INNOVATIVE LANGUAGE PRACTICES IN MULTILINGUAL MATHEMATICS CLASSROOMS

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PART A: RATIONALE, THEORETICAL FRAMEWORK AND METHODOLOGY

1. INTRODUCTION

This report describes the research project, its significance, implications and analysis of data collected. The overarching aim of the project was to provide detailed and rich descriptions of language practices of teachers in multilingual mathematics classrooms.

2. SIGNIFICANCE OF THIS RESEARCH

Linguistic diversity is an important feature of the South African nation. This diversity creates a variety of educational challenges especially when it comes to the use of languages in multilingual classrooms. Recently there has been a lot of debate about this issue in the media. There are at the moment two opposing common sense views, both both of which are about identity and access to economic and political power.

The one view is that in a multilingual country like South Africa, English is a viable language of wider communication (Makua, in The Teacher: 23/09/97). This view maintains that English is increasingly the language of international communication and commerce and therefore speaking it opens doors which are closed to vernacular speakers (Friedman, in Business Day: 03/03/97). Supporters of the view encourage use of English as the language of learning in schools and maintains that vernacular education is a passport to another generation of poverty. It is supported by the reality that in most African schools (particularly in urban areas) in South Africa, pupils do not necessarily share the same first language. Separating learners according to their first languages may be perceived as bringing apartheid back, whilst choosing one of the languages as medium and not the other may also be interpreted as favouring one group and not the other. As Makua (in The Teacher: 23/09/97) put it "English can be a unifying factor".

The other view is that there is a need to develop and promote African languages and one way of doing that is to encourage their use in schools. Supporters of this view maintain that rather than promoting English as the language of international communication, other languages should be given more prominence to ensure that they do not fade away (Mda, 1997; Friedman, 1997; Heugh, 1997). The view suggests multilingualism as a viable way to facilitate meaningful access to both the learners' home language and language of wider communication (English) (Heugh, 1997: 71).

Thus is also consistent with the evidence which concludes that there are cognitive advantages to early learning in a main language and to acquiring proficiency in two or more languages - that these impact favourably on the development of scientific and mathematical thought (Heugh, 1997: 71).

This is an interesting debate which, as this report will show, cannot only be resolved by introducing new policy but by engaging with the practicalities of the policies. The project described here will give substance to the debate by describing multilingual mathematics classroom language practices and suggesting different purposes that these practices serve in context. To put this debate in perspective, however, it is important to provide a historical overview of language policy as it has emerged in African education in South Africa.

2.1 THE HISTORY OF LANGUAGE POLICY IN AFRICAN EDUCATION IN SOUTH AFRICA

Official language policy in formal education in South Africa has a controversial history, particularly regarding the language of learning in African schools. It has been interwoven with the politics of domination and separation, resistance and affirmation (ANC, 1994:61).

The language of learning issue in African education can be traced back to the policies of missionary education during the 19th century. In these schools English featured strongly as a language of learning as well as a school subject. The education policy of English as language of learning in missionary schools was to be continued by government-aided African education following the Union in 1910 (Beukes, 1992:12). The importance of learning in the first language gradually came to be recognised in Natal and also in the Cape Province (Hartshone, 1987: 66). Between 1910 and 1948 the language policy was flexible. Different provinces made decisions on languages of learning. For instance, in Natal, the language of learning in black schools was Zulu until 1948 (Hartshone, 1987: 66).

In 1949 a Commission on National Education, chaired by Dr Eiselen, was appointed by the Nationalist government. At the end of two years the commission recommended a rigid first language learning policy in the name of Christian National Education. (Hartshone , 1987: 68). They recommended that

all education should be through the medium of the mother tongue for the first four years, and that this principle should be progressively extended year by year to all eight years of *primary schooling (in Hartshone, 1987: 68).*

The government, however, did not follow the Eiselen report closely. This was largely because of its concern to protect and expand the influence of the Afrikaans language in the system (Hartshone, 1987: 70). The government introduced English and Afrikaans as compulsory subjects in the first year of schooling[1]. Both English and Afrikaans were also to be used as media of learning when transfer from first language learning took place in the first year of the secondary school (Hartshone, 1987: 70). The educational interests of the pupils became subordinate to ideological and political factors. The government's greatest concern at the time was that the constitution of South Africa required equality of treatment of the two official languages. These policies were centered on fears of the possibilty of the Afrikaner language, culture and tradition being overwhelmed by the older, more internationally established English language, culture and tradition (Reagan&Ntshoe 1992: 249)

The Bantu Education Act of 1953 insisted on the principle of initial first language learning in African education. Hartshone (1981) has argued that the language policy in African education in South Africa since the 1948 election (and particularly since the `Bantu Education Act') has centered on two major issues: that of first language learning and that of the establishment of the primacy of Afrikaans as the preferred language of learning in secondary school level. Both these issues were rejected by the majority of the African people. The mainstream African nationalists, though not unmindful or ashamed of African traditions per se, have generally viewed cultural assimilation as a means by which Africans could be released from a subordinate position in a common, unified society (Reagan & Ntshoe, 1992: 249). They therefore fought against the use of African languages in the schools, since their use was seen as a device to ensure that black South Africans remain "hewers of wood and drawers of water" (Reagan & Ntshoe, 1992: 249).

The language of learning issue became a dominating factor in opposition to the system of Bantu Education: African opinion never became reconciled to the extension of first language learning beyond grade 4, nor to the dual medium policy (of English and Afrikaans) in the secondary school (Hartshone, 1987; 70). The 1976 uprising, which began in Soweto and spread all over the country

[1]English and Afrikaans were the only two official languages, where the latter developed out of the Dutch settlement. None of the indigenous African languages (e.g. Zulu, Tswana. Sotho. Xhosa. etc.) were recognised.

was initially sparked by the use of Afrikaans as a language of learning. As a result a new language policy was introduced in 1979.

This new policy emphasised initial first language learning with an eventual shift in language of learning to English[2]. As a general rule, the African child began his or her schooling in the first language which remained the language of teaming through the fourth year of schooling (Grade 4). During these first four years both English and Afrikaans were studied as subjects. Beginning in the fifth year of schooling (Grade 5) there was a shift in language of learning to either English or Afrikaans, official languages of the country but the languages of the white minority.

In 1997 a new language policy which recognises eleven official languages was introduced. In the section below, I examine what this policy means for schools in an English dominated environment.

2.2 THE CURRENT LANGUAGE POLICY AND THE DOMINANCE OF ENGLISH

The policy defines 11 official languages and flexibility for schools in determining their language policy. Multilingual teaching and teaming is now encouraged. What policy cannot clarify is how teachers can become more multilingual in their approach to teaching a subject like mathematics. Learning mathematics is itself similar to learning a language since it has its own register/ specific discourse.

While the new language policy is intended to address the overvaluing of English and Afrikaans and the undervaluing of African languages, in practice, English dominates. Although it is the mother tongue of only a minority, English is both the language of power and the language of educational and socio-economic advancement, that is, a dominant symbolic resource in the linguistic market (Bourdieu, 1991) in South Africa.

The symbolic market is embodied and enacted in the many key situations (e.g. educational settings, job situations) in which symbolic resources, like certain types of linguistic skills, are demanded of social actors if they want to gain access to valuable social, educational and eventually material resources (Bourdieu, 1991).

The formation of the English-dominated symbolic market has been achieved by various institutional manangement and government policies. Firstly, there has been Afrikaans and English-medium higher-education policy in South Africa for many years. The language of learning in all the universities in South

Africa is either Afrikaans or English and it seems that this policy will continue for many more years since it has not yet been challenged in higher education circles.

Secondly, there is an Afrikaans/English-language pre-requisite for anyone aspiring to become a professional in South Africa. For instance, students need to pass a school-leaving examination in English as a first or second language, in addition to mathematics, to enter and succeed in the English-medium professional training programmes in fields such as medicine and engineering, and in order to earn qualifications to enter these high income professions. "The symbolic market is therefore not a metaphor but one with transactions that have material, socio-economic consequences for individuals" (Lin, 1996: 53).

Thirdly, there have been policies upholding Afrikaans and English as official, legal and government languages. The nine African languages spoken by the majority of South Africans did not enjoy any official status until 1994, when the government of national unity led by the African National Congress (ANC) came into power. However, these languages are still in many ways secondary to English in reality, for example, most of the policy documents are written in English only.

Fourthly, there has been the imposition of an Afrikaans/English-language requirement for individuals aspiring to join the civil service. For instance, ability to communicate in Afrikaans/English is one of the requirements for anyone willing to train as a policeman or policewoman. The fact remains that English is the most important criterion for selection for high-ranking officials, and knowledge of an African language is seen as an additional asset, but not an essential one.

With these institutions and policies well entrenched in the various administrative, educational and professional arenas of South Africa, a symbolic market has been formed where English constitutes the dominant, if not exclusive, symbolic resource and the prerequisite for individuals aspiring to gain a share of the socio-economic, material resources enjoyed by a small elite group.

It can be assumed, therefore, that the language choices of mathematics teachers will not only depend on what policy stipulates, but also on what teachers perceive to be in the interests of their learners. As Baker has argued,

> *"decisions about haw to teach [second language learners] ... does not just reflect curriculum decisions... they are surrounded and underpinned by basic beliefs about ... [the learners' first languages] and equality of opportunity" (1993:247).*

3. THE SIGNIFICANCE OF DOING THIS RESEARCH IN MATHEMATTCS CLASSROOMS

It is well known that language is important for thinking and learning, and therefore this means that language is not only an issue in multilingual mathematics classrooms but in all classrooms, particularly second language classrooms. Doing this study in multilingual mathematics classrooms is however crucial because mathematics, unlike other subjects has its own register or specific discourse. Learning and teaching mathematics in multilingual classrooms in which the language of learning is not the leamers' main language is, therefore, a complicated matter. Leamers have to cope with the new language of mathematics as well as the new language in which mathematics is taught (English). Teachers on the other hand have to develop effective ways of teaching both the language of mathematics and language of learning. It is therefore important to understand the different language practices that teachers in multilingual mathematics classrooms use to facilitate access to communicating mathematics.

4. **THEORETICAL FRAMEWORK**

Three major areas of enquiry inform this study. The first relates to Vygotsky's theory of socio-cultural development. Development occurs in and through socially mediated activity and language plays a key role in mediation (Vygotsky, 1986).

According to Vygotsky's theory, higher mental functions are formed through social interaction (Vygotsky, 1978; 1986; Wertch, 1991) These higher mental functions are mediated by psychological tools and signs that include various systems of counting and mnemonic techniques, with language being the most important (Wertch, 1991). Language mediates both interaction and individual thinking processes. It is therefore not only a tool for thinking but also an essential tool for communication. These two functions of language (communication and thinking) are not separate. They sometimes occur simultaneously. By using language for communication the individual intemalises it for use as a tool for thinking. One ofthe opportunities that school can offer learners is that of involving other people in their thoughts - to use conversations to develop their own thoughts (Mercer, 1995: 4).

In a learning situation a teacher, creates opportunities for learners to involve the teacher and fellow learners in their thoughts and to use talk to develop their own thoughts. Teachers do this by, among other things, asking questions, responding to learners questions and preparing tasks for learners to work on cooperatively.

One of the tasks of a mathematics teacher is to help learners develop ways of talking (about) mathematics which will enable them to understand and be understood by other members of wider communities of educational discourses (Mercer, 1995: 83). This is not an easy task for teachers of second-language learners since the mathematical talk is not in their first language. Learners therefore need to be initiated into the discourse. This initiation includes: recognition of mathematical terms, knowing how to say them (being able to pronounce them), knowing what they mean and being able to use them in mathematical conversations. The challenge here, for many teachers, is assisting learners to move from a position where they cannot understand the language of learning (English) to a point where they use English to talk (about) mathematics.

Within this Vygotskian framework the presence of a more experienced other who embodies and models the intended outcome for the learner is crucial. In a mathematics class, the more experienced other can be the teacher and the intended outcome for the learner is mathematical excellence which includes the ability to talk "within and about mathematics" (Adler, 1998). The teacher, therefore needs "to provide a scaffold for the learner via dialogue that includes probing questions and cues that extend talk as well as intellectual range of the learners" (Khisty, 1995). While teaching, mathematics teachers model ways of doing and talking (about) mathematics.

The second area of enquiry relates to the work that has been done concerning teaching and learning in multilingual or bilingual classrooms. There is much debate among researchers and educators on the effects of bilingualism/multilingualism on the learner. Some maintain that bilingualism has negative effects on language development, educational attainment, cognitive growth and intelligence. Others argue that under certain conditions bilingual skills can have positive effects on the learning process.

The great majority of studies done before 1960 concluded that bilingualism had negative effects on learners' linguistic, cognitive and educational development. Only a few showed no effect or a positive effect (Grosjean, 1982: 221). Bilingualism/multilingualism was seen as unnatural. As Jespersen (in Saunders, 1988) pointed out

"A bilingual child hardly learns either of the two languages as perfectly as he would have done if he had limited himself to one... Secondly, the brain effort required to master two languages instead of one certainly diminishes the child's power of learning other things which might and ought to be learned "

On the other hand Leo Weisgerber believed that bilingualism could impair the intelligence of a whole ethnic group. Reynold (1928 in Saunders:1948) was concerned about the fact that bilingualism leads

to language mixing and language confusion which in turn results in a reduction in the ability to think and act precisely, a decrease in intelligence, an increase in lethargy and reduced self-discipline.

Besides these arguments against bilingualism which were based on personal intuition (Grosjean 1982: 221), other studies also seemed to indicate that bilingualism had a negative effect on intellectual development. For instance Saer (1963, in Grosjean 1982: 221) found that Welsh-English bilingual children in rural areas had lower IQ scores than monolingual children, and this inferiority became greater with each year from age seven to eleven.

Saunders (1988) warns that caution must be exercised when comparing monolinguals and bilinguals on tests of intelligence, particularly on the tests of verbal intelligence, and particularly if, as often happens, the bilinguals are tested in only one of their languages, perhaps the second language.

In 1962 Pearl and Lambert conducted a study that indicated that bilingualism is an asset to the child. They studied the effects of bilingualism on the intellectual functioning of 10 year-old children from six Montreal schools. They found that instead of suffering from `mental confusion' bilinguals are profiting from a language asset. They concluded that;

> *Intellectually (the bilingual's) experience with two language systems seems to have left him with a mental flexibility, a superiority in concept formation, and a more diversified set of mental abilities, in the sense that the patterns* of *abilities developed by bilinguals were more heterogeneous. It is not possible to state from the present study to state whether the intelligent child became bilingual or whether bilingualism aided his intellectual development, but there is no question about the fact that he is superior intellectually In contrast, the monolingual appears to have more unitary structure of intelligence which he must use for all types of intellectual* tasks. (Pearl & Lambert 1962:20)

Although these results were criticised on the grounds that only the intellectually brighter children were chosen for the bilingual group (eg by Macnamara, 1966), the studies that followed also indicate that bilingualism is an asset. Ianco-Worrall's (1972) study of Afrikaans-English 4-9 year-old bilingual children in South Africa showed that bilinguals reach a stage in semantic development two or three years earlier than their monolingual peers. They analyse language more intensively than do monolinguals. Ben Zeef (1977) found the same results in a similar study with Hebrew-English bilinguals and monolingual English and Hebrew children. Bilinguals realise sooner the arbitrary nature of language because the link between the word and its meaning is less strong in bilinguals than in monolinguals. This

result had some implications for the bilinguals' cognitive abilities. As Cummins (1973:33) argues, the ability to separate meaning of a word from its sound is necessary if a child is to use language effectively as a tool for thinking.

Swain and Cummins (1979, in Grosjean, 1982) in comparing the positive and the negative studies, concluded that the positive findings are usually associated with majority language groups in immersion programs. In such cases there is a high value attached to knowing two languages, the second language is added at no cost to the first and the parents are of relatively high socio-economic status. Negative findings on the other hand, are found with submersion students who are surrounded by negative attitudes. They are forced to learn the majority language and are not encouraged to retain their first language. They also do not live in a social environment that induces learning. It is therefore possible that bilingualism has got no major effects (either negative or positive) on the cognitive and intellectual development of children in general. What can perhaps account for the contradictory results in the literature is the psychosocial differences between bilinguals and monolinguals and not bilingualism per se.

In an article entitled "The bilingual as a competent specific speaker-hearer" Grosjean (1985:471) argues for a bilingual (or holistic) view of bilingualism in any consideration of bilinguals. This is different from the monolingual view, which always compares the linguistic ability of bilinguals with that of monolinguals ofthe languages concerned. Bilinguals have a unique and specific language configuration and therefore they should not be considered as the sum of two complete or incomplete monolinguals.

> *The coexistence card constant interaction of the two languages in the bilingual has produced a different but complete language system. An analogy comes from the domain of athletics The high hurdler blends two types of competencies: that of high jumping and that of sprinting. When compared individually with the sprinter or the high jumper, the hurdler meets neither level of competence, and yet when taken as a whole, the hurdler is an athlete in his or her own right. No expert in track and field mould ever compare a high hurdler to a sprinter or to a high jumper, even though the former blends certain characteristics of the latter two. In many ways the bilingual is like the high hurdler. (Grosjean, 1985:471)*

It can therefore be assumed that language practices in multilingual classrooms will not be the same as in any other classroom. For example, an important aspect of bilingualism or multilingualism, that which makes the multilingual person an integrated whole, is code-

language to another in the course of a conversation, can therefore be expected to occur in multilingual or bilingual classrooms and not monolingual classrooms. One of the significant findings in this area relates to the benefits that result from using CS in teaching and learning mathematics (Setati, 1996). Other studies have shown that use of the learners' first language in teaching and learning provides the Il support needed while the learners continue to develop proficiency in the second language (Khisty, 1995; Adler et. al., 1997). Other practices that have been observed in multilingual mathematics classrooms include chanting and chorusing. While in current educational discourse chanting and chorusing are typically described as rote, mindless, authoritarian practices, recent research has shown that these practices can be used in mathematics as classrooms as linguistic, pedagogic and mathematical devices (Adler et. al.; 1996 Setati, 1998).

The third area of enquiry concerns the nature of the language we use to communicate mathematical ideas. One way in which one can make meaning in a mathematics class is through language because mathematics knowledge is a kind of knowledge expressed in a language. Pupils learning mathematics in school in part are attempting to acquire communicative competence in mathematical language. One way of acquiring these competencies is to engage in verbal interactions with both the teacher and other pupils. These verbal interactions are however not easy to start particularly in a second language mathematics class. Every individual wants to communicate to others their meaning, however the difficulty is that in most cases the content of our meanings are far greater than the words that we possess to convey those meanings (Trivett, 1981; Vygotsky, 1972:187).

Learning to be able to articulate the meaning of certain concepts involves the development of a language that can best describe the concepts involved. This is especially pertinent to mathematics because mathematical talk is known for involving both specialised terms and different meanings attached to everyday words. As Frawley (1992:1) points out "mathematics is taught and understood via the sub-language of mathematical discourse, or the mathematical register". Halliday (1975) describes a maths register as a set of meanings that belong to the language of mathematics (the mathematical use of natural language, that is not mathematics itself), and that a language must express if it is used for mathematical purposes (in Pimm, 1987).

A mathematics register[3] does not consist solely of terminology but it also has to do with social usage of particular words and expressions and ways of talking and meaning in mathematics. Part of being a mathematician, therefore, is to gain control of the mathematics register. On the other hand, we cannot

[3]For the purposes of his study, the terms mathematical register, mathematical discourse and mathematical language are used interchangeably.

assume that if you know the mathematics register in one language, you also know it in another language (Khisty, 1995: 287).

Mathematical language comprises both informal and formal components. Informal language is the kind that learners use in their everyday to express their mathematical understanding. For example, learners, in their everyday life, may refer to a half as any fraction of a whole and hence can talk about dividing a whole into three halves. Formal mathematical language refers to the standard use of terminology which is usually developed within formal settings like schools. Looking at the above example of a half, in formal mathematics language it is inappropriate to talk about a whole being divided into three halves, if any whole is divided into three equal parts then we get thirds. In most mathematics classrooms both forms of language are used and these can be either in written or spoken form. "One difficulty facing all teachers, however, is how to encourage movement in their learners from the predominantly informal spoken language with which they are all pretty fluent, to the formal language that is frequently perceived to be the landmark of mathematical activity" (Pimm, 1991: 21). Pimm suggests that there are two possible routes to facilitate this movement: (1) to encourage learners to write down their formal utterances and then work on making the written language more self-sufficient; (2) to work on the formality and self-sufficiency of the spoken language prior to its being written down (1991: 21).

