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**The recruitment of the 'everyday'
in fourteen Grade 7 mathematics classrooms**

by

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**A minor dissertation submitted in partial fulfillment of the requirements for the award
of the**

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Declaration

This work has not been previously submitted in whole, or in part, for the award of any degree. It is my own work. Each significant contribution to, and quotation in, this dissertation from the work, or works, of other people has been attributed, and has been cited and referenced.

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13 February, 2004

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Abstract

This dissertation is concerned with how, if at all, the 'everyday' is employed in fourteen Grade 7 mathematics classrooms.

The study was undertaken in twelve township schools in the Western Cape that were previously under the control of the now defunct Department of Education and Training. The data was collected by means of video-recording one lesson presented by each teacher. Each of the teachers presented a lesson of her/his choice and was allowed either the use of the *Maths for all* Grade 7 Learner Activity Books where this was available, or material of her/his own choice.

The theoretical framework used in this study was derived from the works of both Paul Dowling (1998) and Basil Bernstein (1975). The analytical tools were adapted from the works of Neves and Afonso (2002) and Morais and Neves (2001).

The study shows that despite the introduction of Curriculum 2005 and its privileging of the 'everyday', which prioritised weak classification and framing relations, the framing relations in all the classes were strong over all the discursive rules with only two exceptions. Despite the introduction of the 'everyday' in ten of the fourteen classes, the teachers, not the learners, made this introduction. The teachers used the 'everyday' usually as an introduction to their teaching of standard algorithms. In two classes where the teachers asked the learners to introduce their own narratives, one set of learners were unable to respond because they appeared not to know what the teacher was talking about, while in the other class, the teacher did not use the contributions of the learners as a resource for teaching. The strong framing relations prevalent in the classes did not lend itself to effective employment of the 'everyday'.

The study concludes that in order to use the 'everyday' as a means to induct learners into school mathematics, learners need to have some degree of control over the selection of contents, sequencing, pacing as well as over classroom communication i.e. the framing relations prevalent in the classroom. Where framing relations are very strong, the potential to use learners' everyday experiences as a resource in teaching is minimised.

List of Abbreviations

C2005	Curriculum 2005
DET	Department of Education and Training
DOE	Department of Education
GCSE	General Certificate of Secondary Education
LAB	Learner Activity Book
Mfa	<i>Maths for All</i>
MLMMS	Mathematical Literacy, Mathematics and Mathematical Sciences
NQF	National Qualifications Framework
OBE	Outcomes-based education
RNCS	Revised National Curriculum Statement
SAQA	South African Qualifications Authority

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In broken images

He is quick, thinking in clear images;
I am slow, thinking in broken images.

He becomes dull, trusting to his clear images;
I become sharp, mistrusting my broken images.

Trusting his images, he assumes their relevance;
Mistrusting my images, I question their relevance.

Assuming their relevance, he assumes the fact;
Questioning their relevance, I question the fact.

When the fact fails him, he questions his senses;
When the fact fails me, I approve my senses.

He continues quick and dull in his clear images;
I continue slow and sharp in my broken images.

He in a new confusion of his understanding;
I in a new understanding of my confusion.

Robert Graves

CHAPTER 1. INTRODUCTION

This thesis is concerned with the recruitment of the 'everyday' in mathematics classrooms. The study was based on video-recordings made of fourteen Grade 7 mathematics lessons conducted in twelve different schools in the Western Cape during 2000.

The chapter begins with a discussion of the need to link the learners' everyday experiences with the learning process, as suggested in contemporary South African policy documents. The focus then shifts to a description of Curriculum 2005 and the Mathematics Learning Area. Thereafter, the motivation for the present study is given before moving on to a discussion of the research question. The chapter is concluded with a summary of the thesis.

1.1 The White Paper on Education and Training

In 1995, The White Paper on Education and Training (DOE, 1995) – the recommendations for a new curriculum framework – emphasised the need for recognising the experience and prior learning of the workforce. The recommendations also advocated the relevance of classroom teaching to the workplace. Education was to be transformed from a process of transmission of theory to one where learners were to be equipped with the necessary skills, knowledge, attitudes and values to become meaningful members of the new democratic South Africa. Clause 4 of the second chapter, entitled "Why education and training?" states: –

An integrated approach implies a view of learning which rejects a rigid division between 'academic' and 'applied', 'theory' and 'practice', 'knowledge' and 'skills', 'head' and 'hand'. Such divisions have characterised the organisation of curricula and the distribution of educational opportunity in many countries of the world, including South Africa (DOE, 1995: 15).

This clause appears to suggest that the division between the knowledge gained outside of the school environment and that gained within the school environment should be bridged. In other words, the learners' everyday experience outside of the school

environment needs to be recognised and given expression inside the classroom. In fact, the *Curriculum Framework for General and Further Education and Training (Discussion Document)*, under a paragraph titled *Learner-centredness* states that “Curriculum development, especially the development of learning programmes and materials, should put learners first, recognising and building on their knowledge, skills, abilities and experience, and responding to their needs.” (DOE, 1995: 16) This implies that there should be an emphasis on relevance within the learning process. For this to be achieved, so the policy documents argue, it is necessary to bring academic knowledge and everyday knowledge into closer alignment. For the schoolteacher, and for the purpose of this discussion, the mathematics teacher in particular, the implication is that the material used in the classroom should be relevant to learners’ lives, and that learners should also be allowed to bring their everyday experiences into the learning environment. In other words, the learners should be allowed to contribute more towards their learning experiences.

1.2 The introduction of Curriculum 2005

Curriculum 2005 was introduced in Grade 1 in 1998 and in Grade 7 in 2000 as part of a ‘revolutionary’ approach to what is termed ‘life-long learning’ within the NQF or National Qualifications Framework. “The NQF is the set of principles and guidelines by which records of learner achievement are registered to enable national recognition of acquired skills and knowledge, thereby ensuring an integrated system of life-long learning.”¹ Here, recognition is not only given to academic qualifications, but also to experience acquired in the work place.

Curriculum 2005 was a radical departure from previous school curricula. Whereas in the past education was divided into separate subject areas with very little or no overlap between them, this new curriculum is divided into eight Learning Areas and favours integration² across learning areas. For example, History and Geography stood

¹ <http://www.sqa.org.za>

² In the Foundation Phase (Grades 1, 2 and 3), the eight learning areas are combined into three viz. Literacy, Numeracy and Life Skills. The Intermediate Phase (Grades 4, 5 and 6) has five learning areas viz. Languages; Mathematics; Natural Sciences & Technology; Human, Social and Economic Sciences; Arts and Culture.

as distinct subjects in the traditional curriculum. The contents of those subjects have now been combined to form the Learning Area called Social Sciences (SS).

Originally, Curriculum 2005 consisted of eight Learning Areas each with its own set of Specific Outcomes. There were sixty-six outcomes distributed over these eight learning areas. Each of these specific outcomes had its own Assessment Criteria which were then further broken down into Range Statements and Performance Indicators for the different school phases. Overarching the sixty-six specific outcomes were four compulsory Phase Organisers. Each Phase Organiser had one or more Programme Organisers within which activities that contained the sixty-six outcomes were to be designed. However, this model was so cumbersome, that the majority of the teaching fraternity affected by it, i.e. primary school teachers, found it difficult to implement.

In 2002, a revised model of Curriculum 2005 – the Revised National Curriculum Statement Grades R – 9 (Schools) – was presented to schools for implementation from 2003. In this revised curriculum, the sixty-six Specific Outcomes were cut down to thirty-five Learning Outcomes. The assessment criteria with their range statements and performance indicators were discarded and replaced by assessment standards for each grade. The compulsory phase organisers were similarly discarded but programme organisers were retained along with the integration model.

Within the context of the revised Curriculum 2005, integration also means that the contents of worksheets should be designed in a way to achieve integration across the learning areas. So, whereas in the past a learner would get a worksheet designed for each subject or learning area, under C2005 a worksheet was expected to contain elements of two or more learning areas. All learners are expected to do all eight Learning Areas up to Grade 9³.

Furthermore, with the introduction of C2005, teachers were encouraged to move away from using textbooks in the classroom in order to construct their own learning scenarios with which the learners could identify. The emphasis shifted from the traditional 'chalk-and-talk' transmission pedagogy to a new 'learner-centred' model,

³ At the time of writing, no clear guidelines had been given for Grades 10, 11 and 12.

and it was advised that the learners be presented with material compiled from their own world of experience. This implied that teachers were expected to make learning experiences more relevant for the learners.

1.3 The Mathematics⁴ Learning Area

The MLMMS (Mathematical Literacy, Mathematics and Mathematical Sciences) learning area of the original C2005 Policy Document (DOE; 1997) defines Mathematics as

... the construction of knowledge that deals with qualitative relationships of space and time. It is a human activity that deals with patterns, problem-solving, logical thinking etc., in an attempt to understand the world and make use of that understanding. This understanding is expressed, developed and contested through language, symbols and social interaction (MLMMS-1).

The document states that mathematical literacy, mathematics and mathematical sciences as domains of knowledge are significant cultural achievements of humanity. As such, they have both utilitarian and intrinsic value. Thus, everybody has a right to access these domains and benefit by and from them. They "provide powerful numeric, spacial, temporal, symbolic, communicative and other conceptual tools, skills knowledge, attitudes and values to analyse, make and justify critical decisions, and take transformative action." (MLMMS-1) In so doing, people are empowered to, "*inter alia*, understand the contested nature of mathematical knowledge, interact in a rapidly-changing technological global context, and derive pleasure and satisfaction through the pursuit of rigour, elegance and the analysis of patterns and relationships." (Ibid.)

The revised Mathematics Learning Area, as described in the Revised National Curriculum Statement Grades R-9 (Schools), has five learning outcomes whereas the original C2005 document had 10 specific outcomes. If one takes a cursory glance at these outcomes it is clear that more is required of the mathematics learner than the

⁴ This Learning Area was termed Mathematical Literacy, Mathematics and Mathematical Sciences in the original C2005 document but is now simply called Mathematics in the revised document.

mere application of algorithms and solution strategies. The outcomes require that the learners exhibit a competency in number pattern manipulation, measuring, analysing and representing data, using mathematical language to communicate, and using logical processes (RNCS; 2002: 6)

The description given above of the Mathematics Learning Area appears to reflect the views of the National Council of Teachers of Mathematics (1989) who declared that students exposed to their new curriculum would gain “mathematical power” (p.5). For them, mathematical power

...denotes an individual’s abilities to explore, conjecture and reason logically, as well as the ability to use a variety of mathematical methods effectively to solve non-routine problems. This notion is based on the recognition of mathematics as more than a collection of concepts and skills to be mastered; it includes methods of investigating and reasoning, means of communication, and notions of context. (Ibid.)

The national Department of Education, through the Curriculum 2005 document and its revision, argues that it is attempting to bring South African education in line with what is happening in parts of the international education arena.

To conclude, the policy documents have been introduced here, albeit briefly, to illustrate the importance that they place on relevance, and particularly the recruitment of the ‘everyday’, and how these are linked to learner-centredness. The documents are not clear about what is meant by “learner-centredness”, but by suggesting the introduction of the learners’ own experiences and allowing them to contribute to the lesson content, the implication is that the framing relations⁵ in the classroom should be relaxed.

1.4 Motivation for the study

The motivation for this study derives from the widely held idea that learners, when coming to school, enter the classroom with a wealth of everyday knowledge – knowledge they have acquired through the process of socialisation into their

⁵ This will be discussed in chapter 4.

communities and which forms an important pedagogic resource. This informal knowledge, it is argued, is acquired by observation and first-hand experience, unlike the formal knowledge that is transmitted in the classroom. Curriculum 2005 similarly acknowledges this phenomenon and has prescribed its recognition in the educational arena, as has been indicated earlier (see p. 2).

The concern of this study is to determine to what extent (if at all), and how learners' everyday knowledge is brought into play in the mathematics classroom to facilitate learning. Bernstein (1975: 99) describes everyday knowledge as the "*commonsense* knowledge ... of the pupil, his family and his peer group" (original emphasis). For the purpose of this study, the 'everyday' refers to episodes or narratives that are situated in the experiential world of the child, be these real or imaginary, which can be used as resources for teaching school mathematics.

1.5 The research question

The present thesis focuses on the uncovering of teaching strategies with particular reference to the introduction of the 'everyday' in the context of mathematics lessons in fourteen different Grade 7 classrooms. The study will examine if and how the 'everyday' is employed to introduce the learners into abstract mathematics while using examples from the learners' own world of experience. The teacher's teaching style, the way the subject content is expressed, the extent to which the learners are allowed to determine the selection, sequence and pace of mathematics content, and the way in which the teacher employs 'everyday' examples are of interest in how s/he may contribute to the success with which the learners are able to internalise the subject matter. The research question simply stated is:

"How, if at all, is the 'everyday' employed in the teaching of Grade 7 Mathematics in fourteen ex-DET classrooms in the Western Cape?"

This research is based on data derived from a project initiated by a research team at the University of Cape Town to explore the impact of an OBE-based textbook on teaching and learning in ex-DET schools in the Western Cape (Ensor et al, 2002).

1.6 Structure of the thesis

Chapter 1 presents the scenario in which this research is located. The chapter starts with a discussion of the need to link the learners' everyday experiences with the learning process. The focus then shifts to a description of Curriculum 2005 and the Mathematics Learning Area. The chapter includes the motivation for the present study, and the research question is formalised.

Chapter 2 presents the review of the literature. The chapter is sub-divided into sections that seek to address some of the issues arising from the employment of the 'everyday'.

Chapter 3 is concerned with the theoretical framework used in the study. Here the work of Basil Bernstein (1975) is discussed, particularly his notions of 'classification' and 'framing'. The focus then shifts to a brief discussion of Paul Dowling's (1998) model of apprenticeship and domains of school mathematics practice.

Chapter 4 discusses the research design and the development of an analytical framework. A description of the sample is given as well as a description of the analytical tools used in the study. The chapter also contains a discussion of some of the difficulties that were encountered when the analytical tools were applied. The chapter is concluded with a discussion on research ethics and the reliability, validity and generalisability of results.

Chapter 5 comprises the presentation of findings. In the chapter, two lessons are discussed in detail using Bernstein's notion of framing before moving on to a more brief description of framing relations in each of the other twelve lessons observed.

Chapter 6 is a presentation of the discussion and conclusion. The limitations of the research are presented as well as the questions raised by the research findings. The chapter is concluded with recommendations for further research.

CHAPTER 2. LITERATURE REVIEW

This thesis is concerned with the question: How, if at all, is the 'everyday' employed in fourteen ex-DET classrooms in the Western Cape? In presenting the review of the literature, I have divided the chapter into sections that focus on the different aspects of the recruitment of the 'everyday' in mathematics classrooms. The chapter starts with the argument for the use of the 'everyday' in the mathematics classroom. The focus then turns to a discussion of some studies of classrooms where the 'everyday' and/or a learner-centred pedagogy have been employed. The third section highlights what is expected of teachers when employing the 'everyday' in the mathematics classroom. The last section consists of discussions on the problems of implementation of a learner-centred pedagogy and/or the 'everyday' in the mathematics classroom and raises a number of issues gleaned from the literature.

2.1 Why use the 'everyday' in the mathematics classroom?

In this section I shall present some of the literature that present the argument for introducing the 'everyday' into the mathematics classroom. I refer to the work of researchers as diverse as Carraher (1985), Gay and Cole (1988), Swart (1990), Shan and Bailey (1994), D'Ambrosio (1981) and Cockroft (1994). Diverse as they appear to be, all reveal a common thread. This is the idea that learners are more comfortable learning when new knowledge is linked to their own world of experience. I introduce this section with a report from a local weekly newspaper that highlights the need for an improvement in mathematics education.

2.1.1 The mathematics education paradox

On December 10, 2000, *The Sunday Times* (p. 1) ran an article titled "Asmal wants R2bn for maths". The article states:

An international study released this week highlighted South Africa's problems in mathematics and science. The Third International Mathematics and Science Study Repeat revealed that SA pupils were outperformed by the pupils of 37 countries. In a 1995 study involving 41 countries, SA pupils were at the bottom of the list as well. [...] The latest study, involving 194 schools and 8 147 Grade 8 pupils, was conducted by the Human Sciences Research Council in 1998/99.

SA pupils were compared to pupils in countries such as Tunisia, Chile, England and the US. Less than 0.5% of SA pupils were among the top 10% of pupils internationally.

Swart (1990: 160) stated at a congress on mathematics education:

One reason pupils do badly in Mathematics is that they don't like it. One reason for that is that they don't believe in it. It appears to many as being something like a bag of "magic" tricks: some are hard to perform, some easy, on some days one is lucky and things work out, while on other days you do the same things and the audience throws things at you. Furthermore, it can be quite entertaining but is essentially pointless except to the few magicians who make their living from it, and one is quite grateful that one is not a member of that strange fraternity.

The quote by Swart was taken from the Proceedings of the 10th National Congress on Mathematical Education hosted by The Mathematical Association of Southern Africa held in Durban as long ago as July 1990.

From a different perspective, D'Ambrosio (1981: 14) claims that school children in elementary classes often exhibit sophisticated mathematical skills. He cites an example of a conversation between a group of six-year-old boys exchanging pictures of soccer stars in a Brazilian classroom while the teacher was struggling to explain how to add a simple sum like $3 + 5$. While the teacher resorted to drawing ducks on the board, the one boy is reported to have said to the other boy something like, "Yesterday I gave you ten pictures, now you gave me 7, so you still owe me 3."

In another experiment, also conducted by D'Ambrosio, 7-year-olds 'of lower middle class families' were observed while being introduced to 'hand calculators'. Here again, not only were the children able to handle the calculators without the need for instruction, they also exhibited arithmetic knowledge far beyond what was being taught at the school. However, he noted with surprise that '... the children showed abilities in performing operations which, when presented in the formal class, led to failures in examinations' (Ibid.).

We can see by D'Ambrosio's research that some learners coming to school for the first time already have a fairly sophisticated level of mathematical competence. They may not be able to explain what they are doing, but they seem to know instinctively what is to be done. Just as they seem to be able to develop their own grammatical rules as they learn their native tongue, so too they appear to develop their own mathematical rules.

Carraher et al (1985) conducted a study that looked at the way five street vendors, ranging in age from 9 to 15 and having schooling experience that ranged between 1 and 8 years, dealt with mathematical problems either in the real situation (i. e. while selling their wares in the street) or when the problems were presented in a contextualised or decontextualised way. They found that the participants performed better in the real situation as well as with the contextualised problems. They were not as successful when the problems were decontextualised. Also, when the participants were given a formal test, where the problems were similar to the ones they had to deal with in the real situation, they attempted to use school mathematics to solve the problems. This resulted in a confusion of usage of algorithms and computations.

In the National Research Council's report entitled *Everybody Counts* (1989: 43-44), it is stated that

Virtually all young children like mathematics. They do mathematics naturally, discovering patterns and making conjectures based on observation. Natural curiosity is a powerful teacher, especially for mathematics.

Unfortunately, as children become socialised by school and society, they begin to view mathematics as a rigid system of externally dictated rules governed by standards of accuracy, speed and memory. Their view of mathematics shifts gradually from enthusiasm to apprehension, from confidence to fear.

What I wish to illustrate by citing the above examples is that although children appear to have a common, working knowledge of mathematics before, or at the same time as, they are exposed to formal education, it appears that they are unable to put this knowledge to use in the classroom. Alternatively, as Masingila (1993) also says, the teachers lead them to believe that their knowledge is of no value in the classroom.

Shan and Bailey (1994: 2) comment:

It is distressing that so many students all over the world achieve low levels in mathematics examinations. This sad fact has inspired mathematics educators to examine the cultural context of mathematics in the hope of improving the quality of mathematical education by embedding it in the reality of the students' lives. Their analysis has shown that mathematics takes its values from, and gives value to, a particular culture, and that western mathematics is a product of much that went before.

2.1.2 The cultural – academic divide

Gerdes (1988: 141 – 160) illustrates how ethnomathematics can be used in the teaching of academic mathematics. In his study in Mozambique, he and his research team looked at the geometric forms and shapes of cultural objects such as baskets, pots and fish traps. When they asked student teachers about the mathematics used in everyday life, the latter scoffed at first but when prodded they realised that there was a wealth of mathematics to be uncovered in their community. He concludes that part of the struggle against racial and (neo)colonial prejudice is a reaffirmation of 'cultural-mathematical' concepts. This statement supports the comment made by Shan and Bailey (1994) in that it suggests that the Mozambican student teachers did not recognise that there existed a mathematics within their own culture, thus lending credence to Shan and Bailey's (1994) comment regarding mathematics and culture. Gay and Cole's (1988) study also found that it was cultural differences rather than a lack of mathematical ability that contributed to the Kpelle's incorrect responses to mathematical problems presented in the classroom.

