subject. It could be further assumed that teachers of mathematics fail to make safe transitions of the knowledge that learners come with into school, so that it forms a basis for school mathematics. It is therefore imperative that teachers should be more reflective in their practice, and avoid rushing through and concentrating only on the topics they feel would make up the examination papers, and ignoring teaching to make the subject matter understood through making necessary linkages to learners' own contexts, using variant learning and teaching aids (LTAs) and modes of interactions.

While teachers may want to teach for the examinations, the end result is that achievement levels of learners still remain low and learners still confess a dislike for mathematics (Cockcroft, 1982; Examinations Council of Zambia results, 2006; Wetzel, 2009). This raises issues that need to be addressed. It would therefore be more rewarding to teach to enrich the knowledge base that the

learners already possess, so that they can use it to sustain their lives. After all, even when teaching is examination-oriented, several learners do not pass the subject. I felt that in order to achieve this shift, more reflexivity and a change in classroom practices was required.

1.2 STATEMENT OF THE PROBLEM

With respect to the above discussion, I felt drawn to study the changes brought about in a teacher's classroom practice through reflective practice as I collaborated with him. Classroom practice covered aspects of linking mathematics to everyday life, usage of LTAs and classroom interactions, among others. Reflection is at the core in organising one's work, because it serves to generate knowledge. Generally, we reflect on something in order to consider it in more detail. Reflective teaching could be a resource to help teachers see where they need to apply the content they are teaching to their learners' own contexts, in trying to make concepts clearer and more meaningful. Most pupils fail to pass their JSSLE. Thus, one would ask, 'how reflective are teachers of mathematics in relation to their classroom practice if pupils continue to perform poorly in the subject?'

1.3 PURPOSE OF THE STUDY

The purpose of the research was to examine how reflective practice, based on constructivism, could help change and improve a teacher's classroom practice. It is general knowledge that mathematics plays a very important role in this changing world. Beneficiaries of this development need to know some mathematics in order to achieve fruitful and smooth utilisation of modern technologies, and the mathematics taught in classrooms should cater for the variant needs of pupils. It is for these reasons that I decided to investigate reflective practice, studying a teacher's classroom practice and observing the changes, if any, that took place. The research

addressed this phenomenon through engaging with a practicing teacher of mathematics at Grades 8 and 9 level, that is, junior secondary school or upper basic school level - taking particular interest in the Grade 9 class which was about to write the JSSLE.

1.4 OBJECTIVES OF THE STUDY

The objectives of the study were to:

1. Discover a basic school teacher's views about reflective practice
2. Establish how a basic school teacher's practice exemplifies reflective teaching; and
3. Examine the changes, if any, which take place in a teacher's classroom practice through reflective practice.

1.5 RESEARCH QUESTIONS

The research questions addressed in this study were as follows:

1. What are a basic school teacher's views about reflective practice?
2. How does a basic school teacher's classroom practice exemplify reflective teaching?
3. How can reflective practice facilitate changes in classroom practice?

1.6 SIGNIFICANCE OF THE STUDY

It is anticipated that the findings of this study can be useful to:

1. Mathematics teacher educators – to enable them to reflect better on their classroom practices with a view to helping their students have a rich view of reflexivity in their classroom practice. It could also help instil the idea of doing action research studies to

check practice in both themselves and their students. Additionally, to inculcate in their learners ideals that promote the application of mathematics in their day-to-day lives.

2. Classroom teachers – to make use of the information in their planning for teaching and teacher group meetings, to help improve lesson delivery and promote the need and urge for learners to do mathematics. It could also help in awakening the need for reflexivity and some change in classroom practices in order to contribute towards the improvement of performance in mathematics, since the subject is a compulsory one and a determinant to educational progression.
3. In-service providers – would also benefit from these findings, since they organise teacher group meetings to see which areas require paying attention to. The study could also help to generate the ideals of promoting self-study to enhance quality lesson delivery.
4. Myself as a researcher and teacher educator – the study would be of great help in sharpening my observation and analytical skills concerning my practice as well as those of others, especially my students.

CHAPTER TWO: REVIEW OF RELATED LITERATURE

2.1 INTRODUCTION

The chapter reviews literature related to various aspects connected with the investigation into changes in a teacher's classroom practice through reflective practice. The literature reviewed is arranged into subtopics, section 2.2 discusses the theory of social constructivism which informed my study; section 2.3 discusses reflective practice/teaching; section 2.4 discusses classroom practice, section discusses quality teaching/ good teacher while section 2.6 gives a summary of the chapter.

Most literature reviewed was from outside Zambia as I encountered a limitation in finding some literature on similar works. However, in my reading, I found some research works carried out in Zambia in areas such as classroom practices of degree and non-degree teachers; attempts to unearth strengths and weaknesses among University of Zambia trainee teachers; and factors affecting geography teachers' classroom performance at junior secondary school level in Zambia (Mulwatu, 2006; Manchishi, 2002; Chiyeke, 1987).

2.2 SOCIAL CONSTRUCTIVISM

This case study is conceptualised within the theoretical base of constructivism. I felt that the theory of constructivism would go well with the method (largely qualitative) and approach (action research) which were chosen for the study. Piaget argued that children are active thinkers who construct their own understanding of the events in the world around them (Glaserfeld, 1995). The theory of constructivism has expanded and now includes, for example, radical constructivism and social constructivism, which involves the necessity of the social set-up and

interactions of the learners (Dembo, 1994; Glasersfeld, 1995; Vygotsky, 1999). Constructivism enhances the chances for learners to build their knowledge in interaction with their own environments. It encourages group-based and cooperative work, while acknowledging that knowledge acquisition is different for each individual - which a teacher ought to bear in mind.

Hein (1991) argues that “Constructivism refers to the idea that learners construct knowledge for themselves ... each learner individually (and socially) constructs meaning ... as he or she learns. Constructing meaning is learning.” Glasersfeld (1995) states that learners have the capability to construct their own new knowledge based on what they already know. The process of socialisation is not divorced from the activities that learners engage in alongside the role that the teacher plays (Skemp, 1987; Jaworski, 1994). Grouws (1992) agrees, saying that students construct their own mathematical knowledge rather than receiving it in finished form from the teacher or the textbook.

For this study it would therefore be of interest to observe how the teacher facilitates the construction of knowledge for individual learners as well as collectively. I believe that if the construction of own mathematical knowledge by the learners was encouraged, it would contribute to more effective retention, which would in turn raise attainment. I further want to believe that reflective practice would help a teacher to avoid the temptation of giving all the information to the learners to take in as finished products of the process of arriving at solutions.

Among other founding fathers of the constructivist theory, we take a look at Bruner (Patsula, 1999). Bruner believed that it was a necessity to allow learners to discover things on their own, given some basic facts. He was concerned with the application of the constructivist approach to

teaching and learning of mathematics. Bruner argued that learning is an active process in which learners construct new ideas or concepts based upon their current/past knowledge, adding that the learner has to be given room to select and transform the information he/she receives. The learner has to go further and construct hypotheses and make decisions relying on cognitive structures. According to Bruner, these structures help to provide meaning and to organise experiences, thus allowing an individual to “go beyond the information given.” Going beyond the information given could be possible if the teacher assumed the role of facilitator, leaving room for learners to discover certain knowledge by themselves.

Further, Schifter (2001), cited in Sowder (2007) argues that,

“Mathematics teaching is not only based on the additional mathematical skills, but attending to the mathematics in what one’s students are saying and doing, assessing the mathematical validity of their ideas, listening for the sense in children’s mathematical thinking even when something is amiss and identifying the conceptual issues on which they are working (p. 163)”.

This argument supports the principle advanced by Bruner of going beyond the information given; teachers therefore have the task of facilitating learning in such a way that learners are capacitated to start to make their own informed decisions.

Constructivism, which informs this study, tends to address the concerns of teachers’ classroom practices. It advances the point of view that learners are active problem solvers and are capable of exploring difficult subjects; hence teachers have to attune their practices to boost their learners’ individual capacities. Bruner believed that intuitive and analytical thinking should be encouraged and rewarded, listing three principles for instruction in a constructivist approach,

which he summarised as ‘readiness, spiral organisation and going beyond the information given’(Patsula, 1999). In terms of ‘readiness’, he argued that instruction must be concerned with the experiences and contexts that make the student willing and able to learn. ‘Spiral organisation’ entails the structuring of instruction so that it can easily be grasped by the learner, while the third principle has to do with designing instruction to a level where extrapolation and/or filling in the gaps is facilitated.

If teachers listened carefully to what learners said as well as paying attention to their actions, it might help them see sense of what base their learners were constructing their new knowledge on. As such, teachers’ classroom practices as well as reflexivity become vital in helping learners to scaffold on their knowledge bases through contextualisation. Mathematics should not be taught in a vacuum, rather, it should be connected within itself and with other disciplines to help make it more meaningful to learners. I therefore chose to explore the idea of reflective practice while working within the framework of social constructivism, so as to address the research questions and objectives of this study.

2.3 REFLECTIVE PRACTICE/TEACHING

Reflective teaching, as outlined by Zeichner and Liston (1996), is one idea that I chose to work with in this study. The idea of reflective teaching was propounded by Dewey as early as 1904 (Dewey, 1997). It was further developed by others, for example, Schon of Massachusetts Institute of Technology (1987), two teacher educators from Norway, Handal and Lauvas (1987), who developed a framework for understanding the structure of teachers’ practical theories.

Dewey (1997) defines reflective action as that which involves active, persistent and careful consideration of any belief or practice in the light of the reasons that support it and the further consequences to which it leads. He outlined three attitudes which are cardinal and integral to reflective action: open-mindedness, responsibility and whole-heartedness. He further states that to reflect is to look over what has been done so as to extract the net meanings which are the capital stock for intelligent dealing with further experiences. It is the heart of intellectual organisation and the disciplined mind (Dewey, 1997, p. 87). If a person has to engage in reflection, he or she must be willing to look into a matter with an open mind and without prejudice.

Schon (1987) discussed the reflection-on-action and reflection-in-action notions of reflective teaching, which added both texture and substance to Dewey's understanding; however, this came under criticism since other scholars felt that Schon considered reflective teaching as a solitary process involving a teacher and his or her situation, and not a social process taking place within a learning community. In this study, while reflexivity will be the concept of focus, with consideration of reflection on action and reflection in action, the analysis will be done with a social perspective. The teacher and learners will be taken as social beings and not solitary entities.

Handal and Lauvas (1987) asserted that a reflective teacher recognises that a central source of his or her teaching practice is in his or her practical theories, but is also sensitive to the way in which the contexts he/she works in influence his/her actions. The argument from the above observation is that reflective teaching entails recognition, examination and rumination over the implications of one's beliefs, experiences, attitudes, knowledge and values as well as the opportunities and

constraints provided by the social conditions in which the teacher works. This also strengthens the choice of this idea which drives this study since it spells out aspects of classroom practice.

The discussions above highlight how this study aimed to examine how reflective the teacher was in his planning for teaching, lesson delivery, and engaging learners through his practice as well as in evaluation records. Zeichner (1994), cited in Cohen and Manion (1997), states that proper reflection is often described as a tool for connecting experience and theory, frequently postulating a need for advancement to higher levels of theorisation. This also helps in expanding learners' conceptual understanding so that they can make meaning of the mathematics content they learn in school. The more reflective one becomes, the better decisions one makes, thus effecting change in perception and behaviour, often for the better. Such changes allow for constructivist operations - hence a reflective practitioner is highly likely to engage in constructivism in his or her classroom practice.

Being reflective would help a teacher attract, hold and focus his or her learners' attention of the content being taught. Fahy cited in Patsula (1999, p. 59), asserts that it is important to draw learners' attention by using eclectic approaches to teaching. He further states that if attention is to be held and increased, then it is better to create moderate uncertainty about what is to happen next; while to focus attention would entail teaching learners to interpret certain illustrations. A reflective practitioner, I believe, would find ways and means to bundle together theory and practice and see opportunities to engage learners in discovery learning. Discovery learning is thought to have been originated by Bruner in the 1960s. A constructivist approach coupled with reflexivity would thus be an accelerator to improved classroom practice.

2.4 CLASSROOM PRACTICE

Classroom teaching is a blend of whole class, group and individual instruction; hence teachers must be encouraged to identify essential concepts and instructional foci to ensure that all learners comprehend. We can now look at classroom practice as a total sum of what happens in the classroom when teachers deliver their lessons. The most essential factor affecting student learning is the teacher, and the most effective opportunity to improve education is to improve the competency of our teachers (National Centre on Accessing the General Curriculum, 2002). Obanya argues that for teaching to be successful it must, among other things, be methodical, planned, result from resourcefulness on the part of the teacher, be activity-based, related to learners' real life experiences, and follow a logical sequence (Obanya, 1985). He adds that it is also important that teachers emphasise critical and creative thinking as a goal in designing their lessons in a manner that helps learners make meaning of the content, using some learning and teaching aids (among others) to make learners understand and apply meaning.

It ought to be noted that not all learners in a given class are alike, and so teachers also ought to vary their classroom practices and be flexible in their approaches to teaching and presentation of information to learners so as to cater for all of them. Teaching a subject successfully means that as many learners as possible succeed in learning it. Thus, a teacher of mathematics is expected to vary the teaching approaches, link mathematics to everyday life and be reflective.

Teachers of mathematics ought to like their subject besides knowing it, to be very patient, and to help learners who might appear to be slow as much as possible so that they can build confidence in their abilities to achieve in mathematics. Teachers also need to be resourceful - for example, visual aids are important in helping learners to understand important basic processes. Teaching a

subject successfully must be a teacher's primary aim. A teacher who is willing to learn more about the subject and who thinks logically would do a great deal in attracting pupils to the subject. In all this, the study appreciates the fact that there is no such thing as the right way to teach. Teaching is a challenge and teachers strive to find ways of making learning more effective (Obanya, 1985; Coombs, 1995).

Teachers' classroom practices are influenced by many factors. According to Ernest (1988), these include the teachers' system of beliefs about mathematics and its teaching and learning; the social context of the teaching situation; and teachers' levels of reflection. Thus what one believes in has an influence on how one would conduct him or herself in the classroom. The study extended this to include how teachers plan their lessons, set the learning environment and resources, present lessons and take care of learners, as well as how they write reflection notes after lesson presentation. These would, in turn, indicate how much of a reflective teacher one is.

Classroom practices ought to take care of how the content is delivered to the learners, what linkages are made between the content and learners' own contexts, as well as what kind of interactions take place in the classroom. As a result, teachers of mathematics as well as other teachers ought to be encouraged to strive for development of lessons that are engaging and motivating for a diverse class of pupils. In the same vein, I can also say that a teacher could make these linkages if he/she was reflective and associated theory with practice as opposed to taking theory as a delinked element from practice.

Teachers of mathematics ought to bear in mind that mathematics means more when it is rooted in real-life problems and situations. Roblyer (2006) argues that learning must be anchored in real-

life situations. Additionally, constructivists stress that knowledge is linked to the context in which the experience took place, which increases retention. The key to retaining a process lies in the students' ability to understand not only how the process works but also why it works, Grouws (1992). He further argues that "A mathematical idea or procedure or fact is understood if it is part of an internal network ... the degree of understanding is determined by the number and the strength of connections". He also asserts that if one has weak and fragile connections, they may not be helpful when confronted with new situations or problems to solve, (Grouws 1992, p. 67).

The argument is that those learners who understand mathematics will be able to retain the knowledge and apply it to new situations. For example, according to Hiebert and Grouws (2007), conceptual understanding and procedural fluency can facilitate the development of mathematical proficiency. Everyday mathematics creates an environment that involves children in thinking, exploring, discovering and doing mathematics, thus helping them strengthen their internal networks (The Anchorage School District Publication, 1999). However, this is dependent on teachers' classroom practices, and how reflective they are.

'Everyday mathematics' is a term that is used to describe mathematics teaching and learning that draws from the learners' own contexts with respect to both the content and LTAs used. In this case, 'mathematics care' is to make meaning of the content delivered and attune it in ways that make it relevant to learners. According to Wetzel (2009), the key to teaching mathematics to learners so that they internalise it and transfer their knowledge, is to make learning mathematics personal. He further asserts that no matter how many worksheets or exercises learners complete, they will never make connections between mathematics concepts until they are concrete and

relate to their personal environments. Everyday mathematics needs to be real, reflecting the learners' real-life situations and not just being a set of numbers or endless problems to calculate.

Linking mathematics to the everyday life of the learners makes it a living subject; in most cases where this has been evaluated, learners exposed to this kind of mathematics teaching and learning achieve better results (Wetzel, 2009) Almost all of the research in this field points in the same direction - that children who use everyday mathematics tend to learn more mathematics and like it better than those who use other programmes. This is also an indicator that everyday mathematics is research-based and proven (Wetzel, 2009; National Research Council, 2004). Contextualising mathematics content helps learners understand why mathematics is important and how they reach their answers, so they internalise what they are learning (National Research Council, 2004).

Additionally, Zambia's current National Policy, *Educating our Future* (M o E, 1996) clearly states that the quality and effectiveness of an education system depends heavily on the quality of its teachers. They are 'key' in determining success in meeting the system's goals. The educational and personal well-being of children in schools hinges on teachers' competences, commitment and resourcefulness. Ernest (2008, p. 57) argues that "The preparation of mathematics teachers of high quality is perhaps the central goal of mathematics teacher education – but what is quality teaching?" One could also ask: 'who is a good teacher?'

2.5 QUALITY TEACHING/GOOD TEACHER

Teachers facilitate learning and act as the role models for the learners under their care. Ball, Hill and Bass (2005) argue that student learning might not only result from teachers' knowledge but also from the interplay between teachers' knowledge of students, their learning, and strategies for improving that learning. Adding to the important influence that teachers have on pupils, Ball and Rowan (2005) state that research demonstrates that once children enter school, teachers exercise more influence on their academic growth than any other single factor, including the families in which students grow up, the neighbourhoods where they live and the schools they attend.

The literature also indicates that the role a teacher plays in his or her classroom is very important, and that it affects his or her learners either positively or negatively (Ball & Rowan, 2005; Cockcroft, 1982; Ernest, 2008). Skemp (1987) states that a good teacher can reduce anxiety and build up confidence in a learner by asking questions progressively, starting with what the learner can answer, and thereby improve the performance; while a bad teacher can reduce an averagely intelligent pupil to tongue-tied incompetence through his or her questioning. He further asserts that there are two important tasks that a teacher of mathematics ought to carry out before having contact with the learners. Teachers of mathematics should analyse the materials they are to present and use with their learners, conceptualise these materials and do careful planning. The planning should take care of the construction of necessary schemas which would be in compliance with new other schemas that learners would have to construct later. These are some attributes of a good teacher whose knowledge is respected by learners and from whom they expect to widen their own understanding.

The Ministry of Education in Zambia also recognises the role of teachers, as evidenced in the education policy (1996, p. 107). The policy states that the quality and effectiveness of an education system depends heavily on the quality of its teachers, who are the key persons in delivering success in achieving the system's goals. Therefore, teachers are tasked with making the subject a living one to their learners. Teachers should not just talk of problems and solutions without using effective representations to make mathematics real. Teachers need to be attentive to their learners' needs and help them develop the necessary mathematical skills, which in turn will help them conceptualise the content.

Education describes the total process of human learning by which knowledge is developed, faculties are trained and skills are enhanced (Farrant, 1980). Mathematics is taught and learnt to develop mathematical skill and knowledge; creative capabilities; critical appreciation of the social application and uses of mathematics; and an inner appreciation of the subject. These attributes of mathematics education could help learners to develop powers of numeracy, logical thought and accuracy. While the study of mathematics certainly contributes to these ends and is believed to be at the heart of many successful careers and successful lives, the extent to which it does so depends on the way in which it is taught (NCTM, 1998; Niss, 1996; Skemp, 1987; Hersh 1986).

Darling-Hammond (2000) equally contends that quality of teachers relates more strongly to pupil achievement than other forms of educational investment, like small class sizes and budgets on other school requisites. The onus here lies in the hands of teachers of mathematics to raise the achievement of learners in their subject. The tasks, activities and procedures set for learners should require that the content is made attainable and enjoyable for them.

However, observations have been made that many people fail to make meaningful and profitable use of mathematics, and blame it on the way it was taught to them (Cockcroft, 1982; Skemp, 1987; Scopes, 1973). According to Scopes (1973, p. 12),

“If mathematics is properly approached and organized, it can give moments of success to everyone, the satisfaction of mastering skills or the pleasure of combining with others to present a discovery to a wider audience. It can help to build social values, it runs through the whole of our culture, in art, music, language, logic, and science that it is virtually impossible to do without it.”

While it is suggested that mathematics should be taught in order to develop powers of logical thought, accuracy and spatial awareness and that the study of mathematics can definitely contribute to these ends, the extent to which it does so depends on the way in which it is taught (Skemp, 1987).

Cockcroft (1982) shows that some people have confessed that they did not do well in mathematics and probably could not make good use of the subject even in their adult life because of the teachers they had for the subject. He argues that a teacher of mathematics has a task of enabling each pupil to develop within his capabilities the mathematical skills and understanding required for adult life, employment and further study or training. This calls for reflective practice and having a constructivist mindset on the part of the teacher, where individual learners are encouraged to be responsible for their learning and to be active participants in constructing their own knowledge. Reflexivity could help a teacher to narrow and or even remove the gap that is usually created between theory and practice.

There are variant views of the idea of good teaching. Franke, Kazemi and Battey (2007) state that what accounts for good teaching is controversial and will remain so; however, they contribute that teaching is relational, in that it involves the teacher, learners and materials that are used, and that teaching and the learning environment should support participation by learners. Ernest (2008) describes a good teacher of mathematics as one who is successful in students' achievement and who exhibits a range of teaching approaches and behaviours. He also argues that quality in mathematics teaching lies in the personal epistemologies and belief systems of a teacher of mathematics and his/her classroom practice. The arguments advanced by some researchers, like Skemp (1987), Cockcroft (1982) and others, indicate that there are also traits which might constitute a good teacher or a bad teacher of mathematics, irrespective of the difficulty in defining good teaching.