Another useful way of categorising discourses in mathematical classrooms is to use Sfard's (1998) distinction between calculational and conceptual discourses. She defines calculational discourse as discussions in which the primary topic of conversation is any type of calculational process, and conceptual discourse as discussions in which reasons for calculating in particular ways also become explicit topics of conversations (Sfard, 1998: 46). These definitions can be extended to include procedural discourse in which discussions focus on the procedural manipulation of conventional symbols that do not neccesarily signify anything for the learners. To give an example, in the problem 28 + 18, learners can enter into discussions focussing on the procedure to follow and then get the answer 316. In this case learners do not question the procedure, neither does the procedure mean anything to them because they are not even aware that the answer they got does not make sense let alone that it is incorrect (procedural discourse). Another possibility is that learners can do the calculation and the procedure correctly, without entering into a discussion about why the procedure works (e.g why they do not write 16 under the units) (calculational discourse). The last possibility is that learners solve this problem by engaging in discussions about the problem and also about why a particular procedure works (conceptual discourse).

These distinctions between informal and formal use of mathematical language and also procedural, calculational and conceptual discourses form an important frame for looking at the teachers' language

practices. In mathematics classrooms, teachers model ways of doing and talking (about) mathematics and therefore the discourses that they engage learners in can either facilitate or constrain learners access to communicating mathematics.

5. THE STUDY

This is a qualitative study that focuses on six carefully selected grade 4 teachers together with their learners. The study is both descriptive and interpretative. It is descriptive because it provides a detailed description of language practices of these teachers. It however goes beyond mere description since it gives an interpretation of how the practices used, facilitate or block learners communication of and access to mathematics.

The study was carried out between March and October 1998 (March/April - negotiating access to schools and piloting; May/June - data gathering; July /August - transcription of recorded data; September/October - data analysis and report writing).

5.1 RESEARCH QUESTIONS

The study focussed on the following key questions:

- what is the teachers' understanding of the new language policy?
- what language practices do these teachers use?
    - how does their understanding of the language policy impact on their language practices?
    - how do these teachers' language practices facilitate or block (a) communicating mathematics during teaching and (b) leamer access to mathematics?

5.2 THE SAMPLE

A sample of six mathematics teachers were selected for the study. The following criteria was used to identify teachers:

- grade 4 mathematics teachers with a `good reputation'
- teachers needed to be experienced (at least 2 years) and qualified (at least M+3)
- teachers also had to be multilingual and teachers of second language learners.

This criteria was used to diminish the possibility that the teachers' language practices were due to lack of teaching experience or recognised qualification. The grade 4 class was preferred because according to the new curriculum it is the entry level to intermediate mathematics learning.

The Gauteng Department of Education (GDE) district N5 was approached for assistance to identify possible teachers. Even though I needed six teachers, I asked the district to identify eight teachers. This was done so that if any of the teachers dropped out of the project I would still remain with at least six teachers. The district could not provide me with the names of specific teachers, but they did provide names of schools with `good reputation'. I accepted these do the assumption that 'good teachers are found in good schools'. Seven out of the eight schools agree to participate. One out of the seven grade 4 mathematics teachers whose schools agreed to participate declined to participate. Therefore I remained with six teachers. Visiting the schools, I discovered that two of the six teachers did not have an M+3 qualification. However, they had many years (18 years, 20 years) of experience and a `good reputation'.

Each of the teachers was requested to select six learners (2 'good'; 2 'average'; 2 'weak') who would be interviewed and whose books (class/homework books) could be studied.

5.3 INSTRUMENTS

A range of data was collected: teacher biographical details, potential teaching and learning time, pre-observation teacher interview, classroom observations, reflective teacher interviews, pupil book observations and pupil interviews. This range of data was necessary to understand teachers' practices in context. To understand how the teachers' language practices enable or constrain learners) communication of and access to mathematics learning, it was important to do a clinical interview with the learners and also to observe their written work. Details of the potential teaching and learning time gave an indication of how much time is spent on mathematical activity. Copies of all the instruments used are attached at the end of this report (Appendix 1)

5.3.1 Teacher Biographical Data Questionnaire

Each of the teachers was requested to complete a questionnaire that asked, among other things, about their qualifications, teaching experience and language proficiency. This data was collected soon after the teacher agreed to participate in the study.

5.3.2 Potential Teaching and Learning Time Questionnaire

To establish how much time is spent on mathematics learning in these school, an instrument was developed to record, among other things, the number of mathematics periods per week, length of periods, schools' starting and closing times. This data was collected at the same time as the teacher biographical data.

5.3.3 Pre-observation Interview Schedule

A structured pre-observation interview schedule was developed. It focussed on the teachers' understanding of the national language policy of South Africa, their school's policies and their own language practices and experiences in mathematics classrooms. All the teachers were interviewed (the interviews were tape-recorded) before any of their lessons were observed.

5.3.4 Classroom Observation Schedule

The classroom observation schedule developed focussed on both teacher-pupil and pupil-pupil interactions. This schedule was informed by research done in mathematics classrooms focussing on language practices (Setati, 1998). It covered three possible language practices (code-switching, chanting and chorusing) and the context in which they occurred. For example, whether code-switching occurred during questioning or explanation. It provided an opportunity for an observer to indicate whether the practice occurred in the public domain or during small group discussion and also to give comments or examples ofthe practice. The last two of the five lessons observed in each class were video-recorded.

5.3.5 Reflective Interview Schedule

To enable full descriptions of classroom language practices each teacher was taken through a reflective interview after all observations were completed. The interview schedule was developed after observation and followed-up on practices observed and on teachers' perceptions of the successes and limitations of their lessons. Each of the teachers was interviewed (the interview was tape-recorded) after all the lessons were observed.

5.3.6 Pupils/Written Work Observation Schedule

An instrument was developed to observe the kind of written work that the learners are exposed to in their learning of mathematics. The pupils' written work observation schedule focussed on the form of writing, variety of question types, form of learners' writing and marking. To get this data I only looked at the class/homework books of selected learners in each class. The books were looked at after all classroom observations were completed.

5.3.7 Pupil Interview

An interview was held with the six learners selected by teacher after all observations were completed. The learners were interviewed in pairs (e.g. the `good' ones together) so that they could help each other. This arrangement also gave the researcher an opportunity to observe closely, learners in conversation with each other. The interviews focussed on the mathematics that was dealt with in each of the classes during the researcher's visit. They took place after all classroom observations were completed. All interviews were tape recorded.

5.4 DATA COLLECTION

Data collection started on 04 May 1998 and completed on 05 June 1998. Of the 30 lessons observed, 19 were observed by the research leader while 11 were observed by the research assistants. All interview data and teacher biographical details were collected by the research leader.

5.4.1 Piloting of Instruments

The classroom observation and pre-observation interview schedule were piloted over two days at Tlhophane primary school in Mmakau, north-west of Pretoria. The school was preferred for piloting because of its multilingual nature. Both the teacher and the pupils observed can speak at least two languages. Two grade 4 mathematics classes and their teacher were used. Two different observation schedules were piloted, each one twice in different classes. The final schedule was selected because it gave a better idea of the language practices that occur, the frequency with which they occur, the quality of the practices and how the lesson progressed. As a result of the piloting additional sections were included in the schedule, for example, social control and pupil responses.

5.4.2 Training Of Research Assistants,

Two research assistants were employed. Both of them have Masters degrees in mathematics education and have research experience. Their role was to assist with the collection of classroom observation data and therefore were only trained to use the classroom observation schedule.

One hour was spent with each of them discussing how the observation schedule was to be completed. For the first observation they were accompanied by the researcher to ensure mutual understanding of how the schedule was to be completed.

At the end of each week of observation the researcher met with the field workers to discuss experiences in classrooms to enable the development of the reflective interview schedule.

5.4.3 Negotiating Access To Schools

Negotiating access to schools started with a number of telephone conversations with the head of the Teaching and Learning Staff (TLS) of the N5 district. Since the head of the TLS could not give me permission to work in the schools he arranged for me to meet with the district director and her deputy. While they were happy for me to do the research in their schools they wanted to know how the schools would benefit from the study. I therefore committed myself to do mathematics development work in those same schools. They then provided me with eight names of schools.

Meetings were then arranged with the relevant schools telephonically. On the day of each of the meetings with the schools, I brought letter both the principal and the teacher concerned, explaining what the research is about, what will be required of them and also offering the school mathematics development work. At each school, meetings were held first with the principal and then the teacher concerned. In cases where there were more than one grade 4 mathematics teacher (e.g. School 1), all the grade 4 teachers were addressed and opportunity given to only one volunteer. The research thus proceeded with informed consent.

As explained above two out of the eight schools approached did not agree to participate. At the first school permission was denied after the meeting with the principal, whilst in the second school the principal had agreed and the grade 4 mathematics teachers declined to participate.

Two out of the six school principals required to be given feedback on the classroom observations. It was therefore agreed with them that feedback will be given to all the mathematics teachers in the school together with the principal after all classroom observations and interviews in the school have been completed.

PART B: DESCRIPTION OF SCHOOLS, TEACHERS AND LEARNERS IN THE STUDY

1. SCHOOLS IN THE STUDY

All the six schools in the study are former Department of Education and Training (DET) schools and range from grade 1 to 8. These schools, since the DET days, are classified according to languages: four of the schools are Tswana, one is Xhosa and the other is Zulu This classification means that the schools offer the particular languages as subjects. For instance, learners in a Tswana school will do Tswana first language as a subject. In what follows I give a short description ofeach school.

1.1 School 1

This is a fairly big Tswana school with learners from grade 1 to grade 8. All the learners in the school are first language Tswana speaking, however most of them can speak other languages (e.g. Xhosa; Zulu; S.Sotho). The school draws most of its learners from the nearby informal settlement in the area. Looking at the learners, however, one could not guess that most o£ them are from very poor backgrounds. They were all in uniform and very neat.

1.2 School 2

This is one of the two Xhosa schools in the area. Most of the learners travel long distances to get to school. The school ranges from grade 1 to 8. Although all the children in the school are first language Xhosa speaking, most of them can speak Zulu, which is very similar to Xhosa. They also speak Tswana, which is the dominant language in the township. This school is very active in extra-mural activities, during data collection the school was preparing itself for the music competitions.

1.3 School 3

This seemingly well organised school is predominantly Tswana. It ranges from grade 1 to 8 and most learners can speak two or more languages. There seemed to be a good relationship between management and staff. All the mathematics teachers in the school were briefed about the researcher's visits. Most of the mathematics development workshops conducted by the researcher for teachers in the area were hosted by this school.

1.4 School 4

This Tswana school has learners from grade 1 to 8 and all of them are first language Tswana speaking. It is very active in extra-mural activities. During my first visit to the school the learners spent 30 minutes at the assembly celebrating their victory at the music competitions. In fact, the school represented the Gauteng region at the national music competitions.

1.5 School 5

This school has learners from grade 1 up to 8. All of the learners in the school are first language Tswana speaking, however, most of them can speak other languages spoken in the township (Zulu, Xhosa). This was the only school in which the researcher had contact only with the research teacher. It seemed that other mathematics teachers (including the deputy principal who is also a mathematics teacher) were not briefed about the researcher's visits.

1.6 School 6

School 6 is one of the two `first language Zulu primary schools' in the area. The school ranges from grade 1 to 8. Although all the children in the school are first language Zulu speaking, most of them can speak Tswana which is the dominant language in the township. The principal in this school is also a mathematics teacher and therefore was very interested in the work that the researcher was doing.

1.7 Potential Teaching and Learning Time At Each School

A typical school day at most of these schools starts at 7:45 and ends at 13:30. The first 10 to 15 minutes of the day are used for an assembly and teaching at each of the schools starts at 8:00. All the schools have at least one hour of mathematics at a grade 4 level every day. Table 1 below gives details of the potential teaching and learning time at each of the schools.

TABLE 1: POTENTIAL TEACHING AND LEARNING TIME AT EACH SCHOOL IN 1998

School	No. of periods/ day	length of periods (mins.)	No. of grade 4 Maths periods/week	No of hrs/ average school day	School starting time	School closing time	Days which differ	Closing time on this /these day/s	School breaks	Extra-mural activities during school time	Grade 4 exam in the second term
1	10	30	10	5 hours	7:45	13:45	Wed.	13:00	11:30-11:45	N/A	Yes
2	10	30	10	5 hours	8:00	13:30	No	N/A	11:00-11:30	No	Yes
3	10	35	10	5 hours	7:45	13:30	No	N/A	10:00-10:15 11:40-12:00	N/A	Yes
4	10	30	10	5 hours	7:45	13:30	No	N/A	11:00-11:30	N/A	Yes
5	10	30	10	5 hours	7:50	13:30	No	N/A	11:00-11:30	Mon. 9:30-10:00	Yes
6	10	30	10	4 hrs 30 min.	7:45	13:30	Tues. & Thurs.	12:30	11:00-11:30	Tues. & Wed. from 12:30	Yes

2. TEACHERS IN THE STUDY

All the teachers in the study are suitably qualified and their teaching experiences range from two to twenty years. While none of them is presently engaged in further study in mathematics this year, they all have attended at least one in-service training course in mathematics education conducted by NGOs and/or the GDE in the past three years. One of the teachers (teacher 2), however, has been extensively involved with NGOs since she started teaching and has also presented a `how I teach' paper at a local mathematics education conference in 1995 organised by one of the NGO's.

Each of the teachers can speak at least four languages. This includes English which is the official language of learning in their respective schools. Five out of the six teachers share their first language of the learners. While one of the teachers does not share the first language with the learners, she can communicate in the learners/ main language. One out of the six teachers (Teacher 2) holds an HOD position in her school. Table 2 provides details of the teachers selected for the study.

TABLE 2: TEACHERS

Teacher	Highest qualification	Highest qualif. in Maths	Home language	No. of languages spoken	No. of years teaching
Teacher 1	JPTD (M+3)	JPTD	Tswana	4	10
Teacher 2	B. A (M+4)	SPTD	Zulu	8	10
Teacher 3	SPTD (M+3)	SPTD	Zulu	6	3
Teacher 4	PTC + Matric (M+2)	Matric	Xhosa	9	20
Teacher 5	BA. (Ed.) (M+4)	Matric	Tswana	6	2
Teacher 6	PTC + Matric (M+2)	PTC	Tswana	4	18

3. LEARNERS IN THE STUDY

The ages of the learners in the study ranged from eight to fourteen years old. They were therefore both under-aged and over-aged learners in these classes. The learners were all multilingual or bilingual and could speak from two to four languages and this included English for most of the learners. Their English language proficiency varied widely, in some cases learners themselves confessed that their English was not `good enough'. It was only in one school where some of the learners mentioned that they cannot understand English at all since they arrived in Gauteng from the Eastern Cape rural areas this year. One interesting factor is that a few of the learners in most of the schools mentioned that their parents communicate with them in English, which is neither their first nor main language. The main language in the area is Tswana and most of the learners in the study could communicate in it.

PART C: ANALYSIS OF DATA

1. PROCESS OF DATA ANALYSIS

While this study focuses on language practices in multilingual classrooms, it should be noted that language is an issue in all the other mathematics classrooms. This is the case particularly because, as mentioned earlier, teaming mathematics is very similar to learning a language. This report, therefore, will highlight the practices that are specific or peculiar to multilingual mathematics classrooms.

The findings presented in this report work across the six teachers in the study. It is important to understand that while all these six teachers are black and teach second language learners in multilingual classrooms, they are characterised by diversity. Looking across their practices inevitably masks the complex nuances of each individual teachers practices.

1.1 TRANSCRIPTS OF THE LESSONS AND LEARNER INTERVIEWS

Transcripts were analysed in relation to both the nature of the talk and the language practices in each of the classrooms. To analyse the nature of talk, two categories were used: formal mathematical talk and informal mathematical talk. To analyse the language practices, three broad categories of mathematical discourse were used: procedural, calculational and conceptual discourses. The definitions of these categories were extended from Sfard's definition of calculational and conceptual discourses (1998). Sfard defined calculational discourse as discussions in which the primary topic of conversation is any type of calculational process. She contrasts this with conceptual discourse in which the reasons for calculating in particular ways can also become explicit topics of conversation" (Sfard, 1998: 46). She pointed out that "calculational discourse, therefore can be contrasted with procedural discourse in which learners engage in conversations that focus on the procedural manipulation of conventional symbols that do not necessary signify anything for them". Hence the inclusion here of the third category "procedural discourse".

These categories provided access to the kinds of mathematical conversations pupils were exposed to and engaged in, and how these facilitate or block their access to mathematics.

Transcripts were also coded for the type and purpose of the language practice used. Three broad categories based on previous research (Adler et. al., 1997) were used: code-switching, chanting and chorusing.

Code-switching is when an individual (more or less deliberately) alternates between two or more languages ... code-switches have purposes [and there] are important social and power aspects of switching between languages as there are between switching between dialects ands registers (Baker 1994, 77). In mathematics classrooms code-switching can be used for explanation and /or regulation.

(1) Explanation is when a teacher uses another language to illustrate facts, exemplify them, elaborate them, relate them to learners' experience and seek their involvement. Throughout the data, teachers' use of this mode of code-switching revealed how switching is used to mediate mathematical meaning. When used by the learner it revealed how code-switching facilitates or blocks learner communication of mathematics. (2) Regulation is when the teacher uses code-switching for social control, for instance if a teacher wants to call for attention or issue reprimands. Regulation can be focussed on the behaviour of the learners or the task that the learners are engaged in.

Chanting is a practice whereby words are said or sung repeatedly (LDCE 1978, 171). An important feature of this practice is repetition and this can involve one or more learners in a mathematics classroom. Chorusing on the other hand can be described as a practice whereby a group of people say or sing something together (LDCE, 1978: 183). While in chorusing, words may be sung or said repeatedly, what is crucial is that it should involve more than one person.

Chanting and chorusing in a second language mathematics classrooms can be used to teach both mathematical language and the English language. Research shows that during mathematics periods most second language primary school mathematics teachers also teach English (Adler, et. al., 1996). Chanting and chorusing can therefore be used to introduce learners to English mathematics register and the English language. Chanting and chorusing enables the teacher to introduce new words (English and mathematics) to learners. It can also be used for regulation, in this case the teacher uses it to ensure that all the learners are paying attention.

While research shows that practices such as chanting and chorusing are prevalent in rural primary mathematics classrooms (Adler, et. al., 1997), these practices were not widely used in the classrooms observed in this study. The image of all second language primary mathematics classes being dominated by chanting is therefore not appropriate, particularly in more urban settings.

1.2 PRE-OBSERVATION INTERVIEW TRANSCRIPTS

The following categories were used to analyse the pre-observation interview transcripts: awareness and understanding of national language policy, school policy and preferred language practices. The school policy category included the existence of a formal language policy in the school, how it was developed and how it shaped teachers' practices in mathematics classrooms. Preferred language practices included what the teachers state as their preferred practices and why they prefered them.

1.3 REFLECTIVE INTERVIEW TRANSCRIPTS

The transcript of the reflective interview with the teacher was analysed in order to answer the question: why, from the teachers' point of view, particular practices were used during the lessons?

1.4 PUPILS' WRITTEN WORK OBSERVATION SCHEDULE

Pupils' written work was analysed for the kind of written language learners were exposed to and for the different ways in which learners responded to the questions: whether they only gave standard procedures and/or justifications and explanations.

2. LANGUAGE PRACTICES AND THEIR PURPOSES

In this section I describe the language practices of each of the six teachers in the study. In each case I first provide the teachers background, then explore the teachers' understanding of language policy and their preferences. As will become clear, there are different interpretations and understandings of the national language policy.

I will then continue to describe the lessons observed focussing on the process and content covered in the five days of observation. Teaching mathematics is a complicated activity and therefore the nature of the language practices used in any mathematics class will be impacted on by the teacher's style, mathematical ability and view of mathematics. A discussion on how these factors impact on the nature of talk in the mathematics class is beyond the scope of this study. The focus of this study is to explore the language practices that teachers in multilingual mathematics classrooms use and how these practices block or facilitate learner communication of and access to mathematics. I will focus on code-switching as a practice that is peculiar to multilingual classrooms. I will explore the different ways in which

teachers talk about code-switching and enact it in their classrooms. I will argue that while the new language policy encourages code-switching, teachers actually experience it as a conflictuai issue.
2.1

2.1 TEACHER 1

2.1.1 Background

Like her learners, Teacher 1 is a first language Tswana speaker. However, in addition to Tswana she can speak three other languages (English, Afrikaans, S. Sotho). She has been teaching for ten years and has an M+3 qualification She learned mathematics in Tswana during her primary school and at college she learned mathematics in English While she argues that going to college did not prepare her to teach second language learners, she believes that every teacher should make an effort to understand her learners and deal with the challenges in her school.