Gay and Cole (1988) conducted a study among the Kpelle people of Liberia⁶ and found that there were no inherent learning difficulties associated with their inability to provide correct responses to the mathematical problems posed in the classroom. The reasons for the difficulties the Kpelle experienced stemmed from their inability to make sense, from their cultural perspective, of what was taking place in the classroom. Experiments conducted by Gay and Cole showed that illiterate Kpelle adults performed better than North American adults did when asked to estimate the

⁶ Cited in Gerdes, P. (1988: 137 – 138)

number of cups of rice in a container, or similar mathematics problems to which they could relate. The researchers were convinced that it was necessary to investigate the nature of the indigenous mathematics so as to develop a bridging course to prepare the learners for the mathematics they were to learn at school. D'Ambrosio concurs and adds that this could be achieved by incorporating ethnomathematics in the curriculum (p. 139).

One can see from the comments made by the researchers and studies cited that there exists an argument for a mathematics based on, and derived from, the real or everyday world of the learners rather than teaching 'isolated formal statements' which could possibly be applied in the learners' experience at a later date. Cockcroft acknowledges that the mathematics can become esoteric as it becomes more advanced, but this should be derived naturally from problems based in the real world.

Cockcroft (1994: 50) states:

[F]or most if not all of our students, highly theoretical, axiomatic mathematical systems must be allowed to arise naturally from the study of separate, specific examples and problems, and be seen as a means of increasing the power of the mathematics involved, rather than, in the first place, as isolated formal statements of sets of mathematical premises, with possible applications to follow. ... (A)t all levels mathematics is about problem solving, so that abstract axiomatic systems only become worthy of study in their own right when we recognise the significance of the problem-solving mathematics from which they arise. Of course, at the highest levels the problems and the mathematics needed to solve them can be extremely esoteric and apparently remote from the real world. But the mathematicians involved are still solving problems, not playing a game of 'Let's invent some axioms today, and use them tomorrow'. (original emphasis)

2.1.3 Mathematics within social contexts

In the introduction to her book *Schools, Mathematics and Work*, Mary Harris (1991: 2) asserts that 'it is the duty of schools to provide an education in mathematics broad enough and deep enough for all, whatever their aspirations.' She relates that as early as

the 16th century, Henry VIII's daughter's tutor spoke out against a mathematics that was too academic as it alienates one 'from the common weal' (Ibid.).

Muller and Taylor (1995: 267) discuss the constructivists' argument that claims that a school mathematics that is primarily academic 'is a tool of modernity' and as such, privileges a particular group resulting in the exclusion of 'the working class, black people and women'. In other words, a school mathematics that is primarily academic excludes the majority of people in our country. One part of the solution that the constructivists present is to suggest a programme that would incorporate examples derived from 'the life-world of learners' into school mathematics (Ibid.). They argue that everyday examples of mathematics could serve as a bridge for children to access esoteric mathematics (p. 268).

Commenting on the work of Paul Dowling, Ensor (1997: 40) asserts that in order to allow learners access to the esoteric domain of mathematics, a public domain needs to be constructed where both the content and mode of expression of the mathematics are weakly classified. This, Ensor argues, is realised in school textbooks in the form of 'relevant word problems'. Ensor's comment is echoed by Taylor and Vinjevoid (1999: 113) where they argue that the 'relationship between everyday and school knowledge *provides important pedagogical tools for inducting learners into the art of formal discourse*'. (My emphasis)

Hilary Shuard (1984: 23-24) quotes the following statement contained in a report entitled "Mathematics Education at Pre-school and Primary Level", which was presented at the third International Congress on Mathematical Education in 1976:

Based on the fundamental idea that there is no difference between the nature of a child's thinking and that of a mathematician, a tendency is slowly, but surely establishing itself – this tendency is to replace the learning of mechanisms and their applications to standard problems by activities in which the child demonstrates research and inventiveness ... appealing to children's wanting to understand, letting them develop their own research strategy and thus, experience the pleasure of solving a problem, mobilising their knowledge and previous competencies and inviting them to propose new questions.

The proponents of problem-centred mathematics argue that children more easily solve mathematical problems when the problems are contextualised. These contexts need *necessarily* to be those with which the learners can easily identify. As Cockcroft (1994:50) puts it, '... the teaching must continue to ensure that problems are always presented in contexts which are seen by the students to have relevance, whether in the world outside the classroom, or inside, in mathematics or in other disciplines.' And this comment was made with reference to college students!

Maier (1991) believes that the first goal of mathematics education should be to improve children's 'inherent affinities and abilities' to do folk mathematics. He describes folk mathematics as the mathematics 'that folks do' and 'the repository of much useful and ingenious popular wisdom'. But, at the same time, this 'useful wisdom' is 'largely ignored by the purveyors of academic culture' (p. 63). He claims that folk mathematics and school mathematics cover the same topics but, in everyday life, we use different methods and have different reasons for doing mathematics. In school, most of the mathematics is in the form of written exercises, while outside of school most of the mathematics we do involves mental calculations and estimations (pp. 62 – 63). He refers to the ordinary person as a 'folk mathematician' (p. 65), a term that would sound flattering to a lot of people who have a fear of, and believe that they cannot do mathematics – some of these people being trainee teachers (Breen, 2000).

Maier claims that we have overlooked the reasons for and methods of doing mathematics outside school. He believes that teachers should encourage learners to devise their own solutions to the questions that arise not only in the classrooms, but also in informal settings such as the playground and their homes. They should also be encouraged to discuss what they have discovered while attempting to solve a problem. He is at pains to stress the importance of calling on the learners' prior knowledge to assist in devising solutions. Maier closes his article by admitting that the constraints inherent in schooling 'will prevent school maths and folk maths from ever being the same'. However, he believes that the difference between the two (folk mathematics and school mathematics) does not have to be a 'chasm' (p. 66). Here, again, we see the recognition that there exists a gap between the mathematics that the learners have acquired in their social settings and that which they are taught at school.

For too long teachers have concerned themselves with getting learners to master methods of solving problems rather than with the comprehension of concepts. If, as D'Ambrosio (1981), Carraher (1985), the National Research Council (1989) studies, Shuard (1984), Cockcroft (1994) and Maier (1991) would have us believe, learners 'do mathematics naturally', then teachers need to avoid at all costs engaging learners in activities which would stifle their natural abilities. They should rather present learners with everyday problems designed to bring out the concepts that they want the learners to acquire.

Masingila (1993: 20) argues that, 'All students bring to school mathematical knowledge from everyday situations they have experienced' but that this knowledge is 'often hidden and unused by the students in school'. She ascribes this to the fact that the teacher prescribes and assesses the mathematical procedures that these students are expected to learn to use. The irony is that just as the teachers in school ignore the everyday mathematical activity of the learners, so too, is the mathematical practice in schools 'devalued by the students because of their lack of use of it in out of school situations'.

Boaler (1998: 42) refers to Schoenfeld whom she claims 'argued that teaching methods that focus on standard textbook questions encourage the development of procedural knowledge that is of limited use in non-school situations'. Boaler also claims that a number of mathematics teachers have suggested that this is the case because the students do not fully understand the methods they were taught at school. This lack of understanding they ascribe to the way in which the subject is taught. Boaler believes that it is arguments such as those that 'have contributed to the growing support for open, or process-based, forms of mathematics' (Ibid.). Advocates of this approach to mathematics education believe that if students are presented with 'open-ended, practical and investigative work' where they are allowed to apply their mathematical knowledge in their own way, they would benefit in a number of ways. These benefits include enjoyment and understanding, and even leads to enhanced transfer.

Gravemeijer and Doorman (1999: 111) use the term 'context problems', which they define as 'problems of which the problem situation is experientially real to the student.' These 'context problems' are expected to be presented in such a way that the students would be given opportunities for 'progressive mathematising'.

Núñez et al (1999: 61 – 62) argue that,

Rather than looking for better ways to help students learn 'rigorous' definitions of pre-given mathematical ideas, we need to examine the kinds of understanding and sense-making we want students to develop. We should look at the everyday experiences that provide the initial grounding for the abstractions that constitute mathematics. [...] In either case, what is important is to re-examine mathematical ideas in order to create instruction that complements the ways our conceptual systems naturally work.

Carpenter et al (1998: 16) appear to support Núñez et al's argument. According to them, evidence gleaned from their study suggests that 'invented strategies are closely connected to other concepts that might be taken as representing basic understanding ...'. Invented strategies also demonstrate understanding. Children who use invented strategies are able to transfer and use those strategies flexibly in new situations. This was demonstrated by the fact that the students in the invented-strategy groups of their study were more successful in solving the extension problems that were presented to them than were the students who worked in the algorithm group. The results obtained are, according to the researchers, 'consistent with the theoretical perspective that supports the development of understanding before mastery of procedures' (Ibid.).

Núñez et al (1999: 61) also argue that

one important source of pedagogical problems in mathematics education is the philosophical foundations that have dominated our view of mathematics (objectivism, platonism, formalism). These philosophical commitments are necessarily (if unintentionally) transmitted in the teaching process, which can lead to the teaching of definitions and supposed eternal truths that capture mathematical essences, rather than mind-based, embodied, human forms of sense-making. The fundamental conceptual error underlying this kind of teaching is the idea that

intuition can be replaced by rigor in order to eliminate vagueness. Not only is this not possible but it is not necessary for effective learning.

What is necessary, and probably more valuable, according to Bishop (1991: 38) is to incorporate mathematical ideas from the learners' own home culture into the learning experience of the child even if it only serves to provide access to mathematical constructs. This idea of using mathematical ideas from the learners' own home culture for providing the learner access to mathematical constructs echoes the idea of the use of 'public domain' activities as a portal to the 'esoteric domain' (Ensor, 1997).

2.1.4 Summary

In this section I set out to provide an argument for the use of the 'everyday' in the mathematics classroom. I have cited studies conducted by D'Ambrosio (1981), Carraher (1985), Gerdes (1988) and Gay and Cole (1988) which make the point that learning is enhanced when new knowledge is linked to the learners' own world of experience. These studies are supported by the works of the National Research Council (1989), Shan and Bailey (1994), Cockcroft (1994), Harris (1991), Maier (1991), Ensor (1997), Muller and Taylor (1993), Masingila (1993) and Núñez et al (1999). These studies advocate the incorporation of mathematical ideas from the learners' home environment as a means of accessing esoteric mathematics. The evidence points to the need for learners to actively engage with mathematical problems within settings to which they can relate rather than learn algorithms that do not make sense to them and hence cannot be transferred and applied to situations outside the classroom. Since Atweh et al (1998: 63) rightfully describe the classroom as 'a social context in which mathematical knowledge is negotiated and constructed', this is where the conditions should be created to facilitate the negotiation and construction of mathematical knowledge – a mathematical knowledge that should be transferable from the classroom to everyday settings.

2.2 Studies of teachers' use of the 'everyday' in mathematics classrooms

In this section of the review I shall describe studies on teachers using the 'everyday' in mathematics classrooms.

2.2.1 Procedural knowledge vs. conceptual understanding

Boaler (1998) was interested in determining whether different pedagogies in mathematics classrooms would lead to the development of different forms of mathematical knowledge. She conducted a 3-year ethnographic study of two British schools where the mathematical pedagogy was different. One school, Amber Hill, privileged a traditional, textbook-based approach while the other school, Phoenix Park, prioritised open-ended activities.

Boaler found that where there was a privileging of the traditional method of teaching, the learners found the lessons monotonous. Many of them believed that mathematics was about following rules, memorising formulae and equations. They based their mathematical thinking on what they thought was expected of them rather than the mathematics required by the task at hand. On one occasion, where a set of questions was slightly different to those the learners had done up till then, they gave up because it was contextualised while those of the exercise before required abstract calculations. This, despite the fact that the researcher considered the earlier, abstract questions more difficult than the contextualised ones. The learners were confused because they expected the questions to be more demanding (p. 48). Teachers who were quizzed about this explained that they thought the learners reacted that way because of the 'closed nature of their primary school experiences' (p. 49).

At Phoenix Park, where open-ended activities were used, the students found it more exciting and challenging. They were 'encouraged to take responsibility for their own actions and to be independent thinkers' (Ibid.). When faced with a mathematics problem, students were encouraged to develop their own ideas and to formulate solutions. If one or more students needed to use some mathematics that they did not know, the teacher would lend assistance (Ibid.). The students were free to choose the sequencing of tasks as well as the pace at which they worked. They were even allowed to move out of the class to work in another room (p. 50).

When the students from the two schools sat the GCSE examinations, the Phoenix Park students fared better than those from Amber Hill. Interestingly, there was no

appreciable difference between the scores of the two groups in the “traditional” examination questions.

The students from Amber Hill found the contextualised questions more difficult because they were expected to not only apply rules and formulae but also understand the questions and apply appropriate strategies to obtain answers. In fact, they were quite vocal about their inability to apply school-learned methods in real situations because they could not see the connection between what they had done in the classroom and the demands of the real world. On the other hand, the Phoenix Park students were used to applying their knowledge to unfamiliar situations. They believed that mathematics involved ‘active and flexible thought’. As such, they had developed the ability to adapt and change methods to fit new situations.

Boaler’s findings were that the students who were schooled in the traditional approach (i.e. the Amber Hill students) ‘developed an inert procedural knowledge that was of limited use to them’ in unfamiliar situations (p. 59). The Phoenix Park students did not know more mathematics than those at Amber Hill; rather, they had ‘developed a conceptual understanding that allowed them to transfer their learning’ to unfamiliar situations. Boaler ascribes the Phoenix Park students’ ability to use mathematics to three characteristics. Firstly, there was a ‘willingness and ability to perceive and interpret different situations and develop meaning’. Secondly, they had developed a sufficient understanding of mathematical procedures that allowed them to select the appropriate ones for a given situation. Finally, they possessed the mathematical confidence that ‘enabled them to adapt and change procedures to fit new situations’ (p. 60).

It is interesting to note that all the students at Phoenix Park had used the same textbooks as those used by the Amber Hill students until the end of year-8. It was only at the start of year-9 that the Phoenix Park students had moved over to project-based work (p. 49). It would then appear that the Amber Hill teachers’ claim that their students’ performances can be ascribed to the ‘closed experiences at primary school’ is not a convincing argument.

Boaler concludes, 'There were many indications from this study that the traditional back-to-basics mathematics approach [...] was ineffective in preparing students for the demands of the real world and was no more effective than a process-based approach for preparing students for traditional assessments of content knowledge' (p. 60).

The conclusion that Boaler reached lends support to the views of those who argue for a shift away from the rigor and drilling of algorithms so prevalent in a chalk-and-talk pedagogy in favour of the more progressive pedagogy where learners are given the responsibility of devising their own solution strategies. The idea that this kind of pedagogy allows for easier transferability of learning is also, to an extent, supported by this study. Furthermore, given that the Amber Hill students were so vocal about their inability to see the connection between what they were doing in class and what was required in the real world, the argument for introducing the 'everyday' into the classroom is strengthened by this study.

2.2.2 Apprenticing

In a study conducted by Masingila (1993), she describes how learners were unable to determine the area of a room in square yards when the dimensions were given in feet. When she explained what was required, they responded by reciting the standard formula for determining area. She argues that the learners' concept of area is 'narrow and strongly tied' (p. 20) to an algorithm or formula. She believes that this is so because they have not had a real life experience of this at school so they are unable to apply it in concrete situations. She asserts that the goal of teaching mathematics by means of problem solving and using everyday examples is to construct mathematical concepts from mathematical experiences. She argues that using a problem solving approach 'means that the mathematical information arises out of the [...] activity, along with an understanding of the mathematical concepts and processes involved' (p. 20).

Masingila continues her argument claiming that problem solving is 'consistent' with the way in which floor-coverers learn their skills. She sees the relationship between the master and apprentice as similar to that between teacher and learner although the

dynamics are different. With floor-coverers a one-on-one relationship exists between the master and the apprentice whereas in the case of the teacher, s/he would have 30 or more learners to teach. Also, in the master-apprentice model of the work place, the apprentices are developing context-specific skills whereas in the mathematics classroom, the aim is to allow learners to develop mathematical processes and concepts that may be applied in a number of different (out-of-school) contexts (p.21).

The dynamics in the two situations are also different in that the apprentice in the carpet-laying exercise learns by observing, questioning and participating in the activity. During this process, the master maintains control of the situation and allows the apprentice the opportunity to develop a feel for the work while at the same time monitoring his/her progress. In the classroom, besides the fact that there is not a one-on-one interaction between the teacher and the learners, there is also the co-operative factor between the learners. So, in the classroom, the learners also assist and question each other and in this way acquire access to mathematics (p. 21).

Masingila's reasons for using an apprenticeship model in the classroom are threefold. Firstly, the model allows the development of mathematical knowledge within a context rather than abstractly. This creates a situation with which the students can more easily identify. Secondly, cognitive development occurs as the students work in co-operation with the teacher and lastly, a mathematics culture and community is developed in the classroom into which the students are initiated (p. 21).

Masingila's findings seem similar to the findings in the Boaler (1998) study. The learners in Masingila's study appear to operate like the learners at Amber Hill. The learners were unable to solve a problem simply because they had not been exposed to one like it before. Their concept was tied to a formula and so they could not relate to the problem. Just like the Amber Hill learners, they were unable to solve the problem because they could not get the formula to "fit".

2.2.3 Different teacher abilities and their pedagogies

Manouchehri and Goodman (2000) found that the two teachers in their study reacted differently in their classrooms because of their different strengths. These researchers

conducted an investigation into how two grade 7 teachers implemented and evaluated a Standards-based mathematics textbook. The data suggested that the teachers' mathematical knowledge played the biggest role in how they responded to the textbook. Their mathematical knowledge was manifested in how they planned their lessons, interacted with their learners and how they used the textbooks in their classes (p. 1). One teacher, Gina, adopted a problem-based approach in her lessons. It appeared that she had a rich content knowledge base as well as numerous ways in which she could communicate ideas to the learners. 'Gina was also confident about her ability as a problem solver and a mathematician' (p. 14). As such, she was not uncomfortable with leading conceptual discussions around topics that the students raised in class. 'During these discussions she encouraged students to question the validity of the algorithms that were proposed in the textbook' (Ibid.). Gina would modify her lesson to match the mathematical ideas that the children raised during these discussions or her observations of their class work. She easily deviated from the textbook to discuss points that emerged from the students' discussions and solution methods. 'In this way, she addressed critical mathematical points in contexts that were meaningful to students because they were based on the students' thoughts and ideas' (p. 23). 'She guided her students' work through the use of real life applications and examples' (p. 24).

On the other hand, Bonnie, the other teacher in the study, also adopted a student-centred approach but concentrated on developing the students' self-confidence. She devoted a 'significant amount of time' to individual students who found it difficult using certain materials or solving problems. However, Bonnie's patience in working with individual students was not evident when she was discussing mathematics. She avoided teaching activities with which she did not feel comfortable mathematically, or those 'she failed to view as mathematically significant' (p. 16)..

Although both teachers in the Manouchehri and Goodman (2000) study adopted a problem-based approach in their classrooms, the dynamics were different in their classrooms because of their different teaching strengths. Gina was confident of her mathematical abilities and could, therefore, encourage her learners to be critical about what they were doing. Since the contexts that were sketched in her lessons were meaningful to her learners, they could more easily be guided along. Bonnie was as

helpful towards her learners, but, since she was not as confident about her mathematical abilities, she would not expose her learners to certain activities. This would obviously be detrimental to the development of her learners.

Manouchehri and Goodman's (2000) study reveals serious implications regarding classroom practice. The study suggests that the strengths and weaknesses of the teachers will impact on the kind of activities that the teachers will expose to their learners. This implies that the more confident the teachers are about their mathematics abilities, the more challenging the activities will become, thus steering the learners further along towards the 'esoteric domain' of mathematics. This notion that more challenging activities lead learners closer to the esoteric is supported by the work of Paul Dowling (1998).

2.2.4 Summary

In this section, I have looked at the research done by Boaler (1998), Masingila (1993), and Manouchehri and Goodman (2000). Boaler's (1998) study found that when learners were presented with unfamiliar problems, learners who had been presented with open-ended problems in the classroom, were better equipped to solve the problems than learners who had been taught in the traditional way. It is important to note that the Phoenix Park learners were encouraged to formulate their own solutions, work at their own pace as well as determine the sequencing of the tasks to be completed.

Masingila's study (1993) revealed that, just like the Amber Hill learners in Boaler's study, the learners were unable to solve a problem if they could not 'fit' a formula to it. Manouchehri and Goodman (2000) found that, although both teachers in their study adopted a problem-centred approach, the classroom dynamics were different because of the teachers' different teaching strengths. This led to one group of learners being exposed to more challenging problems than the other. In other words, the one group of learners would be brought closer to the esoteric than the other group.

The above studies lend support to the idea that learners would perform better when presented with mathematical problems presented within 'everyday' contexts. Their

performances could be further enhanced if they are allowed a say in the sequencing, pacing and devising solutions of tasks. However, the teachers' mathematical expertise also plays a significant role in the kind of mathematics to which the learners are exposed.

2.3 What does using the 'everyday' require of teachers?

This section of the literature review will present comments taken from the literature that focus on what is required of teachers when they incorporate the 'everyday' in the mathematics classroom.

Wubbels et al (1997) acknowledge that a consequence of the introduction of the 'everyday' in mathematics education is that teachers had to be prepared for a curriculum distinctly different from the one that they experienced when they were pupils (p. 3).

Manouchehri and Goodman (2000) concur that the new vision of teaching is more demanding than the traditional method where the knowledge is disseminated in piece-meal fashion. They admit that this curriculum demands that teachers have a detailed mathematical knowledge that 'allows for sound reasoning and mathematical problem solving'. They believe that this mathematical knowledge base 'directly impacts' on the teachers' ability to 'advance students' mathematical thinking' (p.29).