Hill, Sleep, Lewis and Ball (2007) state that it is not enough for a teacher of mathematics to know how to solve mathematical problems in front of the learners; a teacher of mathematics ought to display further knowledge, skills and competence beyond that. He or she should be in a position to make the content accessible, interpret students' questions and productions, and be able to explain or represent ideas and procedures in multiple ways, thus teaching reflectively.

Indeed, teachers should display and foster an understanding of mathematics that goes beyond the acquisition of mathematical skill to developing mathematical power to manipulate mathematics for development of self and society, thus making mathematics a living subject (English, 2002; Cockcroft, 1982; Sidhu, 1995). There could, however, be no tight connection between what type of mathematics understanding a teacher holds and how they decide to teach. It has been documented that teachers could say one thing and practise quite another, hence the complications

of defining a good teacher and quality teaching. But the aim of mathematics teacher education is to produce a good teacher that can offer quality teaching. UNESCO (2004) also concludes that the quality of education depends not only on curriculum and materials provided but mainly on teachers.

From the arguments made above, it is now increasingly clear that classroom practices have an effect on what students learn in schools and how they grow academically. As a result, good teachers of mathematics who are reflective and strive to make meaning of the subject matter are a great resource in making the subject link with learners' experiences in their day-to-day lives, and possibly raising achievement in the subject. The Ministry of Education in Zambia recognises the fact that the quality of teachers is central to effective classroom practice, and this study aimed to approach this recognition from the reflexivity point of view in trying to provide ways and means of improving effectiveness in classroom practice.

2.6 SUMMARY

This study tried to address issues of reflexivity in relation to classroom practice at middle basic school level. However, most of the literature reviewed was from outside Zambia; hence the remained the need to examine this phenomenon in Zambia. Furthermore, having read the works of other researchers made me more enthusiastic to add to the body of knowledge on delivery of mathematics in ways that encourage reflections and improved classroom practices which link the subject with realities, as opposed to being a whole set of rules and formulae which make no meaning and turn out to be irrelevant to learners. The reviewed literature also provided me with the urge to develop my own capacity as a researcher and teacher educator.

In the next chapter I examine the methodology used to investigate classroom practice through studying changes in a mathematics teacher's classroom practice.

CHAPTER THREE: METHODOLOGY

3.1 INTRODUCTION

This chapter describes the research design, study population, sampling procedures, research instruments used, data collection procedures and analysis of the data.

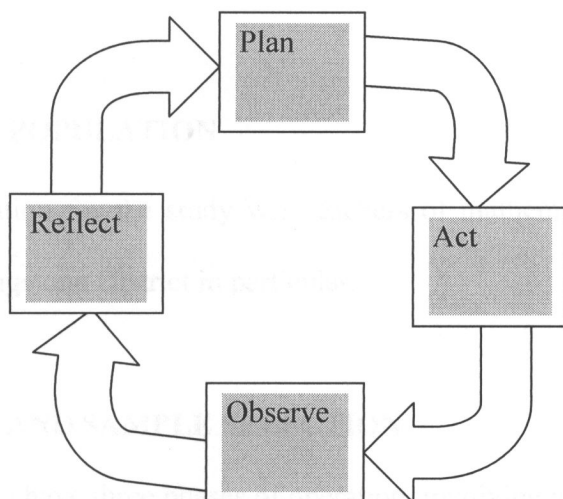
3.2 RESEARCH DESIGN

As mentioned earlier, this study was aimed at investigating changes, if any, in a teacher's classroom practices through reflective practice. In order to address the research questions, I chose to use semi-structured interviews, discussions, and lesson observations as well as studying teaching preparation notes. A research design is a programme that guides the research in collecting, analysing and interpreting the observed phenomenon (Bless & Achola, 1987).

The methodology I found to be appropriate for this study was the action research approach; this was largely because I had to work collaboratively with the teacher and note the changes that were taking place along the way. According to Opie (2004), action research is a reflective process that allows for inquiry and discussion and is often a collaborative activity aimed at searching for solutions to everyday, real problems, and looking for ways to improve practice.

The plan of action used exemplifies this model of action research, which is a process of four main stages: planning, acting, observing and reflecting, as shown in Figure 1 (Kemmis & McTaggart, 1981).

Figure 1: Action research process



In teaching and learning, action research helps raise student achievement and deals with how instruction could be changed to impact on learners as well as improving practice on the part of the teacher (Tiller, 2007; Ferrance, 2000). Carr and Kemmis (1986, p. 162) define action research as “A form of self-reflective enquiry undertaken by participants in social situations in order to improve the rationality and justice of their own practices, their understanding of these practices, and the situations in which the practices are carried out.” They add that it is the research method of preference whenever a social practice is the focus of research activity. Research and reflection allow teachers and researchers to grow and gain confidence in their work, since these influence and improve the skills of thinking, sharing and communicating.

There are different types of action research, depending on which participant is involved in the research. In this study the research was conducted with a practising teacher, and collaborative

action research was used. Collaborative action research centres on a single or several classrooms and allows for a close link with administrators and substitute teachers (Ferrance, 2000).

3.3 TARGET POPULATION

The target population for the study was teachers of mathematics in the Southern Province of Zambia, and Livingstone District in particular.

3.4 SAMPLE AND SAMPLE SELECTION

The study aimed to have three phases of operation, involving about three teachers in the research design. However, only one teacher was finally available for the research. One teacher got transferred, and it took him long to settle down and be available for the research. When he had settled down in his new station, I tried to follow him up, but he was never available at the appointed times for our meetings. The other teacher was approached for the study, but unfortunately she was reported sick for a long time and when she came back was not ready for the task and had all sorts of excuses. I realised that the two were not going to be available for the study. I also got transferred from my research field for close to a school term, which became a hindrance to my progress.

Initially the research topic was introduced to the three partners, and the plan of how the research would be done was discussed with them. The terms of reference were agreed upon, that is, semi-structured interviews first, followed by lesson observations, and studying preparations for teaching documents and reflections, to which each agreed. The plan was for the teachers to reflect on their own and then to reflect together with the researcher, and to go into the next

phases. Just after these introductions, the transfers and sickness cropped up. However, I was confident that the research would still yield the required results despite the fact that it was now a single case study.

A phase in this research meant a complete cycle - planning, acting, observing and reflecting; for each phase undertaken, the four stages of a cycle were observed. We had to plan for the activities to be done, carry them out and make some observations, which became our springboard for the reflections that we did, thus ushering us into the next phase.

The teacher I selected for the study was teaching a Grade 9 class which was due to write the JSSLE by November 2009, the year this study was done. He also had a Grade 8 class, and by then had been teaching for 10 years. He was in essence the only teacher of mathematics in the school, because the teacher who was handling the Grade 8 class had just been transferred after being in the school for barely one term.

The teacher in this study started out as a primary school teacher and was seconded to teach mathematics at junior secondary school. He later decided to go for further training to attain a Diploma in Mathematics and Religious Education. This qualification allowed him to teach at junior secondary school - and so he was now no longer on secondment but rightfully teaching at upper basic school level. By the time of the research he had had 4 years of teaching upper basic level as a seconded teacher with a lower-level teacher qualification and 4 years as a qualified trained teacher for this level, which adds up to 8 years of experience in all.

The study was conducted in Livingstone, since I was working there and was more familiar with the schools in Livingstone than elsewhere. This was also done in the interest of maximising what I could learn in the available time for the study.

3.5 RESEARCH INSTRUMENTS

Some primary sources of evidence identified for case study are documentation, archival records, interviews, direct observation, participant observation, checklists and physical artefacts, among many others (Yin, 1994; Ferrance, 2000). Since the study was an exploratory case study with a collaborative action research approach, it was necessary to use semi-structured interviews, classroom observations, tape-recordings and lesson preparation documentation. I used the semi-structured interviews since they offered me room to ask questions in a more informal manner. I was also able to probe some responses further. This approach is encouraged by Fay and Fontana (1991), who state that semi-structured interviews provide a greater breadth of data than structured interviews and entered the information that I collected on data recording sheets.

I went ahead to tape-record most of these interviews and lessons that I observed, which I later transcribed manually. This helped me to store as much detail as possible for the purpose of data analysis. Denzin and Lincoln (2000) state that observation is a reliable field strategy since it simultaneously combines document analysis, interviewing of respondents and informants, direct participation and observation and introspection. There was triangulation in that I also recognised the importance of multiple sources of data collection to the reliability of the study.

3.6 DATA COLLECTION PROCEDURE

I worked with one teacher of mathematics for Grades 8 and 9 in one school where data were collected. He was the only teacher of mathematics in the school. I approached the school manager, to whom I explained my study mission at one of the demonstration schools, and he helped me gain access to this teacher, who was the head of section as well. I assured the teacher that he was at liberty to decide whether or not to take up the task (see Appendix Two). When he agreed to go ahead, I encouraged him to feel free to do the work as best as he knew how. I explained that I wanted to have discussions with him, observe his lessons, make reflections with him and get his own reflections, as well as plan together. I tried to make a distinction between my looking at his lesson preparation documents and observing his lessons and the routine inspections done by standards officers. I explained that this was a learning process and since we were engaging in action research, by the end of the task we both ought to have learnt something.

Data collection is a systematic way of gathering information about subjects in their areas of occurrence (Yin, 1994). Initially I requested the teacher's timetable for Grade 9, which he provided, and we agreed which periods I could be in class with him. Before observation of lessons, I conducted semi-structured interviews with the teacher on his views about classroom practice and reflective practice, especially during mathematics lessons. I compiled field notes where I recorded some points during the interview and my observations during lessons (see Appendices Three, Four and Five). The teacher's preparation notes and his reflections on or evaluations of his lessons were also collected. The following are the approaches I used during the data collection process:

- Interviews: Semi-structured interviews were conducted to find out the teacher's views about classroom practices and reflective practice. I and the teacher sat in the school manager's office and talked undisturbed. The choice of this kind of interview became more appealing since it offered sufficient flexibility to approach the respondent differently while covering the same areas of data collection. For example, during the interview I asked the teacher to describe the way he conducted his lessons, which I also checked during lesson observations to compare and contrast the data.
- Tape-recording: Observed lessons were tape-recorded to help in capturing information that could be missed out when taking fieldnotes. This was used to capture the classroom rapport in case I missed out some information as I made my fieldnotes. The teacher was given this gadget to use, a limitation of its use being that some responses by pupils were not very audible, though most were.
- Fieldnotes: Interviews, proceedings and lessons were recorded in a book which I used for my fieldwork. I made notes as we discussed and as the lessons were going on. These helped me to record pertinent information while on the scene. I was also able to capture the body language at this level, which I could have missed if I only used the tape-recordings.
- Documents: Teacher's preparation notes and the evaluations of the lessons were collected. I requested the teacher to give me his lesson plans, records of work and schemes of work. The teacher allowed me to look at these documents, and asked me to hand them back as soon as I was through with my work, for his teaching file. Fieldnotes and tape-recordings taken during interviews also formed part of the documentation. This was necessary to compensate for the limitations of the other methods - given that what people say might differ from what they actually do.

McNiff (2002) defines triangulation as cross-checking the existence of certain phenomena and the veracity of individual accounts by gathering data from a number of informants and a number of sources, and subsequently comparing and contrasting one account with another in order to produce as full and balanced a study as possible.

There was methodological triangulation in that the aim was to find out about the same phenomenon from different angles and using different lenses, which is termed data source triangulation. Triangulation increases the reliability of the data and the process of gathering it.

3.7 VALIDITY AND RELIABILITY

Issues of validity and reliability are important considerations for every research project. In this case study an attempt was made to ensure reliability and validity by allowing the teacher I was working with to feel free to express himself in the way he ordinarily would, and through the use of multiple sources of evidence – interviews, documentations, data recording sheets and direct observations (Yin, 1989). Validity deals with the question of whether or not the data collection process is really measuring what it purports to. This was also taken care of by ensuring that the study was responding to the research questions, and through the conclusions that were drawn about the study where the objectives were achieved. Further, this teacher went through the texts and permitted me to go ahead and publish what I had gathered and compiled.

3.8 DATA ANALYSIS

According to Yin (1994), data analysis consists of examining, categorising, tabulating or otherwise recombining the evidence to address the initial propositions of the study. Sidhu (1984) says that data analysis is a means of studying the tabulated material in order to determine inherent meanings and facts. It calls for breaking down of existing complex factors into much simpler units to help with interpretations.

Data analysis was done manually by arranging the emerging themes into phases which were later discussed and interpreted. The routine for confronting these data was by identifying the problem; gathering data; interpreting data; acting on the evidence; and evaluating results (Ferrance, 2000). The data I gathered were used especially during reflection time as a springboard for the discussions we had, mildly suggesting shifts in practice and getting views on challenges the teacher experienced in certain areas. It also helped me to reflect on my own practices while I generated questions and aspects for our discussions.

3.9 SUMMARY

This chapter gave an outline of the research methodology employed in the study. It discussed the research design, target population, research instruments, data collection procedures, validity and reliability as well as data analysis. The next chapter presents the findings of the study.

CHAPTER FOUR: PRESENTATION OF FINDINGS

4.1 INTRODUCTION

The chapter presents the research findings of this study on reflective practice: studying changes in a mathematics teacher's classroom practice. The study was conducted through action research and the findings were presented according to the phases that were undertaken with regard to classroom practice, constructivism and reflexivity. The findings of the study were summarised according to the research questions.

4.2 COLLABORATOR

I referred to the collaborator or participant in this study as 'the teacher' as opposed to using his real identity. Direct quotes were used with the permission of the teacher.

4.3 PHASE ONE: *Pre-Lesson Interviews and First Classroom Observations*

This phase started with some discussions with the teacher. He responded to a semi-structured interview, and classroom observations and reflections were done. The lesson plans and evaluations were also studied. Research findings from this phase are outlined below.

4.3.1 What are a basic school teacher's views about reflective practice?

In brief response to this question, the study revealed that the teacher had some understanding of classroom practice although this was rather limited at the beginning. The findings further show that the teacher's perception changed after the researcher had asked further probing questions. Detailed findings in response to this research questions are outlined below.

4.3.1.1 Semi-structured interview

4.3.1.1.1 *Classroom practice*

When asked what the teacher understood by classroom practice, he stated that classroom practice was about teaching and getting pupils involved. He added that classroom practice was about the teacher imparting knowledge to the learners as well as encouraging them to participate in the lessons. His exact response to the question was as follows:

Eeh, classroom practices, the way I understand it is the involvement of a teacher in deliberation of knowledge, eeh, to the learners that is by teaching. Also in the same vein, the involvement of pupils by participating that is by acquiring knowledge and also participating in exploring skills that they are taught by the teacher.

He further said that his teaching was learner-centred and that he used LTAs at least three times per week, depending on the lesson to be taught. He mentioned that these LTAs were made and organised by both the teacher and pupils, and that mathematics was a practical subject which favoured group work. Additionally, he said that he got ideas from colleagues and used mostly the question and answer method with some of the lecture method. He justified the use of LTAs as follows:

Eeh, LTAs, the reason for using is to make sure that the pupils are involved and what they touch and they see, eeh, stays for a longer period of time in their minds. As you know, mathematics is not all about memorising but it is all about understanding. I often use LTAs just as I have mentioned earlier on, depending on the topic but this is at least, in a week, three times, that is the minimum number of lessons.

With regard to linking mathematics to everyday life, the teacher stated that he was making use of mathematics in day-to-day life activities. He said that in the classroom teachers should make use of the pupils or some learning and teaching aids (LTAs) to link mathematics to everyday life. He gave some examples of how this could happen in the classroom.

Example 1:

Maybe let us say you tell the pupil to come to the front of the classroom, maybe you are considering time in terms of maybe you are teaching on speed, distance and time. Then you can tell the pupil to say come here I want you to be here in maybe three seconds, and that means you are making use of day to day, so one can move slowly or can walk faster.

Example 2:

When we mention LTAs maybe let us say that you are teaching on selling and cost price, you can make use of items sold at the market. So it means you are making use of day-to-day activities because as children or learners go to the market, those are the things that they meet.

Discussing the possibility of involving pupils in linking mathematics to everyday life in other ways than mentioned in these examples, he said that it was possible to involve pupils in linking mathematics to everyday life by making them participate in the lessons and encouraging them to make use of the concepts they had acquired. The teacher mentioned that he linked mathematics to everyday life in his teaching, and he added that learners acquired some of these concepts from their homes or the markets. He also said that he involved his pupils in making LTAs for the lessons. I wanted to see these items that were made by the learners as I went in to make lesson observations.

The teacher said that he planned his lessons on a daily basis and that it was important for a teacher to plan daily. I made a note in my book to check this claim too. He went further by saying that if, say, a teacher had gone out for some time and came back tired, then he or she would just teach and write the lesson plan later. With respect to the frequency of planning, he said:

I write on daily basis but at times, to be frank, maybe one was found to be out, maybe you went for funeral and as you come, maybe you are tired, of course we are human beings (giggles); that way maybe you find that you can have a lesson plan at a later stage. But as a teacher it is vital to have lesson plans on a daily basis, but there are circumstances you cannot run away [from].

As a follow up to the statement that one could teach and do the lesson plan at a later stage, the purpose of having a lesson plan for a teacher was explored further by a discussion on whether a lesson plan was just a record to be kept or was it meant to be used during lesson delivery. The teacher said that it was meant to be used during the lesson.

He added that he evaluated his lessons after teaching, although at times it would be after a day or so, depending on how busy and/or tired he would be. He stated that the essence of evaluating was to check for both the failures and successes, and to see areas of possible improvement - for both the teacher and pupils - which would help a teacher handle the same topic better in future. The ideas advanced by the teacher in his responses were really good and encouraging in that I became more interested in getting to the lesson observation time to see them being executed.

4.3.1.1.2 *Reflective practice*

The next question discussed was “what comes to your mind when I mention the term reflective practice?” The teacher’s actual response was:

What comes to my mind is that you sit and relax, look back to what you have been involved in; in terms of teaching as well as for the learners, what they have acquired, then you start building up the failures. It is more or less like evaluating now which will help you in future.

I made a note here too, considering that I aimed to deal with reflexivity in changing classroom practice. However, as a follow up the respondent was asked if it were possible to reflect while teaching - to which he stated that it was possible. He was now quick to withdraw the aspect of sitting back and relaxing in order to reflect. He elaborated that teachers would reflect as pupils asked questions during the lesson. A teacher would then examine the method he or she was using and see if it needed to be changed to make the pupils understand better. He added that reflection by teachers was done at many levels, like when the lesson was in process, during evaluation, at the end of the term or year, after the release of examination results or after the end of a topic test.

In general therefore, the findings show that the teacher displayed good knowledge about some aspects of reflection. However, the lesson observations at the beginning of the study gave contrary revelations as will be discussed in the next section.

4.3.2 How do basic school teachers' classroom practices exemplify reflective practice?

4.3.2.1 Lesson observations

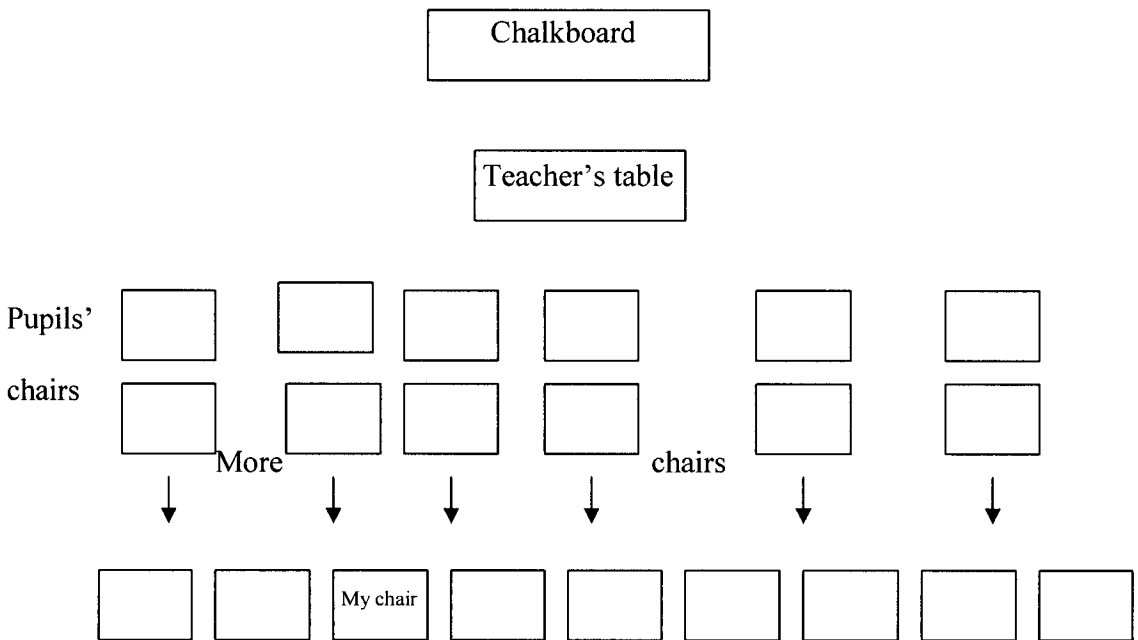
The next step that was undertaken was to observe lessons in order to consolidate the findings from the semi-structured interview. The findings are outlined below.

4.3.2.1.1 Lesson 1

This was one of the lessons the teacher taught just after the semi-structured interview. It was conducted in almost the same manner as the rest of the lessons that were observed during this phase, as will be shown in the presentations below.