Teacher 1's grade 4 class that was observed has 60 pupils in total, 26 girls and 34 boys. They seemed to have a good relationship with Teacher 1, who teaches them all the subjects. Although their communication with her, in and outside the class, was mainly in English, this did not seem to limit their interaction.

2.1.2 Policy Issues

The pre-observation schedule shows that Teacher 1 is aware of the national language policy and understands that now 11 languages are official. She maintains that while the equality of languages is crucial, the international status of English cannot be ignored and supports the fact that English should be given more attention at school.

> *"I think all languages must be equal although English as the international language, it has to still be emphasised and mother tongue I think it's high time that all the kids learn mother tongue and be proud of it. " pre-observation interview)*

She pointed out that it is important for learners to know their own languages. As the above extract shows she is of the view that learners' main languages should be valued. She further emphasised that:

"...after so many years we have been made to feel inferior with our languages because, you know, more often than not in meetings, everywhere, you couldn't just stand up and express yourself in vernacular I mean, you would be ridiculed as somebody who cannot express herself. " (pre-observation interview)

During the pre-observation interview it was not easy to understand what the language policy at Teacher 1's schools is. She initially explained that in 1994 their language of learning changed from English to Tswana. However she did not emphatically say that the language of learning in the school is Tswana, she was very speculative. "Yes it was English, but now basically we have sort of converted into our mother tongue" (Pre-observation interview). During the reflective interview when she was probed more about this issue she mentioned that in the school learners are generally encouraged to communicate in English.

R- Okay, but I mean one thing that I observed watching your lessons and being in the school for the whole week and spending time in the school and going to other classes, is that generally your students are, you know, communicating in English.

T.- Ja

R: Like they bring messages in English, they talk to you in English. T.. Mm.

R: You know, how do you get that? How do you manage to get a grade one coming into a grade four class giving a message in English?

T-Ja, the thing is we do encourage them to speak, when you send them to a teacher, you, we discuss at the meeting that if a child comes to you, you must encourage the child to speak in English So even in the schoolyard; they are being encouraged from assembly, we try encourage them to speak English.

(Reflective Interview)

One can therefore only infer from this conversation that English is the language of learning in the school and perhaps teachers are free to switch codes during teaching. It was clear during my visit to the school that the learners were much more fluent in English than most second language English learners in similar contexts.

In her class she uses both English and Tswana interchangeably. She shared that she uses

In the lessons observed the teacher used mainly Tswana while her learners interacted with her in English. During the reflective interview she mentioned that she was disappointed that her learners ` comm

R: Okay. Is there anything that you did not like?

T Ja like for instance when I maybe taught them in Tswana, they, you know, always tried to answer in English.

R: Mm.

T. So, I think we need to go back and revisit the areas in Tswana.

(Reflective Interview)

It seems that the learners in Teacher 1's class are used to communicating in English and this is what the school encourages them to do. During the interview Teacher I continued to express her dissatisfaction with her learners' use of languages. It seems that Teacher I's concern had a lot to do with the fact that she was aware of the researcher's interests, multilingual classrooms.

T: No, I think I would change- especially when it comes to, I'll go back and say- this is a lesson on multilingualism, but it seems as if in this English is still predominant, I will look into that.

R: So do you think English is predominant in your class?

T.- Ja

R: And do you think that's a problem?

T.. It doesn't make a problem, but as you said initially, that you are coming here for multilingualism -you want to see how multilingualism works in the classroom, but now since English is predominant, it's predominant in the class.

R: What does multilingualism mean to you?

P Multilingualism to me, it's switching to other languages. ' (Reflective Interview)

It is possible that in the absence of a researcher Teacher I is comfortable with her learners using English. The school policy together with the researcher's presence in teacher I's class created a conflict for the teacher.

2.1.3 Overview Of Lessons Observed

Five consecutive lessons were observed in the same grade 4 class and they all focused on multiplication. To introduce the first lesson the teacher started by writing the word multiplication on the board and ,~ talked to the learners about what it means both in Tswana and in English. She proceeded to give them an example on the board:

```
    14
x   16
    84
+14
224
```

This was followed by group exercises and then class-work which were both similar to the example. airing group work there was a lot of interaction between the learners. The learners' interactions were however limited to procedures and very similar to the language of the teacher.

Lesson 2 started with checking and marking of home-work. Volunteers from different groups were called to the board to write their solutions. If the answer on the board was incorrect another volunteer was requested. The teacher identified those who had problems with the home work and did more examples with them, emphasising the procedure, while the rest of the class continued with more multiplication problems. After working with the selected group she gave them an exercise to do as home work. The lesson ended with the whole class singing a song while they put away their mathematics books.

Similar to lesson 2, lesson 3 started with checking and marking of home work. She then worked with one group (`good group') on multiplication of three digit numbers by two digit numbers while the rest of the class was busy with corrections.

After checking and marking homework in different groups during lesson 4, the teacher worked with one group (`good') on a word sum while the rest of the class was very noisy and not involved. The word sum she did with the group was: "In Thusong primary school, there are 10 classes and in each class there are 19 learners. How many learners are there in Thusong?' After doing this example she started a song to get the learners' attention back. At the end of the song she wrote two different exercises on the board: one for the `good group' and the other for everyone else. For the `good group': In KTS there are 15 classes. In every class there are 13 learners. How many learners are there in KTS school?", for the rest of the class: 301 x 15, 408 x 19, 485 x 15.

In lesson 5, after checking and marking the home work, the teacher continued to work with the `good group' on another word sum example: "In the SPCA are 12 cages. In each cage are 12 dogs. How many dogs are there altogether?" The rest of the class was working on yesterday's word sum. In handling the word sum with the `good group', the teacher started by asking them to read and then focused on the new words like SPCA, cage asking them what they mean. This was followed by a discussion on what they were required to find in the word sum and how the solution can be found. After finding the solution she wrote two different exercises on the board for the learners to do as a class test.

2.1.4 Nature Of Talk

During teaching, teacher 1 focused mainly on formal mathematics language. Her classroom mathematical discourse moved across procedural, calculational and conceptual discourse. She taught procedures explicitly and occasionally engaged learners in both calculational and conceptual discourses. In the extract below she lead the learners in finding the solution for 59 x 19 and engaged them in procedural discourse. Her focus here was on getting the learners to master the procedure and not on the reasons for using the procedure or on why the procedure works.

T. Can we start?

Let's start because we've got our tables now.

How do we start?

9 x 9 is 81

Write 1 and carry 8.

And we say 9 x 5 plus 8.

Where do you get this eight from?

P: From 9 x 9.

T.˙ On 1 see, you carried that 8

Now you are saying 9 x 5 is how much?

P: 45.

T.. -15 plus 8?

P: 53

P: Ooh, 53, okay.

1 times 9 is equals to 9 under

1 times 5 is 5.

We say carry down 1 and say 9 plus 3 is 12

We write 2 and carry 1

5+5 plus 1 is 11

Very very good

(The teacher with pupils clap hands.)

(Lesson 4)

The above extract is a typical example of how Teacher 1 talks mathematics in her class: the talk is in terms of procedures where numbers are manipulated, for example, as objects that can be 'carried'. What is interesting is that the teacher is not the only one who `owns' this kind of talk. She models the talk and then gives learners an opportunity to practice it. In the extract the learner is working out the solution for 444 x 19.

P.. *Let us say 9x4 is36*

We write 6 and carry 3 then again we say 9 x 4 36 + 3 is 39 we write 9 and carry 3 We say 9 x 4 again is 36 plus 3

39 and cover the units

We say 1 x 4 is 4. And again 1 x 4 is 4.

We say again 1 x 4 is 4 and then we underline and then 6 + 0 is 6

9+4 is 13 carry 1

9 + 4 is 13 plus 1 is 14 carry 1

3 + 1 plus 4 is 8

T: Hm, that's good

(Lesson 4)

In the above extract, the learner is imitating the `teachers' language' of mathematics where numbers are referred to as objects that can be `covered' and `carried'.

While it can be argued that procedural talk can and does occur in many mathematics classes, what actually makes a difference is the fact that in a multilingual class this kind of talk is supported by the learners' main language. For instance if the teacher discovers that there is an error in the procedure she handles this in the learners' main language. For instance, in the extract below the teacher had asked one of the learners to work out 59 x 19 and according to the procedure she taught them they firstly needed to write this problem vertically. In trying to write it vertically the learner wrote the multiplication sign

incorrectly between the 1 and 9 in 19. The extract shows how the teacher used Tswana to deal with this error in a non-threatening manner.

T.. Alright, I must put it down, okay.
And then we say 1 + 0
3 +... Go na le phoso fa?[Is there a mistake here?] P: No.
T.- Nix, nix? Lebella sentle. [Really? Look carefully]
(The learner corrects the multiplication sign writes it at the correct place.)

(Lesson 4)

This is not the only way in which the learners' main language plays a role. In fact to move from procedural discourse to calculational and conceptual discourse, teacher 1 used the learners' main language. The following episode *which* occurred during lesson 5 is a typical example of how teacher 1 used the learners' main language to engage learners in informal conceptual discourse.

T: Eh, can you all read here?
P: In the SPCA are 12 cages, in each cage are 12 dogs. How many dogs are there altogether?
T.. Now, first of all, what is this SPCA?
P: When your dog is ill..... (unclear)
T.- Yes, sure.
P: Fa nja ya gago e lwala go na le batho ba tlang ba tla go tsaya ntja ya gago a ba a isa ko spetlele fa ba bona e le botoka ba e busa. [If your dog is ill, there are people who will come and take it to the hospital and they bring it back when it is well.]
T Ee, Spetlele sa dintja akere?Ke ko diphologolo, di pets tsa mo nlung di nnang teng akere?[Yes, it is a hospital for dogs, right? It is where pets are kept]
P: Ba kile ba tsaya ntja ya ko gae.[They once took my dog.]
T. Ba kile ba tsaya ya kwa lona? [They once took your dog2]
P. Le ya ko gae [And mine too]
T.- Ao! Ba e tlhadhoba ka eng? La patela? [How do they examine it? Do you pay?]
P. No. Mahala [Free.]
T.˙ Ooh, ke mahala? [Oh it is free?] Go raa gore e a thusa ka gore seo se se tona ke gore re tshwanetse go tlhokomela diphologolo tsa rona akere?[This is helpful because the greatest thing is that we should take care of our pets] 0 t1a bolella baba sa itseng, baagisani gore bathong ga njantyana ya gago e kare e a tlhotsa o tla e isa ko SPCA

[You must tell your neighbours and all those who do not know that if their dogs are ill they can take them to the SPCA)

(Lesson 5)

While it may seem as if the discussion that the teacher is having with the learners above is not important in the mathematics class, in this case it is. The problem that is being dealt with here talks about the SPCA and therefore the teacher uses this as an opportunity to educate the learners about the SPCA The use of the learners' main language here enables active interaction with the teacher, for instance, learners are free to share their stories about the SPCA

T.. *Right Jaanong ga re bala fa yare [when we read here it says] in the SPCA are 12 cages. Ke mang a ka bolellang gore [who can tell us what is a cage? E kare re bolela ka dilo tse re sa itseng gore di ko kae.[It seems that we are talking about things we do not know].*

P: Ke ko ntja e dulang. [where dogs stay].

T.- Ooh, a re ko ntja e dulang, gore ga o batla gore e ske ya latlhega o e tswalela mo caginyaneng.[She says that where dogs stay]...

P: Ee.[Yes]

T.- Jaanrong di cages tse di di kae?[How many cages are there?]

P: 12.

T.. 12?

P. Yes.

T: Ke rata go di kwala ga gore o mongwe o utlwa re re 12 mine ga re di bone akere? O bala le nna gone. [I want to draw them so that we can see them, right? Count with me.] (Draws 12 boxes on chart representing cages. Pupils count together together with her)

T.. Go raa gore re ko SPCA jaanong akere? [We are now at the SPCA)

P: Yes.

(Lesson 5)

In the above extract the teacher is dealing with the word cage, which could be new to most second language learners. It is important to note that while the teacher engages learners in an informal talk about the new words in the problem, these words are explained in the learners' main language and not in English The learners talk about what a cage is in Tswana. The teacher continued in the same manner to get the learners to interpret each of the sentences in the word sum.

In interpreting the sentence "In each cage are 12 dogs' the teacher made drawings of the cages and dogs inside and then moved on to what the question requires them to do.

T Ee ke raa gore tla re baleng potso e.[Let's read the question.]

Ps:. How many dogs are there altogether?

T Go raa goreng? [What does it mean?] Ke batla go tlhaloganya seo pele.[l want to understand that first] Morero keyo a re potso e re botsa gore dintja iso tsotlhe tse di mo dicaging di di kae. [Morero, there is a question, it says, how many dogs are there altogether in the cages.] Dintja iso tsotlhe di di kae? [How many dogs are there altogether?] Jaanong ke batla go itse gore karabo re a go e bona jang [l would like to know how are we going to find the answer.]

P: We are going to write tens, hundreds, thousands and units (Puts chart on the board) Repeat and we must underline, when we are through we say 12 times 12, we underline again when we are through we put the button here and we say 2 x 2.. (Learner goes on with the procedure in English until she gets the answer)

P: The answer is 144.

T.. Go ran gore re na le dintja tse kae? [It means how many dogs do we have?]

P: 144.

(Lesson 5)

It is interesting that in the above extract that the teacher rephrases the question for the learners, a practice that she has not been doing since the beginning of the problem. On the other hand to deal with the teacher's question: "how are we going to find the answer" the learners move out of the informal talk, that they have been interacting with the teacher in, into the formal procedural discourse which they have learned.

What the above extracts show is that these learners are aware of the dominant culture of mathematics classrooms in which formal written mathematical language is valued and therefore when required to give an answer they draw on their knowledge of formal procedures. Another interesting factor is the fact that the formal procedural discourse happens in English and this is perhaps due to the fact that this discourse is acquired in English.

In the next extract the teacher tries to engage them more in conceptual discourse.

T. 144. Mara jaanong go tlile jang gore re tshwanetse gore re di timese ko gonne nna nka nne ka nagana gore mare why re sa re 12 plus 12? [But now how did you know

that you are supposed to multiply, why are we not saying 12 plus 12?]

Kenosi: Because re bath di answer tsa rona di be right. [Because we want our answers to be correct]

T.. Oh, Kenosi o arabile are o batla go bona a tshwara di palo isa gage right ke moo a reng 12 x 12. [Kenosi has responded he wants his answers to be correct.] O mongwe a ka reng? [What do the others say?]A ka re tlhalosetsa jang? [How else can you explain this?](A few pupils raise their hands and she point at one.)

T: O batla go leka?[Do you want to try?]Emella re uthwe, Ntsiki? [Stand up and try, Ntsiki]

Nisiki: Bare ko SPCA go na le di 12 cages ene gape go na to dinya tse 12 bjanong ge re di bala dintja tsse di d kae? [They say at the SPCA there are 12 cages and 12 dogs in each cage, so when you count the dogs in each cage what will you get?]

(Lesson S)

It is interesting that when the teacher asks them why they multiplied, the first reason she gets is that they want their answers to be correct. This is also very typical of most mathematics classrooms where it is important to know what the correct answer is and not why the answer is correct. On asking for alternative answers, Ntsiki used the teacher's drawing to explain how she would get the answer. Her response is also in Tswana.

The table below gives a description of the nature of the classroom discourse in teacher I's class during the lessons observed.

Table 3: Teacher 1

	Conceptual discourse	Calculational Discourse	Procedural discourse
Formal	Lesson 5	Lesson 1	Lesson 1 - 5
Informal	Lesson 5	Lesson 5	

The above table shows that Teacher I's language practice were predominantly formal and procedural. It seems that in so doing the teacher communicated to learners what is valuable mathematics language. It is therefore not surprising that when the learners were engaged in conceptual discourse they quickly shifted back to the formal procedural discourse.

Nevertheless, Teacher 1's learners were exposed to and engaged in all the three kinds of discourses. During the learners' interview learners could draw on all the three kinds of discourses. Teacher 1's

learners were fluent in the English language and perhaps this is not just a function of her language practices but also the fact that use of English is encouraged in the school. Mathematically, teacher 1's learners were very fluent in engaging in both procedural and calculational discourse. They could carry out their procedures with ease and whenever they were required to give reasons for some of the steps in their procedures they managed well. It is feasible to argue here that this teacher's language practices enabled learners both mathematically and linguistically.

2.1.5 Learners Communicating Mathematics

The three pairs of learners interviewed were firstly given formal multiplication problems to work out, for example, 28 x 5;130 x 11. They were also given a word sum which they were initially asked to solve in any way they wanted. They were then also asked to solve it by using pictures.

In working out the formal multiplication problems, both the `good' and the `average' pairs used the procedure and language that the teacher used during teaching. The learners' calculations were correct (formal calculational discourse) and they were also able to give justifications for their procedures (i.e engage in formal conceptual discourse). While the `weak' pair could not engage in any procedural or calculational discourse (i.e were unable to work out the problem using any procedure), they were able to engage in some informal conceptual discourse about what the problem means. In the extract below the `weak' pair were trying to work out 28 x 5 by counting five twenty eights on their fingers.

> *R: Okay, all right now can you do twenty eight multiplied by five, theres a pen, you can write as you are talking, tell me what you are doing.*
> *(Learners are counting on their fingers silently)*
> *R: What are you counting Tshiamo? Tell me what are you counting?*
> *TSHIA: Five, ten, fifteen.... (counting with fingers).*
> *R: Okay, can you count aloud so that 1 can hear what you are counting*
> *TSHLA: Five, ten,.....*
> *R: Le kgaonta eng? [What are you counting?]*
> *TSHM AND LUCKY: Di five (5) di le .... twenty eight [Five twenty eights]*
> *R: So le khaonta bo five ba ba twenty eight ka menwana ya Iona [So you are counting five twenty eights with your fingers?]*
> *TSHIA AND LUCKY: Re etsa twenty eight ebe re dira di group tse, tsa five [We count 28 and then make 5 groups of it]*
>
> (Learner Interview)

What the above extract shows is that these `weak' learners have a clear understanding of multiplication. The initial reaction of all the pairs to a word sum during the learners' interview was to use the procedure. When asked to represent their answer in a drawing the `good' pair's initial reaction was "it is hard" and this was mainly because this was an unfamiliar request. The extract below shows how the `good' pair of learners handled the problem.

N&K Ya, they say, there are five rows of cars with three cars in each row. How marry cars are there altogether? Ok we are going to write thousands, ok hundreds, tens and units; then we write five here and three here and we times, then after we underline twice then after we say five times three is fifteen, we write. Now it means that altogether is fifteen.

R: OK now can you draw me what you are talking about; can you draw what you are talking about?

N&K Huh, it's so hard

R: OK

N&K There are five rows of cars with three cars in each row. How many cars are there altogether? OK, we must draw a road and a car.

R: How many?

N&K We must draw five rows and three cars in each.

N.. But I don't know how to draw a road I draw a car... naa ke t1a drowa tsela [I will draw a road] ...then after I draw the road, then after I do like this Then after I draw another one; it's one row here let me, let me try I am not drawing...

R: Oh, so that's a row.

N.. That's a row, and I draw' again a row.

R: 0K

N. Then after I draw again a car, and that car is moving.

R: O K

N.'Then after I write a road again and draw a road

N.: Then after ... it has three. .. then after I write a road because; I am not going to draw a car again because they say there are five rows of cars with... there are five rows of cars with three cars in each road Okay I understand now, they say here tt's a...it's three cars and here it's three cars and here it's three cars and here its three cars, and again I draw again a car here. And in each ....then after I draw' a last row, I draw a car again Then after we have ...

R: So how many cars do you have now altogether?

N: Altogether there are fifteen.

(Learner Interview)

While the learners in the above extract could understand what the problem requires them to do, it is clear that they were struggling with the words row and road, they seemed to be using them interchangeably. In this case, their use of the words interchangeably does not interfere with solving the i problem, however it raises questions about words used in mathematics classes that sound the same but have different meanings, for instance, size and sides; rectangle and right angle.

The above examples show how enabled the learners are. All the six learners had a clear understanding of multiplication and could engage in different kinds of discourses. The last extract also shows that when faced with an English language mathematics problem they could interpret it both linguistically and mathematically.