Taylor & Vinjevoll (1999: 116) assert that

(w)hile competence pedagogies of whatever kind require that teachers play a more covert role than they would in teacher-centred performance models, they nevertheless make far greater demands on the teacher. Progressive modes require that teachers recognise the difficult and subtle relations between everyday and formal knowledges, and that they coax their charges through these tricky waters. Thus, for Gardner (1991), one of the main obstacles to the successful implementation of progressive education since the time of Dewey, has been the extreme demands it places on teachers.

Núñez et al (1999) feel that instead of looking for better ways to get learners to learn 'rigorous' definitions, we need to determine the kinds of understanding we want them to develop and look at the everyday experiences that 'provide the initial grounding for

the abstractions that constitute mathematics' (p. 61 – 62). We need to 'create instruction that complements the ways our conceptual systems naturally work' (p. 62.). 'Students (and teachers) should know that mathematical theorems, proofs and objects are about ideas, and that these ideas are situated and meaningful because they are grounded in our bodily experience as social animals' (p. 62).

Wubbels et al (1997) believe that from the realistic (and constructivist) view of learning it is necessary that teachers are able to build on the knowledge and way of learning of their learners. Because of this, it is necessary that the teacher is able to listen to the learners in order to understand how they think and to be able to get feedback from them (p. 23).

Masingila (1993: 20) seems to echo these sentiments when she suggests that teachers should 'engage their students in conversation, listen to them and encourage and observe their informal methods of solving problems' (p. 20). In this way the teachers can learn a lot about the students' out-of-school experiences. She argues that by building on the mathematics knowledge students have gained from their everyday experiences, teachers can encourage them to: "a) make connections between these two worlds in a manner that will help formalize the students informal mathematics knowledge, and b) learn mathematics in a more meaningful, relevant way" (p. 20).

Manouchehri and Goodman (2000) complement Masingila's suggestions by suggesting that the teacher should create an environment where mathematical discourse takes place. 'She guides the students' thinking and helps them exchange mathematical ideas in class. The teacher also helps students synthesize their findings and connect those findings to a coherent mathematical structure as she devises strategies to help move the students' thinking from an intuitive to a more rigorous level' (p.1).

Masingila (1993) suggests three ideas for teaching school mathematics, which she derived from her research with mathematics in the carpet-laying exercise. These are:
a) that teachers should build on the mathematics knowledge that the learners bring into the classroom,

- b) teachers should introduce mathematical concepts via problem solving activities, and
 - c) teachers should develop master-apprenticeship relationships with their students to assist them with mathematics and help initiate them into the mathematics community.
- (pp. 19 – 20)

As has already been mentioned, Masingila's reasons for using an apprenticeship model in the classroom are firstly, that the model enables mathematics knowledge to be developed in a context rather than the abstract with which the students find difficulty dealing. Secondly, cognitive development occurs as the students work in co-operation with the teacher and lastly, a mathematics culture and community is developed in the classroom into which the students are initiated. (p.21)

In another article, Masingila (1997) suggests that mathematics activities should be planned in such a way that they can help the students make mathematical connections between doing mathematics in school and out of school. By adapting textbook exercises to reflect the way mathematical problems are encountered in everyday life, problem-solving situations can be created that encourage students to use their intuition and mathematical knowledge which was gained in out-of-school experiences.

2.3.1 Summary

In this section of the literature review I presented comments taken from the literature that focus on what is required of the teachers when they incorporate the 'everyday' in the mathematics classroom. The first, and probably most important, requirement for teachers is suggested by the Wubbels et al (1997) study. This is that teachers need to adapt to a curriculum that is distinctly different to the one that they experienced as pupils. Coupled to this is the teachers' need for a detailed mathematical knowledge in order to recognise the subtle differences between everyday and formal knowledge. This mathematical knowledge will enable the teacher to identify everyday experiences that will provide the basis for developing the mathematical concepts to be learnt. The teacher should be sensitive to where the learners are coming from not only in terms of their social conditions, but also their particular worldview. As Masingila (1993) and Wubbels et al (1997) put it, the teachers should "listen" to their learners. The

implication for teachers is that they should (a) locate mathematical problems in the realm of their learners and/or allow learners to bring problems from their everyday lives into the learning environment (although this second option could present problems – see next section) and (b) develop social relations in the classroom which are conducive to problem solving.

2.4 Problems and cautions regarding implementation of the ‘everyday’ in the classroom

In the last part of the review of the literature, I attempt to highlight some of the problems that could arise from the use of the ‘everyday’ in the mathematics classroom as well as the cautions gleaned from the literature.

According to Wubbels et al (1997: 4), writing about realistic mathematics, student teachers’ conceptions about learning and teaching a subject are strongly influenced by their own schooling experiences⁷. They cite Stofflett and Stoddart (1994) who showed that student teachers who experienced learning in an active way, are, by their own admission, ‘more inclined to plan lessons in a way that facilitates active knowledge construction’. On the other hand, they may have experienced realistic mathematics as students but not sufficiently as ‘managers of learning and instruction’ (p. 20). As such, they may not completely understand the principles of realistic mathematics education to prepare them for their work as teachers. Also, they may not have been sufficiently exposed to tasks to design the type of activities necessary to facilitate the realistic mathematics model (p. 22).

Adler et al (2000: 5) seem to agree with Wubbels et al (1997). They admit that the difficulties the student teachers in their study experienced in developing an integrated mathematics programme could be ascribed to the way in which they had been taught mathematics. Despite the students having had a ‘wealth of resources’, a good grasp of the mathematical concepts they wanted to introduce, and being constantly aware that they needed to extract the mathematics from the themes within which they were working, they still ‘experienced enormous difficulties in producing conceptually

⁷ Cf Chapman, O (1997) ‘Metaphors in the teaching of mathematical problem solving (p. 201 of same vol.)’.

sound integrated materials' (p. 5). Although one could argue that Adler et al's study is different to that of Wubbels et al (1997) in that the former study was concerned with integration of material rather than only embedding the concepts in the 'everyday', the problems faced by the students are similar, if not the same. The students did not have the necessary background to effectively accomplish what was required of them.

Nyabanyaba (1999: 23) also believes that where teachers are to assist the learners in 'crossing the bridges between everyday contexts and school mathematics tasks', the teachers need to be trained for what he calls 'this sophisticated task'. He also feels that the teachers should be clear about the reasons for presenting certain exercises to their learners. In other words, teachers should be aware of the underlying concepts that can be learnt by exposing the learners to certain activities.

Linchevski & Williams (1999: 132) similarly assert that, from the constructivist perspective, learners are expected to bring to school knowledge constructed in outside school situations, and to use this knowledge 'intuitively in classroom tasks'. Contexts are purposefully designed to 'recall these outside-school situations'. But, the contexts that are selected can only be considered experientially real or 'authentic' if they are directly related to the learners' culture, are real and 'make sense' to the learner.

The authors admit that 'learning is structured by its social context and situation'. But, they are concerned that the cultural knowledge that learners bring from outside school could either assist or hinder them in their mathematics. Introducing 'realistic' experiences into the classroom can present problems because the situation in which the knowledge was acquired outside school would probably not exist in the classroom and the activity 'must be reconstituted in some way' (pp.144 – 145). The way in which the classroom activity is enacted could also affect this transformation (p. 146). Because of this, the authors are not convinced that the authenticity of the "outside school situation" survives the transfer into the classroom. They concede:

When we introduce 'realism' into the classroom we cannot recreate exactly the social situation in which the children experienced the 'reality' outside school. We might not evoke the essential intuitive knowledge of the reality, rather as one might sometimes miss the sense of touch and smell at the cinema. [...] In these outside-

school communities of practice learning is implicit, picked up along the way, 'stolen' from old hands on the job without much explicit instruction. (p. 132)

According to Muller and Taylor (1995: 268), the problem that Dowling has with incorporating the everyday into the curriculum is that by recontextualising the material, it is so distorted that "the result is neither 'real mathematics' nor recognisably 'real life'." Lave (1988), quoted by Ensor (1997), could be seen to support this view when Lave states, 'It is doubtful that attempts to imitate or integrate the mathematical relations of everyday life in classroom contexts, even in elaborate realistic word problems, bears any continuity with those experiences' (p. 38).

Evans (1999: 40) admits that there is no straightforward continuity between 'everyday' and school activities. He admits to there being a distinction between the two but is adamant that there is not a disjunction. He acknowledges that people appear to transfer feelings and ideas between contexts, but what they transfer is not always what the teacher expects.

Nyabanyaba (1999: 22) warns that teachers should be careful when setting tasks based on the everyday as some contexts could be more unfamiliar, and hence more confusing than 'traditional school mathematics contexts'. This comment is based on an exercise he did with some in-service teachers discussing the results drawn from a soccer league table. Another problem highlighted in the same exercise is that where the everyday is too real to the learners, they could bring their own knowledge into play in the exercise and then not base their arguments on the information given. This would come about where, for example, the teams on the table are known by the learners. They could unconsciously project their own biases of the teams onto the given information, resulting in inaccurate readings, comments and predictions. The author notes that if teachers are required to employ the everyday in the teaching environment, they need necessarily to be trained to do this effectively (p. 23).

On the other hand, Nyabanyaba also cautions that 'relevant contexts can obscure the school mathematics being promoted' within the context in which it is presented (Ibid.). This could be detrimental to the learners who might not recognise this and

look for the solution within the context. The author advises teachers to be aware of this and ensure that the learners do not fall into that trap.

Linchevski and Williams (1999) argue that learners, teachers and parents understand that classroom activities are designed for learning. Hence, much of the activities in mathematics classrooms require that the child learns new mathematics. The goals of learning are explicit and, as a consequence, not usually congruent with outside-school practices. Using 'realistic' contexts should only be regarded as successful insofar as it supports authentic classroom activity. The problem is that when learners call on their everyday knowledge to solve problems within the classroom context, we must expect shifts in meaning (p. 133). In other words, small differences between the simulated activity and the learners everyday knowledge of the context created might influence the 'quality of involvement and intuition that the activity evokes' (p. 146).

Atweh et al (1998) agree that the classroom can be seen as a social context where mathematical knowledge is negotiated and constructed. But, at the same time, they contend that the teachers and learners are constructed and positioned with regard to that knowledge. These authors argue that the 'classroom context is informed by and in turn reproduces the construction of mathematics in the wider socio-cultural context' (p. 63).

On the other hand, these authors also recognise that society uses school mathematics to stratify learners according to ability. In this way society controls access to higher learning and all its associated advantages (p. 80). They are concerned that the communication dialect that is constructed in the classroom contributes to the development of the image of the learner and consequently to stratification. In other words, if the teacher perceives the learners as not being able to operate at an abstract level and does not expose them to tasks that demand such thinking, they will not develop into abstract thinkers. This has serious implications for the teacher in the 'everyday' mathematics classroom. If s/he does not develop activities that are designed to progressively extend the learners, they will not develop mathematically. Thus, the classroom not only 'reproduces the construction of mathematics in the wider socio-cultural context' (p. 63), but also the socio-cultural context of the learners.

Atweh et al (1998) investigated the social context of two mathematics classrooms that differed with regard to the socio-economic backgrounds and gender of their students. The analysis focused on the effects that the two factors had on teacher perceptions of students' needs and abilities and on how those perceptions affected the discourse in the two classrooms. The authors argue that as the mathematical knowledge is being constructed in the classroom, the student participants are being constructed by the teachers according to their abilities and needs for different dialects of mathematics that have different values in society (p. 69).

In the Atweh et al (1998) study, the two teachers adopted different discourses because of their perceptions of, and expectations they had, of their students. Ivor, one teacher participant, who believed that his students were going on to university, introduced the mathematical ideas formally by presenting rigorous definitions of the terms used in his lessons (p. 70). When Jeff, the other teacher in the study, dealt with definitions, he used a less formal dialect of mathematics. He attempted to use everyday terms rather than the rigorous definitions preferred by Ivor. Although he mentioned the formal terms used in the book, he was not as concerned with developing their meanings than with developing their intuitive and algorithmic usage (p. 71). Jeff believed that the students in his class needed only to know how to use mathematics in situations such as shopping.

Atweh et al's (1998) study suggests that the perceptions that teachers have of their learners will determine the kind of mathematics they will be exposed to and hence determine the kind of work for which they could be prepared on completing their schooling. The teachers' perception of what the learners' aspirations are would also determine the kind of mathematics that the teachers will present to their learners.

Taylor and Vinjevold (1999: 115) identify two dangers that are worth noting that derive from the adoption of a progressive pedagogy, and hence from the employment of the 'everyday'. Firstly, employing real world examples, although they may be appropriate, can often obscure understanding of the concept to be taught. Secondly, the danger exists that it could be assumed that all school knowledge can be based on, or applied to the real world. They also warn,

In foregrounding the everyday at the expense of conceptual knowledge, and in expressing the latter in the most general terms at the expense of a deep study of key concepts, C2005 seems designed to promote superficiality at the expense of systematic and grounded conceptual development (p. 128).

2.4.1 Summary

From the literature cited above, it would appear that one of the problems that arises from the implementation of the 'everyday' is the need to move away from a teacher-centred pedagogy to one where the learner becomes an active contributor in the learning experience. The problem is that since the way teachers were taught strongly influences the way they teach, teachers need to unlearn their experiences and be trained in how to accomplish what Nyabanyaba calls this 'sophisticated task'. A problem related to this, especially in the light of the few workshops that teachers attended with the introduction of Curriculum 2005, is highlighted by Wubbels et al (1997). The teachers might have experienced it, but that does not mean that they know enough to develop material that would facilitate learning. Nyabanyaba (1999) warns that teachers should be clear about why they set certain tasks. The contexts that are created should relate to the learners' view of the world. But, on the other hand, the teacher should also be aware that some tasks could be too real and cause the learners to use their own, real-life knowledge of the context in solving the problem, rather than base their solution on the information given.

Another important problem that needs to be heeded is that the everyday knowledge that the learners are expected to call upon to arrive at solutions to the problems posed in the mathematics classroom could hinder just as easily as it could assist the learner in attempting to solve a problem. The reason for this is the possible shift of meaning that arises as the learner attempts to match the classroom activity with one in her/his bank of experience. A related problem is that of recontextualisation. It is argued that recontextualisation so distorts an activity that it no longer resembles reality. Similarly, the employment of the 'everyday' could be the cause of much confusion either because the context could be unfamiliar to the learners, or it could be so familiar that it could obscure the mathematics it is intended to spotlight.

The last, and probably most important concern, is that signalled by Taylor and Vinjevold (1999). They warn that C2005, by placing so much emphasis on the 'everyday' "seems designed to promote superficiality at the expense of systematic and grounded conceptual development" (p. 128).

2.5 Conclusion

In the first section of the literature review I set out to provide an argument for the use of the 'everyday' in the mathematics classroom. I cited studies conducted by D'Ambrosio (1981), Carraher (1985), Gerdes (1988) and Gay and Cole (1988). I then supported those studies with comments drawn from the works of the National Research Council (1989), Shan and Bailey (1994), Cockcroft (1994), Harris (1991), Maier (1991), Ensor (1997), Muller and Taylor (1993), Masingila (1993) and Núñez et al (1999). The evidence points to the need for learners to actively engage with mathematical problems within settings to which they can relate rather than learn algorithms that do not make sense to them and hence cannot be transferred and applied to situations outside the classroom.

The second section of the review focused on studies where teachers used the 'everyday' in mathematics classrooms. Here I looked at the research done by Boaler (1998), Masingila (1993), and Manouchehri and Goodman (2000). Their studies suggest that learners would be better able to develop mathematical concepts when problems are embedded in everyday contexts. An important observation from Boaler's (1998) study is that the learners who were exposed to open-ended activities were allowed to devise their own solution strategies. They were also allowed to work at their own pace and choose the sequence in which they wanted to complete their tasks. However, from Manouchehri and Goodman's (2000) study, we note that the teacher's mathematical expertise also plays a significant role in the kind of mathematics to which the learners are exposed.

The third section of the literature review looked at what is required of the teachers when they incorporate the 'everyday' in the mathematics classroom. These requirements are:

- a) Teachers need to adapt to a curriculum distinctly different to that which they themselves experienced as pupils.
- b) Teachers need a detailed mathematical knowledge in order to recognise the sometimes subtle, but nevertheless crucial, differences between everyday and formal knowledge. This mathematical knowledge will enable the teacher to identify everyday experiences that will provide the basis for developing the mathematical concepts to be learnt.
- c) The teacher should be sensitive to where the learners are coming from not only in terms of their social conditions, but also their particular worldview.
- d) The teacher should locate mathematical problems in the realm of their learners and/or allow learners to bring problems from their everyday lives into the learning environment, and
- e) the teacher should develop social relations in the classroom which are conducive to problem solving.

The last section of the literature review focused on problems that could arise with the implementation of the 'everyday' in the mathematics classroom. The first problem that was highlighted was that teachers could no longer teach as they had done in the past. They would have to allow the learners a more active role in the learning environment. Secondly, teachers would have to create situations that would facilitate learning. But, in order to do this effectively, they would have to have a sound knowledge of the mathematics to be taught in order to identify the situations that would facilitate the learning. If the teacher has the knowledge and skills to identify the situations, the danger still exists that the scenario could be too realistic and the learners could use their knowledge of the real situation to effect a solution. On the other hand, the 'everyday' knowledge that the learners are expected to call upon to arrive at solutions to the problems posed in the mathematics classroom could hinder just as easily as it could assist the learner in attempting to solve a problem. The reason for this is the possible shift of meaning that arises as the learners attempt to match the classroom activity with one in their bank of experience. However, the context that is created in the activity could be so familiar that it could hide the mathematics it is intended to bring to the fore.

Lastly, emphasising the 'everyday' in the classroom could result in the promotion of superficiality at the expense of the development of conceptual knowledge.

Having reviewed the literature, the discussion will now move to the theoretical framework on which this research is based. Here, the focus is on the works of Basil Bernstein (1975) and Paul Dowling (1998). Bernstein's notions of 'classification' and 'framing' and Dowling's model of apprenticeship and modes of mathematics practice are discussed.

University of Cape Town

CHAPTER 3. THEORETICAL FRAMEWORK

For the purpose of this analysis I have decided to focus on the theoretical work of Basil Bernstein (1975) and, to a lesser extent, that of Paul Dowling (1998). Bernstein has written extensively on the sociological aspects of teaching and learning and his notions of 'classification' and 'framing' lend themselves to the kind of investigation attempted in this study. His description of the types of curricula and the implications that go with the adoption thereof is of importance in the study.

Dowling's model of domains of mathematics practice is useful in that it could be seen as a refinement of Bernstein's notion of 'classification' and embellishes the discussion on the employment of the 'everyday' in the mathematics classroom.

3.1 Classification

Bernstein (1975) uses the notion of classification to refer to the strength of the boundaries between discourses, spaces and agents – boundary strength which makes these aspects more or less distinct from each other. In this study, I am interested in classification of discourses, or putting it differently, school curriculum content. In this context, 'classification' refers to the extent to which various curriculum contents are isolated from each other. If the boundaries between the contents are strongly defined – in other words, the contents are well isolated from each other – then one can refer to 'strong' classification. Where there is a blurring of the boundaries – in other words, the contents are not well isolated – classification is described as being 'weak'.

Another aspect important to classification of school curriculum content, and especially so in the light of the focus of this study, is the distinction between school knowledge and everyday knowledge. Here again, where there is a clear distinction between school knowledge and everyday knowledge, we have strong classification. Where the distinction between school knowledge and everyday knowledge is blurred, we have weak classification. Bernstein (1975) describes school or educational knowledge as "knowledge freed from the particular, the local, through the various languages of the sciences..." (p. 99). He describes everyday knowledge as the "*commonsense* knowledge ... of the pupil, his family and his peer group" (Ibid.).

3.2 Framing

By 'framing' Bernstein refers to the 'pedagogical relationship' between the teacher and the individual(s) being taught. "*Thus frame refers to the degree of control teacher and pupil possess over the selection, organisation, pacing and timing of the knowledge transmitted and received in the pedagogical relationship.*" (p.89) To paraphrase, framing refers to the degree of control that the teacher and learners have over the choice of topics to be covered, how the content will be organised, when and the rate at which the knowledge will be relayed.

By 'selection' is meant the topics that are to be included in what may or may not be taught. Where framing over selection is strong, the learners have no say over the selection of topics to be learnt. Where the framing over selection is weak, the learners would be able to choose the topics to be learnt. 'Organisation' refers to the way in which the 'selection' is put together, in other words, to sequencing. Here again, strong framing would not allow the learners any say in the sequencing of the topics to be learnt, while weak framing would allow the learners to decide in which order the topics should be learnt. 'Pacing' refers to the rate at which the selected topics are dealt with in the classroom. Strong framing over pacing means that the teacher determines the rate at which the learning material is dealt with, while weak framing over pacing allows the learners greater control in determining the pace of the lessons. Thus, strong framing reduces the options of the learners while weak framing allows a greater degree of flexibility of options in the learning environment. Morais (2002: 2) states that "[s]tronger values of framing characterise a theory of instruction more centred on the transmitter [or the teacher] and weaker values of framing characterise a theory of instruction more centred on the acquirer [or the learner]."