The teacher had a lesson plan. The attitude towards pupils was friendly; he smiled at them and addressed them by their names. He had a class of 44 pupils in total and the attendance ranged from 36 to 44 throughout the period of observation. During this lesson, there were 36 pupils present. The class was arranged in rows and columns, and the last row was crowded (Figure 2)

Figure 2. Seating arrangement in the classroom



The lesson for the day was on ‘Ratio and proportion’. He gave the definition of the lesson topic and wrote it on the board, and the pupils were asked to copy it down. He also wrote the short forms of representing ratio (D:E or D/E), then moved on to give some examples.

EXAMPLE 1: The areas of two rectangles are in the ratio 2:3. If the area of the smaller rectangle is 12cm^2 , what is the area of the bigger rectangle?

EXAMPLE 2: Simplify the following ratios: (a) 10kg: 1000g (b) $1/5:1/4$

The teacher made some explanations as he worked out the problems on the chalkboard for the class, and he also asked some basic questions, which few pupils responded to. I noticed that he mostly used one boy to answer his questions. Some of the questions the teacher asked were answered by himself just after a brief pause, without any show of hands from the pupils to answer. I also noticed that only those pupils who raised their hands were given chances to respond. The teacher used textbook questions, which were in the lesson notes he was referring to during his lessons, and he used just the chalkboard to work out the problems.

After working out Example 1, the same boy (I will call him P1) who answered most of the questions, asked this question: “Suppose you have three numbers in the ratio, what would you do, for example, 2:3:4?”. I found this very interesting, and I thought to myself, well, here is a chance for my teacher to allow pupils to explore further the concept he had presented. I even thought the teacher would take pride and interest in such a case too.

However, the teacher responded almost immediately, saying that would be a wrong question. He emphasised that the ratios had to be two only, but the pupil did not seem satisfied because he shook his head in disagreement. Either the teacher did not notice the pupil’s gesture of disagreement or he ignored it. Since the boy did not give a verbal agreement when the teacher asked if his explanation was clear, the teacher decided to go ahead. The teacher repeated his explanation and told the class to take note of the formula he had given them and the way he worked out the problem, referring to the example on the board, in case a question like that came up during the examinations.

I felt let down at this response, and I noted it down as one point of discussion when we met for our reflections. I realised that the relevance of this study was now very evident. How much reflection did the teacher do when he received this question from the pupil - and how far was he willing to allow pupils to go beyond the information given? Such questions as these had to be addressed, to see if there could be some change in later lessons.

The teacher worked out Example 2 - Simplify the following ratios: (a) 10kg: 1 000g (b) 1/5:1/4, and gave out the procedure. The working went like this for (a):

Teacher: For this one, [kgs] have to be converted to grams by multiplying 10kg by 1 000g. Like this:

10kg: 1 000g

(Multiply 10 by 1 000g) 10 x 1 000g: 1 000g

Teacher: (what is 10 times 1 000g?)

Class: 10 000

(teacher writing on the board, 10 000g: 1 000g)

Teacher: The division in this case will be by what? (No response)

Teacher: 1 000. Cancel the zeros [*There was a concern on my side about cancelling zeros; to what extent is this cancelling done?*]

$$\frac{10000}{1000} \quad \frac{1000}{1000}$$

10g: 1g

10:1

A pupil asked why 1 000g was being multiplied by 10; the teacher explained that it was because it had to be converted into grams. He did not, however, specify why kilograms had to be converted into grams. (Just as he did not take note of the pupil's question about 'wrong mathematical order'.) The question was supposed to be 10kg divided by 1 000g and not vice versa. This was an issue of syntax in mathematics.

The teacher moved on to the next part of the example, (b) $1/5:1/4$, which he explained, giving the procedure as he worked it out on the board, almost hurriedly:

$1/5:1/4$ (find denominator)
 $20 \times 1/5 : 1/4 \times 20$ (Teacher asks what is to be done to 20 and gets no response from pupils. He tells the pupils that they had to divide to get the answer and divided with them.)

= 4:5 (the answer).

At the end of this process, he asked the pupils if they had understood and could proceed. The class asked the teacher to repeat the explanation on Example 2 involved fractions. This is what happened:

Teacher: Are you clear on this one?

Class: Yes/no (more negative responses than positive)

Teacher: Where are you not clear?

Class: Start afresh (from most pupils).

There were more negative responses, with the pupils demanding that the teacher worked out Example 2(b) all over again, and the teacher's facial expression displayed unhappiness. He paused a little and told the class to listen attentively as he started giving the whole explanation again, almost verbatim. Immediately after his explanation, he gave a class exercise. He did not ask if the explanation was clear this time; he just started to write the exercise on the board and asked pupils to start answering without wasting any more time. The following were the questions the teacher gave as an exercise:

1. If the perimeters of the two triangles are in the ratio 5:4. If the perimeter of the bigger triangle is 20cm, what is the perimeter of the smaller triangle?
2. Simplify the following ratios (a) 100m:10cm (b) $1/2:1/3$.

I could see that the teacher was rushing through his work to complete what he had planned to do during this lesson. He seemed not to like the idea of being delayed through questions from his pupils, who were seeking clarity. The teacher went round marking and talking to individual pupils. Seemingly, most pupils had problems with question 2. However, as I went round in the classroom with the permission of the teacher, I noted that after he had marked a few books, the rest of the pupils started asking for the correct answers from those with correct answers - who handed their books to friends to copy. The show of hands of those who wanted to have their work marked increased after this. The teacher realised that time had run out; he stopped marking and wrote the homework on the board for pupils to copy. These were the questions:

1. If the areas of 2 squares are in the ratio 4:2. If the area of the smaller square is 4cm^2 , what is the area of bigger square?
2. Simplify (a) $1/3:1/2$ (b) $10\text{cm}:1\text{m}$.

The lesson was not concluded; since the period had long ended, the teacher just told the class to stop writing, hand in their books for marking through the class representative, and get ready for the next lesson, which we had encroached into by some minutes.

I realised that the teacher had prepared a lesson plan, and he felt it more important to complete all the work planned than to allow 'disturbances' through questions and observations by pupils. He even ignored the bell for time up, signalling another lesson by another teacher, so as to reach the end of his lesson plan. I wondered how often we as teachers feel enslaved by our own lesson preparations. I wanted to discuss this issue during our time for reflections. In any case, just after this lesson was over and we were walking towards the staff room, I asked the teacher to give me a brief account about how he felt about his lesson. He said that it was very successful, and I

asked him if he could state what made his lesson very successful, as we sat down to reflect. I also urged him to look at his lesson critically and see if there were some areas that needed improving upon.

4.3.2.1.2 *Lesson 2*

The second lesson I use here was on 'Approximations and estimations'. The teacher had a lesson plan. The attitude towards pupils was friendly; he smiled at them and addressed them by their names. He had a class of 42 pupils out of 44. The class was arranged in rows and columns, as indicated in Figure 2. The overall theme for the day was 'Significant figures'. He gave the definition of approximation as: 'to approximate is to estimate' orally, then he wrote a word problem on the board:

"If 20 men do a job in 40 days, how long will it take 10 men to do the same job?"

After this he asked any member of the class to solve it. There was silence and no one volunteered. The teacher then asked P1 (the same pupil as in Lesson 1; I will address him as such throughout) to solve it on the chalkboard. P1 hesitated, and then he went ahead and worked out the problem like this, without involving the other pupils:

20 men – 40 days

10 men - ?

$\frac{20 \times}{20} \text{ --- } \frac{400}{20}$ (he crossed out the zeros on the left and right sides except one on 400)

= 20 days

The teacher thanked the boy for trying. He asked the class about the formula applied: "Here P1 used the formula and we all did it last time, is it direct or inverse?" Some pupils said direct while others said inverse. His question was vague given the situation at hand - was it the question given

on the board, or the working by the pupil which he was referring to? The teacher told the class that it was inverse, and solved the problem on the chalkboard:

$$\frac{20}{10} = \frac{x}{40} \text{ (since it is inverse we swap } x \text{ and } 40)$$

$$\frac{10x}{10} = \frac{800}{10} \text{ (now we cancel the zeros)}$$

$$= 80 \text{ days (do you now agree?)}$$

Class: Yes/ we agree.

A girl put up her hand and asked “What if 10 men used 40 days and 20 men have x ? Should we divide there [pointing] 20 like 10?”, to which the teacher responded “No, you see this! [he writes $\frac{10}{20} \text{ --- } \frac{x}{40}$]. x comes on top; that is why x comes on top.”

The class seemed confused as there were some murmurs in the room. The teacher asked P1 to tell the class how to solve the problem he had just solved on the board. The boy explained following the explanations that the teacher had just given; after that the teacher told the pupils to memorise the formulae, and started the new lesson.

I then realised that this part of the lesson was meant to be some kind of revision, and it was over amid confusion. The explanations by the teacher were confusing even to me, but I felt that the class was probably used to his way of explaining; I discarded this opinion when the class seemed not to be clear by their mumbling. This was another point to discuss with the teacher. The teacher seemed to be of the view that if P1 knew what was to be done, then the rest of the class had to know too. He did not seem to take into account individual differences.

He wrote the new lesson title, ‘Significant figures’, on the chalkboard and asked the pupils to copy it. He proceeded to ask the following question: “What is to approximate?”. Pupils gave responses such as to find, to get, to define; then he said “To approximate is to estimate, it is not

exact". He also gave the definition of significant figures orally, wrote it on the board and asked the pupils to copy it, but then quickly erased it. I could not capture it, and neither could most of the pupils. I wondered if it was because his definition was not very clear that he decided to erase it almost immediately after writing it down.

The teacher then wrote the following example on the board: '6 078 spectators', and asked the following questions:

Teacher: If you buy a newspaper and found the figure reading 6 100 spectators, would it be correct?

Class: No.

Teacher: If Zambia National Broadcasting Services (ZNBC) says 6 000 spectators, would it be correct?

Class: No.

Teacher: I want to move on, I was bringing day-to-day activities. Any questions?

There were no questions. I noticed here that the teacher was trying to bring in the idea of contextualising content, which we had talked about during our semi-structured interviews and during our evaluations after his lessons.

At this point, the teacher instructed the class to be quiet and pay attention, since there was no time to waste. He explained that in the examples he was 'rounding off' or using significant figures. He said that 6 078 could be written as a significant figure; for example, the newspaper used two significant figures, while ZNBC used one significant figure, then he added that zero was not a significant figure. After this explanation he wrote more examples on the board.

Examples: Write the following numbers to 2 significant figures (a) 671 (b) 68 400
(c) 912 694.

The teacher reminded the class that significant figures had to do with rounding off. He then asked the class to solve the examples. For (a) most pupils gave the answer as 67.1, others 6.71, while some had 67 and P1 said 670. P1 was the only one who gave that answer in the class, after many pupils had given their responses. (The teacher surely has an exceptionally good pupil in P1, but unfortunately feels comfortable even when P1 is the only one who manages to solve a given problem.) The teacher said P1's answer was the correct one, and the class simply agreed.

The teacher explained further:

Okay, we make sure that we count from the first digit. We then look at the next number if it gives us one or not. If not, we write zero, if it does, we add one to the neighbour.

Again, I found this explanation vague. Which was the first digit here? Was it by place value of order of reading? How then would one determine the 'neighbour'? I felt the teacher needed to be more explicit in his explanations than leaving concepts hanging.

For (b) in the above example, 68 400, one girl gave the answer as 68 000, which was unanimously accepted and no explanations were made. For (c), 912 694, variant answers were given, some of which were: 900 690; 900 700; 910 000; 912 000. The teacher said the right answer was 910 000 and repeated his earlier explanation about either adding one or not, and he told the pupils to write the exercise. Then a boy told the teacher that he had not understood what to do, especially on question (c); another pupil asked why they had to add 1. The teacher explained as follows in response to both concerns:

We look at 2 and examine if it is less or more than 5. If it is less, do not add one, but if it is 5 or more, you add 1. Hence, in this case 1 remains 1. Clear?

Another pupil asked what the answer would be if the question required three significant figures, and the teacher simply said "913 000" without explanation. Then he wrote the exercise and homework on the board. I wondered how much attention the teacher paid to pupils' concerns and

questions, so that he could try and use their reasoning to generate debates that would help them discover the unexplained concepts and make sense out of the mathematics they were learning.

Exercise: Write the following numbers to 3 sig. figs (a) 431 945 (b) 71 652

(c) 89 179

Homework: Write the following to 2, 3 and 4 sig. figs 437 801.

The teacher went round marking the pupils' books. He ended the lesson a few minutes after time and asked the class representative to collect the books and take them to his office for marking, for those whose work was not marked during the lesson.

All four other lessons observed during this phase were handled in almost the same way as these, and the teacher neither used any LTAs nor group work contrary to what he stated during the semi-structured interview. The kind of methodology employed, questions asked in examples, exercise and homework, the kind of questioning and who responded and the speed were almost a replica of each other in every lesson taught. In addition, there were some computational and content errors.

I wondered how deeply the teacher understood the content he was teaching. On several occasions he seemed not to notice errors committed by either himself or his pupils. He also tended to use a certain language when explaining, like 'cross out zeros' and 'swap figures' when dividing and multiplying, and yet his class had difficulties in conceptualising what he was teaching. This type of language was actually misunderstood by some pupils, who simply got rid of the zeros wrongly in the other problems given. I also observed that the teacher paid little attention to pupils' questions and concerns, or he deliberately decided to ignore them so as not to 'waste any time.'

It was evident from the follow-up questions asked by pupils after the teacher's hasty explanations that most pupils did not get the concepts right – for example, where a pupil would ask questions where they simply replaced the teacher's figures with their own in the same wording (like “Where you have 40 we put 20, what would be the answer?”). Using reflexivity, the teacher would have realised that the mathematical idea in the given example was not captured, or that his pupils had problems with the four operations in mathematics. The other indicator was where pupils were given 912 694 to write to two significant figures; varied answers were given, with only one pupil providing the correct answer - yet the teacher went ahead as soon as he received this correct answer, without getting the reasoning behind the other responses. If a discussion was allowed it would have enabled pupils to realise the need for a shift in their reasoning bases.

In summary, the findings in response to the second research question reveal the following: Initial lesson observations suggested that the teacher's lessons were more of teacher centred than learner centred. He made his class sit in rows and columns that did not encourage free pupil to pupil interactions. He had also adopted a kind of routine for his lessons. His teaching appeared to be more examination oriented and he often told his pupils to memorise the procedures in case such questions came during the examinations while hurrying through to complete the planned work. He asked questions which were mostly answered by about five boys. He used one pupil more than any other to answer his questions and once the boy responded, the teacher went ahead since the boy almost always gave correct answers. In cases where no response was forthcoming from his pupils few moments just after asking, the teacher would answer his own question.

It was also observed that the teacher never used any LTAs in his teaching. He simply had his lesson plan, chalk and the chalkboard for all lessons observed in this series. Yet looking back at what the teacher claimed was his classroom practice we see a contradiction. These were some of the points I used as a ladder to try and get the teacher to change his practice to a more constructivist one and be more reflective in the second part of the study.

Another aspect of concern in this part was a case of mathematical presentation errors. The teacher either made omissions or conceptual errors as he explained and worked out problems on the board for his class. In certain cases he was corrected by his pupils while in certain cases the errors went unnoticed. It seemed his mathematical knowledge was faulty also. This became one other aspect of concern to be covered during reflections

4.3.3 PHASE TWO: *Reflections*

4.3.3.1 How can changes in classroom practices through reflective practice be facilitated?

We used to have short sessions of reflection after some lessons if the teacher had a free period before his next lesson. However, after observing some lessons, two of which I have transcribed, we sat down to make our reflections on this series of lessons and to discuss the next step in the research – which was discussions and reflections on the teacher's classroom practice through reflective practice. I had my fieldnotes, where I indicated areas which I felt we could discuss, such as rushing the lessons, too quiet a class, unclear explanations, computational errors, questioning, the use of LTAs, and contextualising content, among others.

The teacher commented on his teaching, which he said was generally successful because he made explanations and was always under pressure when it came to marking. He also said that he “used more of pupil-centredness” in his teaching, because he asked questions; when asked what he meant by this, his response was not very precise:

“Usually I like to probe according to my way. It involves a lot of question and answer, discussion and demonstration.”

This response led me to deduce that the teacher used a limited meaning of pupil-centred methodologies. I then asked the respondent to clarify his statement that he was under pressure when marking, and to judge whether his class learnt anything from his lessons. He answered that the pupils learnt something as he assessed when he was marking, and that is what he meant by saying he was under pressure - so many pupils wanted their work marked and almost all of the pupils had correct answers. I asked him if there were aspects of some pupils copying from the fast pupils who had correct answers. I indicated to him that the flash of many hands up for work to be marked was after he had gone round marking for the first few pupils, who were also those who participated actively during lessons. In response to this, the teacher said he had not thought of this aspect of copying from each other before then. He admitted that there could be that possibility.

Referring to my fieldnotes, I asked the teacher if he saw any areas of improvement, apart from the successes he mentioned. I was trying to draw the teacher to discuss areas like making meaning of the content taught, computational and content errors, speed and patience, to mention but a few. He hesitated to answer this question. Finally he said that he realised that at times he was rushing through the work; he attributed this to lack of time to complete the work in view of

his lesson plans and the upcoming JSSLE just a few months away. He also mentioned that he did not use any LTAs in his teaching, for which no explanation was given.

The hesitation in answering made me realise the difficulty in facing negative remarks about one's actions, unless trust and confidence have been built in the person or people one is confiding in. I again reminded the teacher that what we were doing was not for judging his teaching negatively, but to help us to unearth some areas which needed paying attention to. However, I maintained the ethical stance as I reiterated to him that he was at liberty to comment or not. When the teacher started to speak, I was encouraged that some trust and confidence was being built, which was a positive aspect of the study.

As a researcher, I appreciated the fact that the teacher had about five boys in his class who answered most of his questions, but I followed this up with a question as to what he felt about engaging almost all pupils during his lessons. He responded that some pupils never raised their hands to answer questions. When asked whether he still believed that there could never be a question with three ratios - in accordance with the answer he gave to P1 during the 'Ratio and Proportion' lesson, and what he could do to redress the situation if this were not the case, he was not very sure - since he had not reflected on the question from the time it was initially asked and he responded. I also asked him what he meant by saying 'zero was not a significant number', to which he seemed at a loss, and promised that he would re-examine that content too.

I also tried to make him see the need to pay attention to pupils' questions and concerns, as well as paying attention to the mathematical syntax. For example, in Lesson 1, a pupil asked why

1 000 g was to be multiplied by 10kg, where there was a need to convert kilograms into grams; I reminded the teacher that even when we knew so well that multiplication was commutative, it was necessary to keep the meaning of what we were talking about. I gave an example in English of a simple question tag like “‘What is your name?’ and ‘Your name is what?’” to which one could equally respond although the correct form is the first. From this I drew the teacher’s attention to the mathematical syntax, which he confessed he rarely if ever paid attention to in his own explanations nor in the pupils’ questions and contributions.

After our discussions he realised that he needed to take time to consider questions and other concerns raised by pupils. He said that he would look up the question that was asked by the pupil in the textbook and would find time to discuss it with the class once he found out how to handle it. Furthermore, he said that he realised the need for and importance of studying the content to be taught before going to teach. He agreed that a teacher’s good content knowledge was vital in helping pupils understand mathematics.

Having reflected on the strengths and weaknesses of the previous lessons delivered, the teacher and I agreed that we could try to have more pupils - if not all - involved in the lessons through group discussions. We also wanted to try pointing at the pupils at random, that is, involving even those who did not raise their hands to answer when questions were asked. Other agreements were on using some LTAs in the next lessons, and drawing examples from the pupils’ own contexts and making them explain their reasoning through the problems, as opposed to the teacher making all the explanations for the class. Questioning was to be improved from merely knowledge and recall (‘what’) questions to higher-order questions where learners got deeply engaged - the ‘how’ and ‘why’ questions. We then suggested trying to make the pupils work collaboratively so as to

share ideas, rather than having situations where they just copied the correct answers from each other.

Having made these reflections, it was time for the teacher to plan and teach the next set of lessons. However, he was not sure what kind of LTAs to use for some of the topics in mathematics. He specifically asked what LTAs could be used for a topic like congruent and similar triangles, which was his next topic. Together we came up with the kinds of LTAs that could be used, with most input coming from him through probing. This seemingly excited him as he tried out the ideas we discussed, like making paper cut-outs of the triangles. He planned his lesson and suggested using some materials in them, which we sourced collaboratively.

After the reflections, the teacher did the lesson planning on his own according to our shared ideas on how he could change and improve his classroom practice. Some of these ideas were spreading the questions widely in class, using LTAs, contextualising content and allowing pupils to express themselves. I requested that the teacher could accord me his teaching file or just the lesson plans and records of work of the lessons he taught, when we next met. He agreed and asked me to return these documents to him as soon as I had got what I needed.

I wanted to establish how the teacher laid down the activities he had to do and those to be done by pupils, check the various ways presented of solving given problems, LTAs suggested for the lessons and the wording in the tasks, and verify if the planning had room for a constructivist approach. Following the third feature of Bruner's theory of instruction, I discussed with the teacher that there were some modes of representation which were key in teaching - that is, visual, words and symbols. I therefore asked the teacher to try and incorporate these in his next set of

lessons. According to Bruner cited in Patsula (1999), the instructor has the task of encouraging learners to understand and to make decisions which will enable them to discover principles by themselves. I requested that the teacher try and address aspects of sequencing the content properly and structuring it in a way that it could easily and readily be grasped by the learner, in our next set of lessons.

We were now ready to move into the next phase.

4.4 PHASE THREE: *Scaffolding on Reflective Practice*

During this phase we expected to start to notice some changes in the teacher's classroom practice having discussed some challenging areas, hence continuing making responses to the third research question.