What the above discussion shows in terns of Teacher 1's emphasis on the learners main language is that it is probably not usual. However, what is of significance is that while in day to day practice there is probably less code-switching than observed, Teacher 1 uses a range of mathematical discourses. Her learners engage in conversations with her in both languages that are procedural but also conceptual and calculational.

2.2 TEACHER 2

2.2.1 Background Teacher 2 joined the school she is teaching in last year (1997) as a head of department. She has a history of working cooperatively with NGOs in the area. As a result of that she volunteered to co-ordinate the mathematics development workshops that were offered to the research schools. She notified and reminded all the research schools of the dates and venues for workshops. She also worked cooperatively with a nearby private school and invited them to the workshops and demonstration lessons conducted by the researcher.

Her grade 4 class observed has 46 learners, 25 girls and 21 boys. Teacher 2, teaches them only mathematics. She is first language Zulu speaking and can speak another seven languages in addition to Zulu (viz. English, Tswana, Xhosa, S. Sotho, N. Sotho, Afrikaans, Swazi). The main language in her school is Tswana, Even though she can speak Tswana she described herself as not very fluent in it. She

seemed to have a good relationship with her learners and her interactions with them were mainly in English.

At primary school Teacher 2 teamed mathematics in Zulu up to grade 4. At college she learned mathematics in English. She liked mathematics at school and at college and she mentioned that she enjoys teaching it. Teacher 2 has an M + 4 qualification and has been teaching mathematics for the past ten years. She pointed out that her ability to teach mathematics is also a result of her involvement with NGOs, in her own words she says ". .. the workshops, I'm telling you, they really opened my eyes and they really linked with what my lecturer at college said." Teacher 2 is the only teacher in the sample who is a head of department in her school and also a member of her school management team (SMT).

2.2.2 Policy Issues

During the pre-observation interview, Teacher 2 could not commit herself to being aware of the national language policy. When she was asked whether she is aware of the new policy she said: "I would not say that I am very much aware" (Pre-observation schedule). What she could recall explicitly are workshops on language use in multilingual mathematics classroom conducted by an NGO in her previous school. Irrespective of what the new language policy says, Teacher 2 seemed to be very concerned about her immediate situation. She pointed out that the important thing for her as a mathematics teacher is that children should understand their mathematics. While Teacher 2 believes that it is important for leamers to understand what is being taught, she maintains that they should be exposed to English so that they are able to communicate with people from "other schools or cultures"

> T.- *Then at the end of the day we agree that the child must learn with the language that he or she will understand.. the child must understand what you are teaching him, so which means you must make sure that he use the language that the child will understand But still you must not confine a child to a situation where she won't be able to understand other people when she meet or where he meets other people from other schools or other cultures because sometimes I may force English to the child card then after teaching that child in English language, that is not her language or his language, but still I am trying to force it because it is said that is an international language, and he must learn in English. At the end of the day when 1 give that child a test the child might fail the test not because he doesn't know the work but is because of the language. So all of that time if I am using the African Language to the child and came to that I must always make sure that the child understand what 1 am teaching.*

What the above extract shows is a conflictual situation for Teacher 2 in relation to language choice in her teaching. While she wants her learners to understand mathematics, she also would like them to learn and practice speaking English and this creates a dilemma.

The official language of learning in the school is English, however as teacher 2 said "it was never overemphasised to the teachers" (Pre-observation schedule). It seems the fact that it was not emphasised means that teachers are free to use the learners' main language when teaching to facilitate understanding. This policy was agreed to by the school management team, who then discussed it with the school staff and they all agreed to encourage learners to use English.

In her class, Teacher 2 uses both English and Setswana which is the learners' main language. It seems, however, that the learners' main language is used to support not only learner access to mathematics but also their learning of English. Teacher 2 pointed out that she encourages her learners to use English, and there are pragmatic reasons for encouraging English. In the following extract she explains them:

> "*I encourage them to use English because in the past years we were having problems, when we were setting questions. The textbooks are written in English the question papers are to English, so you* find *that the child doesn't understand what is written there. Because all the time you encourage them to speak in English and then you give hlm the question that has been written in English you find that they trying to give you answer, like for instance let me make an example last year during exam time we had a problem children asking, raising their hands asking the invigilator all the question that they do not understand and the problem was the language not the question itself" (Pre-observation int. PI).*

The concerns raised by Teacher 2 above are shared by the majority of second language mathematics teachers particularly those who share a first language with the learners (Setati, 1996, 1997, 1998). It seems that even though in the primary schools children write an internal examination, teachers (and perhaps schools) do not feel empowered to give dual language/medium examination papers. When I asked how she uses both languages when teaching mathematics, Teacher 2's response above indicates her preoccupation with the examinations.

What teacher 2 is expressing in the following extract is consistent with her practice.

"Ja I use both languages sometimes I ask a question in English the look at them you could see sometimes when children don't understand, then I will switch over to

Setswana after switch over to Setswana then I will go back to English in a way, I am giving them new things and maybe on that day a child will learn a new thing from what 1 had been saying that he had not learn before because for instance like word sums; we read three by three and I would ask them what does it mean in Setswana and some of them they know it and then they will say it. So all the time I will see improvement but if the don't understand let me tell you I go back to draw, so that at the end of the day I cannot blame mathematics problems because of the language. (Pre-obs Int. sched p2')

A description of the different ways in which she used switching is explored in the section following the summary. The summary is given to provide the mathematical context in which the language practices occurred.

2.2.3 Summary of the Lessons Observed

The lessons observed focussed on fractions from halves to quarters. Small group work and whole class teaching were used. The teacher used paper cutting for introduction and *then* moved on to using pictures and stories. She focussed more on getting children to understand what the denominator and the numerator represent. She, however, did not use the words denominator and numerator, she spoke about the number on top and the number below. In most of the exercises given, learners had to do a pictorial representation of given fractions.

Although the interaction between the teacher and learners was always initiated by the teacher asking questions, the questions also focussed on application of the concepts in real life. The teacher switched occasionally to rephrase questions and to give explanations. No switching by the leamers was observed during the lesson. Although use of Tswana is not prohibited, it seems that use of Englis h is encouraged and obviously well-practised by the learners.

2.2.4 Nature of Talk

2.2.5 The following table gives a summary of the nature of talk in Teacher 2's class:

Table 4: Teacher 2

	Conceptual discourse	Calculational discourse	Procedural discourse
Formal			

Informal	Lesson 1- 5	Lesson 1 - 5	

The general classroom discourse is mainly conceptual and informal (Col). There is no explicit teaching of procedures. While learners are also inserted in Col, their own use of the discourse is very limited. Further discussion on how the teacher's language practices facilitate or block learners' access to communicating mathematics will follow later.

Teacher 2's observed lessons were interactive and this was not only in the form of learners talking but also doing. Learners were asked to represent their answers on the board in pictures and Teacher 2 asked them a lot of why questions. The following extract from Teacher 2's observed lessons is a typical example of how she involves learners in the lessons:

T: I want you to think Close your eyes, and think about the shopkeeper. What will Mr Nkomo do when you say, "Mr Nkomo 1 want three halves. " Anyone? Don't draw a bread like they sell at the shop neh! Draw like this one. (One of the learners goes to the board to draw the bread)
T: He tried - what is wrong with the bread? Too small, neh!
P: Yes.
T. No. Give others a chance, right. So Bernard is showing us haw many halves
P: Three halves.
T.. Bernard is showing its three halves. So this is one half, one half and another one half neh!
P.- Yes.
T When you go to the shop and you sayyou want three halves, why does not Mr Nkomo take just one bread and say hey I don't want to lose my bread I will just give you one bread and I will cut it into three equal size. Why does not he not do that Molefe? Why Mr Nkomo a sa nke borotho bo boiware, a be a bokgaola dipiece tse three (why doesn't Mr Nkomo take one loaf and cut it into three parts and say 1 can't take another bread because you are going to waste my bread Why a sa etsa yalo? Why does not he do that? Why does he not take one bread and cut it into

two equal halves and another into three equal piece, S'bongile?

P: Because they are three two.

T.. Why a sanke boroto boiwane a be a bokgaola piece tse three tse lekanang? [why doesn't Mr Nkomo take one loaf and cut it into three parts] Why a tsaya borotho boona.(why doesn't Mr Nkomo take one loaf and cut it into three parts] Let's say Mr Nkomo gives this. This is another bread he cut it into two equal parts He gives the 1st child 1/2 and the 2nd child one half But there were three children. Mr Nkomo take another bread and cut it into two equal parts and give another child this bread Why does not he cut in this three, Victor?

P: Because they are not equal.

T.. A re because they are not equal. Are these parts not equal? Are they equal.

P: Yes.

T.- What is wrong? Why ntate Nkomo asanke borotho bo boiwane fela a be a etsa dihalf tse kgaotswe yana [why does n'tMr Nkomo take one loaf and cut halves from it] When he had cutted it like this do we get halves?

P. No.

T.- What is a half. What do we mean, Tebogo?

P: If this is a bread (showing the class with a book), then we must cut it into two equal halves

T. Very good When we talk about half Tebogo, has given us an example, that we must cut it into two equal parts. So, here we don't have two equal parts. So, this are not half neh!

P: Yes.

T. This are now pair. So, you take this piece of bread when you take home this piece of bread If Mr Nkomo had cutted it like this will your parent be happy at home?

P: No.

T.. Why not?

Ps (not in a chorus, most of them talking -not the same

thing- at the same time): Because...

T.. Ok one person at a time. Ok Tebogo?

P. Because they are not equal halves.

T. 7hey are equal parts. They are three equal parts and you say they won't be happy at home, yes Donald?

P: Because is small.

T.. Why is it small?

P. Because it is one bread

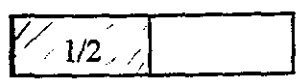
T. One bread that it has been divided into how many parts?

P: Three part

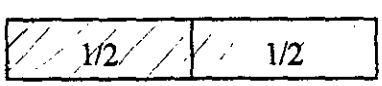
T.. And not how many part?

P: And not two part. (Lesson 4)

The above extract is a good example of how Lindi involves learners in the lesson. This episode started with the her leading the learners in finding 2/2 + 3/2 using pictures on the board. They firstly had to show 2/2 in a drawing which of course they did not have a problem with. The second task was to show 3/2 in a drawing, the first volunteer showed it in this manner:



It seems, however, that the teacher was not satisfied with this kind of representation and therefore engaged learners in a discussion about a realistic situation of a shopkeeper selling bread. As the extract shows, she accepts the answer, challenges them by using an everyday problem and continues to give her own representation of 3/2:



The example that she brings in, makes the learners part of the story and this encouraged a lot of interest and participation from the learners. One of interesting aspects of this episode is that the teacher started with a formal mathematical problem which could have been solved by using formal procedures, for example, since the denominators are the same, you just add the numerators. She then continued to engage learners in informal conceptual discourse and ended up not solving the initial problem 2/2 + 3/2. This kind of discourse as used by teacher 2 enables the learners to gain access to the everyday mathematical meaning of 3/2. In the everyday mathematical situation of selling bread, the first

representation seems to be a waste of bread while in formal mathematics both representations of 3/2 above are acceptable. The teacher did not draw this to the attention of the learners.

As the extract shows, the interactions between the teacher and the learners were mainly in English and the learners seemed able to handle it. The teacher only switched three times in the extract and in all the three cases she used the switching to rephrase the question: "why can't Mr Nkomo take one loaf of bread and cut it into three equal parts?".

Reflecting on this episode during the interview, Teacher 2 explained why she uses stories in her teaching:

> T.- *I've realized that maths is not only in the classroom, and I want the children to now that they live maths, they play maths, at home there's maths, at the shop there's maths, maths is everywhere, it's not just in the classroom. So they must, I want them to take the real situation outside the classroom and put it in the class, so that they can know that what they are doing outside is the same as what we are doing at school. The halves that I'm talking about, I'm talking about the halves that they buy at the shops everyday. Because in the past years before I was workshopped on fractions, I used to see children being frightened when you talk about a half now in a classroom and a quarter in the classroom, eh, they used to think that it's something that is not existing outside the classroom. So it has really helped me doing it that way.*
>
> *R. Do you always do it that way or you only do it with fractions?*
>
> *T.' I always do it even if it's not fractions I like to relate stories, especially relate stories that are relevant to their society, to the community they live in.*
>
> *(Reflective Interview)*

While making use of stories from the learners' experiences can facilitate access to mathematics, there is a possibility that learners use of (mathematics) language will remain at the informal level. As Pimm pointed out, "one of the difficulty facing all mathematics teachers is how to encourage movement in their pupils from predominantly informal spoken language with which they are all pretty fluent, to the formal written language that is frequently perceived to be the hallmark of mathematical activity" (1991: 21). It is evident in the above extract from Teacher 2's lesson that the learners are fluent in the informal spoken mathematics language. They can draw pictures and they also refer to thirds as equal halves.

Their explanations of fractions is in the form of illustrations that involve bread. This was also evident in the learners' interview, when they were asked to show five quarters in a drawing, they showed five quarters of a loaf of bread. In this way they seemed to be locked in the teacher's informal conceptual

discourse from their everyday experience. Across the five lessons, there were limited shifts to formal mathematical discourse.

As mentioned earlier, the discourse in this class happens mainly in English. The observation schedule of day 1 shows that when Teacher 2 did switch this was mainly in the public domain and for explanations. The schedule also shows that the teacher's Tswana explanations were elaborate. From lesson 2 to 5 switching continued to be used, and mainly to rephrase the questions asked. The switching in this class, as seen in the above lesson extract, is from English to Tswana. The teacher firstly asks the question in English and then switches to Tswana.

The following extract is another example that illustrates this further:

T = teacher, P = one learner talking, Ps = more than one learner talking 0 = pause

1 T:. One quarter. We want to see one quarter of eight girls
One quarter of eight girls So the eight girls give us one
3 whole. This is our whole and we want one quarter of these
4 girls. When we see this number four under the line, there is
5 something that we must do to our whole. What is it that we
6 must do to our whole when we see that four under the line?()
7 (a few hands go up) Ga re bona four ola ka fa tlase a line ka 8
mantswe a mangwe o e kgaola yang whole ya rona,
9 Mpho? [When we see that four below the line, into how many
10 parts should we divide our whole, Mpho?]
11 P: In four quarters.
12 T: In four quarters or o mongwe a kare... ?[What about the
13 others?]
14 P: We cut it into four equal pieces.
15 T.- We cut it into four equal pieces ne, ok. So, I want. Ok
16 come and cut it for us because you have given us the answer.
17 Come and cut it into four equal pieces.
18 T:- Good Right. Let's count the parts 19 Ps (in chorus): 1, 2,
3, 4
20 T: Four equal parts so but we just want to see one quarter w
e21 just want to see one quarter of eight girls. Re batla fela
22 quarter e wane. [We want only one quarter] So who can show
23 us one quarter of 8 girls? Who show us one quarter, Marcia?
24 P: (Goes to the board to show one quarter)

25 T.- *Okay, this is a quarter of eight girls, so how many girls are*
26 *there in that one quarter() Go nale banyana ba bakae mo*
27 *kotareng eela? [How many girls are there in that quarter?]*
28 *How many girls? Look at that one quarter, how many girls are* 29
there?
30 *P. Two girls.*
31 *T. There are two girls in that quarter In other words, a*
32 *quarter of eight is equals to two.*
33 *P: 8 girls.*

(Lesson 5)

Prior to this episode Teacher 2 had drawn eight girls on the board and asked learners to show one half of the eight girls. The transcript shows that the learners did not have any difficulties showing one half of eight girls. The teacher did not have to switch to Tswana in order to rephrase the question. What we are seeing in the above extract is a continuation of the lesson and Teacher 2 asking learners to find one quarter ofthe eight girls. Lines 1 to 5 shows Teacher 2 rephrasing the question in English a few times and finally in Tswana. Her rephrasing of the question into Tswana is *preceded by a pause* and only a few learners had their hands up. This confirms what she said in the pre-observation interview that she looks at the learners' body language and when she sees that they cannot understand she switches to Tswana. It should be highlighted here that although Teacher 2 can speak Tswana, her first language is Zulu and she described herself as not very fluent in Tswana. With this background, one can assume that her switching to Tswana is not automatic, it is conscious, and perhaps that is the reason why she is *aware* of it. In lines 13 to 15 Teacher 2 is also using Tswana to clarify what she is really asking: "re batla fela quarter e wane *[we want only one quarter]* In lines 17 to 19 again Teacher 2 rephrases the question in both English and Tswana. It seems that Teacher 2's rephrasing of questions is not only for teaching mathematics but *also to teach the English language. As* she said in the pre-observation interview, she *rephrases* the questions so that they can learn "a new thing from what I have been saying" (p2).

It is important to note that in the above extract the teacher engages learners in informal calculational discourse. The formalisation ofthe discourse in lines 24-25 by the teacher is all in English. This kind of formalisation also occurred in a similar process when the teacher asked the learners to find 3/4 of 8 girls. While the teacher engages learners in informal discourses, the formalisation remains hers, the learners do not get an opportunity to formalise their own discourses.

While Teacher 2 uses code-switching in her class she encourages her learners to communicate in English, she is aware that some of them communicate with each other in Tswana. She also pointed out that those who communicate with each other could be doing it to impress:

> *R: Okay, why do you think they talk to each other in English sometimes?*
>
> *T: Sometimes they talk to each other in English when they see me, just to impress me,like hey teacher I'm doing what you like. Because I have encouraged them to do that and others even come to me to say teacher so and so does not want to speak English. 1 usually give them a problem and then choose a leader in a group and that leader will talk to them in English. Sometimes they even use the words 1 use, for instance I like saying 'I don't want short cuts' and they say the same. Like 'don't just give me the answer 1 want to see how you got that answer'. Then the leader will say the same to them and 1 just laugh.*
>
> *(Pre-obs. Int., p2).*

The above extracts shows that whilst teaching, mathematics teachers also model ways of talking mathematics and about mathematics and this they do intentionally or unintentionally. Teacher 2's phrase "I do not want short cuts' is her way of talking about mathematics. What she is saying in fact, is that the acceptable way of doing mathematics is by avoiding short cuts and showing all steps.

2.2.5 Learners Communicating Mathematics

During the interview learners were requested to draw pictures showing fractions like 5/4, 3/2, 2/3 and then asked to say why they think their drawings are correct. The learners were divided into three pairs: `good', 'average' and 'weak'. In what follows I give extracts from interviews with two of the pairs to show the kinds of interactions they engaged in. Extract I is an interview with the pair identified by the teacher as 'good' and extract 2 is with the 'weak' group.

> *Extract 1 - 'good' pair*
>
> *R: So he took one loaf and cut it into*
>
> *quarters. LI: Yes*
>
> *R: How do you know it's in quarters?*
>
> *LI: Because he's take one loaf and cut 4 pieces.*
>
> *R: If I have two thirds into how many pieces am I going to cut my loaf?*
>
> *L2: Three pieces.*

LI: No, two pieces.

R: Why do you say two pieces? 'Victor is saying three.

Robert is saying two.

Now, Victor can you tell us why you say three?L2:

Because ...you cut 4 pieces.

R: O ka ma wa explaina ka Setswana. [You can explain in Tswana].

L2: Okay, ke kgaotse di piece tse 4 mo borothong bo bo wane .[Okay, I cut one bread into four pieces] Go a ipontsha fa gore e cutile 4 pieces [It shows here how 1 cut four piecesj.

R: So e ipontsha yang 4 pieces [How aloes it show?].

L2: E iponsha gore ke cutile 4 pieces mo borothong [It shows that 1 cut the bread into four pieces].

R: So mona mo two thirds?[So, here with two third?]

L2: Ke tshwamtshe ke thole three pieces [I must get three pieces].

R: Why?

L2: Because three o mpontsha gore ke cut mo bobong ke kgate di piece tse three [Because three shows me that 1 must cut the bread into three pieces].

R' Okay, wena Robert o re two, why ?[So, Robert you said two, can you tell why?]

L2: Ga a correct [He is not correct]. O tshwamtse a mpontshe di piece tse a di jeleng tse two tse di ne di jewa mo borothong mo di piecing tse three [He must show me the two pieces out of the three that are supposed to be eaten].

(Learner Interview)

In the above extract the learners were asked to show firstly 5/4 and then 2/3 in drawing. In both stances these leamers used bread in their illustrations and they referred to "putting into a certain number of pieces and eating some". This kind of talk is similar to the classroom talk which learners were exposed to during the lessons. One other thing to notice here is that these learners were more comfortable communicating in Tswana.

Extract 2 'weak' pair

R: I don't have a ruler. Do you want to use my pen? Tebogo, tell me how do you know that that is 3 halves, what did you draw to know that?