A further aspect of framing that needs to be considered is the "hierarchical rules which regulate [...] pedagogic practice." (Morais & Neves, 2001: 188). These rules refer to the relationship between the teacher and the learners and the relationship between learner and learner. Where the relationship between teacher and taught is strongly defined and formal, the framing of hierarchical rules is described as being strong. Where the relationship between the teacher and the learners is more open and informal, the framing of hierarchical rules is described as weak.

3.3 Collection and Integrated Curricula

Bernstein (1975: 80) distinguishes between two types of curricula. The one he describes as being a 'collection type' and the other he terms an 'integrated type'.

A collection type curriculum is a collection of subjects where the different contents are insulated from each other and are also all taught in relative isolation from each other. That is, the subjects making up the curriculum are strongly classified with respect to each other. The subjects are also allocated a fixed time-period in which they are taught and these periods could vary from one subject to the other. The old South African curriculum is a form of collection curriculum where pupils were taught subjects such as Mathematics, General Science and Geography in isolation from each other although links exist between them.

In the integrated type of curriculum, on the other hand, the subject contents stand in an open relation to each other. Here, the boundaries between the different subject contents are not as clearly defined as in the case of the collection type. In other words, classification of subjects is relatively weak. Also, the time-periods may not be fixed. Here the various contents are "... subordinate to some idea which reduces their isolation from each other. Where we have integration, the various contents become part of a greater whole. ... Where we have integration, there is likely to be a move towards a common pedagogy, a common examining style, a common practice of teaching." (Ibid.)

The integrated model is based on weak classification and framing, where learners are allowed greater control over their learning. In this model they are seen as active participants in the learning process and the teacher is assigned a role very different to that to which the traditional 'chalk-and-talk' teacher is familiar. Here, the teacher's role is less overt and direct intervention is seen as an interference. Hence, the recruitment of the 'everyday' could be seen as a means for the learners to more easily identify with the material to be learnt, and in so doing, making it easier for the learner to develop and/or improve concepts.

Bernstein also indicates that with an integrated curriculum, there will be a shift from education in depth (in other words, where fewer topics are dealt with in greater detail) to education in breadth (where more topics are dealt with at a more superficial level). Furthermore, the emphasis will shift from states of knowledge to ways of knowing. (p. 83) Bernstein adds that curricula could consist of "... various types of collection and various degrees and types of integration." (p.88) In other words, different kinds of curriculum and pedagogy can be described in terms of different expressions of classification and framing.

To complete this chapter the discussion now shifts to the model of domains of practice as presented in the work of Paul Dowling (1998).

3.4 Apprenticeship and Domains of Practice

Dowling (1998) conducted a study concerned with a comparison of two mathematics textbooks from the SMP collection called the 'Y' and 'G' series. He found that the one series – the 'Y' series – were designed to equip the students for higher mathematics learning, while the 'G' series were designed for 'weaker ability' students. He describes the texts as follows:

The G reader – the 'lower ability' voice – is pathologically disabled with respect to the esoteric domain. [...] The Y reader, on the other hand, is a potential initiate into the esoteric domain [...] Thus the Y reader is likely to be positioned as a potential apprentice to a professional worker [...]; the G reader is potentially apprenticed to non-professionals and wage earners. (1998:368)

Dowling (1998: 135) develops Bernstein's notion of classification further by considering four domains of school mathematics practice. He claims that all school mathematics practices can be classified in one of these four domains. These domains he termed 'public', 'expressive', 'descriptive' and 'esoteric'. He argues that 'public domain' texts, such as the G texts in his study, 'pathologically' disable the readers with regard to the 'esoteric domain'. In other words, texts such as the G-series could serve as a device to exclude learners from the 'esoteric domain' and thus determine the future careers of learners who use these texts in their schooling. The 'esoteric domain' texts, such as those of the Y-series, on the other hand, allow learners access to a profession. He found that, in the texts he used in his research, the Y-series texts

favoured 'esoteric domain' activities while the G-series texts favoured 'public domain' activities.

Dowling developed a grid for the classification of mathematics texts (see *figure 1* below). The horizontal axis classified texts in terms of content, while the vertical axis classified texts in terms of mode of expression. A text that is strongly classified, or highly specialised, in terms of both its content and its mode of expression would be classified as falling within the 'esoteric' domain. An example of this would be – "if $n + 7 = 13$, what is $n + 10$?" A text that is weakly classified in terms of both content and mode of expression would be classified as falling in the 'public' domain. An example would be – "What is the cost of half a kilogram of tomatoes and two pockets of oranges?" This question is typical in primary school mathematics textbooks where the prices are displayed in an illustration. A text that is strongly classified in content but weakly classified in mode of expression would fall in the 'expressive' domain. For example, "Fill in the missing links in the chain – 4, 7, 11, 16, __, 29, __, __." Where a text is weakly classified in terms of content and strongly classified in terms of mode of expression, it would fall in the 'descriptive' domain. An example would be "If a car travels at a speed of m km/h for y hours, what distance would it travel? Dowling illustrates these domains thus:-

		Content (signifieds)	
		Strong Classification	Weak Classification
Expression (signifiers)	Strong Classification	Esoteric Domain	Descriptive Domain
	Weak Classification	Expressive Domain	Public Domain

Figure 1: Dowling's (1998: 135) domains of mathematics practice

As was indicated at the start of the chapter, both Bernstein and Dowling are useful in a discussion of the employment of the 'everyday' in the mathematics classroom.

Bernstein's notions of 'classification' and 'framing' provide the tools for interrogating how the recruitment of the 'everyday' is realised in two ways. 'Classification' refers to the issue of integration across the learning areas and between academic and everyday knowledge. So, classification is of interest in a discussion of the use of the 'everyday' in mathematics classrooms to the extent that the curriculum attempts to weaken the boundary between school knowledge and everyday knowledge.

'Framing' refers to the selection and recruitment of the 'everyday' by learners in classrooms as well as the pedagogic relations, i.e. sequencing, pacing, evaluation and hierarchical rules that exist in the classroom. Framing is of interest in the discussion of the use of the 'everyday' in mathematics classrooms to the extent that teachers encourage learners to introduce their own narratives into the classroom and these become a resource in teaching. It is also a useful tool for examining the social relations that prevail in the classroom.

The present project uses framing as a central organising concept for two reasons. Firstly, concerning the recruitment of the 'everyday' into the mathematics classrooms, the focus is on who does this – teachers or learners. This is about framing over selection of content. Secondly, insofar as policy documents link the recruitment of the 'everyday' to "learner-centredness", the focus is on the social relations existing in the classrooms into which the 'everyday' is introduced, and, particularly, the relative freedom of learners to exercise control over sequencing, pacing, evaluation, and hierarchical rules.

In the development of his model of domains of mathematics practice, Dowling provides a refinement of 'classification'. This is useful in that it allows for a more detailed analysis of the types of everyday examples employed in the mathematics classroom and the ways in which these examples are used to provide access to the esoteric domain.

When analysing the data of my study, the discussion will draw largely upon Bernstein's notion of framing. Classification does not feature in the analysis as the curriculum was taken as a given and was thus not a focus of analysis. Framing is used to examine the pedagogic relations that exist in the classes in this study. Bernstein

argues that in order for a learner-centred pedagogy to be effective, the framing relations need to be weak. Dowling's model of apprenticeship and domains of practice could be used to classify the kind of mathematics examples used in the classes, but is beyond the scope of this study.

In the next chapter I shall move on to a description of the research design and the development of an analytical framework. I shall present a description of the sample of the study as well as a description of the analytical tools used. I shall discuss some of the difficulties that were encountered when the analytical tools were applied. I conclude the chapter with a discussion on research ethics and the reliability, validity and generalisability of results.

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CHAPTER 4. RESEARCH DESIGN⁸ AND THE DEVELOPMENT OF AN ANALYTIC FRAMEWORK

This research derived from a larger project designed to study the impact of the *Maths for all Grade 7 Learner Activity Book* in primary school mathematics classrooms (Ensor et al: 2002: 21). To study the impact of the textbook scheme, a quasi-experimental research design was used. Fourteen classrooms from twelve randomly selected ex-DET schools were selected. Ten classrooms were allocated to an experimental group and given the *Maths for all Grade 7 LAB*. The four classrooms allocated to the control group were only given the textbooks at the end of the study.

The 'experimental' group of educators was asked to use the chapters from the *Maths for all Grade 7 LAB*, which would coincide with the mathematics topics that they would be covering in their classes in the second term of 2000. The educators who constituted the 'control' group would cover the same topics that the 'experimental' group covered, but they would use the material that they usually used, not the *Maths for all* textbooks. Lessons were observed and video-recorded and learners were tested at the beginning and end of the study. The findings of the research project are published elsewhere (see Ensor et al, 2002). The present research project was linked to the main project in that it made use of the video data of the lessons, but is in no sense interested in the quasi-experimental nature of the original project. The present study focused on observation of the fourteen lessons and the ways in which the teachers made use of the 'everyday', if at all.

4.1 The sample

According to information provided by the principals of the schools, seven of the schools were located in the townships and five were in informal settlements. One of the township schools also accommodated learners from a nearby informal settlement. The schools' enrolment figures varied from 464 to 1680 learners. The average class size for grade 7 was 45 but the actual number of learners in the class ranged from 26

⁸ All information on the context of schools is derived from Ensor et al (2002)

to 95. The language of instruction was mainly English and Xhosa except at one school where the mother tongue was Sotho (op cit.).

All of the learners at the schools in the sample came from impoverished backgrounds and many of them had health or nutrition problems. Most of the houses did not have running water or electricity. According to members of staff, most of the learners came from homes where the parents or guardians have not had any schooling beyond the primary phase. Most of the schools did not have entrance criteria other than residence in the area. Two of the schools indicated academic performance as a criterion and one gave preference to Sotho speakers (op cit.).

4.2 Data collection

For the purpose of the present study, one videotaped lesson presented by each of the fourteen educators, and classroom observation notes from all fourteen classes, formed the data set for the study. Although the project from which the data was drawn was interested in differences between experimental and control groups, the present study is interested in how teachers in all fourteen classrooms drew on the 'everyday' in their teaching, irrespective of whether they used the *Maths for all Grade 7* textbook or not.

As was indicated earlier, the research team negotiated that certain topics be covered by all the teachers participating in the trial during the second term of the year. The team then made arrangements for members to sit in on the lessons that the teachers had prepared. These lessons were then videotaped with the permission of the teacher and school principal. I was not involved in the data collection process but was asked to design a project based on the classroom data which is reported on in this thesis.

4.3 Analysis of data

The analysis of data for my project consisted of two phases. The first phase was to develop an observation schedule that would capture in broad detail the salient features of the lessons observed. The second phase was to develop a more fine grained instrument that would describe the framing relations that existed in the fourteen lessons that were videotaped.

In the first phase of analysis, a classroom observation schedule was designed to capture those features of the lesson that would facilitate the second phase, i.e. the discussion of the framing relations in the classrooms. The instrument used to capture the framing relations in the classrooms drew on work done by Neves and Afonso (2002) and Morais and Neves (2001).

4.3.1 Phase 1: The classroom observation schedule

The lesson features that were considered relevant to this study were:-

- a) the lesson topic that was being dealt with,
- b) the resources used by the teachers,
- c) whether everyday examples were introduced into the lesson,
- d) in which part of the lesson the everyday examples were introduced,
- e) whether the everyday examples were introduced by the learners or the teachers,
- f) the number of everyday examples introduced, and
- g) whether the learners were working individually or in groups
- h) whether the everyday examples were used inductively (I) or deductively (D)?

The final classroom observation schedule is shown in *figure 2* below.

Class Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Teacher's name														
Lesson Topic: Measurement (M), Fractions (F), Integers (I), Decimals (D)														
Learners working in: groups (G), individuals (I), organised in groups but work individually (GI)														
Resources used by teacher: textbook (T), photocopy (P), or worksheet (W)														
Are everyday examples introduced? (Y/N)														
Who makes reference to everyday examples? Teacher (T), learner (L) or no reference (NR)														
When are everyday examples introduced? Start of lesson (S), middle (M), end (E) or no reference (NR)														
Number of different examples of 'everyday' used in lesson														

Figure 2: The classroom observation schedule

Each of the features considered relevant will now be discussed in turn.

a) The lesson topic

As was indicated earlier, the teachers had indicated which topics they would be dealing with during the period over which the study was conducted. The topics that were selected dealt with measurement, fractions, integers and decimals.

b) Resources used by the teachers

This feature is included to determine the source of the teachers' examples, whether the examples be of the 'everyday' or not.

c) Introducing 'everyday' examples

Because this study is concerned with the employment of the 'everyday' in the mathematics classroom, it is important to determine whether 'everyday' examples were employed in the lessons and in which classes this was done. Whenever a problem was contextualised, or reference was made to something drawn from 'reality', for example, referring to temperature, it was considered to be an example of employment of the 'everyday'.

d) When 'everyday' examples were used

For the purpose of this study, the 'timing' of the introduction of the 'everyday' would indicate whether the teacher was working inductively i.e. employing the 'everyday' as a basis to introduce a concept, or deductively, using the 'everyday' as an application of new concepts and/or algorithms learnt.

e) Who introduces 'everyday' examples?

As was indicated in the literature review, if the learners introduced their own examples rather than being given them by the teacher, some would argue that they would more easily be able to identify with the examples and thus obtain easier access to the concepts to be learnt. For this reason, it was necessary to note who introduced the 'everyday' in the lessons.

f) The number of 'everyday' examples introduced

This dimension was of interest to provide an indication of the range of everyday examples used in the lesson.

g) Learners working individually or in groups⁹

Whether learners worked in groups or alone was taken as a partial indication of the strength of framing over hierarchical rules in the classroom.

4.3.2 Phase 2: Framing relations in the classrooms

This study aims at examining what teachers recruit from the 'everyday' and how it is recruited in the context of the pedagogic relations in the classroom. For this reason, it is not sufficient to merely look at framing over selection, but over sequencing, pacing and evaluation as well. As I have indicated before, the study does not look at classification because the focus is on the teaching of mathematics, rather than on curriculum integration.

The instrument used to capture the framing relations in the classrooms drew on work done by Neves and Afonso (2002), who had designed analytical tools that examined the framing relations that existed between teacher educators and science teachers, and Morais and Neves (2001) who examined the framing relations that existed between science teachers and learners at primary school level. These researchers developed descriptors for the discursive rules that would reflect the framing conditions existing between the teacher and taught in the instructional and regulative contexts.

With regard to the instructional context, strong framing indicates relations that are centred on the teacher educator, in the case of the Neves and Afonso (2002) study, or on the science teacher, in the case of the Morais and Neves (2001) study. Relations that are centred on the teacher, in the Neves and Afonso study (2002), or on the learners in the Morais and Neves (2001) study, would indicate a situation where the framing is weak. Since the instructional context that exists in those scenarios could be seen as a reflection of the one that exists in most cases between teacher and taught, the

⁹ This information was derived from the classroom notes of the researchers concerned with the main project (see p. 43 above).

analytical model designed by those researchers could without much alteration be applied in the classroom to examine the relations between the teacher in the classroom and her/his learners. The only difference would be the development of new descriptors that would bring out the framing relations in the classroom.

Where teachers have considerable control over selection, sequencing, pacing, evaluation, and hierarchical rules, the symbol F^{++} will be used. Where learners have considerable control over these elements, the symbol F^{-} will be used. I shall use the symbols F^{++} , F^{+} , F^{-} and F^{-} to indicate the relative strength of framing i.e. whether the teacher or the learners have more control over the selection, pacing, sequencing and evaluation of the lesson, as well as hierarchical rules. Thus, F^{++} will indicate very strong framing relations between teacher and taught and F^{-} will indicate very weak framing relations between teacher and taught. F^{+} will indicate relatively strong framing relations between teacher and taught and F^{-} will indicate relatively weak framing relations between teacher and taught.

4.3.2.1 Descriptors of framing relations¹⁰

For the purpose of this study, 'selection' refers to the selection of learning contents or the choice of material that is introduced in the lesson. This includes subject matter, examples, illustrations and exercises. 'Sequencing of tasks' refers to the way in which the lesson topics are arranged for presentation to the learners and 'pacing' refers to the rate at which the lesson moves along. 'Evaluation' refers to the explicitness with which the teachers make available evaluative criteria. The 'hierarchical rules' refer to the level of freedom of communication between the teachers and their learners. In the criteria of selection, F^{++} indicates very strong framing where the teacher decides on the content and examples that are introduced and the learners have very little say in what may or may not be introduced into the lesson. F^{-} indicates very weak framing where the learners are allowed to determine the content and examples that may be introduced in the lessons. The table of selection criteria is shown in Table 1.

¹⁰ The indicator and criteria descriptors have been adapted from Morais and Neves (2001) and Neves and Aphonso (2002).

Table 1: Discursive rule – Selection criteria: instrument of analysis

Indicator	F ⁺⁺	F ⁺	F ⁻	F ⁻
Learning contents	The teacher determines the aspects to be studied in each lesson. This includes content, examples and illustrations.	The teacher indicates the aspects s/he considers to be important but accepts the learners' suggestions. Learners may be encouraged to suggest examples or narratives to illustrate a topic.	The teacher makes a full list of contents to be studied – allows learners to make a selection from it. There is great scope for the introduction of learners' own narratives.	The teacher asks the learners to suggest the contents to be studied. There is very wide scope for the introduction of learners' own narratives.

For the criteria of sequencing, very strong framing is indicated where the teacher decides on the order in which activities and content are completed. Where the learners make the decision regarding the order in which the activities are completed, very weak framing is indicated. The table of sequencing criteria is given in Table 2.

Table 2: Discursive rule – Sequencing criteria: instrument of analysis

Indicator	F ⁺⁺	F ⁺	F ⁻	F ⁻
Doing tasks or activities	The sequencing of tasks follows the order decided by the teacher.	The sequencing of tasks follows the order decided by the teacher but can be altered.	The sequencing of tasks follows the order planned by the learners, but guided by the teacher.	The sequencing of tasks follows the order planned only by the learners.

In the case of pacing, very strong framing is evidenced by the teacher exercising complete control over how the lesson time is utilised. Where the learners are allowed to pace the lesson without any pressure from the teacher, very weak framing exists. The table of pacing criteria is shown in Table 3.

Table 3: Discursive rule – Pacing criteria: instrument of analysis

Indicator	F ⁺⁺	F ⁺	F ⁻	F ⁻
Determining the pacing of the lesson	The time planned for each part of the lesson is decided by the teacher and rigorously adhered to.	The teacher allocates time for completing tasks but extra time is allowed when needed.	The learners determine the time needed to explore texts but the teacher presses them to finish.	There is no time determined for the exploration of texts. The time depends on learners' pacing and there is no pressure from the teacher.

Where the teacher dictates how learners should present answers, there exists very strong framing, while very weak framing will be indicated by learners being allowed to present an answer in whichever way they feel comfortable, with no direction from the teacher. The table of evaluation criteria is shown in Table 4.

Table 4: Discursive rule – Evaluation criteria: instrument of analysis

Indicator	F ⁺⁺	F ⁺	F ⁻	F ⁻⁻
In giving answers	The teacher makes clear the evaluative criteria. The teacher prescribes solutions and corrects learners' mistakes.	The teacher gives prescribed solutions but allows different solutions to be presented. Learners' mistakes may be corrected.	The teacher allows the learners to formulate their own solutions but will assist when it is required.	The teacher does not make clear the evaluative criteria. No solutions are prescribed and learners' mistakes are not corrected.

Where the teacher is in full control with regard to who may speak to whom and when, there is very strong framing of hierarchical rules while very weak framing is indicated where communication between teacher and learners is open and informal. The table of hierarchical rules is shown in Table 5.

Table 5: Hierarchical rules between teacher and learners: instrument of analysis

Indicator	F ⁺⁺	F ⁺	F ⁻	F ⁻⁻
Classroom communication	The teacher controls classroom order with no room for learner input.	The teacher controls classroom order with an occasional interaction between teacher and learners.	An open classroom interaction between teacher and learners exists, but a vertical relation between teacher and learners is clearly evident.	A permanent open interaction between teacher and learners exists.

4.4 Difficulties with the application of analytical tools

In general, the analytical tools worked effectively in the analysis of the data. The classroom observation schedule in phase 1 summarised fairly basic information and there were few difficulties in using it. In phase 2, the analytical tools used were for the most part useful for describing the framing relations, but on occasion, the level of delicacy involved made coding difficult. There were times when it was not easy to decide whether to code an interaction as F⁺⁺ or F⁺ or for that matter F⁻ or F⁻⁻. However, such discrepancies did not significantly alter the results of the study as F⁺⁺ and F⁺ indicate different degrees of strong framing relations while F⁻ and F⁻⁻ both

indicate degrees of weak framing relations. Where most of the aspects of framing relations for a particular descriptor were seen as very strong but one aspect only relatively strong, the framing relations were denoted as strong. Similarly, where most of the aspects of framing relations for a particular descriptor were seen as very weak but one aspect was relatively weak, the framing relations were denoted as weak.