4.4.1 Lesson observations

The data presented in this phase are from two lessons, which focused on 'Congruent and similar triangles' and 'Mathematics in transport'. There was a long time lapse between them. One took place immediately after the reflection time in term two, while the other was during the following term, when the class was just a few weeks away from the final Grade 9 examinations. Before this series of lessons, the teacher told me that he had considered the areas he had made some content and presentation errors in his previous lessons. He mentioned that he had made mistakes in his presentations and explanations, and had made efforts to correct these. He said he had organised some extra lessons, and showed me the examples he used during these as he tried to correct the misconceptions. This pleased me as I realised that the collaboration was starting to produce

favourable results. I encouraged the teacher to carefully study the content he was going to teach in the next lessons to avoid a repeat of such errors.

4.4.1.1 Lesson 1

The teacher had a lesson plan and some LTAs. His attitude towards pupils was friendly; he smiled at them and addressed them by their names. There were 40 pupils present, 19 girls and 21 boys. The day's topic was 'Congruent and similar triangles'. The class was initially arranged in rows and columns as shown in Figure 2 on page 38. Just after the greetings, the teacher asked the pupils to quickly form groups of three; he kept repeating the instruction until the grouping was done. Grouping took some time since it seemed that the pupils were wondering what it was all about. He allowed one group to have four members since the class number was not exactly divisible by three. After the grouping exercise, the teacher gave out two A4 sheets of paper to each group and found out how many pupils had rulers as he went round. It appeared that he had not actually asked the class to come with the items he was asking about, since only very few members had them.

The teacher named the groups as groups 1 to 13. He told them that they would share the razorblades and pairs of scissors he provided for the activity, since they were fewer than the number of groups. He gave instructions on the task to the groups, but this time he started by asking some questions which he directed to the groups. The teacher asked questions about flat shapes and finally moved to the properties of a triangle. The questions he asked required the pupils to justify their responses. The task he assigned the class to carry out was to cut out two triangles from one sheet of paper, which should be exactly the same without wasting any piece of the sheet, and it was to be done in five minutes.

The pupils worked for more than five minutes while the teacher went round seeing what they were doing. He extended the activity time twice to allow for groups to complete the task, although eventually he seemed to be getting somewhat impatient. By then only very few groups had completed the task and were waving their triangles proudly. The teacher urged the rest of the groups to be quick. He said:

Hurry up! Hurry up! I said you should not take time. [Going round the classroom] What about this group, are you through? [Response not audible] What are you still waiting for? [Response not audible] You are waiting for what? [Response not audible] You are cutting? Okay.

However, he encouraged the pupils to work as groups and not individually, saying:

Discuss as a group please, let it not be one person doing it. Discuss as a group how you come up with two triangles which are the same.

I made the observation that while pupils were put into groups, some were working as individuals, using their own pieces of paper. I logged that this approach had probably not been employed in a very long time, and pupils were not very comfortable with it in the beginning. I recalled that during phase one lessons, grouping learners was never done. After the teacher's instruction for group members to work together, most adhered. Eventually the teacher could not wait any longer for those pupils who had not yet completed the task. He proceeded with the lesson, saying:

Now, for those who have finished, I think we can start. Eeh, I have.... I have written some numbers. [Class is not very attentive, it is still noisy discussing their work, teacher shouts] Let us be together. Since there are 13 groups now I am requesting for those who are through, you come and stick your triangles, just one out of those two triangles.

The decision by the teacher seemed to hasten the slower groups, who also hurried to go and paste their triangles on the board. He asked the class to discuss the triangles that were stuck on the

board; in the process the idea of congruency, with the property of side, side, side (SSS), came out and the teacher then gave the definition, which he wrote on the board. He gave another task to arrive at the other congruency property. He seemed to be at pains to keep the class quiet; they could be silent for a while and get back to discussing their triangles. As the class was doing the second task, the teacher realised he had forgotten one step in his work, and said:

Very quickly, since we have those triangles there [pointing to the triangles on the board], I hope ... I almost forgot one thing, eeh ... we are going to write the letters just at the end of each side so group one this will be obviously be what? [Pointing to one side of the first triangle on the board]

The teacher together with the class named three triangles, considering the corresponding sides.

After the discussions on the pupils' work, the teacher made chalkboard illustrations showing congruent triangles' properties and the symbol for congruency. He asked the class to ask questions if and where they were not clear concerning the work covered, before he gave an exercise. Then he asked the class if the lesson they just covered had any benefits for them.

Teacher: Have we understood? It is us who were cutting these, have we understood what we were doing?

Class: Yes

Teacher: And why were we doing what we were doing? [Silence from class] We should know that. Now these congruent triangles we make use of them in our day-to-day life, when we are doing what? Who can tell us? [Silence] What benefit do we get of learning these congruent triangles? Who can tell us? In our day-to-day life.

P2: [not audible]

Teacher: Measuring what?

P2: Measuring the field.

Teacher: So you can say that, that field, last year I had a field which was 2 by 3 km so even this time I should have the same measures. In short he is saying also in designing, when you want to go to the tailor. So very quickly you copy

what I will write and do the exercise. I know we do not have too much time.
Return the pairs of scissors.

The teacher gave one question as a written exercise; he drew a set of three triangles and asked the class, in their groups, to identify congruent triangles using the congruency symbol and to work quickly.

After group discussions, he asked them some questions so that they could justify their answers, which was the conclusion to the lesson as there was little time left for the class to do the other exercise, which he ended up giving as homework. He asked questions such as:

Which triangles are congruent?

Why do you say these triangles are congruent?

How did you distinguish the congruent triangles?

Can you make a triangle congruent to this one? [pointing to one triangle]

4.4.1.2 Lesson 2

The teacher had a lesson plan and no LTAs. His attitude towards pupils was friendly; he smiled at them and addressed them by their names. The lesson was on 'Mathematics in transport' under the topic 'Commercial arithmetic'. The class was arranged in rows and columns, but in such a way that two or three pupils at least sat close together. The teacher introduced the lesson by asking what kind of transport they used when coming to school, from which they arrived at the definition of road transport.

Teacher: ...motor cycle, so we now have a good number of transport and now we are looking at transport. Specifically we are looking at road transport. [Teacher writes the topic on the board and continues] Now what is road transport? Who can tell us? What is road transport? P3, what is road transport?

P3: [No response]

Teacher: P4, what is road transport?

P4: It is that which you use on the road to move from one place to another?

Teacher: Yes, in short it is the transport which we use on the roads...

The teacher was asking questions not only to those pupils who were raising their hands. He gave examples which he worked out together with the class by engaging them in an active question and answer session. He requested the pupils to ask questions after working out Example 1, and when they did not he asked them a question.

The first example solved was as follows: 'The car departs Luanshya at 18:32 hrs and arrives in Chingola at 19:50 hrs the same day. Find how long it takes to travel from Luanshya to Chingola.'

The teacher continued:

... Maybe there are some questions on that one? [pause and no questions] Okay, then I will ask you a question just on that one, what if they said, because here it says, the same day, what if they say the following day, what can we do? If they say the car departs Luanshya at 18:32 hrs and arrives in Chingola at 19:50 hrs the following day? What can we do, P5? [No pause, just mentions name immediately and there was no response]

More pupils were asked, and they tried to give their ideas of what was to be done. The boy the teacher used so much to respond to his questions in phase one, P1, gave the right procedure, and the teacher clarified further to the class. The explanation on this question took a long time, and the class did not sound confident, even when there was agreement to go to Example 2. However, the teacher had made a computational error, and the same boy (P1) corrected him. He accepted being corrected. He had computed as shown below, and the correction was done as shown under the computation:

$$\begin{array}{r} 24:00\text{hrs} \\ - 18:32\text{hrs} \\ \hline 15\text{h}68\text{mins} \end{array}$$

P1: But sir, there it is supposed to be zero [pointing at where there was 1 in the Answer]

Teacher: Where?

P1: There where you put 1.

Teacher: Where are you saying there is zero? [Pupil points] You mean here?

[Pointing to 8] Oh you mean here? [Pointing at 1 now]

P1: Yes

Teacher: You are saying it is supposed to be zero?

P1: [Explains, but I did not get it and neither was it clear on the tape]

Teacher: Zero five?

Class: Yes. [Now the class seems to follow their friend's argument]

Teacher: Ooh! We have already got a 1 *ayi*? Okay, thank you. Thank you, I have seen. After getting a 1, okay! it is okay. [He makes the correction] So it is five hours ... thank you very much for that one, 5 hrs 68 minutes...

However, of interest here was the fact that both the teacher and pupils took this correction as the only one, yet the answer was not correct. If you look at it, you will notice that the subtraction on the minute's side was done as though an hour was 100 minutes and not 60 minutes. Such errors in working out problems could be costly, since pupils take what they are given by the teacher as the truth. The answer should have been 5 hours and 28 minutes. I wondered how the teacher could fall back to making such errors in his presentations. This error went unnoticed.

The teacher laboured to explain the question he had asked earlier, before the observation from a pupil. Then he decided to bring in a familiar example in trying to make pupils understand. He rephrased the question as follows:

Teacher: The bus starts off at 18:32 hours, then it reaches eeeh, as we are told here, if it reaches maybe Chipata the following day 19:50hrs. It starts off at Livingstone at 18:32hrs, this day which is Thursday, then it reaches Chipata the following day at 19:50, it means for us to get the time we won't subtract 18:32 from 19:50 just like what we have done. If we subtract the way we have

done here it means it is the same ... the same day now because it is the following day. First of all we have to subtract 18:32 from 24 hrs. Are you okay why we subtract 18:32 from 24hrs?

Class: Yes/no.

Teacher: If there are some who are doubting: P1, why do we subtract 18:32 from 24 hrs?

P1: because one day has 24hrs.

Generally, most pupils seemed satisfied with the explanation this time, they kept nodding in agreement. After this illustration and explanation the class agreed to move to Example 2, which read as follows: 'If Lusaka is 702 km from Mpika and 216 km from Kapirimposhi, find the distance between Mpika and Kapirimposhi.'

The teacher made an illustration of what was meant by this question by using his pupils; this is how he did it:

Teacher: 216, now what do we do to get the distance between Mpika and Kapirimposhi? What do we do? [Pause, no answer, no hands up] What do we do so far? Eeh, yes P6.

P6: We subtract 216 from 702.

Teacher: We subtract 216 from 702, that is what we do, so meaning that we are going to subtract this [pointing at the figures]. This is now Mpika – Kapirimposhi [writing on the board]. Now I need three pupils here so that we understand this nicely. Three pupils, in front [pupils go to the front]. Hurry up! We take it that this is [pointing to the first pupil and class starts to laugh]. Let us be together, we take it that this is Lusaka, isn't it? [Class: Yes; pointing at the rest of the pupils] Then this is Kapirimposhi, then this is.....

Class: Mpika [still giggling].

Teacher: Now from here don't say you are Mpika [addressing the rest of the class and pointing at the boy representing Mpika]. Now they are just standing in for those places. So if this is Lusaka, then Mpika [class corrects the teacher and shout Kapirimposhi] Aah aah! Kapirimposhi then Mpika. From Lusaka going to Mpika, it is 702 km, are we together? From Lusaka there to Mpika. Now from ... Lusaka to Kapirimposhi, this is 200 and... [16 km - completes together with the class]. Now for us to find the distance from Kapirimposhi to Mpika, it

means, this 216 will be removed, isn't it? [Illustrating with the help of pupils standing in for these places]. So that is why we subtract 216 from 702, are we okay there?

Class: Yes.

Teacher: Go and sit thank you very much. [Releasing the three pupils] So let us subtract; 2 minus 6...

The explanation did not take long this time, and the pupils seemed to be following. The teacher gave these questions as a class exercise:

1. A car leaves for Lusaka from Livingstone at 09:30hrs and arrives in Lusaka at 10:30hrs the following day. Find how long the bus took to travel.
2. If Livingstone is 200km from Choma and 60km from Zimba, find the distance between Zimba and Choma.

A pupil noticed the error on question 1, and made the observation to the teacher, who accepted the correction and made the change from bus to car:

P4 puts up his hand and the teacher sees him.

Teacher: Yes P4?

P4: There you have car and there bus.

Teacher: Ooh! Sorry, sorry. [He rubs out bus and writes car]

The teacher wrote the homework activity immediately after writing the exercise; note that here the teacher used local places that the pupils were familiar with. The homework question was as follows:

'The table below shows the distance of some places from Livingstone and time it takes the bus to arrive from Livingstone' [Bell for time up goes, but teacher and pupils continue to work, getting into another lesson's time. The lesson started about 13 minutes after time due to the delayed morning parade.]

Table 1: Homework question

Place	Distance from L/stone	Time it takes for the bus
Kazungula	54 km	45 min
Mwandi	130 km	2h 35 min
Sesheke	193 km	3h 15 min

1. What is the distance between Kazungula and Mwandi?
2. If the bus started from L/stone at 15:09 hrs, what time will it reach Mwandi?

Immediately after the teacher finished writing the homework on the board, he asked the pupils to put up their hands as soon as they finished working out a question from their class exercise. He went round marking and correcting pupils by asking them how they arrived at their answers, for example [some of the conversation between teacher and pupils as he was going round marking. The pupil's responses were not audible]:

- There is no unit here. What is this? How have you come up with 1 day, 1 hour? Why have you subtracted 10 from that? You are adding here, are you adding this or you are doing what? Are you subtracting or adding? Remember that this is the following day. What did we say we do if it is the following day?
- That is 09:30 it is not 19:50, where have you got 19:50?
- Here you have not shown the subtraction sign, show the subtraction sign.
- Where are the answers? When you subtract this you don't get 70. When you get one here, it is representing 1 hour meaning that..... yes so this is why this is wrong.
- How did you get this 70? Because when you get 1 from here it is 1 hour and 1 hour gives you 60 minutes. Because this is for hrs, when you get a 1, then you change it to minutes, how many minutes are in 1 hour? Yes so it is 60 minus 30.
- This gives you an hour, isn't it? Why don't you change it to an hour? Change it to an hour, this one. Change this one to an hour it gives you an hour.

- This is not correct, don't fold a book ,...
- Where are the answers? ... After getting this what do we do?
- 70, how did you get it? You added what and what? Yes now this one you got, these here are hours isn't it? So when you get a 1 you bring it here, you change it, because these are minutes; when you change it into minutes you get how many minutes? 1 hour, yes the ... you subtract 30 from 60, so that is where you went wrong.

Notice from the discussions that the pupils were using the wrong computation on minutes, as in the example where most pupils had 70 minutes. The teacher did not seem to realise where this problem was stemming from, because this time he had the correct concept. He concluded the lesson by going through the exercise questions together with the class. He indicated that many pupils had problems with question one, and he addressed the part where they had problems in computation. However, the error in the example was still unnoticed by both the teacher and the pupils. He addressed pupils' concerns carefully, for example when he was working out the exercise for question, 1 some pupils raised questions:

Teacher: ... 25, we don't have minutes here, so 25 hours it gives us one day and
(class – 1 hour) 1 hour, so that is the answer. Yes P7?

P7: [Question not audible to me]

Teacher: We have an hour which we have carried from here. 30 plus 30 it gives us
1 hr. so we have carried it, we add it to this 24 here – 25. What? [Follow up
from P8, not audible to me] 25hrs? [Not audible] She is saying what if you
write 24 hrs 60 minutes? Already this one has given you an hour, why should
you have it in minutes? Transfer it to hours. Yes! P8, P8? Yes P9, What?
Where? Because of this [pointing] this 40 minutes. You have included the 40
minutes.

The lesson ended some minutes after time. I noted in my fieldnotes that the teacher had displayed a general inadequacy in presenting the content, which was one area we needed to discuss.

4.5.1 MORE REFLECTIONS

After each lesson in this phase, the teacher and I looked into the issue of content delivery. We spent some time evaluating each lesson, and I encouraged the teacher to study the content for each lesson to avoid making computational errors. This was because the teacher continued misrepresenting the content as he taught. These reflections were meant to help the teacher start to realise the importance of making reflections before, during and after teaching, so as to find various ways of handling the content and the learners.

After observing this series of lessons we made more reflections and discussed the next step into the research: discussions and reflections on changes in the teacher's classroom practices through reflective practice. I kept my fieldnotes; some of the entries I made for this session were speed, use of LTAs, questioning, and contextualising content, just as in phase one. The teacher commented on his teaching, saying he involved learners more in these lessons and used more LTAs. He felt there was more interaction between himself and his pupils as well as among pupils. I agreed, as there seemed to be more meaningful interactions in the classroom.

However, he noted the challenge of time available against what he had to cover for the Grade 9 final examinations. With probing, more responses were given: The teacher said that he still had a problem of going somewhat fast with his lesson presentations, although he said there was some improvement. He felt he was more accommodative to pupils' questions and concerns, and that his questioning was better in that he asked the learners to explain their ideas and share with the rest of the pupils. The teacher said that it was important to have adequate apparatus if a teacher had to ask a class to work on practical tasks. This was in relation to the time his class took when he had asked them to do a practical activity.

The teacher affirmed that he linked the mathematics he was teaching to real-life situations through asking the pupils to mention how they would use the mathematics they were learning in their day-to-day lives. Furthermore, he drew his examples from real-life situations and fitted them into the pupils' own contexts. He said that this helped him to make his explanations clearer and better understood by his pupils. However, he acknowledged that he did not find linking content to context very easy, but was positive that over time he would get more and more acquainted to doing that. The teacher also alluded to the issue of collaborating as being a helpful measure in seeing areas of linkages, and what LTAs one needed to use during lesson delivery. He mentioned that he realised that pupils liked working with practical materials, which helped them to do well in the follow-up questions.

I reminded the teacher of some areas we discussed during our first phase reflections, which had recurred in this phase, such as speed and errors in content presentations. I asked him if he realised that these were still a challenge, and he agreed. He did however mention that the errors could have been due to the speed at which he was working in trying to cover the syllabus before the examinations. I asked him which would be more profitable - to complete the syllabus with pupils experiencing a lot of misconceptions, or to make a thorough presentation of the content in readiness for the examinations even when one or two topics were not covered. He seemed to be at pains to make a decision here, since he had a conviction that the syllabus had to be covered at all costs, so that he would not be blamed if pupils failed. I realised that there was a big problem in this area if teachers felt compelled to teach for the examination, whether pupils understood or not. There was little I could do about this at the time.

I allowed the teacher to make self-reflections to allow for self-inquiry, which is cardinal for personal growth in practice. I commended the teacher for the efforts he was making in his self-reflections, as he was able to cover even his challenging areas without much coercion. I helped him through the process by mentioning the areas we covered during phase one and reminding him what we had discussed so that he could compare his current performance against that. He spoke confidently this time about what he was able to do and not able to do. I was impressed that this teacher could now look critically at his practice and notice most of his shortcomings, and was willing to hear of the areas in which he had to improve from an observer's viewpoint.

I also realised that perhaps teacher educators had a big influence on teachers-to-be through the common use of the lecture method, such that the students felt it was the method to be widely employed at the expense of other methods that would help learners be responsible for their own learning. In all this I felt it was imperative for teacher educators to conduct peer monitoring to help them improve their practice too. I recalled that I only got to have peers sit in and observe my lessons just when I engaged into this study, but my colleagues could not let me observe them teach. Comparing my own reflections on my own practice and the comments I got from my peers helped me develop an interest in marrying theory to practice, and I believed the teacher would also be helped in a similar manner since he was willing to go ahead with the study.

The teacher believed that he was more reflective in his teaching this time around, and that he would continue since he found it important and helpful in making explanations clearer for his pupils. It also helped him realise the areas where he needed to improve and think critically. He even said that if teachers were encouraged to teach reflectively, then their classroom practices would improve so much, such that they would be in a position to help their pupils better. This is

what he said when asked if reflective practice would help teachers improve their classroom practices:

“I think it would improve, yes, because teachers will know at every point what is needed by the learners.”

4.6 LESSON PLANS

The teacher planned for the lessons he taught during the time I was collecting data. The second phase lesson plans reflected some LTAs and activities that were to be done by the teacher and the pupils. I noted that some examples used and even the exercise and homework questions were not directly drawn from the textbook; the teacher also phrased some questions in ways that had relationships with his as well as the pupils' contexts. He wrote some evaluations for each lesson taught. The examples were all worked out in the planning. However, at this stage lesson preparation documents were not yet collaboratively discussed in detail.

In this phase, after we discussed suggestions for improvement of his lessons, the teacher became more reflective in his practice. This was manifested in many ways including for example, paying more attention to pupils' questions and observations, spreading questions widely and allowing pupil to pupil interactions. However, although the teacher improved somehow, the aspect of content errors was not satisfactory.

4.7 SUMMARY

This chapter presented the research findings on changes in the teacher's classroom practices through reflective practice. The findings were presented according to the phases completed in response to the research questions, which facilitated the discussion of findings that follows in the

next chapter. This was done with a view to arriving at some conclusions and recommendations from the study.

CHAPTER FIVE: DISCUSSION OF FINDINGS

5.1 INTRODUCTION

The chapter discusses the findings of the study that was undertaken concerning the changes in a teacher's classroom practice through reflective practice. The findings are discussed according to the phases undertaken in the study. The objectives of the study were as follows:

- To discover a basic school teacher's views about reflective practice
- To establish how a basic school teacher's classroom practice exemplifies reflective teaching; and
- To examine the changes, if any, which take place in a teacher's classroom practice through reflective practice.

The first phase was meant to cover pre-lesson interviews and first classroom observations. This was to form a basis for investigating the changes that would take place, if any, during phases two and three.

5.2 PHASE ONE

This phase answered the first research question: 'what are a basic school teacher's views about reflective practice?' in view of this study which focused on reflective practice with regard to studying the changes, if any, that would occur in a mathematics teacher's classroom practice.

During the semi-structured interview it became evident that although the teacher exhibited some doubts in certain areas, he answered most of the questions that were asked with confidence, such that one would have concluded that what was being said was what was actually taking place on

the ground. In most cases we see our teacher changing his stance once probed by the researcher, which to me as researcher was an indicator that there could probably be some differences between what the teacher was saying and what he would end up doing.