T:1 must cut if I'm finished to cut, I must eat one loaf. I must cut into equal parts.

R: O ka nna wa ndlalosetsa ka Setswana [if you like you can speak in Tswana]

T.- I talk with you in English. This three tell us 1 must cut this loaf into 2 equal parts and this in 2 equal parts. And this tell us I must eat one and here I must eat one and here I must eat one. And if you cant this halves I'm eating it. It gives me three 1 count it like this 1 2 3 and we have three here. And this two tell us this loaf I must cut in equal parts and this and this mix together.

(Learner Interview)

The learners in the above extract were requested to show 3/2 in a drawing. Like the 'good group' they also used bread and talked about the parts they are going to eat. It seems that these learners are locked into the language of the teacher, they are not using their own examples or language. An interesting difference between extract 1 and 2 is that the `weak' learners insisted on speaking English while the `good' ones were more comfortable in Tswana.

In general, Teacher 2 used switching whenever she did not get a response from learners. Most of her switches were preceded by a pause and were mainly for rephrasing. It seems that her use of switching only for rephrasing was limited by the fact that she encourages her learners to use English. While she switched, her learners were not observed switching during the lessons. It seems that in this case it is the teacher who has the option of code-switching.

While Teacher 2 engaged learners in both calculational and conceptual discourses, these discourses remained largely informal. She did not facilitate learner access to the formal mathematical talk. As a result of these practices, her learners discourses were locked in the informal.

It seems that Teacher 2's language practices have been influenced by the fact that she has been to a lot of in-service training courses by NGOs. Most of the NGO intervention programmes encourage use of the learners' everyday experiences in teaching. What we are seeing here is that while the NGO interventions are needed they also need to focus on assisting teachers to facilitate learner access to formal communication of mathematics.

2.3 Teacher 3

2.3.1 Background

Teacher 3, has an M+ 3 qualification and has been teaching mathematics for three years. While her first language is Zulu, she can speak another 5 languages (viz. English; Xhosa; Tsonga; Ndebele; Afrikaans). The main language in her school is Zulu. At primary school, teacher 3 learned mathematics in Zulu and she feels that this disadvantaged her linguistically.

While teacher 3 expressed her love for mathematics teaching, during the pre-observation interview, she also recalled how she hated mathematics in school and also when she was training as a teacher.

> *R: You didn't like Maths, why?*
> *T.. It was complicated I don't know, maybe I had an attitude you know. I started enjoying it when I started to teach it. That's when I started to enjoy Maths and now I wish I could go back and start again because I just had an attitude that this thing is tough and difficult and yet now and I'm able to explain to them like I'm so slow with them because I know how hard is Maths. If you start to hate it at an early age you'll end up not liking it in high school or whatever.*
> *R: So it means you do understand because you've been in a situation where you hated it.*
> *T I know.*
> *R: When you were at school, did you also hate Maths?*
> *T.. I did*
> *R: So did you do it up to matric*?
> T.: *I did and I failed it dismally, I hated it with everything you know. I wished 1 could do something else, but then...*

(Pre-observation Schedule)

According to Teacher 3, her experiences impact positively on her teaching, in the sense that she can, from personal experience, understand what her learners are going through. Teacher 3 did not only feel silenced by the fact that she could not express herself in English which was the language of teaming at college, she also feels that she was not adequately prepared to teach second language mathematics learners.

> *R: Do you feel when you were at college, I mean you have already told me you didn't*

like Maths, you had an attitude, but when you went out of college and you started teaching Maths at school, did you feel you were adequately prepared to teach children Maths in English who do not understand English?

T: No, I was so tense, I didn't have a choice actually.

R: So what made you tense? Was it because you were going to teach Maths or was it because you were going to teach Maths in English to children who do not understand English?

T: I think both of them, because I didn't understand Maths and I was supposed to teach it in English

(Pre-observation Interview)

Her grade 4 class observed had 38 learners in total, 15 girls and 23 boys.

2.3.2 Policy Issues

During the pre-observation interview teacher 3 confided that she is not aware of the new national language policy. The official language of learning in her school is English This policy, she said, was negotiated with the whole staff in 1945. One of the reasons for adopting this policy, it seems, is that the student numbers in the school were going down as more and more children in the area were going to what teacher 3 refers to as "multiracial schools" in neighbouring `former white' suburbs.

T: Ja It came in a meeting because now we had a problem. Ah, most children they go to these schools, amamultiracial because you know they think they are doing everything in English. But then here in our school, then we are doing it in Zulu and it means we are killing these children. So we decided to meet and change. Actually, to apply it practically in the class, not to just say we are doing English we are teaching in English yet in class we are using Zulu. So we tried to emphasise to speaking English more in the class, you understand because they don't understand English these children.

(Pre-observation Interview)

The extract shows that in negotiating the school language policy the school was responding to other pressures which were in conflict with national policy.

In her class she uses English reflecting her view expressed in the above extract when she emphasises that for the policy to work it should be implemented in the classrooms. She prefers to teach in English

and believes that this empowers the learners.

R: Is there any particular reason why you prefer English?

T.. I think English, it empowers them, do you understand and at this stage of 8, 9 years, they can be able to speak English unlike us. We never did English in primary and at college we were supposed to answer in English in lectures So we had a problem with this language, so at any early age they just become used to it.

(Pre-observation Interview)

Teacher 3's personal experiences as a learner seemed to play an important role in her language preferences for teaching and learning. Her reflections in the above extract confirm this. Later in the interview Teacher 3 continued to share her reflections:

R: Talking about your own learning, when you were at primary school you were doing things in Zulu. Do you feel that disadvantaged you?

T: I do yes.

R: Do you feel things would have been different if you did it in English? T: Yes.

R: How different would they be?

T.. Like, I'm not comfortable speaking English in front of people; do you understand 1 mean it's a new language, I started doing it nje, Std 10. Even then we were not motivated to speak in groups in English using English We were just using our Zulu unless we were doing Science, then you answer air what is motion you know, we crammed In college that's when we started to I mean we supposed to answer in English obvious. Some of us we had a problem because we come from these schools But those who came from multiracials they did not have a problem even if they didn't know the answer, but they had the idea so they can just express themselves. But we don't know the answer and we are still thinking but how am I going to put this in words, you know. So, it's better at early age.

(Pre-observation Interview)

While her language preferences coincide with official policy of the school, they are mainly influenced by what she perceives to be in the interests of the learners. As Baker has argued,

> *"decisions about how to teach [second language learners) ... does not just reflect curriculum decisions... they are surrounded and underpinned by basic beliefs about ... [the learners' first languages] and equality of opportunity" (1993: 247).*

Teacher 3 is aware of the dominance and power of the English language and would like to make sure that her learners do not go through what she experienced. She pointed out that she sometimes allows them to speak in Zulu, however, that seemed to be more of an exception than the rule.

> T.. ... *they know I don't want them to speak in Zulu neh Unless I see uguthi they cannot speak this in English you know. Maybe he wants to explain something then I can say you can use Zulu uyabona R: You sometimes say to them they can use Zulu?*
> *T:.Ja, for instance, if they like he wants to explain something and I can see that he knows this thing you know, but he doesn't have....., he doesn't know how to put it exactly neh, then I just say, okay, say it in Zulu and I say it for him in English now.*
> *(Pre-observation Interview)*

One of the issues the above extract raises is that it seems that this teacher is not just teaching mathematics but also the English language. Repeating in English what the learners have said in Zulu is a way for her to give learners an opportunity to hear more English spoken.

The challenge for Teacher 3 when she started teaching was not just to teach mathematics in English but also to learn mathematics herself in English and to learn to teach mathematics in English to second language learners.

2.3.3 Summary of the Lessons Observed

All the five consecutive lessons observed focussed on multiplication. As introduction to multiplication, the teacher gave learners a multiplication sum, 36 X 4, and asked them to use their own methods to work it out. Learners volunteered their methods which included the following: 36 X 4 = 36 + 36 +36+ 36 =144, 36 X 4 = 6+6 +6+6 +4 + 4 + 4 + 4 = 36. The teacher responded positively to the methods that yielded the answer 144 and ignored those that did not. She did not legitimate their correct methods, she instead gave them her method and asked them to use it to solve an additional sum. The teacher's

method: 36 X 4 = (30X4) + (6X4) = 120 + 24 = 144. In showing this method to the learners she emphasised the procedure: 'we write equal sign and then open bracket thirty multiplied by 4, close bracket...". For all the lessons observed the learners used the teacher's method including the formal procedural discourse she used. During the reflective interview she was asked about her practice of letting the learners come up with their own methods.

> *R: I realise that when you were teaching, I mean, it was interesting like you started by saying to them, you give them a sum and they must multiply and you said to them use your own method and then they did it, with their own methods and you know they told you what they did their own method Can you tell me what is the importance of doing that.*
>
> *T.. We in Maths course, ne, they encourage us to let the kids use their own method you know, it is not right to tell them use this method Actually they are supposed to use all the methods as long as they get the correct answer.*
>
> *R: Okay.*
>
> *T: As long as they can get the answer mid as long as they can tell you how did they get one answer.*
>
> *R Ja You said to them they can use their own method and after that you show them your method and they got stuck with your method what do you think they got stuck with your method.?*
>
> *T: Ja Uyazi, you know I was surprised. I was surprised vela, because I thought this one was simple you know. Actually they were having problems in that method So I kind of thought maybe it was then my introduction. I don't know...*

(Reflective Interview)

While Teacher 3 would like to have her learners talking, interacting with each other and coming up with their own methods, she is limited by her own understanding of the topic she is dealing with. For instance, she did not know how to deal with this response: 36 X 4 = 3+3+3+3+6+6+6+6 = 12+24 = 36. During the interview she agreed that she ignores the `wrong' methods that learners give.

> *T: Like I think is good that they come with their method you know. Although some of them are going to be wrong, but if maybe we could have attended to this method you know. Maybe we could have found another way through his method of getting the amswer you know. Is just that I never look into this method though, I just ignore it.*

During lesson 1 as learners were explaining how they worked out their multiplication problem using own methods, one of them started her explanation in Zulu and some of the learners shouted "use English". This was perhaps due to the fact that they are aware of the language policy of the school and the class and as Teacher 3 mentioned they know she wants them to speak English.

On the third day, she gave them word sums, which most learners had problems with. It seemed that the learners' difficulties were as a result of their inability to read and interpret the problem. On the fifth day the lesson was devoted to playing a number game. This created a lot of excitement and activity in the class.

23.4 Nature of Talk During Lessons Observed

The table below gives a summary of the nature of talk during the observed lessons in teacher 3's class.

Table 5: Teacher 3

	Conceptual discourse	Calculational discourse	Procedural discourse
Formal			Lesson 1 - 5
Informal			

During all the observed lessons, teacher-pupil interactions in public domain were mainly in English and were initiated by the teacher through questioning. The teacher switched in public domain mainly to reprimand learners. In fact, on the third day, when they were doing word problems, she explicitly pointed out to the learners that "I am not going to use Zulu".

R: And you had photocopies from kiki cards. And as you were like you gave them a warning like I am not going to use Zulu Why did you make is so explicit that you were not going to use Zulu? Was there any reason for that?
T: Because they like to speak Zulu you know, like mm, most of them, let me say just almost 1/2 they didn't understand English quite clearly. They have problems they can hear you sometimes, but when it comes to work sometimes when you just say instructions like go and do this and that, they understand, but when it comes to reading the sum thoroughly, they don't read thoroughly, sometimes they have problems ne. So I tell them I am not going to use Zulu but I can come to you and explain to you in English again
R: As you were walking around the group you were explaining to them.

T: Ja, explaining to them in English, I am not going to use it, because when you use Zulu, you don't encourage them to understand this word sums you know. Because we do set them during the exams So now, who is going to explain because they must be able to understand some of the words which are used so less, more do you understand?
(Reflective Interview)

It seems that Teacher 3 is experiencing the "dilemma of code-switching" (Adler, 1996, 1998). While she knows that her learners do not understand English, she does not want to switch to Zulu because as she says it will not encourage them to speak English. The language preferences she expressed in the pre-observation schedule are consistent with her practice. She switched minimally to Zulu this was mainly for social control.

As pointed out earlier Teacher 3 used mainly formal procedural discourse during teaching. Her talk focussed on the steps to be followed in working out a problem. She does not engage learners in talking about why the procedure works. Throughout all the lessons observed, she carefully drilled learners in this kind of discourse. The extract below is an example of the nature of talk in teacher 3's classroom:

T: Now, read number 1 for me.
P. 35x4.
T.' 35 x 4. What do we do first? Yes, Bongani?
P: (Raise their hands.)
Open the brackets, 3 you add. O, you say multiply close the brackets.
Teacher: No, Multiply by which number?
P: Multiply by 4.
Teacher: A ha.
P. Close the brackets, plus, open the brackets, say 5 multiply by -l, close the brackets.
T: Good. We say 30 multiply by 4 plus 5 multiply by 4.
Then 30 x 4, Precious?
P:30x4=120.
T: 120 plus 5 x 4, Omphile?
P: 20.
T: 20. So, the answer 35 x 4 is equals to? Yes?
P: 140.

(Lesson 4)

All the observed lessons were characterised by this kind of discourse. Teacher 3 pointed out that she drills these procedures so that learners get used to them.

> *T. Okay, I think you know, they must get used to these signs, you know, equals to, open the bracket because they are going to deal with this up until standard 10. I think so and in this new method ne, they mix different multiplying but in the 2nd step is addition so I want them not to mix the operations do you understand? Like for instance, in some sums you don't use plus you just use multiplication until the final step, but in some others like this one, you use multiplication then in the 2nd step you must make sure that you use a plus if you use multiplication, the answer is going to be wrong, you know.*
>
> *(Reflective Interview)*

During the lessons Teacher 3 did not focus on why this multiplication procedure works, her concern was getting the learners to master the formal procedural discourse. Looking at the learners' talk in the lesson transcript, one notices that during teaching learners do not have much opportunity to talk. Their responses to the teacher's questions are one word and of course this denies them an opportunity to enter into mathematical conversations with each other and the teacher. In the section below I look at at the impact that teacher 3's language practices' have on the learners' ability to communicate mathematics.

2.3.5 Learners Communicating Mathematics

Six learners (2 `good', 2 `average' and 2 `weak') were interviewed in pairs. Below I examine extracts from interviews with these learners.

Extract 1- good'

R: Ya. I want you to do this one: 231 x 6.
So, Christopher will be looking on what you are writing.
Tell us what you are writing.
P: I write 200 x 6 close the brackets and
say plus and open the brackets and say
30 x 6 and close the bracket and say plus
open the brackets and say one add zero and say
multiply by 6 close your brackets equals to 200 x 6.
R: You're helping her akere, Christopher, come closer,
you're helping Phumzile neh!

P: 200 x 6

R: 200 x 6

P: Twelve hundred One thousand two hundred

Twelve hundred

R: One thousand two hundred or twelve hundred which one is correct? '

(Learner Interview)

In the above extract the learners imitate the formal procedural language of the teacher They do not talk about why they are multiplying 200 x 6. In this case the researcher did not ask the learners to account for their procedures, however, the average pair was asked to give reasons for their procedure in the next extract:

Extract 2 - `average' pair

R: Two hundred and thirty one multiply by five.

P: Equals to open the brackets two hundred

multiply by five close the brackets plus one

the brackets thirty multiply by five close the brackets

plus open the bracket one multiply by five plus close the bracket.

R: Why are you doing that? Where do you get the two hundred?

P: We take this two and we add two zero.

R: Why do you add two zeroes?

P. Because they are three numbers?

R- So if they were four numbers?

P: We say two thousand?

R: Why mara?

P & S: Because they are same four or three

or if they are two we said we'll write two every

time and multiply by one. Why we add two zeroes

because ten has two numbers thousand have three numbers.

(Learner Interview)

The above extract shows that these learners are very fluent in the formal procedural discourse. Later in the interview I gave them a word problem to solve and the above extract shows how they dealt with it.

Extract 3 - 'average pair'

R: It's now the second problem. Can you read it?

P & S: There are five row of cars with three cars in each row. how many cars are there altogether.

R: Read through

S: Bathi how many cars there?

P: In English

R: No, it doesn't matter any language.

S: They say how much has cars there and how we must write the answer has much they are?

R: So how are you going to find the answer?

P: We gonna do like this

We gonna say five cars plus three cars.

S. *Which numbers?*

P: There are five cars on a row. We gonna say like that. Can I speak Zulu?

R: Yes.

P. Bathi kune row e moto e zi five e ne e row e three [They say there are five cars and three rows]

R: So a ma row a khona a ngaka? [So how many rows are there?]

P: One row.

R: Oh e row e i-one.

P: Yes.

In the above extract when learners are asked how they are going to find the answer, they seemed to be looking for a procedure. In lines 6 and 7 they give their first guess which of course they did not agree on (line 8). From line 10, it seems that they are now aware that their procedures will not work and are therefore looking for another strategy. To find another strategy they use their main language, Zulu (line 10, 12). In this case the learners use Zulu not only because this is a word problem but also because this kind of problem requires an unfamiliar kind of discourse.

What the above extracts show is that while the teacher's discourse enables rehearsed formal procedural discourse, it constrains both formal and informal calculational and conceptual discourses.

2.4 TEACHER 4

2.4.1 Background

Teacher 4 has a long history with the school he is teaching in. He started his primary education in the school and has been teaching mathematics there for 20 years now. One of his children is doing grade 2 in the school and he is a member of the governing council. He is also very active in extra-mural activities, he conducts the school senior choir and is very involved with sports. The grade 4 class observed has 45 children in total[4]. They did not seem to have a very easy relationship with Teacher 4, who only teaches them mathematics. He struggled to keep order in the class. All the learners in his class are first language Xhosa.

While the teacher is first language Xhosa, he can communicate fluently in eight other languages (viz Tswana; S. Sotho; N. Sotho; English; Zulu; Swazi; Ndebele; Afrikaans). At primary school teacher he learned mathematics in Xhosa. He presently has an M + 2 qualification. He pointed out that he has always liked mathematics and he still enjoys teaching the subject even today. He, however, believes that going to college did not adequately prepare him to teach second language learners.

2.4.2 Language Policy

Teacher 4 is not aware of the national language policy. The official language of learning in his school is English from grade 1. He pointed out that the school adopted the policy before the new government came into power.

He prefers to teach in English.

> *P Well I prefer to teach in English why because first of all it is a universal language secondly it has got those the terms which are been used in English it is broad it is unlike whenever I take a vernacular some terms are not there in vernacular but then are direct but in vernacular they are indirect.*
>
> *(Pre-observation Interview)*

Teacher 4's preference for English is for both communicative and mathematical reasons. He recognises '

[4]The teacher did not know the total number of girls and boys, hence it was not recorded.

the fact that English is widely used. This is one of the main reasons why most schools still prefer English to be the language of learning. All the teachers in the study expressed this view in different words. For instance, teacher 2 talked about English as the language of assessment, teacher 3 talked about using English to empower the learners while teacher 1 referred to English as an international language. The bottom line here is that in South Africa, English is both a language of power and of educational and socio-economic advancement.

The other reason why this teacher prefers to use English is that he feels that the Xhosa language does not have a well developed mathematics register.

> *R: Can you give me an example of a words that you can think of that is not there in for instance Xhosa and is there in English which maybe you might want to use T.. For instance let us take a mathematics if ever you speak in terms of a sum you know that now your speaking of that a result of addition but then now in Xhosa we don't have that sum, the word sum.*
>
> *(Pre-observation Interview)*

The teacher's example above shows that the challenge for second language mathematics teachers is not only to teach mathematics and the English language but also to teach the English mathematics register. It is clear that the word sum is not just an English word but a specific mathematics term.

T: But then I find that now some terms like I say in multiplication then now phinda, phmda and all that it would be a long thing. You know sometimes when you do it in Xhosa, Xhosa terms seem to be going right round beating about the bush instead of getting straight to what you want.
R: So phinda phinda is not getting straight
T.- That's multiplication. Yes, what I 'm saying is that now there are but the terms that now if everyou want to say a thing in short, you do not say it in short you've got to go in round because of the vernacular you see that. Because of he some words are not there direct you see. Debanesa use sege sphomo [Add the two numbers and find the total] you see that, that is now what is the sum of this you can say itoni yesphumo sesbalo [what is the total of these] you see that you are making that lengthy.
(Pre-observation interview)

Teacher 4's concern here is also that the Xhosa mathematics register is not appropriate, the terms are long-winded.