To illustrate how the framing relations in the classrooms were coded, I shall highlight a few examples taken from the data. In classroom 6 the teacher asked the learners where they had heard of percentage. Two learners answered and the teacher used their replies to write something on the board. However, he did not use their examples nor did he refer to the examples again. The descriptor for selection F^{++} reads – “The teacher determines the aspects to be studied in each lesson. This includes content, examples and illustrations.” The descriptor for F^+ reads – “The teacher indicates the aspects s/he considers important but accepts the learners’ suggestions. Learners may be encouraged to suggest examples or narratives to illustrate a topic.” So, despite the teacher inviting the learners to proffer everyday examples, the coding for framing over selection is interpreted as very strong because the teacher did not use the examples that the learners gave.

In classroom 11 the framing over sequencing was very strong for the greater part of the lesson, but when the learners were given a worksheet to complete, they had a choice in the section they wanted to complete first. Therefore the coding for framing over sequencing was given as strong¹¹ i.e. F^+ . In the same classroom, the framing over pacing was interpreted as F^- because the teacher allowed the learners all the time they needed to complete the worksheet. There was no pressure from the teacher to get the learners to complete the worksheet. The descriptor for F^- reads, “There is no time determined for the exploration of texts. The time depends on learners’ pacing and there is no pressure from the teacher.”

At times it was difficult to code the hierarchical rules that existed in certain classrooms. The problem was whether to code the interaction between the teacher and

¹¹ The descriptor for sequencing (F^+) reads – “The sequencing of tasks follows the order decided by the teacher but can be altered.” (F^{++}) reads “The sequencing of tasks strictly follows the order decided by the teacher”

her/his learners as F^+ or F^- when there was interaction between them. The problem was solved by determining whether the learners could speak freely in the class or whether they had to wait for permission to speak. If the learner spoke without waiting for permission, the coding would be F^- , and F^+ if the learner had to wait for the teacher to give permission to speak. Another problem that surfaced can be illustrated with reference to Mrs. Gaba's lesson (classroom 14). The descriptors for F^+ and F^- did not clearly fit the hierarchical rules that existed in her classroom. The problem was that there was more than an "occasional" interaction between the learners and the teacher, but there was not an "open" interaction. So, on the strength of the argument presented earlier, the hierarchical rules were coded as F^+ . Finally, where a feature appeared that could have been coded either F^{++} or F^+ or alternatively F^- or F^- , I would use my discretion insofar as I felt that the criteria of the particular indicator that was selected best described the feature.

Before concluding this chapter, I shall comment on the research ethics I have considered in the course of this study as well as the reliability, validity and generalisability of this piece of research.

4.5 Research ethics¹²

Following May's (1980) ethical theories, Deyhle, Hess, Alfred and LeCompte (1992) have explained various categories of ethical positions open to researchers. They define them as:

1. The teleological ethical position, where truth is considered an end in itself.
2. The utilitarian ethical position, where our actions as researchers are measured "by their utility in producing the greatest good for the greatest number" (May, 1980: 360, cited in Deyhle et al, 1992: 604)
3. Critical theory ethics – "the researcher functions as adversary to the established and the powerful who already control ... the levers of power" (Ibid.). the main concern of the researcher is how to emancipate those who are or whom they see as

being oppressed in any given setting with a view to enhancing the lives of the people.

4. The covenantal ethical research position – “the researcher’s paramount responsibility is to those he studies ... This paramount obligation to the people studied derives from mutual personal exchanges.” (p. 608).

As Deyhle et al (1992) point out: researchers do not have to fall into one or other category and other categories do exist. I can identify with the above categories to a lesser or greater extent, and so shall attempt to satisfy the demands of those categories by attempting:

1. to represent the truth – the teleological position
2. to enhance the lives of those being studied by possibly giving feedback based on the research conducted – the critical theoretical position
3. to consider my obligations and responsibility to the educators and their colleagues – the covenantal ethical research position
4. to produce research which would be helpful to the participants in the study and the educator fraternity as a whole – the utilitarian ethical position

4.6 Reliability, validity and generalisability¹³

Reliability, referring to the correctness of results when an instrument is used in different contexts across time, has been attended to here by making explicit to the reader the decisions made about coding data and the difficulties encountered when they arose. This strategy was used instead of using an independent coder, which did not appear to be necessary in this case.

Internal validity refers to the link between the research question, the design and modes of analysis. The greatest potential threat to validity relates to the design of the instrument and its consistency with the theoretical framework. This has been attended to by basing the phase 2 data analysis instrument on previous work by Neves and Afonso (2002) and Morais and Neves (2001). External validity, or generalisability is

¹² This section has been borrowed and adapted from Walters, B. C. (1996: 47 – 48)

¹³ This section is derived from Brown & Dowling (1998)

not put forward as a strong claim. Although the classrooms were randomly selected, the sample is small and no claims are made that the findings are generalisable. However, the findings do raise interesting issues to be considered by policy makers and educators.

4.7 Conclusion

In this chapter, I have set out to describe the sample and analytic framework that was used in this study. I described the classroom observation schedule as well as the indicators that were used to describe the framing relations in the fourteen classes that were used in the study. Also, I gave examples of what was considered problems of coding episodes of data from most of the framing relations indicators. The chapter was concluded with a discussion on research ethics and the reliability, validity and generalisability of the results. In the next chapter I shall present the findings of the study.

CHAPTER 5. PRESENTATION OF FINDINGS

In this chapter I shall present my findings firstly based on the phase 1 classroom observation schedule as described on pages 44 to 46. I shall then present the findings based on the phase 2 framing instruments of analysis. This second presentation will be done in two parts. I shall first discuss two of the fourteen lessons in detail in order to demonstrate how I used the framing tools described on pages 46 to 49. I shall then give a brief description of each of the other twelve lessons as well as a summary of the framing relations in each of those classes. As was indicated earlier, there were fourteen teachers in the sample of twelve randomly selected schools. Ten of the teachers used the *Mfa Grade 7 LAB* and four teachers used their own material.

5.1 The classroom observation schedule

In this section I shall comment on those features in the classroom observation schedule that require elaboration.

5.1.1 General overview

When we look at the observation schedule derived from the lessons in the sample (Table 6 on page 56), we note that the lesson topics covered were measurement, fractions, integers and decimal numbers. One of the teachers, Mr. Rini in classroom 6, also taught percentages. Ten of the teachers dealt with the topics using the *Mfa Grade 7 LAB* while the other four teachers taught the topics using other resources such as photocopies or worksheets. In eight of the classrooms the learners were working in groups and in five classrooms the learners were working on their own. In the other classroom, the learners started off working individually, after which the teacher asked them to work in groups. As indicated earlier, the determination as to whether learners were working in groups was made on the basis of classroom notes compiled by one of the researchers involved with the original project.

Ten of the fourteen teachers made reference to the 'everyday' in their lessons. In most cases, these references sketched a scenario that was expected to be identifiable by the learners. For the purpose of this study, whenever a teacher or a learner mentioned a

Table 6: Phase 1: The classroom observation schedule

Class Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Teacher's name	Mr. Tutu	Mr Zam-ela	Ms Nqo-lobe	Mr. Mfiki	Mrs Hlo-hlo	Mr Rini	Mrs Mthe-thwa	Mr Man-yela	Mr Wel-ani	Mrs Xha-pa	Mrs Mga-ba	Mr Maq-oko.	Mr. Ket-ani	Mrs Gaba
Lesson Topic: Measurement (M), Fractions (F), Integers (I), Decimals (D)	D	I	F	M	D	D/%	M	M	M	M	M	F	F	M
Learners working in: groups (G), individuals (I), organised in groups but work individually (GI)	G	G	G,I	G,I	G	G	G,I	G	I	I then G	G	I	G	G
Resources used by the teacher: Textbook (<i>Mfa</i>), photocopy (P), worksheet (W), board (B), other (O)	<i>Mfa</i>	<i>Mfa</i>	<i>Mfa</i>	O	<i>Mfa</i>	<i>Mfa</i>	<i>Mfa</i>	<i>Mfa</i>	<i>Mfa</i>	<i>Mfa</i>	P	B	W	<i>Mfa</i>
Are everyday examples introduced? (Y/N)	N	Y	Y	N	N	Y	Y	N	Y	Y	Y	Y	Y	Y
Who makes reference to everyday examples? Teacher (T), learner (L), or no reference (NR)	NR	T	T	NR	NR	T,L	T	NR	T	T	T,L	T	T	T,L
When are everyday examples introduced? Start of lesson (S), middle(M), end (E) or no reference(NR)	NR	S	S	NR	NR	S,E	S	NR	S	S	S	S	S	S,E
Number of different examples of the 'everyday' used in lesson	0	3	1	0	0	5	6	0	2	3	4	2	2	3

mathematics problem/example that was contextualised or made reference to the 'everyday' within the context of the lesson, this was seen as an example of the employment of the 'everyday'. Two of the teachers (classrooms 4 and 5) did not do this in any way. They taught an algorithm that they expected the learners to apply to some decontextualised problems. In one lesson (classroom 8) the learners were required to determine which of two figures, bearing either a square or triangular grid, "were bigger"¹³. The remaining teacher (classroom 1) used the period for learners to do solutions of work from the previous day on the chalkboard, none of which contained everyday examples.

5.1.2 Employment of the 'everyday'

In the classes where reference was made to the 'everyday', the reference was made by the teachers. The number of references made to the 'everyday' in the different classes ranged from none to five. In classroom 9, the teacher used the 'everyday' not to contextualise, but rather to draw attention to the exercise the learners were about to do. He asked them to identify some shapes they saw in the classroom, stating that "shapes are everywhere, north, south, east and west". This comment prefaced a task where the learners had to determine which of two shapes, on either a square or triangular grid, was "bigger". He described a grid as something used for braaiing¹⁴. In only three of the fourteen classes in the study (6, 11 and 14) did a learner or learners refer to the 'everyday' and this only after the teacher had asked the class to give examples. In all cases, though, the teachers did not incorporate these references into the lesson, nor did the teachers ask the learners to elaborate on the references they had made.

5.1.2.1 Learners' examples

In classroom 6, the teacher was dealing with the topic of percentage and asked the class where they had heard the word before. One learner called out 'salary' and another 'petrol'. The teacher did not ask them to elaborate nor did he elaborate on their ideas. He used their terms to write 'increase in salary' and 'decrease and increase

¹³ see appendix 1

¹⁴ see appendix 1

in petrol' on the board but did not discuss this any further. He then mentioned an increase and decrease of 7% in the price of cars and asked the learners to define 'percentage'.

In classroom 11, the teacher asked the learners where measurement could be used. They gave answers such as 'height', 'length', 'food' and 'buying clothes'. The teacher did not ask the learners to elaborate, but rather indicated that she would give them a worksheet based on measurement that she wanted them to complete. She explained what they needed to do, then distributed the worksheets and allowed them to start measuring everyday objects inside and outside the classroom.

In classroom 14, the learners ventured answers after the teacher had asked them what the first thing was that a builder needed to do in order to build another room onto an existing building. They ventured answers such as 'measure', 'design', and 'level'. She did not respond to the learners who said 'design' and 'level', but picked up on the word 'measure' and asked more leading questions about the building problem. She led the learners along this discussion and then asked two learners to draw two different shapes of foundations on the board. This discussion served as an introduction to an exercise on perimeter and area.

5.1.2.2 Teachers' employment of the 'everyday'

One of the ten teachers who recruited the 'everyday', asked the learners the day before the lesson to go home to find 'everyday' examples of the mathematics topic to be discussed. This was in Mr. Zamela's lesson on negative numbers. However, it appeared that the learners could not identify with the topic and, thus, none of them were able to come up with examples from within their realm of experience. The teacher's use of the examples given in the textbook – temperatures below zero in weather reports, temperatures in the refrigerators, and lifts with negative numbers denoting floors below ground floor – did not assist the learners as these examples were not ones with which they could easily identify. Readings of the winter temperatures in different parts of South Africa, for example, were not from the learners' realm of experience, as the temperatures rarely, if ever, drop below freezing point in that part of the Western Cape. Even if they did, thermometers are not a

common occurrence in most homes, thus removing the discussion away from the learners' realm of everyday experience. This could explain why none of them appeared to be able to relate to what the teacher was saying.

In two of the lessons (classrooms 11 and 7), teachers attempted to adopt a "hands-on" approach by getting the learners actively engaged in measuring different lengths – very much like the "master-apprentice" approach suggested by Masingila (1993). The problem that surfaced here was that the teachers did not guide their learners as suggested by Masingila (cf. pp. 20-21 above). The teachers did not constantly monitor what their learners were doing. This resulted in some confusion and incorrect procedures being followed.

In classroom 11 the learners were given worksheets on which they were to estimate the lengths of various objects, determine the actual lengths by using measuring tapes, and then to calculate the differences between the estimated and measured lengths. The teacher explained what was required of the learners when doing the respective tasks and then left the learners on their own to complete their worksheets. This led to some confusion as some of the learners were not aware that they were measuring in one unit (inches) and recording it as another (centimetres).

In classroom 7, the learners were asked to use everyday objects such as string, matchsticks, tracing paper and pencil-lengths to measure the lengths of objects in the classroom such as their textbooks and desk heights. In this classroom there was some confusion that arose partly because of a lack of understanding of counting unit lengths, and the use of incorrect terminology. The problem arose when the learners had to do part of an exercise in the *Mfa Grade 7 LAB*. The exercise required that the learners indicate the length of a matchstick in an illustration (see Appendix 2). The problem was that a few learners were counting the points of the ruler rather than the unit spaces. The teacher exacerbated the problem by using the term "points" when she should have been talking about units. This resulted in the learners not understanding why their answer was one more than that of the rest of the class.

In the other classes where the 'everyday' was employed, it was generally used to introduce the lesson. For example, in classroom 3, the teacher dealt with addition and

subtraction of fractions. She started the lesson by describing a situation where a mother cut a cake into eight parts. She used this example to explain the idea of adding fractions. In classroom 10 the teacher introduced the concept of 'area' by asking the learners to rub their hands over the covers of their workbooks. In both these cases, the learners were not given open-ended problems to solve, as was the case with the Phoenix Park learners in the Boaler (1998) study. Rather, the teachers used the 'everyday' to *explain* or introduce an algorithm rather than use it to present the learners with problems to which they needed to devise and/or present solutions. In other words, the selection of everyday examples came from the teachers and was used to introduce the teaching of algorithms deductively, rather than for developing concepts inductively.

5.2 Summary

Considering the classroom observation schedule and the issues raised, one can see that the 'everyday' was introduced in all but four of the lessons. However, the examples were always recruited by the teachers. Where learners made reference to the 'everyday', they only did so when invited to do so by the teachers. Even so, the references were never contextualised and were never used by the teachers.

5.3 The framing instruments of analysis

As was indicated at the start of the chapter, this section will be set out in two parts. I shall first discuss two of the fourteen lessons in detail, using the framing tools described on pages 49 to 51. I shall then give a brief description of each of the other twelve lessons as well as a summary of the framing relations in each of those classes.

The two teachers who are the subjects of the first part of the discussion are Mr. Zamela and Mrs. Gaba. Although these teachers were working in the same grade, their working strategies were markedly different and also had remarkably different results. Despite both the teachers trying to adopt an approach that privileged the employment of the 'everyday' in the mathematics classroom, an analysis of their respective lessons indicate that the two had very different learner responses to their attempts.

To construct a systematic analysis of each of the lessons, I shall start by giving a synopsis of the lesson. I shall then highlight the examples of the 'everyday' introduced into the lesson by the teacher. From there I shall move on to analysing the lesson employing the framing instruments of analysis.

To conclude the chapter I shall apply the same instruments of analysis to the other classes to determine the type of framing relations prevalent in those classes.

5.3.1 Mr Zamela's Lesson (classroom 2)

Mr. Zamela is one of the teachers who used the *Mfa Grade 7 LAB*. He started the lesson with a question about negative numbers. He asked the learners what negative numbers were, and when they did not respond, he started suggesting situations where these numbers were to be found. He spoke about the temperatures of different places as presented on the SABC TV weather report. He then referred to the learners' homes and spoke about their refrigerators. He explained that they consisted of two compartments, one for freezing things and another for keeping things cold. He explained that the temperature of the freezer was below zero degrees and that the temperature inside the fridge could be adjusted by a switch found inside. The teacher again referred to the weather, explaining that when the temperature is less than minus one "ice is raining". He claimed that "hail will not fall" when the temperature is 1 degree or higher, "but the minute you get temperatures which is minus three degrees, then you get ice because the temperature is below freezing point."

Next, Mr. Zamela referred the learners to page 193 of the *Mfa Grade 7 LAB* and started reading through the outcomes for the chapter, explaining each one as he went along. He got to the outcome that read "Work with negative numbers in everyday contexts." At this point he reminded them about the weather report and then started talking about a lift. He explained that one would see negative numbers in a lift, but when he asked them whether they could comment on this, there was no reply. He responded to this silence by suggesting that perhaps they had never been in a lift. This comment raised a bit of laughter.

Mr. Zamela went on to explain that above the ground floor there were first, second and third floors but the floors below ground floor would be indicated by a “minus”. “So the first floor is minus 1, the second floor is minus 2. [...] When you are riding a lift you will be able to identify negative numbers. [...] You go up – positive, but the minute you go below the ground floor then you talk about negative numbers¹⁵. Which means to say that negative numbers are the opposite of positive numbers.”

He then continued reading the outcomes for the chapter, explaining each one as he went along. After reading through all the outcomes, Mr. Zamela asked the class to work on the first activity of that chapter. The activity involved the use of negative numbers in the context of a lift¹⁶. There was an illustration of the console of a lift bearing the numbers from 3 to -2 on the page. There were three questions based on this illustration. The instructions of the activity were set out as follows –

“This is a control panel in a lift.

- a) What does - 2 mean here?
- b) If you got in this lift at floor 1 and went down 2 floors, where would you end up?
- c) Which floor is lower: -1 or -2?”

He gave them about 10 minutes to complete the activity but, since they had not completed in that time, he gave them some more time then asked them to report. Before they started reporting, the teacher explained the context of the activity then asked for feedback. The students did not respond, so he started prompting them by talking them through the questions posed in the activity.

Table 7: examples of the ‘everyday’ in Mr. Zamela’s lesson

	Tasks/examples of the ‘everyday’ in Mr. Zamela’s class	Source of task/example Book, Teacher Learner
1	TV	T
2	Fridge/freezer	T
3	Lift	B

¹⁵ It appears that the teacher took it for granted that this is the case with all lifts, but it is not. I have not come across any lifts where floors below ground level are indicated by means of negative numbers. This could be why the learners were not able to comment.

¹⁶ See Appendix III

Framing over selection

Mr. Zamela tried to introduce the 'everyday' almost from the start of the lesson. He asked the learners to give him some examples of negative numbers that they had encountered in their daily experiences but they were not able to do this. He then started discussing what appeared to be a fairly everyday discussion about the SABC television weather report and temperature yet there appeared to be no sign from the learners that they could identify with what the teacher was saying. He moved on to describe the workings of the fridges in their homes and there was still not any notable response¹⁷. Finally he referred the learners to the activity in the textbook and started discussing it. Still the teacher did not appear to get them to submit the kind of responses that he would find acceptable.

It is clear that there was an attempt by the teacher to get the learners involved in the lesson as he asked them whether they had found examples of negative numbers in their day-to-day experience. When they were not able to do so he attempted to do this himself by using the examples from the textbook. But these examples were apparently not recognisable to the learners. Despite the teacher asking the learners to give examples of the 'everyday', the fact that they were not able to, and that he had to introduce the examples, resulted in the framing over selection for the indicator 'Learning contents' being coded F⁺.

Table 8: Discursive rule – Selection criteria: instrument of analysis

Indicator	F ⁺⁺	F ⁺	F	F ⁻
Learning content	The teacher determines the aspects to be studied in each lesson. This includes content, examples and illustrations.	The teacher indicates the aspects s/he considers to be important but accepts the learners' suggestions. Learners may be encouraged to suggest examples or narratives to illustrate a topic.	The teacher makes a full list of contents to be studied – allows learners to make a selection from it. There is great scope for the introduction of learners' own narratives.	The teacher asks the learners to suggest the contents to be studied. There is very wide scope for the introduction of learners' own narratives.

¹⁶ It appears that the teacher took it for granted that this is the case with all lifts, but it is not. I have not come across any lifts where floors below ground level are indicated by means of negative numbers. This could be why the learners were not able to comment.

¹⁷ Given that many learners come from impoverished communities it is quite possible that they don't have fridges in their homes. Also, not many, if any, fridges have temperature gauges. They tend to have temperature-regulating knobs calibrated from 1 to 5.

Framing over sequencing

The lesson started off with a discussion of examples of the 'everyday'. The teacher asked the learners what negative numbers were, then, not getting any response, he turned to a discussion of where the learners would be able to see examples of negative numbers in their day-to-day experiences. From there he moved on to reading the outcomes of the relevant chapter in the *Maths for all* textbook before asking them to do the first activity from that chapter. After a given time, the teacher asked the learners to report on their results but before they could venture any solutions, he started talking them through the questions. Thus, the sequencing in this lesson for the indicator 'Doing tasks or activities' was coded F⁺⁺.