When the issue of reflection was being discussed, the teacher took it that reflection was something that one did only after an action had been carried out. He did not indicate then that reflection could be done before and even during an action. Yet when probed further to find out if it were possible to reflect during a lesson and not just after a lesson had been taught, the teacher was quick to change his statement about reflection and said that it was very possible during and even before a lesson was conducted. He even elaborated more on when the teacher could reflect, and to this effect mentioned that reflection was vital if teachers were to handle learners in more satisfactory ways.

He said reflection was important since it made teachers aware of whether the learners were learning anything from the lesson being taught or not. He further asserted that if teachers were reflective, then they would be in a position to use methodologies and approaches that would help learners to understand what was being taught. This change of opinion excited me, such that I really wanted to observe the teacher teaching to see how he made decisions that were reflective as he handled his lessons.

During the semi-structured interview other aspects that the teacher talked about and were indicative of someone that was applying constructivist approaches to teaching as well as being reflective, were the use of LTAs and learner-centred approaches. The teacher said he used a lot of group work as well as other learner-centred approaches as he engaged his learners in the

lessons, and that he used lecture method minimally. He also mentioned that he used some LTAs at least three times in a week, and not only this, but that he involved his pupils in the making and organisation of these LTAs. He even emphasised the point that mathematics was a practical subject and not dependant on memory work. He referred to the Chinese adage that what learners saw and touched was highly likely to stay in their memories for a longer period of time.

It was evident from the findings of the study that this teacher knew what he needed to do in his teaching in order to make his classroom practice more reflective - and yet he did not do much to translate his theoretical knowledge into practice. What he did and what he said did not match, as evidenced through responses to the semi-structured interview and the actual classroom observations, especially during this phase. This was before we had collaborative reflections concerning the teacher's lesson delivery. Asked why he did not practice what he talked about, the teacher felt that what he learnt in college was not what was practiced in the actual school teaching, because in college the emphasis was not on results achieved in examinations, as was the case in the field. He also mentioned that sometimes he thought it was not important to bring his theoretical knowledge into his teaching, as long as he was teaching the way he was used to, which enabled him to complete the syllabus.

From the semi-structured interview one would have concluded that the study was not necessary, since the teacher articulated the issues to do with reflective practice and classroom practices satisfactorily. While in few cases he seemed to be in doubt, the responses were conclusively encouraging. However, disparities noted from the responses and indeed the findings of the study after conducting some lesson observations encouraged me to go on with the study.

There were some disagreements between what was said during the semi-structured interviews and what was actually done during lesson delivery, which is supported by Ernest (1989), who argues that teachers say one thing and do another. He referred to what teachers said as 'espoused' and what they did as 'enacted' theories of mathematics teaching. This was evident during this phase.

It is not clear what causes discrepancies between the espoused and enacted theories of teaching and this was not the subject of this study. However, some causes could be speculated. Since higher education teaching is associated with lecture teaching method, it is possible that the teacher only memorised the concept without having proper understanding. Osborne et al. (2002) observed that although lecture and copying notes have been a normal feature of teaching in higher education, there is little mental processing in the activity so much so that it does not result in proper understanding of the learners. In fact other studies have also shown that lecture and copying notes mainly lead to rote learning (Zoller, 1993).

During lesson observations it was found that the teacher was not really practising what he talked about. He had an almost rigid way of teaching, and rarely using variant methods. He did not engage the learners in the ways he spoke about. He applied no group work at all, such that even when he gave exercises for the class to work out, pupils worked individually and in silence save for some whispers here and there. The teacher's lessons for the whole period of the first phase were very similar, with very minor variations. His class was arranged in rows and columns that did not encourage pupil-to-pupil interaction. Drawing from Jaworski (1994), I observed that the teacher had an almost fixed agenda of how he conducted his lessons, which was something like this:

- Greet the class and settle down;
- Write the lesson title on the board;
- Write the definition of the lesson title on the board and pupils copy;
- Teacher works out examples while pupils answer a few questions and copy the examples;
- Teacher gives exercise and goes round marking;
- Teacher gives homework;
- Lesson ends minutes after time, teacher asks the class monitor to collect exercise books and take them to his office for marking.

Looking at this scenario concerning his lessons, I deduced that the teacher had a full cycle that did not permit any new inclusions, hence his not paying attention to pupils' concerns and questions. I imagined that the teacher had set this agenda to help him complete the syllabus, at the expense of pupils' understanding. However, I made good use of his agenda to negotiate my way through and introduce the aspects of the constructivist approach and reflective practice in his lesson delivery. I had to make reflections on how to penetrate his smart procedure. For example, I asked him if we could allow for the pupils to realise the meaning of a topic through questions and tasks rather than giving definitions the way they were in textbooks, to help learners understand what such definitions meant. I realised that it was not going to be the easiest task to dismantle this order, but I was determined to try, as this study entailed.

It should be mentioned here that the lecture method is not the only way in which one would teach mathematics, which was in fact alluded to by the teacher himself during the interview. There are other ways in which the subject could be taught, which I felt I could discuss with the teacher during the reflection time. Sidhu (1995) argues that the lecture method which teachers seem to

apply so much does not allow for active pupil participation. Very few mathematical topics lend themselves to effective treatment by this method. There also exists a body of research which asserts that learners in cooperative learning environments perform better than those in competitive or individualistic ones in terms of their reasoning, generation of new ideas and solutions, and how they transfer what they learn from one situation to another, thus making linkages (Adler, Ball, Krainer, Lin & Novotna, 2005; Adler, 2007; Bishop, 2003; Sizer, 2001). I felt that I and the teacher needed to discuss some other ways of presenting the content to the pupils.

I was fully aware that there was no specific method that one would suggest that every teacher should use, because what might work for one class might not necessarily be suitable for the other. However, Cockcroft cited in the VVOB publication (2009) suggests that the following elements need to be present in successful mathematics teaching to pupils across ages; mathematics at all levels should include opportunities for: Exposition by the teacher; discussion between teacher and pupils and between pupils themselves; appropriate practical work; consolidation of practice of fundamental skills and routines; problem solving, including the application of mathematics to everyday situations; and investigational work.

This is where the basis for the argument for reflection time emanated from, considering that the teacher had almost one way of teaching his lessons and taking into account what the study set out to achieve. I tried to introduce these positive approaches to the teacher, most of which he ably talked about during the interview. These approaches would also be a channel to constructivism, and they tend to marry theory to practice. To ably handle these approaches would require reflexivity. I realised that my role would be to help the teacher reach a level where he would

realise the need to change his practice, and if he did not I would have to analyse the factors behind that. This change in practice was not meant to be forced, but rather where the teacher would identify his successes and challenges and find remedies to improve his practice.

The teacher under study was almost always rushing through his lessons to complete his agenda and accomplish what he had set out to do in a particular lesson. He made explanations to the class with limited questions here and there, seeking recall information and not engaging learners in deep, critical thinking. The questions that were being asked were almost always answered by the same few pupils (boys) and the teacher himself. Little or no efforts were made to get the rest of the class to participate in the limited question and answer sessions. The teacher seemed unperturbed by this, supposedly because he had set his agenda to accomplish the task of completing the syllabus with the five or so participating boys responding to his questions.

As a result of either hurrying his lessons or inadequate preparation or working out the problems almost by himself, the teacher made several computational errors in class. The interesting aspect noted was that there were only a few pupils in his class who could in most cases correct him, although these were limited to the computation and not the procedure. Once corrected, the teacher would rub off the wrong entries and put in the correct ones with little or no follow-up at all. However, the mathematical errors in the computations were hardly noted by either the teacher or the pupils. This was a source of concern which I discussed with the teacher after the lessons.

Added to the aforesaid, findings also revealed that the teacher took very little time to attend to pupils' questions and observations during the lessons. He seemed to be of the view that the more

pupils were allowed to ask and make observations during a lesson, the less time there was for him to finish his planned work. For example, at one time during the 'Ratio and proportion' lesson, the teacher was asked by one pupil what would happen if the given and solved question in his examples came in a different way. I saw this as an interesting point to generate discussion for the pupils and engage them into thinking beyond what was being presented. The question from the pupil was: "Suppose we had three ratios and not just two, like 2:3:4, how would we solve the problem?"

To my surprise, the teacher quickly told the class that there would never be such a question, and that if they came across it, then they would have to consider it as an incorrect question. His emphasis was on the formula he presented with only two ratios, and he even emphasised that the pupils just had to take note of the way he solved the questions in the examples and know the formula in case such questions came up during the forthcoming examinations.

The teacher seemed to feel derailed by pupils who raised questions and made observations. He would remind the class that they did not have time to waste. Another interesting thing that cropped up here was the depth of the teacher's knowledge of the subject matter. The teacher did not seem to display a very good understanding of the topics he was teaching in reference to the above case and other similar incidents. Ball and Bass (2003) cited in Hill *et al.* (2007) assert that teaching mathematics is not the same as standing at the board and doing mathematics in front of students; it entails additional mathematical knowledge, competencies and skills, called 'mathematical knowledge for teaching'. To this effect, I encouraged the teacher to get actively involved in mathematics teacher group meetings in the district and to subscribe to mathematics associations so that he would get the chance to share experiences with other teachers and also use

these meetings as a learning ground. I also offered myself as a colleague in discussing some topics in mathematics which he felt he needed to get more clarity about.

Besides this, in this first lessons observations phase, the teacher took almost no time to reflect on what pupils were talking about either, because that was not part of his lesson plan or he felt challenged by the questions and observations made, so he brushed them aside. At one time, for example, the pupil who asked the question was obviously not satisfied by the teacher's response; he shook his head in disagreement, but the teacher just told the class to take note of the way examples were being solved and the formulae used for the forthcoming examinations. I felt that this was an area that needed to be addressed, because it left the pupils in a state of not comprehending what they were being taught and unable to attach meaning to it. This is one practice that would reduce learners to mere listeners who just had to take that which their teacher gave as a finished product. While rote learning has its own merits, it would be too much for learners to memorise the many formulae in their junior secondary syllabus. I noted that in most cases the pupils were not given the freedom to construct their own knowledge and build on it. Such approaches to teaching make pupils lose confidence in the teacher as well as losing interest in the subject.

Yet during the semi-structured interview the teacher mentioned that reflection during the lesson would help teachers to see what to do and how to change approach or make explanations clearer. In practice however we saw the opposite of this. He could have taken the various opportunities to let pupils discuss their friends' ideas and build on them. I saw the teacher placing himself at the centre of the whole learning process, instead of allowing learners to be active participants too. He made most of the explanations and asked questions which he ended up answering himself.

Schifter (2001), cited in Sowder (2007, p. 163), argues that the basis for teaching mathematics is not only based on the mathematical skills but “attending to the mathematics in what one’s students are saying and doing, assessing the mathematical validity of their ideas, listening for the sense in children’s mathematical thinking even when something is amiss and identifying the conceptual issues on which they are working”. In line with this view, in this phase I saw pupils who wanted to understand what they were faced with and a teacher who did not create space for such opportunities in his lessons. During our reflections I tried to make the teacher realise that he needed to cater for individual differences in learners. I suggested that it would be helpful to carefully plan his work and allow pupils to discuss the divergent views that cropped up during the course of the lesson. I also encouraged him to always read ahead of his class so that he could pass correct judgements in response to pupils’ questions and concerns.

It is worth mentioning that the teacher taught with enthusiasm during his lessons, and tried to move with his pupils in that he would ask them some questions as he solved problems. The kind of questions he posed, however, were ‘what’ questions which needed pupils to recall some information and not get seriously involved in the thinking process of what was taking place and why things were turning out the way they did. The teacher depended on a few boys in his class to provide answers because they were seemingly the fast ones in grasping the concepts. There was one particular boy who was very good: he was quick to notice errors made by the teacher or fellow pupils and asked challenging questions. The teacher only seemed to take advantage of this boy in responding to his questions, but not by addressing the questions this boy asked. In almost all cases, the teacher appeared to be taken unawares by the boy’s questions and hardly gave satisfactory answers. I realised that the teacher felt more comfortable avoiding facing the

majority who could not give him the desired responses, by concentrating on the few who could, since he kept mentioning the aspect of inadequate time available for him to complete the syllabus before the Grade 9 final examinations.

He actually mentioned that some pupils would never answer any questions, which was why he was using the few he had identified, and that I also came to know by name. I thought it would be a good idea to dwell on this area during reflection time, since it would auger well if almost all pupils were engaged during the lessons rather than just a few. The type of questioning was another area we would look into to come up with ways of getting pupils to think more critically. While the teacher provided information to the pupils, they in turn ought to be given chances to process the information and generate knowledge by being encouraged to actively explore and think. This would be facilitated by good questioning techniques and skills. Here we saw a teacher who just changed figures from his example phrases into class exercises and homework. A pupil would just have to keep changing figures and carry out the four operations correctly to get the correct answers, without much thinking.

The teacher did almost all the explanations and neatly laid down his work on the chalkboard which most pupils emulated this in their exercise books. Most of the pupils' books were kept neatly and the writing was neat too. I thought I would encourage the teacher to keep up this good work. His vigour and friendly attitude towards learners made me anticipate that there could be room for change in the teacher - which was what the study set out to investigate. According to work by Ma (1999) with American and Chinese teachers, "... the Chinese teachers develop and deepen their subject matter knowledge of elementary mathematics by preparing for classes,

teaching the material and reflecting on the process.” I felt drawn to get the teacher to make adequate preparations and to make lesson evaluations that would be informative.

The teacher prepared for his classes and taught the material but seemed to fall short of reflecting on the value of the process of lesson preparations in terms of contextualising the content, engaging pupils actively and mastering the content. There was a need for him to collaborate with others in order to help him to look at his practice differently. The collaborative approach helps in making reflections of how a team is functioning and how to allow it to function even better. In this case, he was collaborating with me as the researcher and we were going to help each other learn, applaud successes and efforts and check out weaknesses and challenges.

As action research entails, this study also gave me a chance to learn. I learnt that collaboration was a very good medium in bringing out aspects of one’s teaching that needed attention. I also realised that there are times during our teaching when we teach material which we do not really understand, especially when we expect less or no challenge at all from the learners. For example, and with reference to my field notes, I found that the teacher felt satisfied even when few pupils responded to his questions. He did not appreciate questions from the learners and neither did he use these as a springboard to gauge the conceptualisation of the content by himself as well as by his pupils.

From the above discussion, I learnt that it was not easy for the teacher to appreciate his learners’ observations, since he felt that he was the one in control. I also learnt that it is not an automatic exercise to carry out an honest self-evaluation, especially in front of another person, hence the

less beneficial self-evaluations in lesson plans. I suggested that we plan the next lessons together and see how we could include some positive approaches.

The teacher talked of his lesson evaluations in terms of him covering the planned work and being under pressure to mark since many pupils wanted to have their books marked. The teacher's assessment of the success of his teaching was also based on how many ticks for correct work he gave to the pupils. It did not really seem to matter if some pupils copied from their friends who were fast and got the problems right. Looking at his reflection notes from the lesson plans, they were made in terms of whether he had succeeded in achieving what he set out to do, *vis à vis* completing his agenda.

This revelation from the study indicated that there was very little of constructing knowledge by learners. The examples, class and homework exercises were always the same, with minor variations in figures but the same wording. Explanations by the teacher in most cases were laborious, and the tasks that followed offered little mathematical challenge as they were a replica of the examples solved. The pupils seemed so used to their teacher's explanations and depended on them so much that there was little evidence of them doing any creative or original thinking, save for very isolated cases where some asked constructive questions.

Further, the examples and exercises mostly lacked connection to context, since they were drawn straight from the textbooks. In constructivist terms, it was hard to tell what sense the pupils made of the mathematics they encountered. I saw that this was an area that could be explored and perhaps improved on in accordance with what Dembo (1994) states - that learning activities, tasks and assignments should increase student interest and involvement in learning. It is not

enough to have pupils complete activities, tasks and assignments comprising boring exercises or using the class period to have them look up answers from textbook questions rather than providing them with activities designed to stimulate curiosity and an interest in learning.

I also discovered that his class was a very quiet one. Pupils worked individually and quietly almost all the time, except for some whispers. There were whispers in the classroom as pupils copied from each other; that is, the fast pupils who got the problems right gave their books to the slow ones to copy. The teacher seemed not to be aware of this trend, and confessed as much during our reflection time. He confirmed that there could be a possibility of pupils whispering so that they could solicit answers, because he always wanted them to work out the exercises in silence and individually. This revelation helped me to discuss the issue of pupil-to-pupil interactions with him.

A quiet class in itself was not bad, since every teacher manages his pupils in the way she or he wants. This was the standard of discipline that this teacher had set for his class, and class management is an attribute to this study. According to Dembo (1994, p. 285), "... if the teacher's primary goal is to keep students quiet, he may use control techniques that get the job done but have negative consequences on students' attitude toward learning." In agreement with this statement, I felt that it would be healthier for pupils to be allowed to interact than was the current practice, where they simply copied from each other without understanding what they were doing for the sake of getting the correct ticks at the end of it all. I felt it would be better to encourage pupil-to-pupil interactions and at the same time maintain order, since not all noise is disturbing, empty noise.

The foregoing discussion suggests that lecture method is supposed to be combined with other teaching methods that enable mental processing to take place if it is to be effective. Such methods could include group discussions and practical experiences. For teacher training, practical experience is one of the core components where student teachers go for teaching practice. Teacher trainers are expected to guide these students in the applications of the theories they taught them during lectures at college. From my experience as a teacher trainer, teaching practice is usually associated with many challenges including inadequate supervision due to large numbers of trainees or lack of funding and sometimes lack of seriousness on the part of trainees, inadequate duration. From the experiences with the teacher in this study, it is possible that the teacher did not have adequate practice with regards to reflective practice, during his teacher training period including teaching practice.

5.3 PHASE TWO

This was a reflection phase. Indeed, Kemmis and McTaggart (1992) argue that to do action research is to plan, act, observe and reflect more carefully, more systematically and more rigorously than one usually does in everyday life. During our reflection time, the teacher talked of his successes in teaching, as discussed above; he hardly mentioned any area of weakness that needed improvement. I encouraged the teacher to open up and see areas where he needed to improve his practice. I had my field notes to refer to in order to help the teacher see some areas of his practice differently. I had indicated areas to do with interactions, using teaching and learning aids, and many more, as stated earlier. I also had a tough time planning how to engage the teacher on all these aspects, realising that there is a limit to how much one can accept being diverted from his or her normal way of doing things.

I carefully drew the teacher's attention to these areas of concern, and eventually he started talking about them. With more probing, I proposed some suggestions to try and address the areas of challenge in the next lessons. The teacher agreed with me and also suggested some ways of handling his lessons. He seemed quite excited with this new turn of events, where he was able to face up to his shortcomings. He realised that he needed to adjust in certain ways and was willing to try them out. He was no longer defensive of the way he used to conduct his lessons as being 'perfect'. This was pleasing since it was in line with what Cohen, Manion and Morrison (2007, p. 303) state: "for a reflective practitioner, action research is an improvement to professional practice at the local, perhaps classroom level, within the capacities of individuals and the situation in which they are working." The teacher was no longer defensive and hesitant to consult; he even asked how to go about certain aspects, such as linking mathematics to everyday life situations and using LTAs.

During the interview the teacher had said that he used LTAs to help him get pupils involved, but this was not evident when he taught. He also said that he was aware that what the pupils touched and saw stayed in their minds for a longer period of time. In a way, he was agreeing with Van den Broek (2006), cited in the VVOB publication (2009), who said: "We remember 10% of what we read, 20% of what we hear, 30% of what we see, 50% of what we hear and see, 70% of what we discuss with others, 80% of what we evaluate and discuss and 90% of what we explain to others." However, the teacher hardly used any LTAs in his lessons, and there were no LTAs for his lessons in any of his cabinets.

To help the teacher be more critical in the way he evaluated his lessons, I facilitated a process for him to look back at his practice at this time, to praise and criticise himself genuinely, and see

where he needed to improve. From his own explanations about reflection, I encouraged him to be a quick decision-maker in practice, to judge whether his methodologies, strategies and approaches were helping learners understand the content and were sustaining retention.

In view of the aforesaid, we agreed on how we would proceed with the next set of lessons. We agreed on creating situations where pupil-to-pupil interactions were encouraged and asking questions that needed pupils to explain their ideas and look at issues more critically. During this time we also discussed the linkage of content to context and how it would help the pupils' retention and enjoyment of the subject. This is consistent with the assertion by UNESCO (2003) that the objective of basic education is to prepare pupils to pursue knowledge to higher levels for acquisition of survival and life skills, as well as for earning a living after school in a real-life situation. This phase was concluded with the above agreements, and the teacher then went ahead to plan for phase three lessons.

5.4 PHASE THREE

In this phase the focus was on helping the teacher appreciate the different approaches to teaching which would help pupils conceptualise the content better. The interaction between the two of us over time was fundamental to the changes expected in this phase. Having engaged the teacher in effective communication now I expected to see the results of the discussions that we held and the way in which the changes suggested were going to be effected. I had to note the successes made and challenges faced by the teacher to determine whether there was some change in practice or not with respect to constructivism and reflexivity. Six lessons were also observed in this phase. As mentioned earlier, some lessons were taught immediately after our reflections while others

came about one and a half months later. This was due to the school end of term tests and holiday time.

As said above, this phase set out to examine if there would be any changes in the teacher's classroom practice after the reflections. Noffke and Zeichner (1987), cited in Cohen, Manion and Morrison (2007) make several claims for action research with teachers. Among others they say that it:

- Increases their feelings of self-worth and confidence;
- Increases awareness of classroom issues;
- Improves their dispositions towards reflection;
- Changes their values and beliefs; and
- Broadens their views on teaching, schooling and society.