Most of Teacher 4's learners do not understand English at all. Most came into Gauteng this year from the rural areas in the Eastern Cape. During the pre-observation interview Teacher 4 talked about his learners' fluency in both English and Xhosa.

> T.. *No, some are better than others (in English), the other thing that make difficult with this classes some kids are introverts then now as time goes on you will only get it when they write and see their understanding but then now some of them found that now the differ in the level of this language because even I must just be honest with you now even those who are, when coming to vernacular language they are not the same, some of them you put them in to dark whenever you start getting in terms in Xhosa but then now if ever you combine this you found that there are those who understand English better than Xhosa.*
>
> *(Pre-observation Interview)*

With this kind of diversity, language choice in Teacher 4's class is not easy. He mentioned that he uses "flexibility of languages".

> *T. Well they aren't that much fluent but then now because of the method that we are using were by now we use the flexibility of the languages where I see that now this kids are not following then now I 'm able to add vernac and from vernac take it back to English every time.*
>
> (Pre-observation Interview)

While Teacher 4 mentioned that he is not aware of the national language policy, the flexibility of languages that he is explaining here is actually encouraged by policy. The way in which Teacher 4 is explaining it seems to indicate that the aim is to teach the English language.

> *T: Well they do interact with me in this way but then I found that now many time when address me, I address them in English and they respond in vernac then sometimes I correct them and help them to say now if ever you want to answer me in this way you must say this then that way try to develop them.*
>
> *(Pre-ohs Int., p2)*

Teacher 4's reference to development in the above extract is about the English language and not mathematics. It seems that while using flexibility of languages is what Teacher 4 would like to use to assist his learners understand mathematics and learn the English language, in practice it is not easy.

T: Many a time I use English

R: Is there a reason for that ?

T: Well hence I said that now English is got the terms which I, are easily used and understood by the kids.

(Pre-observation Interview)

There seems be an assumption in Teacher 4's talk that English is more accessible than Xhosa in certain instances and perhaps this explains why Teacher 4 used mainly English during the observed lessons.

Like all the other teachers in the study, when preparing to teach, Teacher 4 prepares his lessons in English.

T. No, what's happening is that now in preparing, Il just consciously say okay this is to be done in English. But then now circumstances do control me in the classroom because now you find that in class A they simply take that and see them moving. In class B you find that sometimes there's that stiffness and all that and then until I've got to make them to loosen up and address them even in Xhosa and go back to English and all that, until I get that response.

(Pre-obs. Int., p S)

The fact that teachers prepare their lessons in English is interesting and it means that they need to be very alert and responsive not only to the leamers' mathematecal need but also linguistic needs. In the next, section I will explore the kinds of talk which occurred in teacher 4's class during the observed lessons, I start with a summary of observed lessons.

2.4.3 Summary of the Lessons Observed

Five consecutive lessons on measurement were observed in the same grade 4 class over a week. The teacher used mainly whole class teaching. The lessons covered the units used to measure distance (mm, cm, dm, m, dm, km) and conversion from one unit of measure to the other.

During the first lesson Teacher 4 introduced the words centimetre (cm), millimetre (mm), Kilometre (km). He started by letting them measure bricks in class with their rulers and then it became clear when they gave him their measurements that they did not know what cm on their rulers represented. They referred to centimetre as `see em'. Teacher 4 used chanting to let the

written on the board for the learners to read. Teacher 4's explanation of the relationship between mm, cm and km was however not clear and therefore the learners spent the week without a clear idea of the difference between cm, mm and km. During the second lesson he introduced decimetres also by chanting the word and not giving clear explanation. Chanting and~featured a lot during lesson one and two and perhaps this is due to the fact that the lesson was new and there were new words to be learned. Chorusing featured throughout all the lessons. Learners completed the teachers sentences, for instance,

T:- ten millimetres gives us one... ?

Ps: (in chorus): centimetre

(lesson 2)

In lesson 3 the teacher introduced decimetres (1 dm = 100 mm). He then continued to ask the learners to compare decimeters, centimetres and millimetres. In lesson 4 the teacher dealt with metres, millimetres, centimetres and decimetres. He asked the learners to measure the perimeter of the staff room in the school and then continued to asking learners to convert cm to metres. The focus of lesson 5 was also conversion from cm to metres.

2.4.4 Nature of Talk

The table below gives a summary of the discourses used by Teacher 4 in his lessons.

Table 6: Teacher 4

	Procedural Discourse	Calculational discourse	Conceptual discourse
Formal	Lessons 1 - 5		
Informal			

Throughout all the lessons there was not much interaction between the teacher and learners. The learners only spoke to the teacher when he asked them questions and these were answered with one word. The following extract from lesson 4 is an example of the kind of teacher-pupil interactions that occurred during the lessons observed.

T: Right, now, I said how many decimeters equals to 1 metre.

P. 10.

T: 10 decimeters equals 1 metre. Now. Right, here's our tape. Who will be able to show me a metre. Everyone is going to show me a metre first. A metre. 1 metre.

(A pupil volunteers) Can this be a metre?

P: No.

T:Come, next one, come and help and show her a metre. (Another pupil comes to help.)

K Is this a metre?

P: (Quiet.)

T: Look what it says. If ever we estimate, can we estimate such as to be a metre. Who will show us a metre on this tape. Take off that hat. Who will show us a metre on *this tape. (One boy volunteers)Somebody to help him, come. Metre, I metre. (2 boys try to find a metre on a tape.) Okay. Somebody to use this tape. This one. (1 boy tries with the other tape) Do we agree that this is a metre?*

P. (Quiet.)

T.. You see our measuring tape is being marked a what? a metre. Look at it. Do you see a metre? Our tape here is being marked 1 metre. This is a distance of a metre. This is a distance of a metre.

(Lesson 4)

Most of Teacher 4's questions required one word answers and therefore learners did not enter into a conversation with him On the other hand some of the questions were responded to by silence from the learners and this could have been due to a variety of reasons. As I pointed out earlier Teacher 4's explanations were not clear and it seemed that most learners could not follow what he was doing. The other possible reason could be that learners did not understand what he was saying since he used mainly English during his lessons even though it was clear that most learners were struggling with the language. The observation schedule and transcripts of lessons show that Teacher 4 occasionally switched to Xhosa, for social control, to communicate with individual groups and also to rephrase questions.

T: Now, okay. Sshhtt Right, now. First of all, what are you looking for, before you can say, before you can see that now it's 5m. What are you looking for? what do you say before you can say 5m? Before you come to that 5m for you to find that 5m. What did you say? () U ye wa thini? [what did you say] Ento yok'qala eze entee hho, u 51. ento e nisebese. fhe first thingyou &d find this 5] What did you use?Yes? Ufne intoko. Ndyabuza man, (I'm asking]. Right, listen, Yes? We don't just take the numbers We are looking for what? You looked for what?

(Lesson 4)

in the above extract Teacher 4 had just asked the learners " how many metres are there in 500 cm?" One of the learners gave the answer 5 m and the teacher wanted to know how he got that answer. Before this extract the teacher had rephrased the question a few times in English and the learners were still not responding in a manner that he expected and hence he switched to Xhosa. The fact that learners are not responding to the teacher's question in this case is obviously not because of language since the question was also asked in Xhosa. The difficulty here is engaging in conceptual mathematical discourse. Teacher 4 also switched to Xhosa when interacting with learners in groups.

1. T They are 5. Then now the 500cm when we say okay that now they are 5 then they
2 *give us the meters, which is 5m right. Which is 5m. And then, what is remaining,*
3 *remain as cm's. because we were told that we must change into m and cm's. Right,*
4 *let's change this one now. Look at this one. Change this one (1343cm). Change this*
5 *into cm and m. Charge that number into cm and m. Do it in your group. In your*
6 *group 1343 i. e. 1343 into m and cm's. You do it in group. You don't just write it.*
7 *Take a page and centre and then you talk Work together. That is 1343. One*
9 *thousand 3 hundred and 43. Now change into help each other. Hey, are you talking*
9 *there or is she doing it alone? Help him, help him. No, I said you talk together. A*
10 *ufanelanga ukuthi u ibalele wedwa [You 12. are not supposed to do it alone]. Hey,*
I 1 *ndithe masthetheni, sthetheni sonke qa ubone ukuthi wenza njani, siabonisana ukuthi*
12 *si yenza kanje. [Hey, I said we should work together, talk and show each other the way*
13 *to do it] Explain to them, explain to them why do you we say it's wrong. (Another*
14 *group.)Kanjani, ifunde kuthi ithini. Uthini wena?[Haw, read it. What do you say?]*
15 *P: I-wrong.*
16 *T. Le [This] is it right? Ithetheni man ungabali. [talk,man don't count] Ma uthini*
17 *e wrong, thethesha ukuthi e wrong kanjani. [why is it wrong] Talk together, thetham*
18 *nonke. (Work as a group.)*
19 *Right, right. Alright let's look*

(Lesson 5)

Xhosa here was used mainly to encourage the learners to work together. With switching in this extract the teacher does not necessarily repeat what he has just said in English, he continues with the discourse in the learners' main language. Merritt et al. referred to this kind of switching as switching which contains the content of activity (199). With his switching he challenges learners to justify their answers (see line 14).

In the above extracts and throughout teacher 4's lesson transcripts it seems that this teacher encourages rote learning. One possible reason is that because he does not switch for explanations and his learners' do not understand English, teaching rules is the only option he has. He does not teach learners particular procedures nor does he engage them in any conceptual discourse. In the section below I look at how this limited use of language impacts on the leamers ability to communicate mathematics.

2.4.5 Learners Communicating Mathematics

The interview with teacher 4's learners was not easy going because the learners were not free to communicate. Two of them indicated at the beginning of the interview that they cannot understand English at all. The learners' responses during the interview were very abbreviated. The extracts below are taken from the interviews with the `average' and `weak ` pans.

Extract 1- average' pair

R: Can you measure the same line with mm. (Lunde turns his ruler around) Now Nomakmga tell me why does he turn this ruler around (Nomalanga is quiet.) Lumde what are you doing ? Lumde: 10 cm

R: No, I said you have... that line is 10 cm 1 want you to measure same line in mm and tell me how many mm are there okay now Lumde is busy,

Nomalanga. Yes

R: Why did he turn his ruler around.? did you see what he did; he turned the ruler around

Nomakaga: Was measure mm R: What's the answer Lumde? Lumde? 100

R: 100 what?

Lumde: mm

R: Why do you say is 100 mm why is it not 100 cm ? why is it not 100 cm is it 100 mm

Lum and Nom: No, cm

(Learner Interview)

The first thing to note here is that these learners are not very fluent in English. When Lunde is asked what he is doing he answers 10 cm and when Nomalanga is asked why Lunde turned his ruler around she answers that "was measure millimetres". These responses are a clear indication that the learners do not understand the language at all.

The kind of responses the learners give in the above extract are very abbreviated. For instance, instead of saying 100 turn they say 100 and the researcher has to ask 100 what? This kind of abbreviated talk was also observed during the lessons and the teacher seemed not to be discouraging it. Their responses also seem to be guesses, when they are challenged on their answers, rather than defending them they change them. For instance when the researcher asked them why is your answer 100mm and not 100 cm, they then changed their answer to cm. This is mainly because they are used to this kind of conceptual discourse. For them the researcher's challenging of their answer means that it is incorrect. The next abstract also shows the abbreviated answers that learners gave during the interview.

Extract 2 - `weak' pair

R: Okay, so this hundred centimetre iyalingana ne 10 cm?[is 100 cm equal to 10 cm?]

P. No

R: Ayilingani?[They are not equal]

P. Yes

R: I-millimetre

R: Ngisho (I mean] hundred centimetre ne 10 centimetre P. Yes

R: Ziyalingana?(Are they equal?]

P. Mmmmmmh [no]

R: Iphi eyinkulu (Which one is bigger?]

P. Hundred millimetre

(Learner Interview)

What the above extract shows is that these learners are not able to communicate mathematically. During lessons they were not given much opportunity to communicate either formally or informally.

It is therefore clear that teacher 4, while he is in a difficult situation of most learners not being able to speak English at all, his language practices are not enabling for the learners, they in fact block access to communication of mathematics.

2.5 Teacher 5

2.5.1 Background

Teacher 5 has an M + 4 qualification and has been teaching for two years. At primary school she learned mathematics in Tswana and while she liked the subject and enjoys teaching it, she did not continue to study it after matric. She was therefore not trained as a mathematics teacher.

The grade 4 class observed has 46 learners in total, 25 girls and 21 boys. Their mathematics teacher, teacher 5, also teaches them all the other subjects. Although she is first language Tswana speaking, she can also communicate in five other languages (viz. English, Afrikaans; S. Sotho, N. Sotho, Zulu).

2.5.2 Policy Issues

The pre-observation interview transcript shows that Teacher 5 is aware of the new language policy and her understanding of it is that different languages should be used for teaching. In her school the official language of learning is English, however, teachers are allowed to switch into Tswana if learners do not understand.

> T.- *The policy of the school is that we use English but if a child does not understand English then we also use Tswana.*

(Pre-observation Interview) Teacher 5 explained that this policy was negotiated with all the teachers in the school. The main reason for this policy she said is that most learners are not fluent in English. She gave an example that, in her class there is only a few learners who can understand English but are not able to express themselves in the language.

Teacher 5 mentioned that while learners in her class are free to use any language, she encourages them to use English and this she does because she wants them to be able to cope in the higher classes.

> *T. In most of cases 1 encourage them to use English*
> *R: Is there a reason for that?*
> *T: Ja, because if they do not learn the language how they will be cope in higher classes they will not cope. I let them to use Setswana if they wanted to ask certain thing or if they wanted to understand certain something that I ask but not allow them to use Tswana language right through.*
>
> *(Pre-obs interview)*

Teacher 5 also seems to be experiencing the "dilemma of code- switching" (Adler, 1996, 1998). While she uses and allows her learners to use Tswana to facilitate understanding during the mathematics lesson, she also would like them to use English to learn the language. She recognises the dominance of English in higher education and therefore wants to prepare her learners to cope with the English language demands of higher education.

2.5.3 Summary of Lessons Observed

The five consecutive lessons observed focussed on money. For the first lesson the teacher dealt with the South African coin money, its colour and the pictures on the different coins. This first lesson included some general questions such as: what is money?, where do you get money?, where do you keep money? In dealing with these the teacher switched freely between Tswana and English.

The second lesson focussed on addition of money not more than one rand, for example, 18c + 18c; 90c + 10c. Most of the learners used their fingers to add and did not use the coins that the teacher had provided them with to do the exercise. While learners did not have a problem solving these kinds of problems in groups, they had problems when sums such as 18c + 28c were done on the board. The main reason here is the teacher used vertical addition where the learners have to firstly add the units and then carry the remaining ten.

Lesson three focussed on subtraction of the form: 14c - 4c, 15c - 10c, etc. Like in lesson two the problems involved money not more than one rand. The teacher provided learners with money in envelopes to do these problems. Most of the learners did not use the money provided by the teacher, they just did the exercise mentally and a few of them counted on their fingers. The observer noticed that the groups of learners who used the money provided by the teacher to solve the problems took more time to find the solutions.

In lesson four the teacher introduced rands. She started by giving them examples of how they can convert money written in cents into rands, for example, 326c = 83,26. This was done very procedurally, focussing on where do we put the comma rather than how many rands are there and why are we putting the comma here. After dealing with conversion from cents to rands, the teacher gave learners group tasks which included questions such as: `how many R5 coins in R10 and addition and subtraction of money involving rands and cents (e.g R20,50 + R20, 50; R60,50 + R40). She again provided the learners with money in envelopes to use for the exercise which most learners did not use.

Lesson five was on shopping. Learners were given envelopes with `play money' and shopping tasks, for instance, you have R80,00.you buy a soccer ball at R20,00, a rugby ball at R10,00 and a tennis ball at R10,00. a) How did you spend? b) how much do you have left? Doing an example first on the board, the teacher simply isolated the numbers in the problem added and then subtracted to find the answer. She focussed on what the answer is rather than what the problem requires and how to find the solution. In each of the five lessons observed, the teacher followed the same process. She started each of the lessons by giving an example, then group tasks similar to the example and finally a whole class session where solutions to the group tasks are done on the board. This was then followed by an individual exercise to be done either as class-work or home-work. Throughout the lessons the teacher seemed to be struggling with keeping order in the class, she spent most of her time during group tasks calling learners to order.

2.5.4 Nature of Talk

The following table gives a summary of the nature of talk in Teacher 5's class during the observed lessons:

Table 7: Teacher 5

	Conceptual discourse	Calculational discourse	Procedural discourse
Formal			Lesson 1-5
Informal			Lesson 1

During teaching, teacher 5 focuses mainly on the formal mathematics language and her classroom mathematical discourse remained procedural. As I have discussed in the earlier section on the summary of lessons, there were attempts by the teacher to engage learners in some informal talk about money. This kind of talk was, however not continued in other lessons. In lesson 5 the teacher introduced shopping as a context for addition and subtraction involving money. While this was an opportunity to engage leamers in some informal conceptual and calculational discourses, the teacher did not do that. She instead ignored the context and just identified the numbers to be added and subtracted.

The fact that the learners did not use the money they were given to use in working out the problems, and shows that learning materials are not resources in and of themselves, their functions need to be mediated to the learners. In this class the money provided had no function.

The extract below is a typical example of the kinds of discourses that occurred in teacher 5's class.

T We are going to talk about rands, right. If are 100 cents, I mean one rand akere?

P. Yes

T.. 100 cents equals to one rand akere?

P. Yes

T.. *Class, you see these are the hundreds, the tens, the units. You only put a comma after this is the units the tenths and you put a comma here and you write one R here. That is one rand ne.*

P. Yes

T- Right and then another example, 200 cent equals to two rand akere?

P: Yes,

T.. *200 cent equals to two rands. Again in his case we have to put a comma here. The units the tens and hundreds. After the hundred you put a comma ne, right.*

T.. *Even if I can write 326 cents. Where will I put my comma? 326 cents? Come and show me Thepiso. Where will 1 put my comma? 326 cents, (Tshepiso quietly goes to the board to show where the comma should be put)*

T: Here, good

T: So; we put our comma here and please don't forget to put your R here to .show that we care talking about 3 rand 26 cents, ne. Right, and then if I say 450 cents? Where will I put my comma? Where wi11 I put my comma and my R? Where will I put comma and my R?

T Where will I put my R, Joseph? So this is 4 rand fifty cents, ne. R4;50c, So today we are going to have just like yesterday You are going to add and you are going to subtract ne. Right, group leader, group A, group B, right, group C D, E, F, G, H, right.

(Lesson 4)

The above extract is a beginning of lesson 4 and the teacher is introducing rands and how to convert money written in cents to rands. She, in the extract, starts with 100 cents and attempts to explain to the learners how they can write it in rands. In her explanation, she focusses on where to put the comma (lines 6 - 9). She then does examples with the learners on the board where they write 200 cents, 326 cents and 450 cents in the form of rands. Whilst dealing with the examples her emphasis is on where to put the comma and the R, hence the questions she asks: "where will I put my comma?, where will

I put my R?" (lines 19;23 - 25). By asking these questions; teacher 5 is actually saying to the learners, `these are the kinds of questions that you need to ask yourself when dealing with these kinds of problems'. She is modelling ways of doing mathematics and of talking (about) mathematics: The ways of of talking she is modelling here are limiting because she is not engaging learners in talking about why they have to put the comma after the hundreds, (formal conceptual discourse) and what will happen in a case where they have, for instance, a four digit number (formal calculational discourse). It seems, therefore, that the teacher here is not concerned about the learners' conceptual understanding of what they are doing: What she seems to be more concerned about is for the learners to remember where to put the comma and the R (procedural discourse), and she says that explicitly in the extract "... please do not forget to put the R here... "(20 -21).

Another interesting factor in the extract is the learners' talk. In the extract learners had only 4 utterances all of which were giving the answer 'yes' (lines 3, 5,10,13). While the fact that learners are' saying very little may look trivial / like a non-issue here, it is actually an issue because this factor was a dominant characteristic of the teacher-pupil interaction in all the lessons observed in teacher 5's class. What the learners are given an opportunity to say in a mathematics class is, of course, just as important as what they are not given an opportunity to say. In this case the learners are not given an opportunity to engage in calculational and conceptual discourses about money and how it is written and experienced.

The next extract shows how teacher 5 teaches formal mathematics procedures.