Table 9: Discursive rule – Sequencing criteria: instrument of analysis

Indicator	F ⁺⁺	F ⁺	F ⁻	F ⁻⁻
Doing tasks or activities	The sequencing of tasks follows the order decided by the teacher.	The sequencing of tasks follows the order decided by the teacher but can be altered.	The sequencing of tasks follows the order planned by learners, but guided by the teacher.	The sequencing of tasks follows the order planned only by the learners.

Framing over pacing

As can be seen from the earlier discussion, Mr. Zamela controlled virtually the whole lesson except when it came to the time needed to complete the activity when he gave the learners extra time. Even then, Mr. Zamela determined how much extra time they would be allowed to complete the activity. The framing then for the indicator 'determining the pacing of the lesson' was coded F⁺.

Table 10: Discursive rule – Pacing criteria: instrument of analysis

Indicator	F ⁺⁺	F ⁺	F ⁻	F ⁻⁻
Determining the pacing of the lesson	The time planned for each part of the lesson is decided by the teacher and rigorously adhered to.	The teacher allocates time for completing tasks but extra time is allowed when needed.	The learners determine the time needed to explore texts but the teacher presses them to finish.	There is no time determined for the exploration of texts. The time depends on learners' pacing and there is no pressure from the teacher.

Framing over evaluation

While the teacher was explaining what negative numbers were and giving examples, the learners sat attentively, not writing anything. The teacher did not ask them to write down anything either. He went along from one example to the next, writing things on the board, but not asking the learners to write down anything.

Throughout the lesson, Mr. Zamela kept on prompting the learners for the type of answers he wanted to hear. If the answers the learners gave were not what he wanted to hear, he would either ignore them or, if they were close to the answer he was expecting, he would add to what was said. Thus, for the evaluation criteria indicator 'in giving solutions' the framing was coded F^{++} .

Table 11: Discursive rule – evaluation criteria: instrument of analysis

Indicator	F^{++}	F^+	F^-	F^-
In giving answers	The teacher makes clear the evaluative criteria. The teacher prescribes solutions and corrects learners' mistakes.	The teacher gives prescribed solutions but allows different solutions to be presented. Learners' mistakes may be corrected.	The teacher allows the learners to formulate their own solutions but will assist when it is required.	The teacher does not make clear the evaluative criteria. No solutions are prescribed and learners' mistakes are not corrected.

Hierarchical rules

In this classroom, the framing for hierarchical rules was coded F^+ . The teacher moved around the room randomly choosing who would give the next answer. There was no evidence of any regular kind of interaction between the teacher and learners. The only interaction that was initiated by a learner was when a learner asked whether she and a partner could work as a pair rather than as part of a group.

Table 12: Hierarchical rules between teacher and learners: instrument of analysis

Indicator	F^{++}	F^+	F^-	F^-
Classroom communication	The teacher controls classroom order with no room for learner input.	The teacher controls classroom order with an occasional interaction between teacher and learners.	An open classroom interaction exists between teacher and learners but a vertical relation is also clearly evident.	A permanent open interaction exists between teacher and learners.

Summary of framing relations in Mr. Zamela's classroom

Considering the lesson presented by Mr. Zamela, one can see that there is strong framing over selection (F^+) as there is very little input given by the learners. The teacher introduced the lesson by asking for input, but since the learners' responses were so hesitant, the teacher took charge and then, for the duration of the lesson determined what was discussed.

The teacher, too, determined the sequencing as he moved from one discussion to the next. The learners were not able to contribute to the discussion and could, therefore, not have any impact on the sequencing of the lesson. Thus the framing was coded as very strong i.e. F^{++} .

The teacher determined the pacing throughout most of the lesson as he moved through his discussion of negative numbers. He determined how long he would spend illustrating what negative numbers were (F^{++}), he determined when and how long it would take to discuss the outcomes of the unit of the textbook (F^{++}) and he determined the amount of time allocated to feedback. The only part of the lesson where the learners had any influence on the pacing of the lesson was when it came to the completion of the textbook activity. The teacher was to give them 10 minutes, but they were unable to complete the exercise in the allotted time, so he gave them some extra time (F^+).

To summarise, the framing in this classroom was very strong for most of the lesson, the only exception being when the learners were busy with the activity from the textbook. The teacher determined the selection of material, examples and topic. The teacher also determined the sequencing although he was to an extent guided by the textbook¹⁸.

As was indicated earlier, the only time the pacing was determined by the learners was with regard to evaluation, there were a number of times when the teacher ignored the

¹⁸ This is an example of relatively strong external framing over selection.

responses of the learners because the responses appeared to be unsatisfactory to him. Here too, there was very strong framing.

Table 13: Summary of framing relations in Mr Zamela's classroom

Framing	
Selection	F ⁺
Sequencing	F ⁺⁺
Pacing	F ⁺
Evaluation	F ⁺⁺
Hierarchical rules	F ⁺

5.3.2 Mrs. Gaba's Lesson (classroom 14)

Mrs. Gaba's lesson was an introduction to area and perimeter. She started the lesson by sketching the situation where the school needed a new classroom. She told the learners that the materials required to build the room were all there, but she needed the class to tell her what the first thing was that the builder needed to do. A few learners gave varied responses like "level", "build", "measure" and "design" but the teacher did not respond to these answers. One learner again gave the answer 'measure'. The teacher wanted to know what the builder should measure and how the builder would measure. A learner said that the builder should measure the ground. Another said that the foundation should be measured. The teacher ignored the learner who answered 'ground' but asked how the foundation should be measured. One learner answered that the builder should use a tape measure. Another learner said that one could measure using one's feet. The teacher ignored the 'tape measure' response but she asked the learner who had answered that one could use one's feet to demonstrate how this would be done. The learner went to the front of the class and paced out a few steps. The teacher asked the class what the size of a large step was, to which a learner answered that it was a metre. The teacher agreed and said that this was no longer done as the builders used tape measures. She then asked two learners to draw two different shapes of foundations. She asked the class to comment on the sides of the drawings. They indicated that the opposite sides were equal.

Mrs. Gaba then handed the class a worksheet. The worksheet required that the learners draw three rectangles of different given lengths and breadths. They were then

required to calculate the area and perimeter of each rectangle. They were to work in groups.

After about 17 minutes, the various groups reported their 'findings'. Some of them gave the area answers in cms while others gave theirs as cm^2 . The teacher asked the class what the correct answer was. When they gave the correct answer she handed out another worksheet. This worksheet required that the learners indicate which rectangles were larger. They had to motivate their answers. She asked the learners what the term was for the distance around the rectangle. Once they told her this, she told them, "We say the perimeter of rectangle A is bigger than the perimeter of rectangle B." She then wrote on the board –

Perimeter is the total distance around anything

Area is the space inside anything

The teacher then asked the learners to show her the perimeter of their desks. Next, she asked them to show her the area of their desks and finally, she asked them to point out to her the area of the classroom. She then referred them to the answers that they had given her on the worksheet. She reminded them that they had said that rectangle B was bigger because of its perimeter. She then drew their attention back to the classroom and said that the area referred to the inside of a figure. She referred to the classroom that they were in and asked them how many learners were in the class. She referred them to the other Grade 7 class in the school and asked them which of the two classes were bigger. They answered that the other class was bigger because they had more learners. She corrected this perception and said that there were as many learners in the other class. The learners then argued that there was more space in the other classroom. She then asked them what was "big in that classroom". Someone answered that it was the inside to which the teacher responded that it meant that the area of the other classroom was bigger than the one in which they were. She said that the perimeter of the other classroom was also bigger than the perimeter of the one in which they were. The class then concluded that the perimeter and the area of rectangle B were bigger than the perimeter and area of rectangle A.

Table 14: Examples of the 'everyday' in Mrs. Gaba's lesson

	Tasks/examples of the 'everyday' in Mrs. Gaba's class	Source of task/example Book, Teacher Learner
1	Building	T
2	Classroom	T

Framing over selection

Mrs. Gaba started the lesson by sketching a scenario where the school needed another classroom. She then led the learners through a series of questions which ended in getting them to draw some diagrams of rectangles with given lengths and breadths. She asked them to work in groups and then got the group leaders to report. So, for the framing over selection, the coding was considered to be F^+ because she took some of the learners' suggestions.

Table 15: Discursive rule – Selection criteria: instrument of analysis

Indicator	F^{++}	F^+	F^-	F^-
Learning content	The teacher determines the aspects to be studied in each lesson. This includes content, examples and illustrations.	The teacher indicates the aspects s/he considers to be important but accepts the learners' suggestions. Learners may be encouraged to suggest examples or narratives to illustrate a topic.	The teacher makes a full list of contents to be studied – allows learners to make a selection from it. There is great scope for the introduction of learners' own narratives.	The teacher asks the learners to suggest the contents to be studied. There is very wide scope for the introduction of learners' own narratives.

Framing over sequencing

It appeared that Mrs. Gaba had determined the sequence of the lesson herself and that she had designed/ accessed worksheets to facilitate this process. Mrs. Gaba introduced the lesson by asking the learners to close their eyes while she described the problem she wanted them to solve. She moved the lesson along by asking relevant questions that would lead them to the point where they could tackle the first work-sheet. In this lesson the framing for sequencing was coded F^{++} as the teacher determined the sequencing of content.

Table 16: Discursive rule – Sequencing criteria: instrument of analysis

Indicator	F ⁺⁺	F ⁺	F ⁻	F ⁻
Doing tasks or activities	The sequencing of tasks follows the order decided by the teacher.	The sequencing of tasks follows the order decided by the teacher but can be altered.	The sequencing of tasks follows the order planned by the learners, but guided by the teacher.	The sequencing of tasks follows the order planned only by the learners.

Framing over pacing

Here again, the teacher determined what was to happen in the classroom. The teacher controlled the pace from the start of the lesson. She determined the direction of the discussion (even when a learner answered that one uses a spade to measure and she quickly responded to this) and the amount of time taken with each task given. However, because she was flexible with regard to the amount of time spent on each discussion, the framing over pacing was coded as F⁺.

Table 17: Discursive rule – Pacing criteria: instrument of analysis

Indicator	F ⁺⁺	F ⁺	F ⁻	F ⁻
Determining the pacing of the lesson	The time planned for each part of the lesson is decided by the teacher and rigorously adhered to.	The teacher allocates time for completing tasks but extra time is allowed when needed.	The learners determine the time needed to explore texts but the teacher presses them to finish.	There is no time determined for the exploration of texts. The time depends on learners' pacing and there is no pressure from the teacher.

Framing over evaluation

In this lesson, the teacher referred many of the learners' responses to her questions to the other learners to evaluate. Very rarely did the teacher decide to respond to learners' answers herself. She almost always asked the class whether they agreed with a particular learner's answer. Even when they disagreed she asked them to give the correct answer. When some group leaders gave area measurements in cms rather than cm² she first allowed all leaders to answer before asking the class which of the two versions were correct. When a learner answered that cm² was correct the teacher emphasised this by asking the class what unit was used when expressing area. Despite the teacher referring to the learners to indicate whether a response was correct, she

always ensured that the correct responses were verbalised and endorsed by her. The framing over evaluation was coded F^{++} .

Table 18: Discursive rule – evaluation criteria: instrument of analysis

Indicator	F^{++}	F^+	F^-	F^-
In giving answers	The teacher makes clear the evaluative criteria. The teacher prescribes solutions and corrects learners' mistakes.	The teacher gives prescribed solutions but allows different solutions to be presented. Learners' mistakes may be corrected.	The teacher allows the learners to formulate their own solutions but will assist when it is required.	The teacher does not make clear the evaluative criteria. No solutions are prescribed and learners' mistakes are not corrected.

The hierarchical rules

In this classroom, the framing over hierarchical rules between teacher and learners was coded F^+ . The teacher randomly chose who would answer the questions. There was, of course, occasion where all group leaders were allowed to answer. On other occasions the teacher allowed certain learners to venture answers. At no stage were all learners allowed to give answers or initiate discussion.

Table 19: Hierarchical rules between teacher and learners: instrument of analysis

Indicator	F^{++}	F^+	F^-	F^-
Classroom communication	The teacher controls classroom order with no room for learner input.	The teacher controls classroom order with an occasional interaction between teacher and learners.	An open classroom interaction between teacher and learners but a vertical relation is clearly evident.	A permanent open interaction exists between teacher and learners.

Summary of framing relations in Mrs. Gaba's classroom

In Mrs. Gaba's lesson, the framing ranged from F^{++} to F^+ . The framing over sequencing and evaluation was coded F^{++} while the framing over selection, pacing and the hierarchical rules was coded F^+ . The teacher started the discussion about building another classroom, then directed the course of the discussion from there. She asked leading questions and responded only to the answers she was looking for to further her discussion. After she had completed the first part of the discussion, she handed out worksheets and allowed the learners time to complete them. She gave them approximately fifteen minutes to complete the worksheets. Here, again, the teacher was in control, determining what should be done and how long it should take

the learners to complete the task. She also determined what responses were acceptable and what she would ignore.

Table 20: Summary of framing relations in Mrs. Gaba's classroom

Framing	
Selection	F^+
Sequencing	F^{++}
Pacing	F^+
Evaluation	F^{++}
Hierarchical rules	F^+

5.4 Framing relations in the other classes

Having completed a detailed description of two of the fourteen lessons in the study, I shall now move on to give a short description of each of the other twelve lessons observed, together with a summary of the framing conditions in those classes.

5.4.1 Mr. Tutu's Lesson (classroom 1)

The lesson was about expanded notation involving decimal fractions. The lesson started with feedback of the work given on the previous day. The learners were called to the board to write down the answers they had got. When they were done, the teacher went through the answers written on the board, explaining the steps as he went along. He asked some learners to explain what they had done but, to a large extent, did most of the explaining himself. There were no examples of the 'everyday' brought into the lesson. Because Mr. Tutu adopted a teacher-centred approach, he alone determined the selection, sequencing and pacing of the lesson. He also evaluated the correctness of the learners' responses and when and who would respond to his questions and instructions. Therefore, the framing in this lesson was considered to be very strong over all the discursive rules.

Table 21: Summary of framing relations in Mr. Tutu's classroom

Framing	
Selection	F^{++}
Sequencing	F^{++}
Pacing	F^{++}
Evaluation	F^{++}
Hierarchical rules	F^{++}

5.4.2 Mrs. Nqolobe's Lesson¹⁹ (classroom 3)

This teacher worked with addition and subtraction of fractions. She started off by sketching a scenario where a mother cut a cake into eight parts. She used this example to introduce the idea of adding fractions. From there, she moved on to describing how to add fractions with different denominators. She explained that the denominators could be changed by finding the lowest common denominator (LCD) or by finding equivalent fractions.

The teacher went on to subtraction of fractions. She returned to her earlier example of the cake, then went through the same discussion about the LCD and equivalent fractions. She then wrote a few questions on the board and asked the learners to do them using either of the methods that she had previously discussed.

Thus, in this class, the teacher started off with an example of the 'everyday' then moved on to the algorithm to explain the concept before giving the learners a few questions to consolidate the concept. When the learners had a problem with one of the questions in the textbook – ' $1 + \frac{1}{2}$ ', Mrs. Nqolobe referred them to her example saying, "It's the same way as I did it with the cake where I said 8 over 8 is equal to 1."

Despite the teacher starting the lesson with an example of the 'everyday', the framing over all of the discursive rules was coded as very strong because the teacher determined the content of the lesson, the examples that would be used, the sequencing and pacing of the lesson, as well as the evaluation criteria. Mrs. Nqolobe also determined the hierarchical rules, only allowing learners to speak when they put up their hands.

Table 22: Summary of framing relations in Mrs. Nqolobe's classroom

Framing	
Selection	F ⁺⁺
Sequencing	F ⁺⁺
Pacing	F ⁺⁺
Evaluation	F ⁺⁺
Hierarchical rules	F ⁺⁺

¹⁹ Mr. Zamela is classroom 2

5.4.3 Mr. Mfiki's Lesson (classroom 4)

The whole of this lesson was devoted to the correcting of homework. The learners had been given a worksheet that required them to convert lengths from centimetres to kilometres and vice versa. The lesson consisted largely of learners doing solutions on the chalkboard. Towards the end of the lesson the teacher distributed photocopies of a page from *Mfa Grade 7 LAB* which required that they measure the length of a piece of knotted string. They were to go home and make different geometrical shapes using string or wool. They were required to draw the shapes in their books and give the lengths of the string or wool used for the shapes.

In this lesson, the teacher determined who would do the solutions on the chalkboard, when they would be done and in what order they would be done. After the solutions had been done, the teacher determined the next exercise to be done and when it would be done. At no stage were the learners consulted on anything that was happening in the lesson. Thus, the framing over all the discursive rules was coded as very strong.

Table 23: Summary of framing relations in Mr. Mfiki's classroom

Framing	
Selection	F ⁺⁺
Sequencing	F ⁺⁺
Pacing	F ⁺⁺
Evaluation	F ⁺⁺
Hierarchical rules	F ⁺⁺

5.4.4 Mrs. Hlohlo's lesson (classroom 5)

The lesson was about decimal fractions and was a continuation of a previous lesson. The lesson started with the teacher referring the learners to page 131 of *Mfa Grade 7 LAB*, where they were required to convert ordinary fractions to decimal fractions. There were two methods of doing this, and the teacher demonstrated both methods before asking the learners to indicate which of the methods they preferred. After this, the teacher asked two learners to convert the given fraction into a decimal fraction by using the two different methods. Both learners, when doing the conversion on the board, emulated the teacher by talking with the class while doing the conversion. The question required the conversion of $\frac{2}{5}$ and the learner asked, "2 multiplied by 2" and the class answered "4". He then asked "2 multiplied by 5" and the class said "10".

The second learner, using the alternative method of division went so far as to ask the class, after having arrived at the answer, whether there was a remainder (just as the teacher had done). The rest of the lesson continued in the same vein, with learners going to the board and completing the answers. They also dealt with the recurring decimal with the teacher explaining how it was written.

In this lesson, the framing over selection and sequencing was very strong because the learners had no say in these matters. Since the teacher allowed the learners to emulate her and, in so doing, relinquish some control while they were doing the solutions on the board, the framing over pacing, evaluation and hierarchical rules was coded as strong i.e. F^+ .

Table 24: Summary of framing relations in Mrs. Hlohlo's classroom

Framing	
Selection	F^{++}
Sequencing	F^{++}
Pacing	F^+
Evaluation	F^+
Hierarchical rules	F^+

5.4.5 Mr. Rini's lesson (classroom 6)

The lesson was about converting ordinary fractions to decimal fractions. The teacher started the lesson by asking the learners for an example of where an ordinary fraction can be changed into a decimal fraction. A learner responded by saying 'Half.' The teacher asked how it could be changed into a decimal fraction and was told that the number had to be multiplied by 5. He asked the class why this had to be done and another learner said that it was because they wanted to 'get any power of ten'. The teacher then wrote the numbers 10; 100; 1000; 10000 on the board saying 'ten to the power of 1, 10 to the power of 2 etc.' he told them that they could change any fraction into a decimal fraction and then started discussing percentages.

Mr. Rini asked the class where they had heard the term 'percentage' and some learners called out 'salary' and 'petrol'. He mentioned increase and decrease to them and wrote *increase in salary* and *decrease* and *increase in petrol* on the board. He said, "The price of cars were reduced or increased by 7%" and then wrote the sign '%' on the board. He asked them to define 'percentage' and a learner said 'sixty over a

hundred'. The teacher wrote this on the board and asked how he should write 13%. He prompted them by saying '13 over ?' He defined percentage as 'anything over 100'. He then asked the learners to do activity 6 on page 132 in the *Mfa Grade 7 LAB*.

Activity 6 dealt with the concept of 50% and 100%. There were a few pictures and the learners had to explain what 50% meant in each of the illustrations. Instead of allowing the learners to complete the activity on their own, the teacher used the illustrations to teach.

The third question of the activity required the learners to write 50% as a decimal. He asked the class what the answer was and a learner said that it was 0,05. He asked the class whether she was correct and they chorused that she was not. Another learner answered '0,5' and the teacher wrote it on the board, again asking the class if she was correct. When some learners answered that the answer was wrong, the teacher wanted them to explain why they felt that the answer was wrong. They replied that the answer should be 0,50. The teacher replied that the additional zero did not change the value of the number. He then moved on to discussing the next question.

Mr. Rini discussed all the questions, then used the class itself as an example. He told the class that if there were 43 girls in the class and no boys then they could say that 100% of the class were girls. But, since there were 24 girls and 29 boys they could not say that there were 100% girls.

The teacher then went directly to the exercise on page 134 of the textbook, ignoring the notes as well as activity 7 on page 133. He asked the class to do question 1 of the exercise in class. He started discussing the answers before all of them could finish. At times he allowed the learners to chorus answers while at other times he asked individuals to give answers. He ended the lesson by summarising what they had done, referring to the increase in the price of petrol and markdowns at sales.

In Mr. Rini's classroom the framing over all the discursive rules was very strong, with the teacher not allowing the learners control in the way the lesson progressed. Despite the teacher having asked the learners to give an example of where they had heard of percentage being used, the coding of framing over selection was coded F⁺⁺ because he

did not use the examples that were offered by the learners. Similarly, the framing over evaluation was very strong because, although the teacher sometimes allowed the learners to say whether an answer was correct or not, he ultimately decided.