I witnessed most of the above-mentioned points coming into play during the study. The teacher now approached his lessons in ways where one could not say exactly what was expected next, unlike in phase one, where little changed. He created moderate uncertainty about what was about to happen next, which is one of the principles of attracting pupils' attention. The pupils seemed to be at a loss as to what was happening at the beginning, but eventually they too seemed to adjust to the new approaches by the teacher. They became aware that the teacher could ask any one of them to answer questions, and so they were kept alert. Eventually the pupils seemed to be getting excited, and I observed that they participated enthusiastically. They were even free to ask me to check their work and offer help if the teacher was on the other side of the classroom.

The teacher would have pupils seated in groups, in rows and columns but with two or three pupils next to each other, and not the way they used to sit before. The first time they were

arranged differently it took some time, as the pupils were not sure of which groups they had to belong to. The teacher allowed them to group themselves, and just this change in sitting arrangements was an indicator to me as a researcher of the teacher changing his practice. Dembo (1994) argues that grouping focuses on students' ability to work cooperatively with others rather than competitively on school tasks. The way the pupils were made to sit encouraged cooperative learning or rather pupil-to-pupil interactions. This was supported by the constructivist characteristic which casts the learner in a very active and independent role and the teacher as someone who supports the construction of knowledge by the learner.

The teacher asked pupils to form small groups, which made it easier to get everyone involved. He encouraged the pupils to discuss and work on the tasks given as groups and not individually. This excited his pupils as they almost immediately took advantage of these arrangements to consult each other. They discussed and presented their group findings, and discussed as a whole class the findings from groups. The interactions that developed were encouraging, but it took some time for the teacher to adjust to this arrangement since he usually would tell his class to be quiet and hurry up. His earlier lessons were hurried, with him making the explanations with no arguments as to the ideas being presented. *This time he was not the one at the centre of the lessons; pupils discussed, asked and answered questions.*

At one time I was getting worried that the teacher was going to drop this whole idea, but after the first few lessons I noticed that he was becoming more accommodative of this kind of arrangement for his lessons. While I scored this as a change, I waited for the reflection time to hear from the teacher if he also realised the shift in his own practice. Cohen, Manion and Morrison (2007, p. 310) observe that:

“What is being required in the notion of reflexivity is self-conscious awareness of the effects that the participants-as-practitioners-and-researchers are having on the research process, how their values, attitudes, perceptions, opinions, actions, feelings etc are feeding into the situation being studied. They need to apply to themselves the same critical scrutiny that they are applying to others and to the research.”

The teacher used LTAs and effectively this time around; he allowed pupils to interact with the materials for some lessons, and asked follow-up questions. The first lesson after reflection was planned as a practical one. The teacher gave out some materials he wanted the pupils to work with, and asked them to use some of their own. The pupils worked with interest, and one could see the smiles and pride after they accomplished the tasks. Although the task took longer since some groups still wanted to operate as individuals, and it took some coercion from the teacher to get them to cooperate, it was noted that more pupils than was usually the case actively participated in the discussions that followed the hands-on activities.

This kind of pupils' involvement made it easier for the pupils to contribute during the lesson. They mentioned what they did and connected it to what they were learning. The number of pupils who raised their hands to answer questions increased from the few cases (about five or so) to more than half the class, and when asked to justify their answers they tried to do so. I deduced that just as the teacher was comfortable with just the very few boys answering questions, even the fellow pupils had left the task of answering class questions to those the teacher depended upon. Such an attitude is not in line with a constructivist approach to learning, because some learners were deprived of chances to explore.

The teacher led the class on to defining what they were doing, as opposed to him giving the definitions outright. However, there were some times when the teacher seemed to feel that time was being wasted, like when the pupils were working on their tasks. He kept on hurrying them up and wanting them to stop before they could complete their tasks. It was encouraging to note that the pupils did not want to be stopped in the middle of the tasks. This did not cause an open conflict; pupils politely requested a time extension and the teacher was accommodative, he did not leave the pupils to work entirely on their own. He went around looking at the work, facilitating the activities and encouraging his pupils to work a little faster, but as groups and not individuals. I realised that the teacher felt he was losing time, while pupils seemed happy that they were discovering and sharing ideas.

Most pupils did well with the practical parts of the lessons as they discussed and interacted. I noticed that of the 13 groups the teacher set out to work with, about 10 were doing very well while the three at the back had problems. I asked the teacher to consider changing the compositions of group members, so as to make the group work beneficial to almost all pupils. I had observed earlier that the group of boys who sat at the back had a carefree attitude during lessons, which we had discussed. They hardly raised their hands to answer questions, and nor did they write the examples and exercises. Since my chair was placed at the back, I was able to notice this attitude almost immediately, and I asked the teacher to start involving the ‘back benchers’, as they were called. During group discussions I joined these groups and discovered that they had problems in getting to do the work, since in most cases they did not participate in lessons.

These groups had to be changed after we discussed the issue, and we included boys that the teacher usually used in phase one in each one of them. P1 was an interesting boy, he asked one member in his group to take notes of the discussions and told another that he was going to present after they had discussed. This group was very close to my chair. He led his two friends into the discussion and got them to participate. When the time came for this group to present, the one assigned to do so went and presented. To my surprise, the class applauded as the boy walked to the front, but they gave him chance to speak. He presented and now they genuinely clapped for him; even the teacher praised him. This showed us that some pupils needed to be assisted beyond what we could do for others, to get them involved. The teacher commented that it was almost a miracle to get that boy speak in front of the class. I commended P1 in my notes and the teacher for his flexibility in allowing for these changes in his practice.

I noticed that after such involvement by learners, even the written activities that followed were done well by most pupils, who managed to solve the exercises with fewer difficulties compared to earlier observations. More pupils participated and they made explanations to each other freely, as opposed to being quiet and copying from each other. The teacher did not belabour so much to explain the concepts. It was most gratifying to see the teacher take this 'unusual' way of lesson delivery in such a tolerant manner. He commented afterwards that it was not an easy and automatic thing to teach in that way, but that he found it to be more beneficial. He mentioned that he was glad that he was a participant in the study, which helped him to rediscover himself as a teacher of mathematics. He mentioned that he found collaboration useful, as long as one was ready to accept facing one's weaknesses openly. He said he was seeing a real need for reflection by teachers. This really excited me as the researcher working with him.

The teacher used not only one approach to teaching, as previously observed, but was now more eclectic. For example, he involved learners in group discussions, he used question and answer, teacher exposition was used minimally, and he gave the chance to pupils to answer questions that were posed by fellow pupils. His examples, class and homework exercises were no longer replicas of each other. This brought with it the realisation that teachers just need some good collaboration to adopt classroom practices that are constructivist and reflective.

The teacher phrased questions in a manner that evoked critical thought in learners - considering the fact that they were usually treated to low-order questioning. The higher-order questions helped the learners to think about the processes of reaching their solutions. For example, he asked pupils to compare and contrast given shapes to come up with conclusions of their observations. Pupils also rose to the challenge by trying to explain their answers and reasoning. The teacher asked even those pupils whose hands were not raised to respond, although he could easily have fallen back on the few who had always been his active respondents. He coerced pupils to at least say something and speak out their ideas relating to the questions asked. He managed this largely due to his friendly manner during lessons; pupils did not seem to feel threatened by his presence. By the time of the close of the lesson observations, pupils had become freer to speak out their thoughts and defend their reasoning.

The teacher made some computational errors even in this phase, although fewer than in phase one. He allowed pupils to correct his errors where they noted them, as before, but this time he would draw the attention of the class to the part that was of concern. However, as mentioned earlier on, of interest here was the fact that some mathematical errors still occurred that went unnoticed. For example, both the teacher and pupils took the corrected answer of 5 hrs 68 mins

(in the question where 18:32 hrs was to be subtracted from 24:00 hrs) as the correct one. Note here that the answer was earlier corrected by P1, who realised that the teacher had written 15 hrs 68 mins. However, the computation was still not correct with regard to the mathematical idea being taught; the subtraction on the minute's side was done as though an hour was 100 minutes and not 60 minutes. Such errors in working out problems could be costly, since pupils mostly take what information they are given by the teacher to be the truth, which was the case here. The answer should have been 5 hrs and 28 minutes.

Then, when the teacher later gave another exercise, there was a question where almost all of the pupils carried out the subtraction on the minute's side in the erroneous way that the example was done. Yet the teacher could not reflect back to where this misconception stemmed from. Such errors were a recurrence from the first phase. There was still a need for the teacher to take greater care in terms of the content. I reiterated the need for more interactions with other teachers of mathematics besides me, and of reading widely on the part of the teacher to help him improve his mathematical knowledge for teaching.

A pupil initially made an observation that the subtraction was not right, which was supposed to help the teacher to look at his computation critically. If he had, he might have noticed the mix-up in concepts. The teacher could have noted the error in the answer, which appeared correct and yet was not, probably because in most cases our problems are related to base 10.

I also discovered that the group of pupils that the teacher relied upon so much to answer questions earlier, during the first phase, was also a great resource for the other pupils during group work. They helped to get the discussions going but did not champion them; the teacher

also tried to make as many pupils as possible participate actively and seemed to be doing fine in this area. He allowed pupils to approach problems differently and to explain why they were doing what they were doing. He no longer made all the explanations to his class. He allowed pupils to discuss among themselves when and if questions were posed by either the teacher or fellow pupils. He treated pupils' questions differently this time, by either asking the other pupils to respond or giving them careful thought and answering them either directly or by asking related questions.

The concerns raised by the pupils received attention. Where pupils sought clarity, he sought to provide this not by repeating his earlier explanations but using other means. For example, when a pupil asked why for some problems they had to subtract from 24 hours, the teacher responded by asking related questions; he asked the class how many hours made a day, and also asked them to mention places within Zambia which they could not reach the same day by road. Such questioning helped the pupils to understand why they had to carry out that operation. Teacher exposition was no longer the primary method of lesson delivery. The teacher used question and answer, discussion, brainstorming and other approaches which worked as catalysts towards catching and sustaining pupils' attention and interest in the lessons.

Despite all of this, the teacher still fell back upon rushing some lessons and emphasising certain procedures of working out problems in view of the forthcoming Grade 9 final examinations. Glasersfeld (1995) discussing a point of view from the United States of America which in fact also pertains in Zambia, argued that it was unfortunate that the schooling system set-up has led to the widespread notion that one studies in order to pass exams, rather than to become more competent intellectually.

During reflections, the teacher mentioned that there was a remarkable change in his classroom practice, which he wished to uphold and even share with other teachers in his school, and even with neighbouring schools during teacher group meetings. He said that he was amazed that he had developed to the level where he could contextualise content and allow pupils to discuss openly. However, he mentioned that it was not easy to make these strides, and that although he had not yet become very good in being reflective and linking content to everyday life, he was far better than the rest of the many teachers of mathematics in these areas. He asserted that most teachers only linked mathematics to everyday life and were reflective for barely about 20% of their teaching, if at all. He confidently said that he was escaping from this bracket, and was getting better. He said he was going to continue with these practices and even improve, since he was going to teach a Grade 8 class, where he would have more time to introduce these constructivist approaches to teaching way before the time came for completing the JSSLE.

He alluded to the importance of collaboration, and thanked me for involving him in the research, which he said was useful. He said he found the aspects of reflexivity and constructivism helpful in teaching practice. As Glasersfeld (1995, p. 177) says, "... constructivism cannot tell teachers new things to do, but it may suggest why certain attitudes and procedures are fruitless or counter-productive; and it may point out opportunities for teachers to use their own spontaneous imagination." The truth of this assertion became evident from the research findings and discussions in this study.

The teacher went round marking and asking pupils to explain how they reached their answers and/or helping those who were facing problems by asking them suggestive questions. The pupils

also helped each other by discussing, as opposed to merely copying from each other. The teacher encouraged these practices through, for example, the seating arrangement and telling pupils to work as groups. He accepted different ways of working out the problems, as long as the pupils were making correct computations and were able to explain how the procedures used worked. This helped pupils widen their views about solving mathematical problems. Looking at where we started from during this research, it was encouraging to experience these shifts. The above perceptions support Glasersfeld's (1995) position that:

“Teachers who start out with the conviction that there is a fixed body of knowledge that has to be instilled into the students are likely to see their activity as a form of negotiation. Yet those who have a record of effective teaching and have begun to examine what it was that made them effective are no doubt aware of the fact that any given piece of knowledge may be approached and then seen differently by individual learners (p.191).”

I noted some changes in the way the lesson plans were written, in that there were varied activities and exercises set. The teacher also included other LTAs than the chalkboard, which was previously so prominent in every lesson plan. In addition, he listed different methodologies for dealing with the content he had to deliver. His lesson evaluations had not changed much; he still commented on the successes with little on challenges and remedies. However, in isolated incidents where he indicated challenges, he suggested remedies to aid pupils encountering difficulties with the work. Generally speaking, as witnessed and stated by the teacher, there were remarkable shifts in the classroom practice by the end of the second phase. Grey (2005) observed that effective teachers will value genuine team work, and appreciate mutual feedback through lesson observations or other means as an essential part of professional development. Suffice to say, this also took effect in this study.

Dewey (1997) observes that a primary responsibility of educators is that they not only be aware of the general principle of the shaping of actual experience by environmental conditions, but that they also recognise in the concrete which surroundings are conducive to having experiences that lead to growth. Above all, they should know how to utilise the surroundings that exist - physical and social - so as to extract from them all that they have to contribute to building up experiences that are worthwhile (Dewey, 1997, p. 40). Teaching practices that emphasise learner interactions improve both problem solving and conceptual understanding, and this was evident in this study that examined the changes that took place in the teacher's classroom practices through the lenses of reflective practice and constructivism.

The finding that the teacher made some good progress in his reflection after guidance from the researcher is a sign that it is possible to change a teacher's practice for the better. This can be done both through pre-service and in-service training but also in normal routine supervision and advisory services. If during pre-service training, students are given sufficient guidance, it is possible that these trainees could acquire skills of a reflective practitioner which will not be forgotten once the trainee graduates. However, in-service training, either through school based or cluster based trainings could also serve this role. Another even cheaper avenue is through use of inspectorate and advisory services departments of Ministry of Education. These departments have a mandate to visit, advise and inspect teachers. If the concept of reflective practice is taken on board by these inspectors, there would be a higher likelihood the reflective practice could be one of the main features of mathematics lessons in the schools.

5.5 SUMMARY

In this chapter the findings were discussed. The discussions showed the views the teacher held about classroom practice and reflective practice, which he initially just spoke about and was not actually enacted. However, there was a great turn-about after the collaborations and reflections took place. The changes that the teacher made were noticed by the pupils and these showed some signs of discomfort. For example, pupils did not easily get along with the aspect of group work and being asked to answer when they had not raised their hands to answer a question, but interestingly, the pupils slowly accepted. What remains now is to make recommendations from these findings, which is the concern of the chapter which follows.

CHAPTER SIX: CONCLUSIONS AND RECOMMENDATIONS

6.1 INTRODUCTION

In this chapter some conclusions and recommendations from the two phases of this action research on a mathematics basic school teacher's classroom practice and the impact of reflection are given.

6.2 CONCLUSIONS

The study sought to explore a teacher's understanding of reflective practice and how his understanding was reflected in his classroom practice. In addition, the study sought to explore whether tangible changes could be seen in the teacher's practice after some interventions. From the findings of the study indicated that this basic school teacher of mathematics expressed theoretical knowledge of issues pertaining to classroom practice and reflective practice. It also revealed that the teacher spoke of his classroom practice in the constructivist sense. However, it was noted that there were several disparities between what the teacher said he did and what he actually ended up doing. While he spoke of engaging learners actively in phase one during the semi-structured interview, during the first lesson observation it was found that the opposite occurred. Instead, it was the teacher who was more active and the icon of the lessons, hardly using LTAs or engaging learners in practical activities.

Furthermore, the study observed that while the teacher said one thing and did another, there were indicators for possible change once collaborative reflections were done. The study findings showed that there was room for the teacher to put into practice that which he spoke about

However, it was noted that the possible changes discussed could not be taken for granted before they were actually practiced or rather enacted.

The study also showed that the teacher became more and more reflective in his practices after the collaborative reflection sessions. There were notable improvements in the teacher-to-pupil and pupil-to-pupil interactions due to the introduction of a diversity of approaches and methodologies used in teaching which were more learner-centred as opposed to teacher-centred. Participation by the learners improved too, as many pupils became active participants in the lessons.

The study observed that the teacher rushed through his lessons so that he could complete his planned work - at the expense of his pupils' relational understanding. The rush was due to the imminent examinations that the pupils had to sit for in Grade 9, so completing the syllabus and drilling were paramount to him at this point. This in turn was because the education system laid so much emphasis on examinations rather than on understanding of the content, which could breed self-reliance that would contribute to sustainable development of the self, community and indeed the nation. This orientation made the teacher feel and believe that he was the one to make all the explanations while pupils listened and copied down the given work, as was witnessed in the first phase.

Another conclusion drawn from the study is that little value was attached to planning for lessons other than routine, which goes for reflections or rather evaluations too. It was observed that vital documents to effective teaching were written for outsiders who would need to see them and probably evaluate the teachers' performances, like the standards officers and school managers including researchers, rather than for their intended purposes.

The study also established that the teacher hardly - if ever - observed or invited another teacher to observe his lessons, and nor did he sit to plan together with other teachers of mathematics. Action research was not encouraged among teachers, and was not even introduced to most teachers during their initial training. While teachers held teacher group meetings, issues to deal with professional development in terms of lesson delivery aimed at making pupils take responsibility for their own learning were rarely emphasised, as evidenced from the lesson observations. If emphasised during these meetings, then they were not being practised, and there were no traces of follow-up of the same.

The findings of the study have shown therefore that a teacher may have adequate understanding of a theory of teaching and learning, however, this understanding may not always be translated into practice in the classroom situation for various reasons. The study has further evidenced that it is possible to facilitate translation of theory into practice through scaffolding by someone who has more knowledge.

This study set out to investigate a teacher's classroom practice and to see if there could be any changes by employing the constructivist approach and using the concept of reflective practice. In the final analysis, it could be said that from the research findings, several conclusions were drawn, as stated above, regarding the topic under investigation, and some changes in practice were noted after collaboration with this teacher through our reflection times.

Some recommendations are now proposed in response to the conclusions drawn from the study.

6.3 RECOMMENDATIONS

Although the findings relate to one teacher and may not be generalised to other teachers, they are indicative of the practice of some teachers in Zambia. As such the following recommendation could be made:

- (a) Teacher educators should inculcate ideas of reflexivity, constructivism, and being eclectic in teaching into trainee teachers to help them in their classroom practice in the field.
- (b) Teachers should be encouraged to work cooperatively more often and to generate a spirit of carrying out action research in their own set-ups.
- (c) In-service providers should focus on teacher group meetings that aid teachers to improve their classroom practice; that is, addressing issues like studying the content for teaching, contextualising content, and sourcing and using LTAs, among others.

6.4 FURTHER RESEARCH

More research should be conducted into related aspects of this study. Areas of possible research might include:

- (i) A comparative study on pupils' performance in Grade 9 examinations between teachers who teach with reflexivity using a constructivist approach and those who do not.
- (ii) A survey to find out pupils' views about their teachers' classroom practices.

The conclusions and recommendations made and presented above help to summarise this study, which was directed at changing classroom practice through reflective practice.

6.5 LIMITATION OF THE STUDY

The research was a single case study conducted as action research, and as such the results obtained (consistent with case studies) are therefore not able nor meant to be generalised although they could be relatable.

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LIST OF APPENDICES

APPENDIX ONE: Informed Consent Form for Teachers

You are invited to participate in a research project being conducted by Chikuba Munakasaka. I am a student pursuing Master's of Education in Mathematics Education at the University of Zambia. I would like to ask you to collaborate with me in this study which is in the form of action research. Your teaching through the phases we shall have, will help me to determine if there will be any changes in your classroom practice. This research may be valuable in the future for teachers of mathematics at different levels, even the standards officers and in-service providers. I will work closely with you for about one term. Your name and those of your pupils will not appear on any of the documents to ensure confidentiality, if the opposite happens, you will duly be requested for that. Therefore I would safely say there are no foreseeable risks to your participating in this study except for your time and maybe inconvenience. However, you should understand that participation is voluntary. If you choose to take part in this study you may stop any time during the study without any consequences following you.

Benefits

There are direct benefits to you as a teacher and your class as this study may provide valuable insights to your classroom practice which may benefit many others like, Mathematics Heads of Department and mathematics teachers as they plan for teaching.

Contact Information

For easy communication concerning this study please contact Ms Chikuba Muna at David Livingstone College of Education House Number 24, or call on 0977829637 or email munakasaka@yahoo.co.uk

Thank you very much for your consideration.

Yours sincerely,

Chikuba Munakasaka

I _____ Signature _____ agree to take part in the study.

APPENDIX TWO: Ministry of Education: Southern Province 2006 JSSLE Results

Analysis for Districts – Mathematics.

District	No. Sat		Fail grade		No absent		No. missing		% pass	
	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2
Choma	5387	5375	4718	5002	364	362	8	22	12.4	6.9
Livingstone	3489	3484	3312	3336	218	222	0	1	5.1	4.2
Monze	3132	3240	2626	3013	427	319	0	0	16.2	7
Kalomo	2969	2956	2627	2838	342	350	0	5	11.5	4
Gwembe	575	575	561	572	63	63	4	0	2.4	0.5
Siavonga	682	673	636	664	51	55	34	8	6.7	1.3
Sinazongwe	1196	1198	1081	1113	80	78	0	0	9.6	7.1
Kazungula	514	515	509	514	51	50	0	0	1	0.2
Mazabuka	4197	4153	3517	3846	251	255	0	40	16.2	7.4
Namwala	735	733	643	680	81	81	0	0	12.5	7.2
Itezhi-Tezhi	577	576	423	536	86	87	0	0	26.7	6.9
TOTAL	23 453	23 474	20 653	22 114	2014	1922	46	76	11.9	5.8

APPENDIX THREE: Lesson on ‘Congruent triangles’

Topic: Congruent and Similar Triangles

Lesson: Congruent triangles

Duration: 80 minutes

Teacher (T): Greets the class and tells them to be in groups of threes. [It takes some time for the class to settle.] Let’s hope I have given each group two papers.