I T We get R60. Then R10, 25 + R10, 25 is how much? R10,25 +

2 R10, 25 is how much?

3 P: R20,50

4 T Good we get R20,50. And then if we add R20,50 + R20,50,

5 then is how much ha, ha, sit down, sit down How much do we get,

6 Vinolia?

7 P: 50c

8 T A, a, a, no. R20,50 + R20,50, Stumo?

9 P: R41.00

10 T.: Zero + zero is how much?

11 P. Zero.

12 T.- 5 + 5 is how much?

13 P: 10

14 T Then you carry one. One plus zero?

15 P: One.

16 T. Plus zero? 17

P. One.

18 K So; then you write one, 2 plus 1 is how much?

19 P.4

20 T So; the answer is R41 ne,

(Lesson 4)

In this extract the teacher is dealing with the addition of money. Learners have just completed group exercises and the teacher is now doing the solutions with them Before this episode and up to line 5; the learners have been giving correct responses and the teacher has not written these on the board nor asked them how they found their solutions. In line 10, one of the learners (Vinolia) gives an incorrect answer to 820,50 +820,50. While the teacher managed to get a correct answer from another volunteer, she continued to give an explanation of how they obtained the answer (lines 14 - 25). Her formal and procedural explanation was not only oral but also in writing. As the extract shows the written mathematics language is also formal. One interesting point to note is that the teacher's explanation of procedure here is the same as the one she gave before the learners did the group exercise,

The learners' responses in this extract are also just one word answers. Interaction between the teacher and learners during the lessons was initiated by the teacher through questioning. The questions, however, required only recall of procedures and therefore did not generate enough conversation between the teacher and the learners. The following extract from lesson 4 is an example of the kinds of conversations the teacher entered into with the learners. While I can not claim, however, that this is typical of interactions in Teacher 5's class, it certainly is typical of interactions during the lessons observed.

T.- We have 4 R5 coins in R20 ne.And then we have how many R50 notes in R50? Mo R50 re na le di R50 ise kae? How many R50 note in R50?

P: (Andries) One.

T.- We have only one R50 note in R50 ne. Right, we have how many RIO in R30? Mo R30 re nale RIO ise kae?

P. (Isaac) 3

T.- We have 3 RIO note in R30 ne. We have 3 RIO note in R30 ne. We have how many R20 notes in R80? We have how many R20 notes in R80 ?Re na le R20 ise kae mo R80?

P: (Abraham) 4

T We have 4 R20 notes to R80 and then; we have how marry
R5 coins in R20, ha..ha? How many 5 coins in R20, Joseph?
P: 4

(Lesson 4)

The extract shows that the teacher does not create an opportunity for pupil talk in this case, she asks them questions that require one word answers and does not ask them to justify their answers. This however does not mean that she does not value pupil talk. It is clear in the reflective interview that she values pupil talk. When asked what she liked about her lessons throughout the week, she mentioned that she liked "the way the learners communicated amongst themselves" (p 1).

During the lesson the teacher switched to Tswana to rephrase questions and to reprimand learners. Explanations were, however, mainly in English. Teacher 5 pointed out that she switches to Tswana during teaching to facilitate understanding. Occasionally during the lessons she switched to rephrase the questions in Tswana. For instance, "from R80 - R10. O nale R80 o ntsha R10 o sala ka bokae, Betty`? [You haw R80 and you subtract *R10, how much do you remain with, Betty?]" {less 4, p4).* Most of her switching was for social control. The lesson transcripts also show that the learners switched when working in small groups.

The extract below shows learners communicating in the ir main language Tswana whilst working in groups.

1 P: Ten rand ise 2 ke R20 [2 ten rands make R20]: R20 tse 4 ke R80 [4 twenty rands
2 make R80]. Waitse o kwala yang, o kwala R e be o kwala answer e be o etsa yana [Do
3 you know how we are going to write it, we R and then we write the answer, and then we
4 do this]. Ke etsa fela nne ke etsa fela nne, ke a lebontsha ke lehontsha fela [I am just
5 doing this to show you]. Re kwala yang [we write this way]. Eng akere ke le bonsha
6 fela? [what?, I mean I am just showingyou]
7 (Teacher comes to the group)
8 T.- Did you go on and ask how many R10 makes a fifty rand?
9 P: Comma ga ise he kwale [I have not written dawn the comma]. Tlisa [Bring that].
10 T Just write how many five rands makes a fifty rand. A number. How many?
t 1 K How many five rands make R10?
12 P: Two.
13 T: So, you must write two. How many RIO in R20?
14 T What about this one? How many RIO in R50. Then you are going to write this one
15 and this one. Zakhele, you make use of this one. Make use of this one. You are going

16 *to calculate and write in two cents Coins. R20. 22c and you add Where did you get*

17 *that R20 from? You have to add R10 plus R5. Is how much? Then the 2nd one R40*

18 *plus R10 plus R10. Where is your money?*

19 *P. Ke ye.*

20 *T Then use your money right. What is your answer? Answera ya gago ke mang? 50*

21 *+ 20 is how much, ha.ha...?*

22 *P: 70*

(lesson 4)

What is interesting in the above extract is the learner talk and how it changes as the teacher comes to the group. Lines I - 5 occurred in the absence o£ the teacher and in Tswana. The explanation given by the learner in these lines is in the language of the teacher, that is, "I put the R here and the comma here" In line 6 the teacher gets to the group and asks them a question in English and the learner's response in line 8, seems not to be related to the teacher's question, it seems to be a continuation of the talk they had before the teacher came into the group. As soon as the teacher gets into the group, the extract shows that the learners resume their one word conversations with her. Her talk remains in English and therefore the learners also mainly respond to her in English.

It was also interesting to notice that the teacher allows and encourages learners to use Tswana mathematics textbooks since they do not have any English mathematics textbooks in the school. The Tswana textbooks belong to the school. The teacher has two English mathematics textbooks which she uses for preparation of lessons. She mentioned that she uses the Tswana textbooks only for exercises and indicated that learners are doing well with the exercises in the Tswana textbooks "because they are written in Tswana and it is simple for them to understand". The teacher was, however, very emphatic during the reflective interview about the fact that she does not allow her learners to write Tswana in their textbooks. She was asked as to whether she would consider giving learners Tswana word problems from the textbook.

.J: Ja maybe, maybe next time but not now. I don't think I'll prefer word sums in Tswana unless if they didn't understand but not to read them. So, I don't want them to write Tswana in their class work automatically, they will write their word sums in Tswana in their class work books

R: So in their class work books you don't want them to write Tswana?

J.˙ Yes.

R: But yon don't have problems if they read the questions in Tswana? .

J: Yes, I don't have any problems.

R. So; do you have any reason for not wanting Tswana in your Maths

book?

J.- No. Yes, I do have a reason, because even though we use two languages, you are not to teach them in entirely Tswana It is only for them to understand

(Reflective Interview)

The above extract shows two things: the position that the teacher is taking in relation to language use in her class and also the status of Tswana in this mathematics class, Teacher 5, in the above extracts mentions that "even though we use two languages, you are not supposed to teach them entirely in Tswana". She is talking here like someone who is following the rules regarding language use. She is happy to use Tswana for the children to understand, however, she does not want them to write Tswana in their books. Tswana here is seen as a resource which can be used to teach both mathematics and the English language. If it were a resource to teach mathematics only, then surely there would not be a problem for learners to write Tswana in their books as long as they understand the mathematics.

2.5.5 Learners Communicating Mathematics

During the interview, it became clear that the teacher's classroom discourses limited the learners. Each pair of learners were given two problems to work out, the first required them to find out how many fifty cents are there in R5,00 and then explain how they found their answer. The second was a word problem: Mpho saves two rands each month How much money will she have saved after three months? Here they were asked firstly to say in their main language what the question is requiring them to do. For the first problem learners managed to get the correct answer and give a justification for it. The extract below shows the justification given by the `weak' pair of learners.

R: 0 e kereile bynng?[How did you find it?]

0: Ke countile.[I counted]

R: 0 e countile jang? [How did you count?] Re countele re bone [Count for us let's see.] 0 itse jang gore ke ten? [How' do you know it is ten?]

E: Ke ntse ke counta [I've been counting].

R: Re bontshe gore o countile jang.[Show us how you counted]

E. Ke ntse ke counta ka mo tlhaloganyong [did it mentally]

R: And then ge o counta ka mo tlhaloganyong ya gao o irile jang?[How did you count mentally?]

E., Nise ke kopantsha two rand le di five bob gore go tswa use kae.[I asked myself how many 50 cents are there in R2?]

R: So o rile mo two rand go tswa di five bob tse kae? [So how many did you find?]

E. Tse four.

R: And then?

E: Mo two rand tse four? [In R2 they are four/

R: And then?

E. Mo rand tse two. [in RI they are two.]

(Learner Interview)

Perhaps it is important to note that in the above extract the interaction with the researcher is in the leamers' main language and also that for this question this pair was the only one that gave their response in Tswana. Another interesting factor is that while their answer was correct and they were asked to justify it, the learners still continued to give abbreviated answers. As the extract shows, the learners did not volunteer their explanation, the researcher had to probe to get every bit of information out. One of the reasons why learners did not freely volunteer their explanations could be that they are not used to it, in their classroom answers are more important and not how you found them. For the second question, all the three pairs were not able to solve, however, the 'good' and 'average' pairs were able to tell what the question required them to do.

2.6 Teacher 6

2.6.1 Background

Teacher 6 has an M + 2 qualification and has been teaching for 18 years. Like her learners she is first language Tswana, however, she can communicate in another four languages, namely, English, Afrikaans, S. Sotho, N. Sotho. At primary school she learned mathematics in Tswana and at college she did it in English. While she said that she liked mathematics even when she was training to be a teacher, she was quick to mention that she did not specialise in it.

L: Yes 1 did that in English.

R: Okay, and did you like it?

L: Yes.

R: Okay.

L: Though I didn't hhmm... specialise with it.

IL Okay, but you did PTC so you did all the subjects.

L: Ya, I did all the subjects.

(Pre-observation Schedule)

Her grade 4 class observed has 38 learners, 20 girls and 18 boys. Teacher 6 teaches them mathematics and Tswana.

When Teacher 6 was~whether she feels that she has been adequately prepared to teach second language mathematics learners she answered "I think so" which seemed to indicate that she was not certain. In the extract below she shares the training she received to teach second language mathematics learners.

R Okay, did ymtfeel when you get out of college, after your teacher training that you were adequately prepared for a situation where you are teaching children in English and they don't understand English; did you feel you were prepared adequately from college to hande that kind of situation?

L: I think so.

R: How did they prepare you to handle that kind of situation?

L: Hhmm...

R: Like you're having children here and they speak Tswana; the can understand Tswana well but the language of instruction is English, so you're teaching them in English but they don't understand it well How did they prepare you for that situation?

L: First thing I need to build words So then lesson on sounds. I mean I start with sounds then after that building words and then they learn those words and then we make sentences .. we make sentences and those sentences, and after that...

(Pre-observation Interview)

What Teacher 6 is explaining in lines 11 - 13 seems to be training to teach English to second language learners and not mathematics. One can infer from this that she did not get any training to teach mathematics to second language learners.

2.6.2 Summary of Lessons Observed

Four consecutive lessons focussing on division were observed. Due to fact that Teacher 6 got ill on the fifth day, the fifth lesson was observed only a week later. During the fifth lesson the teacher was introducing fractions.

For the first lesson the teacher demonstrated two methods of division emphasising steps to be followed. The first was the long division method and the second was by expanded notation. It is interesting to note that while teacher 6 introduced methods in the beginning she ignored the first and focussed on the second method which she obviously preferred. There was however an error in the second method which she preferred. For instance, in 26 - 2 = 20/2 x 6/2 = 10 + 3 = 3. The error occurred for three

lessons and after the third lesson the observer talked to the teacher about it. Although the error was not corrected openly during the fourth lesson, it was not observed on the board during the fourth lesson. It is not clear, however, as to whether the learners continued to write that error in their books.

The teacher used whole class teaching and small group work interchangeably. Group work was not well coordinated. In some groups learners did not co-operate on the task. Teacher-pupil interactions were initiated by the teacher through questions. The questions asked only required recall of a procedure. The teacher did not ask for explanations. The teacher used English mainly for teaching and switched to Tswana to rephrase questions and to reprimand learners.

Charting and chorusing featured strongly in this class and also in the school as a whole. The observer could hear a lot of chanting from other classes wbilst walking around the school. During the lessons the teacher led the learners in chanting the different steps of division problems.

2.6.3 Policy Issues

Teacher 6 is aware that new language policy stipulates eleven official languages, she is however not clear about what such a policy means for schools. For her it means that children should learn all the official languages.

> *L: I mean our having this multilingual languages; so they must learn all the languages in South Africa.*
> *(Pre-observation Interview)*

During the pre-observation interview, it seemed that teacher 6 was finding it difficult to talk about the official language of learning in the school.

> *R: Your language policy, what's the language of learning in the school?*
> *L: English.*
> *R: So the medium of instruction is English*
> *L: English and Tswana*
> *R: O K And then when you say and Tswana; how does the Tswana come in?*
> *L: Ehh... we have ehh... African language periods.*
> *R: Oh, O K So it's not the policy of the school to teach in an African language. L: No, you can do that.*
> *R: You can teach in an African language.*
> *R: 0 K Did you...who was involved in developing this policy in the school, the policy that you know... it's English but you can use Tswana. Did you sit down and talk about*

FORM OF LEARNERS' WRITING

Standard procedures only	Varied procedures	Standard procedures + other (e.g. explanations, justification, discussion of results etc.)	Varied procedures + other (e.g. explanations, justification, discussion of results etc.)

Comment: .....
.....
.....
.....
.....
.....

MARKING

BY WHOM	None	Teacher only	Learners only	Teacher and learners
FREQUENCY	None	Infrequent		Frequent
NATURE OF FEEDBACK	None	Ticks and crosses only	Ticks and crosses + evaluative comment	Ticks and crosses + guidance to learners
FOCUS OF MARKING	Answer only		Process/Procedure	Other (specify)

Comment: .....
.....
.....
.....
.....
.....

FLAWS NOTICED IN THE BOOKS ATTRIBUTABLE TO THE TEACHER

Many	Occasional	None noticed

Comment (mention the error and state why you think it is attributable to the teacher):
.....
.....
.....
.....
.....
.....

TASK/ ACTIVITY 5	....							PD/SG Duration: .....
	None	English	Main Lang	CS to main	CS to English	Chant	Chorus	Comments and examples
Teacher questions								....
Pupil responses (indiv.)								....
Pupil responses (group)								....
Pupil questions								....
Teacher explanations								....
Pupil explanations								....
Oral instructions								....
Written instructions								....
Social control								....

	only symbols	English only	Main lang.	Mixed	Comments/examples
Written work					....

After the lesson write comments on:

* how mathematics content was presented and developed and task demands.
* the teaching/learning approach and quality of teacher-pupil and pupil-pupil interactions.
* comment on what was learned and could have been learned.

.....

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it as staff?

L: No, we didn't do that.

R: How did it come about?

L: Just.

R: Oh, it just happened

L: Yes

(Pre-observation Interview)

It is clear in the above extract that teacher 6 is not clear about the official language of learning in the school. It seems that at the time of the interview there was no officially agreed upon policy in the school. In many ways this can be understood because in the past, schools never had to define their own language of learning, the government told the schools what to do. With the introduction of the new language policy, schools have the right to choose their own language of learning. It will therefore not be surprising that most schools (like Teacher 6's schools) have not `consciously' made the choice because they never had to do that and perhaps they need to be guided on how to negotiate a school language policy.

In her class Teacher 6 would like to use only English to teach mathematics, however, she says this is not possible since most of her learners are not fluent in it. She therefore uses both English and Tswana.

T.- I am not satisfied because; I want to use only one language, but because they have problems, so that is why I mix two languages.

R: Which language would you like to use? T.- English

R: Oh, why would like to use English?

T.- English, but because they do not understand so I mix two languages, English and Setswana.

(Pre-observation Interview)

Like most of the second language primary school mathematics teachers, teacher 6 encourages her learners to use English during the mathematics lesson and as she explained she does this so that they can learn the language.

T I encourage them to use English always.

R: Why do you encourage them, is there any particulm reason?

T. No, not any particular reason, so that they am learn the language.

(Pre-observation Interview)

She mentioned that when she prepares to teach she prepares to teach in English and whilst in class switches to Tswana whenever she thinks it is necessary.

2.6.4 Nature of Talk

Teacher 6's class was the only one in the study in which chanting and chorusing were dominant features. These practices were also prevalent in her school. During the visit the researcher could hear a lot of chanting from other classes whilst walking around the school. All the chants and chorusing that occurred during the lessons were initiated and led by the teacher. While these practices can be used in a mathematics class to teach a new language (i.e maths language and or English) in this class use of chanting and chorusing did not serve any of these purposes. The two extracts that follow are examples of how this teacher used chorusing and chanting in her class.

Chorusing

T.- Right, group A, what is the answer?

Group A (in chorus): The answer is one.

T.. Give them a big clap. Come on group B, what is the answer?

Group B (in chorus): The answer is six.

(Lesson 4)

In the above extract the teacher had given learners exercises to do in their groups and now here she is asking the groups to give their answers. In this case chorusing does not seem to have any mathematical or linguistic significance.

Chanting

T. Right, now, here is a fraction What is a fraction What is a fraction ?A fraction is a part of a whole, what is a fraction class ?

P's (in chorus): A fraction is a part of a whole.

T.. Again

P (in chorus, chanting): A fraction is apart of a whole

T.- A fraction is apart of a whole. There is my whole, now I am going to fold . This whole of mine, then you must tell me how many pieces you saw, how many?

P (in chorus): Two.

P How many pieces you saw ?

P (in chorus chanting): Two

T. Two parts, how many

P (in chorus, chanting): Two Parts

T Two parts

(Lesson 5)

The above extract shows the beginning of a lesson on fractions. She leads the learners in chanting the definition of a fraction and the correct responses to her questions. It can be argued here that chanting the definition of a fraction has no mathematical significance since it will not enable learners to handle any mathematical problem involving fractions.

The table below is a summary of the kind of discourses that Teacher 6 used in her class.

Table 8: Teacher 6

	Conceptual discourse	Calculational discourse	Procedural discourse
Formal			Lesson 1- 4
Informal			Lesson 5

In general, teacher 6 uses mainly formal procedural talk during teaching. Her explanations focus on the steps to be followed and not on why they should be followed. Throughout the first four lessons observed she carefirlly drilled learners in this kind of discourse. Due to her focus on the formal procedure, there were times during the lessons when the teacher made mathematical errors which she could not detect because she was not focussing on why the procedures work. For instance, for the first three days the teacher taught the learners a mathematically incorrect procedure for division: e.g. 33 divided by 3 = 30/3 x 3/3 =10 + 1= 11 (lesson 3). This kind of procedure was done with the learners on the board chanting steps to follow. What I am arguing here is that if the teacher engaged learners in calculational and conceptual discourses, the possibility is that she would have identified the error probably on the first day because she would have had to deal with questions like why are we putting a multiplication sign here? (calculational discourse).

The extract below is a typical example of the procedural discourses that the teacher engaged learners in. It also shows the written mathematics language that she used on the board.

T 34./.3 can also be written as thirty plus four divided by three. Let us do this with me first, 3 into 3?

P's (in chorus): 3 into 3 goes one time. T 3 into 3 again?

P's (in chorus chanting): 3 into 3 goes one time.

T.- 3 into zero?

P(in chorus): 3 into zero goes zero times.

T: Again

P (in chorus, chanting): 3 into zero goes zero times

T: 3 into 4?

P (in chorus): 3 into 4 goes 1 time.

T: Remainder?

P (in chorus): Remainder 1.

T: 10 plus one remainder 1. So the answer is?

P: (in chorus): The answer is 11 remainder 1

(Lesson 4)

Both the written and spoken languages in the above extract are formal. The teacher leads learners in writing down the next step. While the answer that they obtained in the above extract is correct, the written formal mathematical language is flawed and this might block the learners' access to mathematics in the future. For instance, the way in which the teacher divided by cancelling is mathematically incorrect and while the procedure worked in this case, it might not work in other cases, e.g. 3x + 6 3x

It was also not clear why the teacher decomposed the number 34 in step 2. It seems that this practice is not sustained by meaning, but by the fact that Teacher 6 learned this particular procedure without meaning.

The other confusing factor in the teacher's formal written language is the way in which she shows remainders. The way in which she wrote the answer eleven remainder one can also be read as eleven to the power r. What I am arguing here is that the formal written language of the teacher might block the learners' access to mathematics.