Table 25: Summary of framing relations in Mr. Rini's classroom

Framing	
Selection	F ⁺⁺
Sequencing	F ⁺⁺
Pacing	F ⁺⁺
Evaluation	F ⁺⁺
Hierarchical rules	F ⁺⁺

5.4.6 Mrs. Mthethwa's Lesson (Classroom 7)

The lesson was a continuation of the previous day's lesson on measurement. The teacher started the lesson by distributing photocopies of pages 67, 68 and 69 of the *Mfa Grade 7 LAB*. She then revised the work done the previous day and asked learners to explain what they had done. She cued them by saying, "We used...?" to which the class chorused, "String." She next asked them how they had used the string. A learner tried to explain, but she was not able to do so, so the teacher asked her to demonstrate using her notebook. After this demonstration, the teacher asked the class what else they had used for measuring to which another learner answered that they had used tracing paper. The teacher asked the learner to explain how he had done this. He explained that he had used line segments to obtain units of length. These units of length were counted to get an answer.

Mrs Mthethwa continued discussing the work they had done the previous day, getting the learners to describe what they had measured, how they had done it and the reasons for their different answers. After one such exchange, the teacher said, "Which means that some other people drew long line segments and others drew ...?" The class chorused, "Short line segments."

Later in the lesson, after another discussion about measuring, Mrs. Mthethwa claimed, "In other words, we can measure with a string; we can see which one is bigger than the other even by using a string. Did we use a ruler for this exercise?" The class

answered that they did not and the teacher continued, “We didn’t use a ruler so we can measure by using anything.”²¹ Right, let’s come to point number two.”

‘Point number two’ involved the learners measuring the heights of their desks using their pencils. Because the pencils were of different lengths, the learners gave different answers in their feedback. The teacher concluded, pointing to the longest pencil, “So that is why we are having few points here. Can you see that? So if we are having a longer unit of length so we use this pencil as our unit of length. Pencil C was the shortest that is why it has more units.” Mrs. Mthethwa then told the class to write a sentence about what they had “found out” through doing the exercise. “Write – If I measure with a larger pencil I get few or many points.”

After a textbook exercise²² that entailed measuring the length of a matchstick using rulers where the calibrations were different, there was a difference of opinion about the length of the matchstick that they had to measure. The teacher asked the class if there were still some of them who felt that the answer was 5 units²³. A few learners held up their hands so she asked one of them to show her on the board how he had got his answer. He went to the sketch and started counting the markings from 4 to 8. The teacher asked him in what year he was born. He said 1985. She wrote this on the board. She asked him when he was a year old. He said 1986. The teacher wrote this on the board as well. She asked him if he was not one year old in 1985 and he said that that was 1986. She pointed out that “point 4” was the “beginning” but he could not understand. She made a mark on the floor and asked him to take a few steps. She asked him how many steps he had taken from the “beginning”. The answer he gave was one more than the number of steps he had taken. She made him do it again but he could still not understand what she was trying to say. She tried to explain, “You don’t count where you start; you only count when you have moved. From here²⁴ you start counting.” She went back to a sketch on the board and drew ‘loops’ from 4 to 8 while saying, “Do you understand? When you start to move you start to count – 1, 2, 3, 4

²¹ ‘Anything’, although not clarified by the teacher, is probably to be understood here to mean ‘that which can be used to determine differences in length’. This is significant when discussing language use in the mathematics classroom.

²² See appendix 2 and p. 59 above.

²³ The correct answer was four.

²⁴ This is confusing because she points to the start, which she doesn’t want him to count.

points.”²⁴ This was reinforced in the next discussion about measuring the length of the same matchstick while using a different unit of length.

The teacher said, “Our units of length are not the same that’s why you have different measurements. Next time we will carry on with measurement.” These were her closing remarks for the lesson.

In Mrs. Mthethwa’s classroom the framing over selection and sequencing was coded as very strong. The learners were not allowed any input in the content or examples in, or order of, the lesson. Mrs. Mthethwa allowed the learners some leeway in the pace of the lesson as well as what was a correct response to her questions, thus the framing over these two rules was not considered to be very strong. Because the teacher allowed the learners to answer and to enter into a discussion about their responses, the framing over hierarchical rules was coded as weak.

Table 26: Summary of framing relations in Mrs. Mthethwa’s classroom

Framing	
Selection	F ⁺⁺
Sequencing	F ⁺⁺
Pacing	F ⁺
Evaluation	F ⁺
Hierarchical rules	F ⁻

5.4.7 Mr. Manyela’s Lesson (classroom 8)

The lesson topic was “Area and Perimeter” and appeared to be a continuation of a previous lesson. The teacher started the lesson by handing out photocopies of page 72 of the *Maths for all* textbook. The page contained four figures, two of them had square grids and the other two had triangular grids. He explained that they were to determine which of the two figures were bigger. He asked the learners to do question 1 first before going on to the second question. He asked them to work in groups.

After a while, he checked whether all the groups were ready then went to the board and, asking each group for their answers, wrote them on the board. The teacher was the one who initiated the discussion, asked questions and checked answers. He

²⁴ This episode is an example of cardinal-ordinal confusion.

controlled what was happening in the class – the content, the pace, the sequencing and evaluation, hence the framing over all the discursive rules was coded as very strong.

Table 27: Summary of framing relations in Mr. Manyela's classroom

Framing	
Selection	F ⁺⁺
Sequencing	F ⁺⁺
Pacing	F ⁺⁺
Evaluation	F ⁺⁺
Hierarchical rules	F ⁺⁺

5.4.8 Mr. Welani's lesson (classroom 9)

This lesson topic was the same as the one in Mr. Manyela's class. Here again, the teacher had photocopied page 72 from the *Mfa Grade 7 LAB* and asked the learners to work through the activity. This teacher also treated the topic as a counting exercise rather than an exploration of the concepts of area and perimeter. The difference in this lesson was that the teacher talked the learners through the activity (as in whole class teaching) without giving them much of a chance to settle down and get to grips with the activity. By the end of the lesson, there were a number of learners who had not completed their work. As in Mr. Manyela's lesson, this teacher also determined what had to be done, the time allowed to complete the task, the sequence of the work and what responses were acceptable. Here, too, the framing over all the discursive rules was considered to be very strong.

Table 28: Summary of framing relations in Mr. Welani's classroom

Framing	
Selection	F ⁺⁺
Sequencing	F ⁺⁺
Pacing	F ⁺⁺
Evaluation	F ⁺⁺
Hierarchical rules	F ⁺⁺

5.4.9 Mrs. Xhapa's Lesson (classroom 10)

The lesson was an introductory lesson on area. The teacher used page 75 of the *Mfa Grade 7 LAB*. Despite this being an introductory lesson on Area, the teacher did not start on page 72 of the textbook – the start of the section on area – although the class was working from the books rather than photocopies as the other two classes – classes 8 and 9 – had done.

The teacher introduced the concept 'area' by getting the learners to rub their hands over the covers of their workbooks. She informed them that the surface of an object was its area. She wrote her definition of "area – the amount of surface of the closed shape" on the board. She also said, "Now when we talk about the area, we are talking about the surface." She then got them to point to the surface of their desks and said, "Do you understand when we are talking about the area we are talking also about the ... surface." She asked someone to show her the surface of the chalkboard then told the class that there were certain rules that they needed to follow when working with area. She reminded them about their discussion about standard units. She told them that the standard unit for area is the square centimetre and wrote it on the board.

Mrs. Xhapa told the learners to measure the blocks in the first figure on page 75. Next, she got them to count the rows in the first figure but they were not sure what rows were. She explained it to them. After a while, she moved on to determining the area of the figures. She asked a learner to use a book to show the class what was meant by length and breadth. She described length as the "larger side" and breadth as the "shorter side" of a rectangle. On the board she wrote – Rules: Area of rectangle

$$\begin{aligned} &= L \times B \\ &= 6\text{cm} \times 4\text{cm} \end{aligned}$$

She then explained the algorithm and emphasised that the answer had to be written in square centimetres. The class was asked to calculate the answers for numbers 3 and 5 of the exercise. She gave the class time to complete their work then asked learners to write their solutions on the board. While they did this, the teacher got the class to repeat what was being done on the board. She also reminded them which was the length and which the breadth of a rectangle.

In Mrs. Xhapa's class the framing relations was coded as very strong over all the discursive rules. The teacher was in control, directing everything that was happening in the lesson. She had determined the content, sequencing and pacing of the lesson and she also prescribed the method of presenting solutions.

Table 29: Summary of framing relations in Mrs. Xhapa's classroom

Framing	
Selection	F^{++}
Sequencing	F^{++}
Pacing	F^{++}
Evaluation	F^{++}
Hierarchical rules	F^{++}

5.4.10 Mrs. Mgaba's Lesson (classroom 11)

The lesson appeared to be a continuation of a previous one on measurement. The teacher asked the learners for examples of where measurement could be used. They responded with numerous examples, the teacher adding to their contributions. She then handed out worksheets and measuring tapes for each group. The worksheet required learners to indicate the unit of measurement they would use to measure certain given objects, estimate the measurement, write down the actual measurement and calculate the difference between the estimated and actual measurements. Some of the learners were not sure what to do so the teacher went over the instructions again. For the rest of the lesson, the learners went about the task of measuring and recording the measurements of the objects listed on the worksheet. Unfortunately, the measuring tapes that the learners were using were calibrated with inches on the one side and centimetres on the other. Some of them were not aware of this and were measuring in inches but recording it as centimetres. They also made the mistake of measuring their heights by placing the tape along the contours of their bodies rather than measuring vertically straight.

In Mrs. Mgaba's lesson, the hierarchical rules were very strong until the learners started measuring the objects mentioned in the worksheet. There was then a 'looser' relationship between the teacher and her learners. Therefore, the framing over hierarchical rules was F^+ . The teacher had decided on the lesson content and prescribed the method of presenting solutions so the framing over selection and evaluation was very strong. Because the learners could choose what part of the worksheet they would complete first, the sequencing is coded as F^+ . There was no time limit given in which to complete the task so the framing over pacing was coded as very weak²⁵.

²⁵ See p.50

Table 30: Summary of framing relations in Mrs. Mgaba's classroom

Framing	
Selection	F^{++}
Sequencing	F^+
Pacing	F^-
Evaluation	F^{++}
Hierarchical rules	F^+

5.4.11 Mr. Maqoko's Lesson (classroom 12)

The lesson was a continuation of previous lessons based on fractions. The teacher started the lesson by introducing addition of fractions using the everyday example of a loaf of bread. He discussed how to calculate the answers to $\frac{1}{2} + \frac{1}{2}$ and $\frac{1}{2} - \frac{1}{4}$. He then chose the example $\frac{3}{4} + \frac{6}{7}$ and, without contextualising the problem, asked the class how to add the two numbers. A learner answered by adding the numerators and denominators to get the answer $\frac{9}{11}$. The teacher asked the class whether they agreed with the answer and they confirmed it. He referred them to the previous two examples he had done and applied their method. They realised that their method was wrong. The teacher showed them the traditional method of determining the LCD (lowest common denominator) then how to work with the algorithm.

Mr. Maqoko moved on to discuss improper fractions, defining them as "a fraction with denominator smaller than the numerator." He showed them how to change these into mixed fractions then asked a learner to do one on the board. He told her to ask questions while doing the calculation and the class would answer. After this a few more learners went to the board to do a question. When one learner was unable to get to the answer, the teacher remarked, "The problem with you is you don't want to follow the pattern. [...] You see how the others are doing it but you won't follow. You don't want to ask questions. You don't learn from what that person is saying."

After a few more responses from the class, the teacher retorted, "Listen, listen, the purpose of your finding out the common denominator is you want to know which denominator can all these (pointing at the board) denominators go into. Then go and ask how many times does this and this one go into this one. Because you said all of them can get into this denominator. Are we all together?" The class chorused, "Yes." The teacher then continued the lesson.

In Mr. Maqoko's lesson, the framing was coded as very strong over all of the discursive rules. He controlled the selection, sequencing, pacing and hierarchical rules in the class. The teacher gave the learners the opportunity to decide on whether a learner's response was correct or not but since he adjudicated this, the framing over evaluation was coded as F^{++} .

Table 31: Summary of framing relations in Mr. Maqoko's classroom

Framing	
Selection	F^{++}
Sequencing	F^{++}
Pacing	F^{++}
Evaluation	F^{++}
Hierarchical rules	F^{++}

5.4.12 Mr. Ketane's Lesson (classroom 13)

The lesson was an introduction to fractions although it was not the first time that the learners had dealt with the topic. This is evidenced by their knowledge of terminology such as 'LCD', 'numerator' and 'denominator'. The learners were given a worksheet which required them to shade a section of a figure and to write the shaded part as the numerator of a fraction. Thereafter, they had to write down the numerator from a diagram that was partly shaded. Finally, they had to add the fractions that they had derived from the diagrams. To demonstrate the method of addition of fractions, the teacher used as an example an apple cut into 8 parts and an orange cut into 4 parts. He talked them through the example before asking them to complete the exercise in groups. After a while he asked one of the groups to demonstrate how they had got their answer. The scribe of the group went to the board and talked them through the steps as the teacher had done earlier. For homework, the learners had to write down two fractions which they were to give to their partners to add the next day.

Because the teacher had determined the lesson topic, sequencing and pacing of the lesson without any input from the learners, the framing over these discursive rules was coded F^{++} i.e. very strong. The framing over evaluation and hierarchical rules were coded F^+ because the teacher allowed one of the learners to 'conduct' a part of the lesson.

Table 32: Summary of framing relations in Mr. Ketane's classroom

Framing	
Selection	F ⁺⁺
Sequencing	F ⁺⁺
Pacing	F ⁺⁺
Evaluation	F ⁺
Hierarchical rules	F ⁺

Table 33: Summary of framing relations in the classrooms

Framing	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Selection: Learning contents	F ⁺⁺	F ⁺	F ⁺⁺	F ⁺⁺	F ⁺⁺	F ⁺⁺	F ⁺⁺	F ⁺⁺	F ⁺⁺	F ⁺⁺	F ⁺⁺	F ⁺⁺	F ⁺⁺	F ⁺
Sequencing: Doing tasks or activities	F ⁺⁺	F ⁺⁺	F ⁺⁺	F ⁺⁺	F ⁺⁺	F ⁺⁺	F ⁺⁺	F ⁺⁺	F ⁺⁺	F ⁺⁺	F ⁺	F ⁺⁺	F ⁺⁺	F ⁺⁺
Pacing: Determining the pacing of the lesson	F ⁺⁺	F ⁺	F ⁺⁺	F ⁺⁺	F ⁺	F ⁺⁺	F ⁺	F ⁺⁺	F ⁺⁺	F ⁺⁺	F ⁻	F ⁺⁺	F ⁺⁺	F ⁺
Evaluation: In giving answers.	F ⁺⁺	F ⁺⁺	F ⁺⁺	F ⁺⁺	F ⁺	F ⁺⁺	F ⁺	F ⁺⁺	F ⁺⁺	F ⁺⁺	F ⁺⁺	F ⁺⁺	F ⁺⁺	F ⁺⁺
Hierarchical rules: Classroom communication	F ⁺⁺	F ⁺	F ⁺⁺	F ⁺⁺	F ⁺	F ⁺⁺	F ⁻	F ⁺⁺	F ⁺⁺	F ⁺⁺	F ⁺	F ⁺⁺	F ⁺	F ⁺

5.5 Summary of framing relations in the classrooms

In the classes observed, the framing over all the discursive rules was generally strong, ranging between F⁺⁺ to F⁺. The only exceptions were in classroom 11 where the framing over pacing was F⁻, and in classroom 7 where the framing over hierarchical rules was F⁻. In eight of the classes the framing relations were very strong over all the discursive rules. In one class the framing relations were very strong over three of the discursive rules and in five classes the framing relations were very strong over two of the discursive rules. There were no classes where the framing relations were weak over all the discursive rules.

For framing over selection, all but two of the classes had very strong framing of F⁺⁺. The exceptions were classrooms 2 and 14 where the framing over selection was F⁺. For framing over sequencing the framing was also generally very strong, with the exception being in classroom 11 where the framing was F⁺. In nine of the classes, the

framing over pacing was very strong, F^{++} . In four of the classes (2, 5, 7, 14) the framing over pacing was strong, while in one class (11) the framing was very weak – F^- . An analysis of the framing over evaluation shows that in eleven of the classes the framing was very strong and in three of the classes (5, 7 and 13) the framing was strong. In eight of the classes the hierarchical rules were very strong, in five of the classes the framing was strong and in the remaining class the hierarchical rules were weak.

5.6 Conclusion

Considering tables 6 (on page 56) and 33 (on page 85), we can see that some of the teachers have employed the ‘everyday’ but within a strongly framed environment. Teachers have introduced everyday settings, and on some, albeit rare, occasions invited learners to do the same. The policy documents discussed in chapter 1, suggest that the recruitment of the ‘everyday’ is not only a route to mathematical understanding, but also a means to make the ‘everyday’ accessible in mathematical terms. Although sometimes explicit, other times implicit, these policy documents suggest the use of the ‘everyday’ as part of a “learner-centred” (i.e. weakly framed) classroom environment. As these results suggest, in the fourteen classrooms studied, the ‘everyday’ was being recruited, but within very strongly framed classrooms, with interesting implications for the teaching and learning of mathematics.

CHAPTER 6. DISCUSSION AND CONCLUSION

6.1 Introduction

In this chapter, I shall discuss my findings of the study in the light of policy imperatives and the views expressed by the authors discussed in the literature review. In other words, I shall interrogate the findings from the perspective of the questions raised both by policy and mathematics educators. In this way I shall determine the extent to which, and for what purpose, the 'everyday' was employed in mathematics classrooms. I shall point out what I consider to be the limitations of the research as well as the questions raised by the research findings. I shall conclude the chapter with recommendations for further research.

The research question which forms the focus of this study is:

"How, if at all, is the 'everyday' employed in the teaching of Grade 7 Mathematics in fourteen ex-DET classrooms in the Western Cape?"

6.2 Discussion of findings

When we look at the classroom observation schedule on page 56, we note that in twelve of the fourteen classrooms the learners were seated in groups – an arrangement that lends itself to the relaxation of framing relations in the classroom. In ten of the fourteen lessons observed, reference was made to the 'everyday'. In eight of those lessons the references were made by the teachers and in two of the lessons, 6 and 14, references also came from learners. However, in those cases, the references were in response to prompts from the teachers. Also, because the examples of the 'everyday' were introduced by the teachers the learners were, to a large extent, not invited to contribute to the learning process. The teachers selected the examples, introduced them to the learners and expected them to work with those examples. The result of this practice is illustrated in the two lessons chosen for discussion, namely classrooms 2 and 14. In classroom 2, the examples introduced were firstly not proffered by the learners and secondly, were so removed from their everyday experience that they were either reluctant or unable to contribute to the topic of discussion. On the other hand, the teacher in classroom 14 selected an example so 'close to home' that there was animated discussion of the topic. So, despite the 'everyday' being introduced by

the teacher, the immediacy of the problem presented, coupled with the leading questions posed by the teacher, allowed the learners room for participation. In the other eight classes, the teachers introduced their lessons with an example or two, but did not ask the learners to contribute further examples. They recruited the 'everyday' to illustrate the topic they were introducing, then moved on to more decontextualised questions. In the remaining four lessons observed, the 'everyday' was not recruited at all. In classroom 1 and 4 the learners were asked to present their answers on the board and the teachers described the steps the learners had gone through to arrive at their answers. In classroom 5 the teacher gave the learners two methods for converting ordinary fractions to decimal fractions and then asked a few of them to do some conversions on the board. In classroom 8, the teacher had the learners working in groups then asked each group to present its answers to the class.

In eight of the fourteen lessons observed, more than half of the lessons, the framing was very strong over all the discursive rules. In all the classrooms observed, the framing was generally strong, ranging between F^{++} to F^+ . The only exceptions were in classroom 11 where the framing for pacing was F^- , and in classroom 7 where the framing for hierarchical rules was F^- . Classroom 11 was the only class where there was no pressure from the teacher to get the learners to complete their task within a given time. The learners were also allowed to complete the given task in the order they chose. Thus, the coding over sequencing was F^+ . The coding for hierarchical rules was also F^+ because the relationship between the teacher and her learners was more relaxed once they started working on the given worksheet. In classroom 7, the coding for framing over hierarchical rules was F^- because the teacher allowed the learners to discuss their responses with her.

In classroom 13 the evaluation and hierarchical rules were coded F^+ because the teacher allowed one of the learners to 'conduct' a part of the lesson. In classroom 5 the coding for the discursive rules pacing, evaluation and hierarchical rules was given as F^+ because the teacher allowed some of the learners to emulate her while doing solutions on the board, thus relinquishing some control of these criteria.

In classrooms 2 and 14 we find a coding of F^+ over three of the discursive rules. The selection was coded F^+ because both teachers invited the learners to contribute

examples in the lesson. The discursive rule pacing was coded F⁺ because the teachers were more flexible when it came to the time needed to complete tasks. The hierarchical rules were coded F⁺ in the two classrooms because the teachers allowed the learners to interact with them, albeit with very different results.