Class: Yes.

T: Now from there, in your groups, how many have the rule? [Asking individuals, as he goes round the classroom.] You have a rule? [He talks of razorblades, but I couldn’t hear exactly what he said, then he said out loud] You will be exchanging these [referring to razorblades]. Okay, now be attentive, have you received those papers?

Class: Yes

T: Now each group I will give you the name, you are group 1, group 2, group 3, group 4, group 5, group 6, group 7; are you attentive, it is like you are not attentive. What is your group? [pointing to one group he had just named]

Group (G): Group 7.

T: Group 8, group 9, group 10, group 11, group 12, group 13, so we have how many groups?

Class: Thirteen.

T: Groups 1 to 13, these are our groups. Now from group 12, I have given you papers, now the papers that you have, they in which shape? Tell us the shape, just one of you from your group should answer, the shape of the papers you have been given, which shape?

[Pause - no response.]

T: Group 12, where is group 12? [The group raises their hands] Yes there, tell us the answer.

G12: Rectangle.

T: They are saying rectangle, are they right?

Class: Yes.

T: That is a rectangle, now group 3, tell us the number of sides that shape has, the one which we say rectangle. Yes?

G3: Four.

T: Yah, four, four sides [pause], now there is another shape. I want this answer coming from now group 5. There is another shape which has three sides, eeh, a three-sided figure shape, what do we call that shape? From group 3, yes three.

G5: [Answer comes from group 5] Triangle.

T: Triangle. So we triangle. we want to look at a triangle, one which has how many sides?

Class: Three sides.

T: So a triangle we know that it has three sides, now, from ... out of those two papers you have been given, I want you to come up with two tria... listen very carefully, two triangles which are the same. Do not. This is a rectangle, isn't it?

Class: Yes.

T: Listen carefully, do not even get another piece and throw it then that's when you come up with the two triangles. The way it is come up with two triangles which are the same. Are we together? [Noise from the class] Two triangles which are the sa...

Class: Same.

T: Are the same. The other paper which I have given you, you should reserve it for another activity. It's up to you now to ... these two triangles should be the same [shouting now as the class is noisy]. I am giving you just five minutes for that.

[Class gets down to work, and teacher shouts some instructions]

T: As a group, work as a group, two triangles which are the same.

[Class continues to work discussing, arguing and seemingly enjoying the task as they share ideas. *It was the first time that I experienced this class discussing.* Teacher goes round the classroom checking on groups' progress, I could see him talking to the groups. One boy from a group nearby to where I was seated observing asks me a question]

Boy: Madam, should we cut? [Teacher seems to have heard the boy's question and gives a response to the whole class]

T: To come up with two triangles means you should cut, these two triangles should be the same

[The boy looks at me for response and I repeat the teacher's explanation, "Yes, you should cut so that you have two separate triangles." The group gets back to work after showing me their attempt to make two triangles. I encouraged them to follow the instructions and see how best they could do it. Work continues in groups and teacher cuts in again amidst the class noise]

T: Discuss as a group please, let it not be one person doing it. Discuss as group how you come up with two triangles which are the same. [The class continues to discuss and teacher shouts again.] Discuss as a group. Reserve the other paper, the other paper should be reserved just make use of one. [Discussions continue; teacher cuts in again.] Remember, we said that a triangle has how many sides?

Class: Three.

T: Once it has more than three sides then it is not a triangle. [Discussions go on. Teacher seems to get a question from a group or it is his own observation] No that is not what I said, I said do not even remove not even a small piece of paper, the way it is just come up with two triangles which are the same.

[The task continues and it is well over five minutes that was initially given.]

T: Please I said I am giving you few minutes for that so hurry up. [Work on the task continues and noise is slowly dying out as most of the groups are now on the cutting stage. I notice that the pupils are taking good care in cutting out the triangles. Those who finish wave their triangles probably for others to admire too. There are happy faces in the classroom. There is a shortage of materials to cut with and so the exercise takes a little longer again. Teacher gives out another ending time.]

T: I am just giving you four minutes for that. How many have finished?

Groups: [Respond by waving their triangles]

T: Ah ah, just put them down, don't show us.

[The cutting exercise continues but I could see some groups getting papers from their books to start the exercise afresh.]

T: Hurry up, hurry up, I said you should not take time. What about this group, are you through? [He gets response which I could not catch.] What are you still waiting for? [Another response] You are waiting for what? [Response] You are cutting, okay.

[Teacher goes on asking some groups about their progress.]

T: Now, for those who have finished, I think we can start. Eeh, I have.... I have written some numbers. [Class is not attentive.] Let us be together, since there are 13 groups now I am requesting for those who are through you come and stick your triangle, just one out of those two triangles.

[Groups send representatives to stick their triangles and the class starts to admire some and they giggle at some triangles that don't seem to be right. The room is noisy again as they discuss the stuck shapes. It takes long again.]

T: [Amid the class noise, teacher shouts] How many groups ... eeh please! Immediately you are through, put your triangle here the way you feel it will [could not hear the rest. Teacher continues to ask the groups to work faster and he shouts once more.] Keep the remaining triangles safely. They should be safe. [Sticking continues.]

T: We are remaining with group 5, group 6, group 11 and group 4, hurry up [pause]. Where is group 11? Hurry up [pause], hurry up, hurry up.

[Groups continue to stick their triangles.]

T: What is happening, [pupil's name], what is happening with the triangle? What has happened? Make sure that you have.... okay, now let us all look at the board. Let us be attentive and look at the board. The question is, what is your comment? Just by looking at those triangles? [Silence.] Who can tell us something? Yes Pupil 1?

Pupil 1 (boy): Triangles have got three sides.

T: You are saying all the triangles have got

Pupil 1: Three sides.

T: That is his comment. Now may I ask you, do we a triangle with two sides?

Class: No. [Some giggling.]

T: Because he is saying all the triangles have three sides and we know that each triangle has how many sides?

Class: Three sides.

T: Thank you very much for your comment; another one, who has another comment? Yes pupil 2?

Pupil 2 (boy): Some groups did not cut well.

T: They did not cut well, that is his concern.

Pupil 2: Like number 11 [class mentions others which were not well cut out].

T: He is saying like group 11, they did not cut well, like group 11. So group 11, next time you have to be careful. Eeh I saw the hand, eeh yes pupil 3?

Pupil 3 (boy): The sides are not equal.

T: The sides are not equal, that is his concern. [Pause, looking at the shapes on the board.] Are the sides not equal?

Class: Yes.

T: Yes! Are the sides not equal? [Response from some pupils] They are? Him is saying they are not equal. What do we say? What is our comment? Are they equal or are they not equal?

Class: They are not equal.

T: They are not equal?

Class: Yes.

T: [Girl says something about being told to cut from something, not audible.] If you were told what? [Response] Then what?

Class: Ummmh.

T: So these sides are not what?

Class: Equal.

T: Not equal. In short, each triangle has got its measurements. Maybe if we were to say this one [pointing at a triangle] is 5 cm, this one maybe it is 7 cm and that one maybe is 4 cm so the sides are not equal. Just by looking you can tell that the sides are not equal. Any other comment? [Pause] Yes pupil 4?

Pupil 4(boy): They are all the same, but arranged in different ways.

T: Okay, he is saying all these triangles, they are what?

Class: The same.

T: They are the same, though they are arranged in different ways. Some triangles are of course arranged in the way maybe eeh, more especially like this one it almost like the way that one is. So what we conclude is all these triangles are what?

Class: Are the same.

T: Are the same. Are we together?

Class: Yes [some do not respond]

T: Because, why are they the same? You were given the same... the same piece of what?

Class: Paper.

T: ...paper, which is a rectangle with the same measurements and it is like all of you, you followed the rules though others were busy struggling at first. Now these, the triangles, be very careful now, I am telling what is The triangles which have the same lengths or the same sides and the same angles which have the same corresponding sides, which are the corresponding sides which are the same and corresponding angles which are the same, we call them congruent triangles.

Pupil from the background: Congruent?

T: Congruent...

Class: Triangles.

T: So in short, I am saying congruent triangles are triangles which have the corresponding sides and the corresponding angles which are the same. So just like what you have said, the corresponding sides are the same and also we know about angles, isn't it?

Class: [some pupils] Yes.

T: So now since we have said that they are the same, let me ask one member from group 8 or let me say group 8 members you choose one to come and fit that triangle that you have, to fit it in another triangle so that we see whether they are the same. Group 8! [Group 8 goes to the front. Class starts to talk] Let us be observant. Let us be attentive, we look at the board and see what is happening.

[Group 8 tries to fit the triangle, class starts to tell him what to do and teacher speaks]

T: I said any, I didn't specify because we have what I mean, have you got the instructions clearly? Have you got the instructions clearly [addressing the boy at the board; boy shakes his head negatively]. What did I say? Who can tell us? What did I say, pupil 5?

Pupil 5 (boy): You fit it anywhere.

T: You fit it on another triangle so that we see that they are the same. [Pupil tries again and there is laughter from some of the classmates as the boy tries and fails to make it fit with other triangles. Some pupils give him ideas of what to do.] Hurry up, group 8.

[Class tries to tell him which triangles he should try to fit it on.]

T: Now do you know fitting? What I mean by fitting? You put on top. On top of that triangle so that we see that they are the same. [The boy struggles some more and finally he manages to fit it on one.] Okay, you have seen what has happened?

Class: Yes.

T: Yes, it has covered the other one, though he has not put the other side there but if I do like this you will see that they are the same. Just like what you have said some groups were not careful when cutting. You can see like here [pointing at a triangle] there is this part, so..... So this is what we are saying; congruent triangles are triangles which have corresponding angles and corresponding sides which are equal or the same. So that is what the.... but the main topic is congruent and similar triangles but today we are looking at ...

T and Class: Congruent triangles.

T: These are the triangles [pointing at the triangles on the board], are we together?

Class: Yes.

T: Now just, with the remaining triangles that you have, come up with two triangles again from the same triangle. Hurry up.

[Class starts to work in their groups. Teacher goes outside and the class is confused about the same triangle concept. I explain to them that the teacher just said two triangles and not exactly the same triangles. Teacher comes back and tells the class to hurry up.]

T: Okay, have you finished?

Class: Yes/no

T: Very quickly, since we have those triangles there, I hope, I almost forgot one thing, eeh.. we are going to write the letters just at the end of each side so group one this will obviously be what?

Class: a

T: Then we are going to have our b then our c, then what do you think, after c we have what?

Class: d

T: Now where do you think our d should be? Here, there or there [pointing at the different sides of the next triangle].

Class: [Different answers from the class.]

T: Where do you think our d will be? Here, there, or there? We want to follow the same format of this triangle [pointing to triangle ABC].

Class: [Shouts] There!

T: [Pointing] Here?

Class: No.

T: There?

Class: Yes.

T: So where will our e be? We want to follow the same format. Here?

Class: No.

T: There?

Class: Yes. Then the next one becomes our f. for the next one where will our g be? Left or top..

Class: Left.

T: So this our g and what about our ...?

Class: Right.

T: Right or on top?

Class: Right.

T: Then obviously our i is here. We will only confine ourselves with these three triangles. I almost forgot to name them so we will just concentrate on those three triangles. [Pause.] Are you through with cutting?

Class: Yes.

T: Now before we go to the second triangles, we looked at these triangles and had comments; we said that they are the same, so there is what we call side side side (SSS), meaning that these sides are equal. Are we together?

Class: Yes.

T: Meaning that, like this, we have AB, isn't it?

Class: Yes.

T: Now when we go to group 2, triangle for group two, AB is equal to which side?

Class: DE

T: So $AB = DE$ so we say AB is equal to what?

Class: DE

T: Now what about BC? BC is equal to..?

Class: EF

T: Do we all agree that it is equal to EF?

Class: Yes.

T: So [writing on the board] $BC = EF$. What about BC? AC I mean?

Class: FG/ GF

T: AC is equal to GF. You have seen what is happening?

Class: Yes.

T: Now we call these, they are sides, it means the corresponding sides, you remember even when I was defining, these are the corresponding sides they are equal. Now we call it side side side (SSS), meaning the corresponding sides are equal [writing on the board]. You have seen that? That's what we call SSS.

Now there is what we call, now the one we want to make use of are those triangles. I will just ask three groups just to... group 1, group 9 and group 13 just to come and stick their triangles here so that we see. Yes just one triangle of your choice. [Groups come forward to stick their triangles.] Maybe these groups will stick the smaller triangles, the smaller triangles, then group 2, group 7 and group 5 you stick the bigger triangles of the two. [Sticking goes on.] The groups, the other groups I told you stick the bigger triangles. [Sticking goes on.] Okay, hurry up [pupil from one group; sticking goes on.] Okay let us be attentive now, we move together so that by the time we come to the eeh, the theory part we know what is expected of us. Now we are concentrating on these other triangles which we have. The other groups you forgive us ayi! We just want to make use of these groups which have just stuck. Okay they have just brought the triangles for group what?

Class: Group 12.

T: These triangles which have just come out from this, they came out from the original triangle which is this one eh? It was like this [fitting it on the bigger triangle], you have seen? It was like this before it was cut. It was like this [trying to hold it exactly on top of the other triangle]. Now after cutting, which [pause, triangles falling off]. Before, it was like this, are we together?

Class: Yes.

T: Now after being like this, there is angle which has been disturbed. Which angle? This angle is represented by letter A and this one by letter B and that one by letter C. which angle has been affected after cutting? Because now we cut this ... [class interjects].

Class: C

T: C? It's angle what?

Class: [Some pupils] B

T: B?

Class: B/A

T: You mean which angle has been affected?

Class: [Some] C

T: Between A B and C?

Class: [Predominantly] C [some say A]

T: C has been affected because we cut it, but for A has remained and B has remained. We have come up with another triangle there and another triangle. Now this triangle, we are getting this other triangle. B has not been affected, so you can see if you get this angle it is still the same with this angle according to that one. It is the same, B is the same with this angle. Do we agree?

Class: Yes.

T: Yes, B is the same as E [class provides answer alongside the teacher]. Have you seen that? [Yes from some pupils] so we have this side which is that side, then we have this angle B which is, let me now remove it, it is like this. This angle which is the same as that one. Now you realize that the angle is the same, then we also have the sides. There is what we call, side angle side (SAS). Meaning that the sides, two sides are what?

Class: Equal.

T: Yah, we have two given sides which are equal and also an angle in between. Are we together?

Class: Yes [answering is not energetic now].

T: Which if I have to draw it is like this. [Pause, drawing on the board.] If this is PQR it means this angle, this is the side and that is the side. ST then U, so this angle, meaning that this angle, you have seen this angle?

Class: Yes.

T: It has been marked by how many lines?

Class: Two lines/curves.

T: Two lines. So this angle and that angle is equal, then that side it has been marked by one line, you have seen [Yes – class] even that one meaning that this side is equal to that then this angle is equal to that, then this side which is marked by two lines is equal to that one. It is just the same even for the sides. For the sides one, if this VWX then we have KLM it means this side [marking the sides], meaning that this side, it marked by one line but [girl] and your friend you are talking, because now we referring to what we are doing. This side is marked by one line, you have seen that?

Class: Yes [more lively].

T: Are you attentive now [girl]? [She says yes.] But [to another girl] you are obstructing your friend there. [There are calls of ‘Sir! Sir!’ But no response and he continues.] So this is marked by one line the same as that side also which has been marked by one line. Do you see that?

Class: Yes.

T: Then here this one has been marked by two lines which is equal to, which is WX is equal to LM which is also marked by two lines. Then VX is marked by how many lines?

Class: Three lines.

T: Which is equal to what?

Class: KM

T: KM because it is marked by three lines. Now this is how you will be identifying the sides which are...

T and Class: Equal.

T: Are we together?

Class: Yes.

T: But it doesn't mean that ... the shape can sometimes be drawn differently just like the way you have arranged these but what is important is for you to check the sides and the angles. Are we together?

Class: Yes.

T: Now there is the symbol which is used for triangles which are congruent. For an equal sign we use how many lines? [Answering his own question. He seems to be rushing now.] They are three isn't it? They are two for equal sign but on congruent triangles they are three. Are we together?

Class: Yes.

T: If we say triangle [writing on the board] PQR is congruent to triangle NOP, this is the symbol you use, like the way this one is ($PQR \cong NOP$). Triangle N... You draw the symbol of a triangle $\triangle ABC \cong \triangle DEF$. are we together? [Class – yes] - so the symbol is very important. Now before we go to the written what, may be there are some questions [pause – no response from class]. Just on the activity and the explanation that we have, the activity and the explanation on the activity that we have. Maybe there are some questions? The questions are most welcome. [No response from the class.] We are okay?

Class: Yes.

T: Have we understood? It is us who were cutting these, have we understood what we were doing?

Class: Yes.

T: And why were we doing what we were doing? [Silence] We should know that. Now these congruent triangles we make use of them in our day-to-day life, when we are doing what? Who can tell us? What benefit do we get because of learning these congruent triangles? Who can tell us? In our day-to-day life

Pupil 6 (boy): Measuring [not audible].

T: Measuring what?

Pupil 6: Measuring the field.

T: So you can say that that field, I had a field which 2 by 3 km so even this time I should have the same measures. In short he is saying also in designing, when you want to go the tailor. So very quickly you copy what I will write and do the exercise. I know we don't have too much time. Return the pairs of scissors.

[Teacher gave a written exercise to the class. He tells the class to start writing; he has the definition of congruent triangles on the board for pupils to copy too.]

T: Start writing, we are behind time.

APPENDIX FOUR: Data recording sheet

A. Data Recording Sheet

Establish the background of Respondents	Name of Teacher being interviewed	Gender M/F	School	Years in service	Date of interview DD/MM/YYYY
	Teacher	M	Xx basic school	10	
Objective 1	To find out basic school teachers' views about linking mathematics to everyday life.				
What comes to your mind when I mention the term "linking mathematics to everyday life"?	That is making use of mathematics, the knowledge acquired to what we find ourselves in, the activities that we find ourselves in, in day-to-day life That is making use of mathematics knowledge acquired in the activities we find ourselves in, in day-to-day life				
How possible is it to link mathematics to everyday life during the teaching and learning process?	It can happen. Maybe let us say you tell the pupil to come to the front of the classroom, maybe you are considering time in terms of maybe you are teaching on speed, distance and time. Then you can tell the pupil to say come here I want you to be here maybe in three seconds and, that means you making use of day-to-day, so one can move slowly or one can walk faster.				
In which ways do you link mathematics to everyday life in your teaching?	Yes I do, as I mentioned earlier on that I do use LTAs or apparatus. When we mention LTAs maybe let us say that you are teaching on selling and cost price you can make use of items sold at the market. So it means you are making use of day-to-day activities because as children or learners go to the market, those are the things that they meet.				
How could pupils be involved in linking mathematics to everyday life?	Making use of them that is by them participating in the lesson and also when they go out they have to encouraged to make use of these same concepts that they have acquired, though some of them they discover them while at home or at the market as I mentioned.				

Objective 2	To establish how basic school teachers' classroom practices exemplify reflective teaching
What do you understand by "classroom practice"?	Classroom practice the way I understand it is the involvement of a teacher in deliberation of knowledge to the learners that is by teaching. Also in the same vain the involvement of pupils by participating that is by acquiring knowledge and also participating in exploring skills that they are taught by the teacher.
Could you give me a brief of how you conduct your lessons?	The way I conduct the mathematics lessons being a mathematics teacher, it depends, I make use of the LTAs, that is apparatus depending on the lesson to be taught. Of course not all lessons may have the LTAs. You know that mathematics is a practical subject, so usually I do involve much of pupils especially group work after attaining the knowledge from colleagues. Of course at times it cannot be group work but the whole classroom involvement that is of course. What I mean is little time is done for lecture method but most of the time I use question and answer method.
How often do you use LTAs in your lessons? Why?	LTAs - the reason for using is to make sure that the pupils are involved and what the pupils touch and they see that stays, it actually stays for a longer period of time in their mind. As you know mathematics is not all about memorising but it is all about understanding. I often use LTAs just like what I have mentioned earlier on, depending on the topic, but this is at least in a week three times, that is the minimum number of lessons.
Who organises and prepares these LTAs? Do you have LTAs that were prepared by pupils?	Both the teacher and pupils are involved in preparing the LTAS. Yes I have some that were prepared by the pupils.
Do you write lesson plans for your lessons and how often? Why?	I write on daily basis but at times to be frank maybe one was found to be out, maybe you went out for a funeral and as you come, maybe you are tired, of course we are human beings that way maybe you find that you can have a lesson plan at a later stage. But as teacher it is vital to have a lesson plan on daily basis but there are circumstances you cannot run away.