If we look at classrooms 2 and 14, we note that the coding of the framing relations in the two classrooms is the same despite there having been more interaction between the teacher and learners in classroom 14. One would have expected a different coding at least with regard to the hierarchical rules. However, the interaction is not so much a consequence of the framing relations, but rather, the extent to which the learners could identify with the example of the 'everyday' recruited in the lesson. The teacher introduced her lesson on area and perimeter by talking about building an additional classroom at the school. She engaged the learners by asking them leading questions about the construction. Because the learners could relate to the problem posed, they immediately started offering suggestions, which got them involved in the lesson. This did not happen in classroom 2 because the learners did not appear to be able to relate to the problem posed namely, to find examples of negative numbers.

The framing conditions prevalent in the fourteen classes observed in the study are not in alignment with the aims expressed in the White Paper on Education and Training that rejects the "rigid division between 'academic' and 'applied', 'theory' and 'practice', 'knowledge' and 'skills', 'head' and 'hand'" (DOE, 1995: 15), and that places emphasis on "learner-centredness". These policy priorities call for framing conditions that are generally weak over all of the discursive rules, except perhaps over selection and evaluation criteria. In order for the learners to be able to identify with the lesson content, policy argues, they should be allowed to introduce their experiences into the classroom setting. They should be allowed to determine the sequencing and pacing of the lessons as well as the ways in which solutions and/or answers are to be formulated and presented. To facilitate this process, hierarchical rules need to be weak in order that the learners feel free to communicate with both their peers and the teachers. This is not in contradiction with Neves and Afonso (2002) who point out that the teachers need strong framing over selection of learning content, as they would know better what concepts the learners need to know. This

does not, however, imply that the learners should be denied the chance to contribute to the learning material relevant to the concepts to be learnt.

In the literature review, a number of authors argued in favour of employing the 'everyday' in the mathematics classroom. Their reasons range from Ensor (1997), Maier (1991) and Muller & Taylor's (1995) arguments that it could serve as a bridge to access the esoteric, to those such as D' Ambrosio (1981) and Carraher (1985) who argue that the learners have a natural ability to do mathematics – an ability that is destroyed or, as Masingila (1993) puts it, devalued when they get into the school environment. This devaluing of their ability to do mathematics can be countered by allowing them to introduce their own experiences into the lessons. Others such as Cockcroft (1994), Bishop (1991) and Núñez et al (1999) argue that the everyday experiences of the learners should be used as a basis to develop mathematical concepts. These everyday experiences need to be allowed into the classroom so that they can be effectively utilised in the development of the mathematical concepts to be learnt. In the classrooms observed in this study, ten of the teachers introduced the 'everyday', but the examples used were not from the everyday experiences of the learners. They were examples initiated by the teachers as an introduction to the teaching of algorithms. The teachers did not give learners the opportunity to introduce their own experiences. In one class (no. 6), where the teacher asked the learners where they had heard the term percentage, some learners responded, but he did not ask them to offer an example, nor did he expand on the reference made by the learners.

This leads us to the next question that was posed by the literature review. The question concerns what is required of teachers when using the 'everyday' in the mathematics classroom.

As was pointed out earlier, the 'everyday' was not employed in a way conducive to the kind of learning envisaged in the new curriculum. Taylor & Vinjevold (1999) admit that teachers should now play a more covert role in the classroom, but at the same time, far greater demands are made on the teacher. Wubbels et al (1997) believe that teachers should be prepared for this different curriculum where they are expected to build on the knowledge that the learners possess. To achieve this, both Wubbels et al (1997) and Masingila (1993) believe that the teachers should listen to their students

in order to understand how they think. Manouchehri & Goodman (2000) add that the teacher should create an environment where mathematical discourse takes place. In order for this to happen, the teacher should, logically, have a sound mathematical knowledge. If one looks at the demands made on the teacher in implementing this new approach, it is clear that there needs to be a relaxing of the hierarchical rules in the classroom. The hierarchical rules in the classes were generally strong with eight classes coded F^{++} , five coded F^+ and only one coded F . In the class coded F there was a lot of interaction between the teacher and the learners, but there still existed a vertical relationship between them and there was no doubt that the teacher was in control.

This leads us to the problems that arise from the implementation of the 'everyday' in the mathematics classroom. The first problem that is immediately apparent is that raised by Adler et al (2000). In their study they admitted that part of the reason for the teachers in their study not being able to adequately complete the integration task that was given to them was due to the way they had been taught mathematics at school.

Wubbels et al (1997) believe that this is only part of the problem. In their study, the student teachers had been exposed to "realistic mathematics" as students, but not as teachers. This could mean that they do not fully understand the underlying principles that would make them effective teachers. Nyabanyaba (1999) concurs with this. In fact, he argues that teachers should be trained for what he calls "this sophisticated task" (p. 23).

As was indicated earlier, the data used for this study was collected in the first year that C2005 was implemented at grade 7 level i.e. 2000. This implementation occurred after the teachers had spent one afternoon at a MLMMS workshop. Just as in the cases of the teachers in the Wubbels et al (1997) and Adler et al (2000) studies, the teachers in this study, too, could not have been fully equipped for the task at hand.

If teachers are not adequately prepared for "this sophisticated task" the consequences could lead to a situation such as that highlighted by the Manouchehri and Goodman (2000) study where learners are exposed to a different level of mathematics because of the different strengths of their teachers. Atweh et al's (1994) study highlights one

of the problems that could arise where teachers are not aware of the pitfalls of the particular 'brand' of mathematics they present to their learners. Here, the teachers presented mathematics in a way that they perceived was suitable to the needs of their charges. The result was that one teacher prepared his learners for university while the other one prepared his learners for situations no more demanding than shopping.

Adler et al (2000: 10 – 11) claim that C2005 promotes the blurring of the boundaries between learning areas as well as the relaxing of the boundaries between school knowledge and everyday knowledge (a matter of classification). The argument here is that if the mathematical concepts that the learners need to acquire were couched in everyday settings (a matter of framing), the learners would more easily make sense of the concepts. Although they agree with this argument, the problem that they raise with this approach is that of access and equity. They warn that where a teacher, for example in a rural area, presents learners with only the kinds of problems they would be able to identify with in that setting, the teacher could, albeit unwittingly, restrict the learners' access to further study as was highlighted by the study conducted by Bernstein (1996). They do, however, add that they are not suggesting a reversion to a transmission pedagogy, but rather "cautioning against a pendulum swing that emphasises relevance and integration at the expense of conceptual mathematical knowledge and algorithmic and computational efficiency." (p. 11)

Westbury et al (1994: 34) state:

The calls for change in mathematics education, change in support of student attention to and success with mathematical problem solving, focus simultaneously on change in the ways teachers and students think about mathematics, and change in the ways students are helped to come to know the subject. First, "the notion that mathematics is a set of rules and formalisms invented by experts, which everyone else is to memorise and use to obtain unique, correct answers, must be changed." (Romberg, 1990. P. 472) Mathematics must be understood [...] as a language with signs and symbols and terms that help us investigate, reason, and communicate. Second, the process of teaching and learning also must shift from drill-and-practice, from rote learning of algorithms, to regular and sustained work with interesting problems.

6.3 Conclusions

If we look at the findings of this study in relation to its research question, we can see that it is not only important that the 'everyday' be introduced into mathematics lessons, but, more importantly, the manner in which this is employed. Firstly, if the learners are not allowed to introduce examples derived from their 'communal' experiences, they might not be able to relate to the problem to be solved.

Secondly, the problems presented should be solved in a manner with which they can relate, rather than the learners being presented with algorithms, the logic of which they might not always be able to understand. Lastly, the hierarchical rules should be relaxed to allow the learners to interact more freely with their teachers so that they can feel free to introduce their own problems into the mathematics classroom. At the same time, the learners should be able to communicate freely with the teacher, and each other, to remove any doubts they might have regarding a problem, and also increase their confidence in tackling unknown problems. The classroom set up, in most classes was conducive to the relaxation of the hierarchical rules because most of the classes had the learners seated in groups, but the framing relations worked against this.

Despite the fact that the 'everyday' was introduced into many of the lessons, it was introduced by the teacher, not by the learners. Also, the 'everyday' was recruited to introduce the application of algorithms rather than as a problem that the learners were to solve in their own creative way. There were very few opportunities for the learners to introduce their own examples or experiences. In two classes where the teachers invited examples, they were not recruited effectively. In Mr. Zamela's lesson the learners did not appear to know what negative numbers were, so they were unable to contribute. In Mr. Rini's lesson, he asked the learners where they had heard of percentages but when the learners answered, he did not ask them to elaborate, nor did he use the instances to sketch a scenario as an illustration of the topic he was dealing with. In the other two classrooms (11 and 14) where the teachers asked learners to cite examples of the everyday, the examples were not central to the lesson content.

As was mentioned earlier, the framing over selection was very strong in most of the classes. This is not necessarily a problem as was indicated by Neves and Afonso

(2002). But, this strong framing over selection is linked to strong framing over the other discursive rules and hierarchical rules. In other words, the teachers were not creating the circumstances where they could utilise the learners' experiences as a resource for teaching. It is necessary for the teachers to be less prescriptive in the time allocated for tasks to be completed and the way in which solutions and/or answers are given. This could to an extent be achieved if the hierarchical rules are relaxed, allowing the learners to interact more freely with the teacher and each other.

6.4 Limitations of the study

This study was conducted in the first year of the implementation of C2005 at grade 7 level i.e. 2000. A number of teachers were still struggling to find their feet with what was then called a paradigm shift in education. The change was too sudden and, as such, most of the teachers were struggling to get to grips with the new terminology. In addition, since most teachers teach the way they were taught (Linchevski, 1999), to expect a change so soon, without the teachers getting intensive training, is too demanding on a group who already suffered an inferior education during the Apartheid years.

Hilary Shuard (1984: 24 – 25) acknowledges that the implementation of a programme that “replaces the learning of mechanisms and their applications” with one that “encourages the child to solve a problem by “mobilising their knowledge and previous competencies” would be fraught with difficulties, even in the developed countries. This was confirmed in a report issued by the Department of Education and Science (England) who found that in a third of the classes of all ages surveyed, learners were still spending too much time practising procedures that they had already mastered (Ibid.). If this is so, and applies to developed countries, it should come as no surprise that a similar scenario is being played out on the Cape Flats, where most of the population is of working-class origin.

As was indicated at the start of the thesis, the study is based on video-recordings of lessons conducted by the fourteen teachers in the sample. This means that the data captured a “snap-shot” of “teaching as normal” across a number of classrooms. However, this does not mean that any hard claims can be made about how

representative this “snapshot” is, either for the individual teachers or for the system as a whole. Nonetheless, the insights gained from this study are suggestive of the ways teachers might think about how they draw on the ‘everyday’, and how they guarantee its effectiveness in the ways in which they shape social relations in their classrooms.

Although the schools in the sample were randomly selected, the sample is too small to be seen as representative of ex-DET schools throughout the Cape Flats region. We also need to bear in mind that there are, in addition to the ex-DET schools, far more schools from the other previously segregated education departments which have their own sets of dynamics, not only in the Western Cape but throughout South Africa.

6.5 Recommendations for further research

It was stated earlier that the current study was based on video-recordings of single lessons done at twelve different ex-DET schools in the Western Cape. As such, one cannot be sure that these lessons were representative of the way the teachers worked throughout the year. It was also mentioned that these lessons were conducted quite early after the implementation of C2005 in grade 7. This could mean that the teachers in the study were still trying to adapt to the new pedagogy and were not yet comfortable with it. Lastly, it was indicated that the sample was too small to be seen as representative of grade 7 classrooms not only for South Africa but also for the Western Cape.

If one takes into account the comments made in the previous section of this work, certain recommendations for further research are suggested. Firstly, it would be interesting to see whether there has been any change in the classroom dynamics at the schools in the sample a few years later. A piece of related research that would be informative, would be a longitudinal study of the same set of teachers, or even a few of them, dealing with a few different topics in the same year. Another piece of research that would be interesting is a comparative study in Western Cape schools from each of the previously segregated education departments.

In addition to suggesting further research questions, the present study raises issues of analysis and how one uses instruments such as those used here, to meaningfully capture differences in pedagogy across different settings.

6.5 Implications for teacher education

This project began by taking policy priorities, such as those set out in Curriculum 2005, the NQF and related documents, which emphasise the recruitment of everyday contexts into teaching and learning in the classroom. This recruitment is prioritised because it is seen as a way of endorsing the lives and experiences of learners, and using these as a portal into abstract mathematics. Invariably, the recruitment of the 'everyday', by policy documents, is accompanied by a privileging of "learner-centredness" – that is, weak framing over selection, sequencing, pacing and hierarchical rules (and possibly over evaluative criteria). This study has used Bernstein's notion of framing to describe classroom pedagogy (and hence the incidence of learner-centredness) as well as the recruitment of the 'everyday'. It suggests that unless framing relations over the discursive rules are relaxed, it is difficult for teachers to facilitate the recruitment of the 'everyday' in ways that are meaningful to learners. This has implications for teacher education in that at the same time that they emphasise the recruitment of the 'everyday', teacher educators need to place importance on the relaxation of other discursive rules so as to allow for the drawing in of the 'everyday' to serve as the basis for student exploration.

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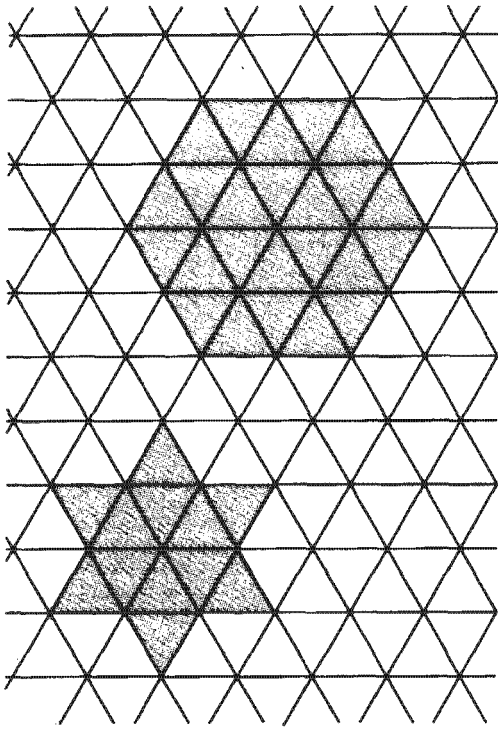
Appendix 1

The activity from Mfa (p. 72) used in classroom 9

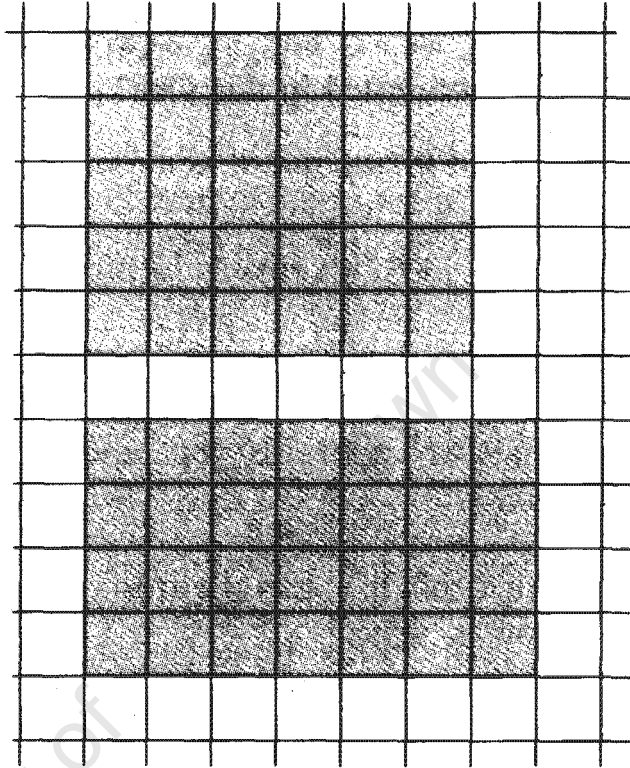
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Activity 5 How big are these figures?

We have drawn the figures below on triangular and square *grids*. See if the grids help you to answer the questions.



triangular grid



square grid

1. Which figure on the triangular grid is bigger?
2. Which figure on the square grid is bigger?
3. In each case, how did you work out your answer?
4. Compare your methods to those used by others in your class?
5. a) Design your own grid. Try not to use triangles or squares. Compare grids in class.
b) Draw a three-sided and a five-sided figure on your grid. Ask a friend to work out which figure is bigger.

Appendix 1I

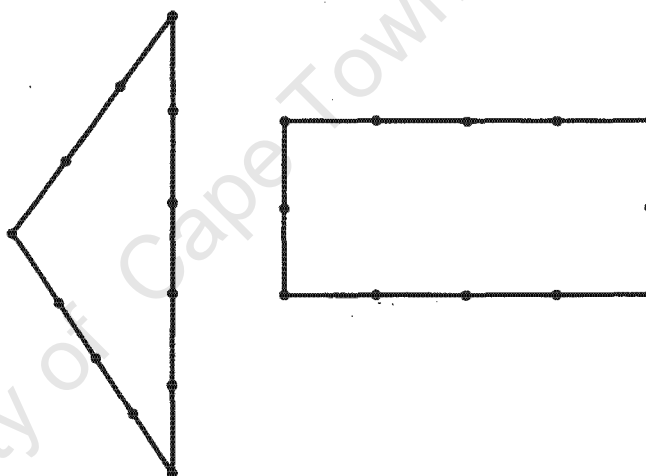
The exercise from Mfa (p. 68) used in classroom 7

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- In this activity you measure the lengths of the roads by using a small straight line segment as a unit of measurement. We call this line segment a *unit of length*.
- The length of each road is found by adding up the units of length that fit on it.
- The longer the road, the more units of length fit on it.
- By using a unit of length, you are able to say how much longer or how much shorter the roads are compared to each other.
- The smaller (or shorter) the units of length, the greater the number of them that will make up the full length of a road. The smaller (or shorter) the units of length, the more accurately you can measure.

Exercise 1 Practice with units of length

1. a) Two pieces of string are used to make the shapes alongside. The lengths of string have equally spaced knots in them. Which shape uses the longer piece of string, or are they formed with equal string lengths?



- b) Draw the unit of length used here.
- c) Cut a piece of string or wool to the same length as that used to make the shapes here. Use the wool to form other straight-edged shapes. Draw pictures of each one.
2. Use matchsticks as your unit of length to measure the length, width and thickness of your mathematics textbook. Compare and discuss your answers in class.
3. Measure the height of your desk in pencil lengths. Compare and discuss your answers in class.
4. Two students, Thelma and Zulaigha, measure the length of a matchstick with rulers they have made themselves:



Thelma: the matchstick is 4 units long.



Zulaigha: the matchstick is $7\frac{1}{2}$ units long.

Appendix III

The activity from Mfa (p. 194) used in classroom 2

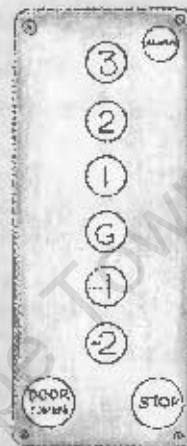
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10.1 Negative numbers in banking and other places

Negative numbers are always written with a minus symbol ($-$). This is usually written in front of a number, but sometimes it is written after it. Negative numbers are used in many different contexts but do not always have the same meaning in these contexts.

Activity 1 Reading negative numbers everywhere

- This is the control panel in a lift.
 - What does -2 mean here?
 - If you got in this lift at floor 1 and went down 2 floors, where would you end up?
 - Which floor is lower: -1 or -2 ?



- This is a weather map.



Appendix 1V

The RNCS Mathematics Outcomes

University of Cape Town

Mathematics Learning Outcomes

The unique features and scope of the Mathematics Learning Area are consolidated into five Learning Outcomes:



Learning Outcome 1: Numbers, Operations and Relationships

The learner will be able to recognise, describe and represent numbers and their relationships, and to count, estimate, calculate and check with competence and confidence in solving problems.



Learning Outcome 2: Patterns, Functions and Algebra

The learner will be able to recognise, describe and represent patterns and relationships, as well as to solve problems using algebraic language and skills.



Learning Outcome 3: Space and Shape (Geometry)

The learner will be able to describe and represent characteristics and relationships between two-dimensional shapes and three-dimensional objects in a variety of orientations and positions.



Learning Outcome 4: Measurement

The learner will be able to use appropriate measuring units, instruments and formulae in a variety of contexts.



Learning Outcome 5: Data Handling

The learner will be able to collect, summarise, display and critically analyse data in order to draw conclusions and make predictions, and to interpret and determine chance variation.

These Learning Outcomes and their Assessment Standards are cognitively dependent and supportive of each other. For example, important Number Development (Learning Outcome 1) can happen in the context of Measurement (Learning Outcome 4) or Data Handling (Learning Outcome 5). These cognitive links are reflected in Assessment Standards that sometimes stay the same across one or more grades. Progression in these Assessment Standards should be interpreted in terms of increased knowledge and skills developed between grades in other Learning Outcomes/Assessment Standards. Assessment should take place in the increasingly sophisticated contexts in which learners can work as they progress from one grade to the next.