<p>I suppose a lesson plan is meant to be used during the teaching of that particular lesson.</p>	<p>Yes.</p>
<p>What do you do in case you fail to complete your planned lessons? What are the implications of this on the daily lesson planning in view of the next lesson?</p>	<p>There usually, when I don't complete a lesson, at times I would request the pupils maybe in the afternoon so that I continue with the same lesson or if that is not the case then it means I teach it the next lesson. I will not plan because it will just be a re-do. I will plan because that work was done; I will just, in short I will say I will plan partially. Yes, because it will be more or less like a repetition though the examples will be different.</p>
<p>Being the only teacher of mathematics, do you ever plan your teaching in collaboration with other teachers? If yes, what merits and demerits do you find in team planning? Could you elaborate a bit on what you mean by when need arises?</p>	<p>Yes I do, of course there are those other teachers though they are not specialised in mathematics, but they have that interest, we share ideas. The merits are that we share knowledge. For you being the teacher of that subject you need also others to also encourage you in one way or the other. At times the teachers who are not trained in that subject find difficulties to understand, those are the demerits. I collaborate whenever need arises because as teacher as you are going through when you are preparing there are some areas of concern. I would say even during teacher group meetings though those have specific topics, but there are some topics sometimes we share ideas.</p>
<p>How often do you use experts in your teaching? Why (not)?</p>	<p>I don't use any experts. I have not done it.</p>
<p>What methodologies do you usually use in your teaching?</p>	<p>I would say, group work, I like using group work that is also pairing at times. Then also lecture method though at a minimum rate.</p>
<p>Do you evaluate your lessons after teaching? What aspects do you include in them if you do? If not why?</p>	<p>I do, though at times you know we are human beings you might end up evaluating the following day. The aspects that I consider are the successes both for the teacher and the pupils, of course those are the things that will help me handle the same topic in future, because by looking at the failures and the successes, where you have successes then it means you have to improve on those even the weaker stages or where you didn't do well it means you need improvement; for both successes and failures.</p>

<p>What do you understand by “reflective teaching”?</p>	<p>What comes to my mind is that you sit and relax, look back to what you have been involved in, in terms of teaching as well as for the learners what they have acquired then, you start building up the failures. It is more or less like evaluating now which will help you in future.</p>
<p>Is it possible to reflect while teaching? If so how? If not, why?</p>	<p>Yes it is possible and important at the same time because that is time when, let us say maybe a pupil is asking a question, you can reflect maybe on the method which you were using; maybe the pupils did not understand then you can change to another method for the betterment of the pupils to acquire the knowledge and skills in fullness. Through questioning and also after marking.</p>
<p>At what level of the teachers’ work do they need to be reflective?</p>	<p>According to my own opinion, I think there are many levels. Because as you put it, at least when the lesson is going on, during the time of evaluation. Of course as we are aware that we have the long term and short term, it can be termly and also at the end of the year. Because right up to now when we look at the results the teacher should be reflective; also so depending on the stage, maybe when giving end of topic test.</p>
<p>Objective 3</p>	<p>To examine the changes that take place in the participating teachers’ views and classroom practices in relation with linking mathematics to everyday life through reflective practice</p>
<p>Could you mention any notable changes you have observed in your own practice through our collaboration in this research if any? If none, explain.</p>	<p>I now feel more confident in teaching mathematics because I look back and see what I need to do for the pupils. I give them chance to ask questions and they discuss them. I don’t explain everything and my pupils correct me if I make mistakes. I have also known that finding LTAs is not always looking for complex materials. This work has taught me to be fair in judgement and evaluation and I wish more teachers could do the same because pupils have a chance to speak and enjoy lessons. I see that bringing in familiar stories and places in questions make the pupils solve them better, but again examinations will have those other places. As you said, madam, I still agree with you that if the idea is known then any problem can be solved because during extra lessons I give past papers and pupils manage to solve. So it really doesn’t matter. I wish we more time. But will you at times allow me to use your tape-recorder so that I can listen to my lessons? [I agree], then that will help me and I want to present at the Teacher Group Meeting (TGM).</p>

<p>What would you suggest would be some of the helpful ways of helping teachers to link mathematics to everyday life?</p>	<p>It is not an easy task, madam, but maybe 1. is to know the mathematics, I have found this to be important now because we just get examples from books. And 2. is to plan carefully before lessons and not write lesson plans for the inspectors. We could also, number 3, work in TGMs to teach lessons which others find difficult because there are topics we teachers don't want to teach; maybe one can have good ways of teaching and if you observe you see many problems than one who teaches like in this case. You have helped in many areas I didn't know were not done well and when I listened to my lessons I sometimes thought it was not me teaching like that so even tape-recorders can help us a lot.</p>
<p>Would reflective practice help teachers improve on their classroom practices and linking mathematics to everyday life?</p>	<p>I think it would improve, yes, because teacher will know at every point what is needed by the learners. I have seen that there are times I had to explain different from my plan when I paid good attention to my pupils. You see even some girls started to put their hands up and they talked. Now here there were times I found that I was not sure how some topics link to real-life; some I asked you and I hope you will still help me after the research. Here also TGMs are important but sometimes we teachers of mathematics are selfish. One thing is we compete.</p>
<p>What challenges did you face in this collaboration of linking mathematics to everyday life through reflective practice?</p>	<p>As I have said, some topics are not easy to link with everyday life and so finding good examples was a problem. Also at times, especially when we just started, I forgot that part and did it at a time it was not really fitting. But you encouraged me to not panic and this helped. I sometimes was very fast in my lessons because I wanted to finish the work, so it is faster to just use examples in the textbook.</p>
<p>Any other comments?</p>	<p>This study has made me want to study further also, but I have no degree now so I have to get one then do my research. I have found it so educative and I wish many people were getting concerned even those who set exams. Why don't you arrange to have meetings with teachers of mathematics in the district, talk to the District Education Board Secretary (DEBS)? We can be helped.</p>
<p>Finally</p>	<p>I thanked the teacher and told him I would seriously consider his suggestions and I encouraged him to continue being reflective and employing constructivist approaches. I told him I would assist him with the tape-recorder whenever he needed to use it.</p>

B. Classroom Observation

Checklist

No.	Statements/Questions
1	Examine the teacher-to-pupils; pupil-to-pupil relationship.
Comment	Friendly attitude towards pupils. Less interactions in phase one. Some changes noted in phase two.
2	Check for teacher : pupil ratio (Class size - male and female)
Comment	42 pupils (22 boys, 20 girls) but 36 to 42 present during the study period, good attendance.
3	Examine seating arrangement
Comment	Seated in rows and columns in phase one but changed to group set-up and pair sitting arrangements as we progressed with the study.
4	Examine how the teacher introduces the lesson
Comment	In phase one, 1 – Teacher defines the terms and gives the formulae; 2 – Teacher asks questions from previous lesson. This changed in phase two, where the teacher did not introduce his lessons in a definite way.
5	Teachers' knowledge of subject matter
Comment	This was worrisome, especially when we just started the collaboration, but with encouragement and helping each other understand the content before every lesson, there were fewer errors and when they occurred the teacher reversed the mistakes by explaining or asked a pupil to explain what ought to have been done.
6	Class participation (including gender aspects)
Comment	In phase one, about five boys answered the teacher's questions with one being at the top for answering and explaining concepts. Once this boy gave a correct answer the teacher moved on. Girls hardly contributed, but as the study progressed I asked the teacher to pay attention to all pupils as well as the girls. With the deliberate move of pointing at even those whose hands were not raised to answer questions, more and more pupils got involved. However, the teacher at times settled for choral responses.
7	Examine how the lesson flows/time management.

Comment	Lessons were systematically presented and in phase one the teacher ensured that there were few derailments through pupils' questions and concerns, which he seemed to ignore. Time management was a challenge in that the teacher seemed not satisfied if he failed to reach the last point of his lesson preparation. We discussed that the lesson plan was a guide and that by the time the teacher was supposed to gauge the level of assimilation by his class to be able to plan work that would fit in the available times for the lessons.
8	Examine the questioning techniques (note relation to day-to-day life)
Comment	The teacher tended to ask pupils to provide answers to some operational questions like '10 x 1000 is what?' rather than make them explain what was happening in problems presented. His questions had very shallow room for exploration. This started to improve as the study progressed, though he needed to work on questioning techniques. At times the teacher called on the respondent before posing his question, while at times he gave very lengthy statements such that the pupils ended up somewhat confused.
9	Type of teaching aids being used and the way they are being utilised.
Comment	These were hardly utilised in phase one and even in phase two where they were used, at times they were not effectively used. At one time the teacher had the process worked out on a chart but he kept on writing the same process on the board. The teacher was encouraged to make maximum use of the set LTAs to save time, add variety and capture pupils' attention.
10	Check all necessary documents, e.g. lesson plans, homework, tests, schemes of work, and lesson evaluation
Type of document	Comment
10.a Homework	Given almost every lesson, and books collected by the teacher for marking. The problem here was that some pupils did not have homework books and so they were denied the chances of revising their class work at home as they used the same class work books for homework. I drew the teacher's attention to this aspect who said all pupils were asked to have homework books, so they should have complied. I requested him to find out the number that had homework books and those who did not to help him make an informed decision on the way forward.
10.b Tests	These were not given during normal class time but I was told they were usually given during the extra lessons time as these were almost compulsory for examination

	classes.
10c. Register	The teacher marked the class register often; sometimes I could see him counting the pupils then asking who was absent and asking for reasons for the absence if any, which helped him mark the register quickly.
10d. Schemes of work	These were written and filed and it was against this that the teacher was rushing through his lessons.
10e. Lesson plans.	These were neatly written too at first with examples and exercises drawn directly from the textbook which later changed. They also reflected the different methodologies and class organisation as the study progressed.
10f. Records of work/lessons evaluation.	At first these reflected successes only. Comments like 'lesson taught well', and 'successfully taught' were common. Later the teacher stated some successes as well as challenges and what he hoped to do next time.

APPENDIX FIVE: A reflection session in phase one

Researcher (I): What comments would you make about the lesson you have just taught?

Teacher (T): I observed that they still need me to come in more especially for the previous one where by that boy mentioned something else. I could see they are still mixed up, yes, but for the current one at least I tried to explain, eeeh its like I was more pupil-centred I could involve them or let ask them questions; where they fail then I come in. Because all I wanted is to see what they know. Before I just lead to say this is what it is expected; it is better them they tell me what they know. [I say - good point.] Yes, also I observed that, of course I mentioned time management where I tried to catch up with time that is a weak area I also observed, and eeh also the other part is just like what I mentioned earlier on, there is need for remedial work in short. In brief I would say the lesson was successful because why I say it was a successful lesson, eeh I could see I even became under pressure on the issue of marking [teacher laughs]. Though I observed just like what I mentioned for question 1 they had some difficulties they couldn't most of them they couldn't borrow a 1 from the 9 which is the immediate number on the right-hand side, which I emphasised as I was going through the whole exercise during conclusion. These are the points; that is how I viewed the lesson.

I: Can I ask you two questions from what you just said now? [Teacher nods in agreement.] The first one is where you said the teaching was more student-centred [Teacher: Yes.] Is it more than usual in your classes or ... [teacher comes in before question is concluded].

T: Eeh not really that but usually I like pupil-centred because you have to probe them to find out from them what they know before you just come in as a teacher, because that is why even yesterday I mentioned the issue of the area or the project you picked is a good one because we are concerned of understanding. Though demonstration is also [some pause] ... demonstration is also the way I look at mathematics, according to my way of, eeh the way I view mathematics I look at it that it involves more of question and answer and also demonstration Eeh and discussion. It doesn't involve lecture method so mostly I like using question and answer.

I: You said it doesn't involve what method?

T: Lecture method. It involves but it is at a minimal level.

I: Yah you said it mostly involves question and answer... [Teacher comes in]

T: ... Question and answer then discussion and demonstration. These are the key areas.

I: My other question is a question which I always, always ask teachers if I visit a student or a teacher in class. I ask afterwards "Do you think the students learnt anything today?"

T: Uuh, they learnt yes. Eeh they learnt because I assessed them when I was marking, that tells me that they learnt something. That's why I even said generally most of them had difficulties with question one

which now gives me homework. Though I eeh... I explained that of course during conclusion when I referring to say you forgot, eeh most of you forgot to borrow a 1 from the immediate number, 9, would say they learnt something.

I: So for that reason I thought that when you dealt with the first example, 43.2007, why didn't include 4 sig figures here because then [counting figures] 1, 2, 3, 4, you would raise the problem at changing the zero to 1, so it could have been there already in the beginning but you didn't take 4 you 3, 2 and 1 and so it became a problem.

T: Uuh yes! Yes! Sure, that's true.

I: So these were your views, this is what you have assessed today. Now since you were marking and would mark this book then move to the back and mark another book, don't you see a possibility someone copying from the one that has got them right?

T: Eeh eeh, the possibility is there, eeh of course, that we cannot run away from. But usually I encourage my students because I encourage them to work independently; of course there is consultation but not a direct one whereby one would like to get the answer direct from the friend, but just a way course mathematics involves discussion. Maybe one creates a different question, I encourage my students to do that. Whereby maybe one is stuck, just create another question which is related to that, so that possibility is there and I cannot, we cannot run away from that. Eeh I wouldn't defend to say maybe of course maybe some copied from their friends, and at the end of it all I may say, eeh it was a successful lesson yet maybe only three got them right. The possibility, actually it could be there. Yes and it means this is also giving me a homework of being conscious, but usually I encourage them to work independently. Being conscious though it is a bit difficult you know when you are marking and I think you also observed, I was trying to explain because that is why we discourage the..., like I personally I'm not of a type of marking whereby maybe pupils submit all the books then I mark, I like mark individually, then I explain, because that is when you identify the weakness of a pupil. So that is a good question, madam.

I: But is that..., well that is worth while reflecting upon, uhm, if students cooperate, that maybe a negative thing, I simply say may I borrow your book and I copy whole answers, show to you and you give me a tick and everything is fine, and maybe I am happy with that. I got a tick, but I haven't learnt anything all. That is the negative aspect, but the positive is, if you and I start talking together, then I see, if I tell you I don't understand question b and you tell me how you understand it, then our conversation may be very fruitful. So talking together, helping each other not by just giving the book, telling the answer but trying to explain what to do and explain what the question means, that is a positive.

T: Yes.

I: Really using language helps a lot. So it could be difficult, especially if you are in the opposite corner of the room, to understand is this copying, is it just giving the answer, or is this conversation which develops the mind?

T: That's true. I think usually on that one, I almost forgot one aspect, usually what I do so that I make sure that they work independently or they consult, usually I do consult them as I am marking, how have you come up with this answer? Maybe deliberately I will mark the first question without consulting, then I go to the second one, how have you come up with this? Just to see whether that student has, eeh, the concept or has just copied, you can tell. Yes you can tell that this one has just copied.

I: That is a very good point I think, well a very good point. But the problem with this part of your session was that it took a very long time for you to cover all the students in class, so many of who were quiet whether they understood it or not, but at least they did it right or wrong but they did it quickly and then they sat there with a hand raised just waiting and waiting and waiting and waiting.

T: Yes.

I: So I thought could these be somehow put into action while waiting; for instance, have more problems. Perhaps you would assess one or two problems but they have more problems to do, to work on while they wait for you. Eeh, because they were quite a bit passive after a while.

T: So in short, you are saying, eeh, is it encouraged just there, maybe I, eeh I overlooked one aspect [...part not audible]. Is it advisable, maybe even those which are not reflecting in a lesson plan, because what we are following are those in the lesson plan. Is it advisable you can give them the other questions so that they start working, or how is it done? Eeh, I'm just trying to consult on that aspect.

I: Yah, yah, yah, and my short answer will be yes. It is advisable, you can even reflect it in your lesson plan, you put the exercise and then you put extra work. The extra work is for those who finish early. Or you don't even write extra work, here we shall check, 'given so many problems pupils should answer many' so we know that you want everyone to work out three but the questions are six, which means the extra three are meant for fast learners. But it is not always that you prepare work for fast learners, I think the idea of cooperation that we have talked about is very important. We should also realise that people understand each other at peer level better than understanding from elsewhere, so you should probably, when we plan for the next lessons, we are going to see how it works. If we avoid putting them in orderly rows and columns like that but we see if we can make them sit in ways that they can cooperate.

T: Right.

I: Yah, have a formation that will allow for discussions to help each other share ideas, to avoid copying answers to get a tick, but cooperate to get the answer. We should try it, maybe try it even before I visit you next time. Well, do you think that would be time-consuming on your part?

T: Aah, no I don't think it is time-consuming, but maybe for the first time but as we go along they come used to that and you know when you are introducing something, of course you have to undergo some problems.

I: Have you tried it before?

T: Eeh, I tried with the previous group.

I: How did it work out for you?

T: Aah, it didn't... though I introduced it was at a later stage in the third term. I, aah it worked anyway, though what I observed it was taking time, I think the book racks more especially if it is in the second period for them to get organised like that, I think you also observed, when we entered the book racks were not in order because the people swept late.

I: This is where time management comes in, if you have a purpose and you think that thing serves a very big purpose, you can always create time. Because it doesn't take long, eeh making them to cooperate would either be haphazardly or you simply say could you be in twos, threes just next neighbours, so they will just pull chairs so that they are close to each other.

T: Aah yes.

I: There are times you would say let's play a game like 'capsizing boat' and pupils will get together in those numbers mentioned, so you come up with random groups that would actually be mixed ability groups. Because, when you are recapping, it is not always that you ask questions, you could use different approaches and such games would serve as recap as well as grouping strategies, as long as there is correlation to what is to be taught. And also if you give them an exercise and you tell them work on this in your group until you agree on the solution of this exercise, then you can go and explain to the group and you can mark one book for the group because they have agreed and you can give one explanation to the whole group.

T: Ok. Ok.

I: Because they have agreed so that saves time so you have saved some of the time you have used talking to individual pupils, cutting the time by two-thirds or so.

T: I see, that is true.

I: But also that is a change for the students, maybe for the first time or second time it is confusing and I usually sit here but if you get used to doing such things, then it becomes a habit and they don't think of such things any more, they know what you mean and they know your intention by doing it so that they are not confused and so furious and they get to know that now we have to work that way. But if you remember, for instance, hearing about Vigotsky in your teacher education, he is one of those who emphasises so much how we learn through language and that means not only hearing language but making language, talking to myself and others. If I don't understand an explanation or you don't, just my

asking and maybe my explanation would help you understand and would also help me understand even more. Because I have observed that some of your learners come out of class not having said anything at all.

T: That is true.

I: They could be willing but maybe they have no chance of doing so.

T: That is true, those are good suggestions.

I: I really liked one thing, you seem to know pupils by name and you address them by such though your concentration was on a handful I also can call by name by now. However, the fact that whoever you called out you did by name, it gives pupils the feeling of confidence that 'I am seen by my teacher, I am identified, I am not just anybody in class', that is a good thing for it makes the class be alert. This actually makes it easier for you to involve almost all your pupils because you know I have asked that boy, that girl but I have not yet made that one talk so you could call on them to say something too. What I mean is you could use this social aspect to make your class participate at a large scale.

T: Thank you, I will do that, it was only that some pupils never put up their hands. I will involve them.

I: There are times after teaching when one realises that I have made an error in explaining that concept. How do you go back to make the corrections if that has ever happened to you?

T: That one I, eeh actually I seek apology as a teacher because I shouldn't pretend to be right yet I was wrong. I seek apology then I start afresh and say, please, here I made an error, I seek apology because it is more or less like writing in someone's book, you write without permission so, all I do is I seek apology. I remember last as we were revising a boy bought a question on finding circumference, so I don't know what came to my mind - I solved using the method for area. Then when I reached home that's when I realised that I made a mistake.

I: How did you feel about that?

T: I tell you, I felt as if I had committed suicide because as a teacher there is that feeling because it will mean the pupils now they have gone with that in their mind, so the following day that was my first thing to do. The moment I entered class I apologised to the whole class. I said sorry we are also human beings I recorded the question as if it was area and yet it was not, then I explained. That was a good question, I appreciate.

I: Thanks, I wanted us to come to that one; maybe there is a better explanation on this one, you seemed to present the concept of sig. figs in a confusing manner even to me as a colleague. You presented the concept using whole numbers and decimal fractions in contradicting ways. Could you explain?

T: [Tries to explain] Maybe let us discuss, let me learn here also. I am confused now, I just got it this way from the book.

I: You got answers from the class that made interesting arguments. Some answers were difficult to follow, one could not place the reasoning of the pupils, but you ignored such cases for you to evaluate what the problems were. Looking at most cases, pupils missed completely the idea of sig. figs. By the way, we should ask ourselves questions like: What do we need sig. figs in the syllabus for? Of what significance is such a topic to the life of a pupil? Is there any practical concept, is it useful for any purpose? And if the answer is yes it is useful, I think they ought to know.

T: Yes it is useful. Eeh I see. I think I missed the concepts here, yes.

I: This where the question of usefulness comes in. Say you have K10 000 and you want to divide it between six children and you calculate, how much will each get? And if I am correct each one will get K1 666.666... which is meaningless, you can never pay anybody that, it doesn't make sense in the practical world. That is why we round off to a meaningful number, it could be to some decimal places, to a whole number, to the nearest hundred or whatever, to four sig. figs. But it is always rounding off for a reason. So we would say pay each one K1667.00. If we said we write correct to two sig. figs the way you argued in class today, we would pay K17.00 - is that a true reflection? Have you now noticed where you made mistakes?

T: Aah, that is serious I see it so it comes to this low K17.00 from K1 667.00. No it was wrong, ayi?

I: So do you see why it is important to relate content to our daily lives? If you had this in mind and you used it with the class, then pupils would have understood why they were being asked to round off.

T: So if it was one sig. fig, each would get K2.00 [he laughs at his mistake and jokes], then I would remain with the rest as the teacher. My God, this is serious. Then it means you have come at the right time, because I was almost now going to standard form without realising I was making mistakes. I will re-teach the lesson and this one still needs to be emphasised. Yes that is good. I appreciate this. [We went ahead discussing the content using the examples he used in class and others we could come up with till the teacher was comfortable. He asked some questions and we tried to clarify.]

I: I liked that you knew your pupils by name and you tried to explain how you thought. You also tried to involve the class but try to avoid chorus answers. You also ought to have followed the pupils' line of thoughts when they give you some responses. You made some conceptual errors which you need to correct. When we mention the errors ...

T: ... which the teacher did not see and could not have realised ...

I: We mean well in that we could now focus and see how to correct the errors and how to avoid making such errors and omissions in the next lessons. I appreciate your contributions and involvement. It is good that now we are opening up more and more. I hope we shall continue to make such helpful reflections, but since we running out of time we shall meet the next appointment time. Thank you.