As the above table shows, Teacher 6 used mainly informal procedural discourse in lesson 5. She did not focus on the written mathematical procedures but on the procedures the learners need to follow to show a half in a circle and a square. While her talk was informal, it still remained procedural because she did not engage learners in discourses about why one part is called a half or a quarter. As a result of this, the fact that the two parts into which the whole is divided to make halves need to be equal, she emphasised the procedure of cutting and then shading. The other interesting factor about her engagement in informal talk is that she switched to the learners main language particularly during group work, a practice which was not observed when she engaged learners in formal procedural talk. The transcript

for lesson 5 shows that she switched to the leamers' main language for her informal talk. The extract below is a typical example of this kind of talk and how she switched.

[Teacher with a group]

T : A circle, ke o nalemaphaigi mo yo wena cutang circle [do you pages to cut a circle?]. Eseng a e two/not two pages] Ga o na sekero sa go cuta circle? [you don't have a a pair of scissors] Hae e nyane, e nyane [No, yours is small]. Circle ya go ekae [Where is your circle] Dikae dinoutu tsa lona [Where are your notes]. O seka wa tshameka ka phaigi e o, re tlo tswellape ka yona [Do not play with that page we are going to use it] Le feditse [Are you through]

P: Yes

T. Right Dikae di circle diemiseny ke bone [Where are your circles? you lift them up let me see] O mongwe le o mongwe o nale circle gagwe [Does everyone have a circle?]

P.. Yes

[THE TEACBER START TO TEACH AGAIN - public domain]

T.- So I am going to fold this circle of mine and you will tell me how many pieces you saw & do The same with yours

T. How many pieces ?

P.. Two piece

(Lesson 5)

What is interesting, in the above extract is that while the teacher is engaged in informal talk with learners in groups she uses Tswana and as soon as she gets into the formal talk and public domain she switches back to English. During the lessons switching by the learners was not observed.

When asked about use of languages in her class, teacher 6 pointed out that she uses Tswana to rephrase her questions, particularly when she sees that they do not understand what she is saying.

R: English and Setswona? Can you give me an example, how do you do that?

L: Ah.. maybe like I wrote twenty four multiplied by two. I ask them: what is the value of 4; so some of them they become embarrassed they don't know what I'm actually talking about. So ke a simmolla ka re: "ke botsa gore 4 o emetse eng? "[So I ask, "what does this four stand for?]"

(Pre-observation Interview)

Most of the questions that the teacher asked during the lessons required one word answers and were about procedures or answers and therefore the cognitive demands were minimal. The teacher was therefore not observed rephrasing questions during teaching.

2.6.5 Learners Communicating Mathematics

During the learner interview, learners were asked two questions: the first was to find 23 divided by 2, white the second was a division word problem. While all the three pairs managed to do the first problem, none ofthem were able to do the word problem. The important issue here is not the fact that they could not give a solution for the word problem, but the way in which they responded to the question. What was interesting is that all the three pairs responded by saying that they cannot do the problem. The extract below is a typical example:

> *Average pair'*
> *R: Okay, thank you girls lets do this one, this last one. Can you read this one?*
> *Pupils: I have 21 oranges and I divide them by equally between 3 children. How many oranges will each get?*
> *(Silence)*
> *R- Ka Setswana e reng, mpotse yona ka Setswana e reng, potso e reng ka Setswana Moses [Can you tell me what it says in Tswana, Moses]*
> *Moses. Ke nale di orange tse 21 ke di divider ka 3 ka bana ba ba 3, go sala tseikae gore de di kereye [I have 21 oranges, I divide them by 3, by 3 children, how many are left]*
> *R: And then wena wa reng Moses o e boletse pila [What do you say Moses, are you satisfied?]*
> *Boitumelo: Yes*
> *R: Okay, can you do it?*
> *Moses: I don't, I can't*
> *R: You can't do it*
> *Moses: Yes*
> *R: Can you do it*
> *Boitumelo: No*
>
> *(Learner Interview)*

As the above extract shows, while these learners could read the words, they had a problem with the English language, it seems that they did not understand what the question was requiting them to do. Another interesting point in the above extract is what seems to be an unwillingness to attempt to solve the problem hence their response "I can't do it".

For the first problem, learners were asked questions about the procedures they are using and why they were using them. The extract below is an example of how the `average pair' handled the questions.

Moses : 23 divided by 2

R, Where does that come from

Moses. This come ...two units, two ten is equals to 20

R: Okay

Moses. 2 at 2 is equal to one, it goes one time again 2 at zero, zero time

2 at 2 goes one time

2 at 3 goes one time remainder one

R: Oh 2 into 3 goes 2 time remainder one

Boitnmtelo: One time, one time...

Moses: One time remainder one, 10 at one remainder one is equal to 11 remainder one

R: Where does this addition come from because you had division and then multiplication and now you are having addition mm 'talk to me

Moses: Yes

R: Talk to me 1 do not understand

Moses: 1 do it like this, this I change to *multiply R: Oh you change division to multiply.*

Moses: Yes

R Why? m' then you change multiply to addtion Moses: To add

(Learner Interview)

In the extract, the learners are committing the same error that the teacher made in the first three lessons. The `weak pair' made the same error as well. It is clear in the extract that the learners could not justify their procedures. For instance, they could not tell why they changed their division sign to multiplication.

The next extract shows the `good' pair solving the problem 23 divided by 2.

Botpelo : 23 divided 2

R: Ja

Itumeleng. Ke kwala 3, ke kwaleng [I write 3, then write..]),

Boipelo: 2 divided 2 add 3 divided by 2, 2 into 2 goes one time

R: Mh'

Boipelo: Two stands for ten

R: What stands for ten?

Boipelo: 1 mean m 'one, one is equals to, I mean one is equals to ten

R: Why is one equals to ten

Botpelo: I forgot to put zero here

R: Okay, where does the zero come from, sheba (look]

and then you can help. Where does the zero come from why do you put 20 there.

Botpelo: Two time is equals to 20

R: Where does thus that 20 come from? a kere re startile ka 23 so 20 etswa kae Seipelo, do you know?

Boipelo: Tens

R: Tens, which tens

Botpelo: There are tens and units '

(Learner Interview)

The above extract is a typical example of how learners in Teacher 6's class carry out procedures without meaning. In dividing 20 by 2, they said 2 into 2 and therefore got the answer 1 (line 5), when probed about the one Boipelo (line 13) indicates that they forgot to write the zero. While these two learners were able to find the answer to 23 divided by 2, they could not give justifications for their methods. This was not surprising since during the lessons they were not exposed to giving justifications (conceptual and calculational discourses). As mentioned earlier, during the lessons observed, learners were drilled on the procedure to follow when dividing.

What this shows is that the learners are locked in the formal procedural mathematical discourse of the teacher and this does not enable them to handle new problems.

PART D: SUMMARY OF THE FINDINGS, CONCLUSION AND IMPLICATIONS

1. SUMMARY OF THE FINDINGS

While the detailed descriptions are lengthy, they lead to straight forward conclusions which will be discussed in the section that follows the table below. Table 9 below give a summary of the findings.

TABLE 9: FINDINGS

Teacher	*National language policy*	*Teachers' own learning*	*Switching in public domain?*	*Purposes*	*Dominant discourses in public domain*	*Learner access*
1	Aware	Tswana	Yes	Teaching	Informal & Formal Procedural, conceptual and calculational	Enabled
2	Uncertain	Zulu	Yes	Rephrasing	Informal Conceptual & calculational	Blocked
3	Unaware	Zulu	No	n/a	Formal Procedural	Blocked
4	Unaware	Xhosa	Yes	Rephrasing; social control	Formal Procedural	Blocked
5	Aware	Tswana	Yes	Rephrasing, social control	Formal Procedural	Blocked
6	Aware	Tswana	No	n/a	Formal Procedural	Blocked

2. POLICY ISSUES

There are three significant factors impacting on the teachers language practices in their classrooms: 1. Their awareness, understanding and interpretation of the national language policy, 2. The fact that in South Africa, English is still the language of power and socio-economic advancement and 3. Teachers' own learning experiences.

Firstly, three out of the six teachers in the study are aware of the national language policy, however, their interpretations of it are very different. For instance, for teacher 6 the policy means that children should learn all the 11 official languages at school while for teacher 1 it means that the learners' main languages should not be ignored. These interpretations impacted both positively and negatively on the Language practices of the teachers. Teacher 1, for instance, conducted her lessons mainly in the learners ' main language and while this enabled learner participation and access to mathematics it created a dilemma for her particularly because she also wants her learners to be able to communicate in English.

Secondly, the reality that English is still a language of power and socio-economic advancement in South Africa also played a major role in the teachers' language practices. During the pre-observation interviews, each of the teachers alluded to the importance of English. Teacher 4 referred to English as the universal language, teacher 2 referred to it as an international language while teacher 3 mentioned that English is important for the empowerment of the learners. The other three teachers talked about English as being important for higher education and communication with people from other cultures. An area where English manifests itself as a language of power in multilingual mathematics classrooms, is the examinations. While some of the teachers (e.g. teacher 1, 2, 3, 4) viewed the learners' languages as a resource and used it as such in their teaching, the fact is that the language of assessment in their schools is still English. As a result they used code-switching mainly for rephrasing.

Thirdly, teachers' own learning experiences also impacted on their language practices, even though most of them did not talk about this explicitly. All the teachers in the study learned mathematics in their main languages at primary schools. Their pre-service training was, however, in English and one can assume that all of them (in one way or another) experienced the disadvantage of not being very fluent in English. Teacher 3 is the only one who explicitly talked about how her inability to communicate fluently in English disadvantaged her while studying at college. The teachers' awareness of the dominance and power of English and the fact that they were trained to teach in English is probably the reason why use of English dominated in their classrooms. It is therefore clear that these teachers used language practices which they perceive as being in the interests of the learners. As teacher 3 aptly put it, as a teacher she does not want her learners to go through what she went through. What this means, therefore, is that different histories may lead to different practices.

2.1 IMPLICATIONS

Introduction of a progressive language policy, as the one in our country today, does not necessarily mean an immediate change in language practices in mathematics classrooms. Another factor is that the biggest change in our language policy is the fact that schools should choose their own language of learning. On the basis of this study, I want to argue that choosing a language of learning when you never had to choose one before (i.e the government always chose for you), is not an easy task. In some of the schools in the study, the language policies were not negotiated with the staff and parents (e.g. in school 2 the SMT decided and then notified the teachers), some were tacitly accepted (e.g schools 1, 5). The only school where the language policy seemed to be thought through and negotiated by teachers and parents is school 3.

It is therefore not enough for government just to introduce policy, multilingualism needs to be promoted firstly outside the schools. I believe that if the nine official African languages can be used widely (e.g in the media, in parliament, etc.), then perhaps they will also be valued in schools. There also need to be greater public awareness of the new language policy, like 1 is the case presently with curriculum 2005.

As this study has shown, most schools do not have a negotiated school language policy, it is therefore important that schools be trained on `encouraging multilingualism' and processes to follow when negotiating a school language policy. This will ensure involvement of all the stakeholders and a better understanding of multilingualism which is crucial in setting up a school language policy in South Africa. Another factor is that of giving the schools the right to choose a language of learning in an environment where one language (i.e English) is clearly dominant. This seems to be a mythical choice (i.e not `real' choice at least at perceptual / political level) and therefore it is not surprising that all the schools in the study either chose or assumed English to be the language of learning.

3. LANGUAGE PRACTICES

Table 9 above shows that there is a correlation between code-switching, its purporses kinds of discourses and whether these enable or constrain learner access to communicating mathematics. Four out of the six teachers in the study switched in the public domain and two of these teachers (teacher 2, 4 and 5) used switching mainly for rephrasing and social control. This limited use of switching produced formal procedural mathematical discourses. These discourses also dominated in the classrooms where code-switching was not used at all. It seems therefore, that the absence or limited use of code-switching

constrained the mathematical discourses and therefore lead to a blockage in leamer access to communicating mathematics.

While Teacher 2 also used code-switching for rephrasing and her practices led to a blockage in learner access to communicating mathematics, her discourses were not the same as those of Teachers 3, 4, 5 and 6. Her conceptual and calculational discourses were largely informal. What blocked the learners' access is that her discourses remained informal, she did not facilitate the learners' movement to the formal written mathematical language, which as Pimm has pointed out, "is perceived to be the hallmark of mathematical activity" (1991, 21). Her learners' communication of mathematics was locked in the informal mathematical discourses.

Teacher 1 stands out as the contrasting example. She used a range of discourses and switched mainly for teaching. What this means is that her teaching was mainly in the learners' main language. Her learners were enabled, they could communicate across the three mathematical discourses in both English and their main language.

It seems, therefore, that for teachers to facilitate learners' access to mathematics and communicating mathematics, teachers need to use code-switching in varied ways and also engage learners in a range of discourses.

3.1 IMPLICATIONS

This study has shown that while code-switching is now valued and encouraged by policy, not all teachers use it and the majority of those who use it, do so in limited ways. Given the power of English, rephrasing seems to be the most automatic or commonsense use of code-switching. As this study has shown, most teachers would like to have their learners communicating in English. This wish therefore pushes them to use mainly English when teaching and only switch if learners are not responding to an English utterance.

Recommending code-switching is therefore not straight-forward and unproblematic. As the study shows, limited use of code-switching can lead to blockage of learner access to mathematics and its communication. Teachers, therefore, need to be exposed to exemplars of effective language practices in *which* code-switching is used in different ways and learners are exposed to a range of mathematical discourses. These exemplars can be in the form of video cassettes or an intervention programme in a few schools where teachers from neighbouring schools can come and observe.

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APPENDIX 1

PEI RESEARCH: Teacher Biographical Data

Name Of Teacher (Underline Surname) .....

Postal Address .....

.....

.....

Residential Address .....

.....

Telephone Number .....(H).....(W)

Name Of School .....

Name Of Principal .....

No. Of Years Teaching .....

No. Of Years Teaching Mathematics .....

No. Of Years In The School .....

Which Grades Do You Teach *Mathematics?* .....

Which Other Subjects Do You Teach? .....

Highest Qualification .....

Highest Qualification *In Mathematics:* .....

What Studies Are You Engaged In At The Moment ? .....

Please Give Details (If Any) Of Further Studies In *Mathematics* You Are Presently Engaged In.

.....

.....

CONTENTS

PART C: ANALYSIS OF DATA

LIST OF TABLES

PRE-OBSERVATION INTERVIEW SCHEDULE

Request the teacher to have the interview tape recorded.

Thank you again for agreeing to work with us on this research project. Before we start with the interview I just want you to know that I am not here to evaluate you, I am here to learn. I do not have 'right' answers for the questions that I am going to ask you all I want to have are your views. If you do not understand any of the questions that I am asking please let me know so that I can rephrase or explain myself.

1. LANGUAGE POLICY

* are you aware of the new language in education policy of South Africa?
* what is your understanding of it?
* what are your views about it?

* do you have a language policy in the school?
* what is it?/how does it work?/can you describe it?
* whenwas it developed?
*what was your involvement in its development?
* who else was involved in the development of the policy?
* is it being implemented?
* what languages are teachers using in their classrooms?

2. OWN BELIEFS ABOUT LANGUAGE USE IN MATHS LEARNING

* which language / languages do you prefer to teach in? Why?
*

3. ENGLISH LANGUAGE PROFICIENCY OF THE STUDENTS

* how fluent are your students in English? (Ask this by reffering back, e.g you said...)
* is there a range? / are they all like that?

4. CLASSROOM INTERACTIONS

* do students generally interact with each other during your lessons?
* in which language does your students interact with each other in during the maths class?
* in which language does your students interact with you in during the maths class?
* do you encourage students to use any particular language during the maths class? why?

* is there anything that you would like to see change about the way languages are used in your class? what? why?

5.TEACHING

* You have already talked to me about how interactions happen in your class, how would you describe your method of teaching in general?
* When teaching, teachers do a variety of things which include asking questions and giving instructions, which language do you mainly use to ask questions in your class?
*which language do you mainly use to give instructions in your class?
* which topic/section will you be teaching during my visits to your class?
* are you comfortable with it?

* when you prepare your lessons do you prepare consciously to use particular languages?
* how do you encourage interaction and discussion in your class?
* are you anticipating any language problems? What are they?
* how do you plan to deal with them?

6. TEACHER'S OWN LEARNING
* tell me about your mathematics learning at primary school
* which language/s did you learn in?
* did you like maths?
* when you were training to be a teacher, did you study maths?
* which language did you learn in?
* do you feel that you were adequately prepared/trained to teach maths to second language learners? why?

7. Do you like teaching mathematics? Why?

MATHEMATICS LANGUAGE RESEARCH PROJECT

CLASSROOM OBSERVATION SCHEDULE

NAME OF SCHOOL: .....

NAME OF OBSERVER: .....

DATE OF OBSERVATION: .....

TEACHER'S NAME: .....

GRADE: .....

TOTAL NUMBER OF PUPILS: ☐ FEMALE: ☐ MALE: ☐

NUMBER OF PUPILS PRESENT: ☐ FEMALE: ☐ MALE: ☐

LANGUAGE OF LEARNING: .....

LANGUAGES IN CLASS: (according to teacher) .....

TEACHER'S HOME LANGUAGE: .....

LESSON TOPIC: .....

LENGTH OF LESSON: .....

TIME OF LESSON: .....

OBSERVED LESSON LESSON No.: .....

VIDEO:

YES	NO

CHECKLIST: CLASSROOM MATERIALS

USE GREY LINES FOR COMMENTS

		YES	NO
1.	Is there a desk/table and chair for each pupils?		
2.	Is there sufficient room for pupils to work?		
3.	Is there a chalkboard?		
4.	Is there chalk?		
5.	Is there a duster?		
6.	Is there a table and chair for the teacher?		
7.	Does each pupil have a textbook for the lesson?		
8.	Is there enough room for teacher and pupils movement in class?		
9.	Does each pupil have an exercise book or paper to write in ?		
10.	Are there any additional teaching /learning aids visible in the class?		
If yes, list			
11.	Is there electricity?		
Is it used?			
12.	Is there enough light in the classroom throughout the lesson?		
13.	Is there a lot of noise coming from outside the class?		
14.	Are there any other physical constraints?		

15.	How are the pupils arranged? (TICK)	ROWS INDIVIDUAL	GROUPS	PAIRS
16.	Does the arrangement change during the lesson?		YES	NO

**Indicate the duration of the task/activity and whether the task takes place in public domain (PD) or in small groups (SG) in the space provided.

TASK/ ACTIVITY 1	....							PD/SG Duration: .....
	None	English	Main Lang	CS to main	CS to English	Chant	Chorus	Comments and examples
Teacher questions								....
Pupil responses (indiv.)								....
Pupil responses (group)								....
Pupil questions								....
Teacher explanations								....
Pupil explanations								....
Oral instructions								....
Written instructions								....
Social control								....

TASK/ ACTIVITY 2	....							PD/SG Duration: .....
	None	English	Main Lang	CS to main	CS to English	Chant	Chorus	Comments and examples
Teacher questions								....
Pupil responses (indiv.)								....
Pupil responses (group)								....
Pupil questions								....
Teacher explanations								....
Pupil explanations								....
Oral instructions								....
Written instructions								....
Social control								....

TASK/ ACTIVITY 4	.....							PD/SG Duration: .....
	None	English	Main Lang	CS to main	CS to English	Chant	Chorus	Comments and examples
Teacher questions								....
Pupil responses (indiv.)								....
Pupil response (group)								....
Pupil questions								....
Teacher explanations								....
Pupil explanations								....
Oral instructions								....
Written instructions								....
Social control								....

TASK/ ACTIVITY 3	....							PD/SG Duration: .....
	None	English	Main Lang	CS to main	CS to English	Chant	Chorus	Comments and examples
Teacher questions								....
Pupil responses (indiv.)								....
Pupil responses (group)								....
Pupil questions								....
'Teacher explanations								....
Pupil explanations								....
Oral instructions								....
Written instructions								....
Social control								....

Have You Attended Any *Mathematics* In-Service Training Workshop/Course In The Last Three Years ?(If Yes, Give Details) .....

.....

.....

.....

Home Language? .....

Other Languages: **Rate Yourself Good/Fair/Poor**

	Speak	Read	Write
Tswana			
S. Sotho			
N. Sotho			
English			
Zulu			
Swazi			
Venda			
Xhosa			
Tsonga			
Ndebele			
Afrikaans			

POTENTIAL TEACHING AND LEARNING TIME AT THE SCHOOLS : 1998

Name of school: .....

Name of teacher: .....

Number of periods per day: .....

Length of periods: .....

Number of grade 4 maths periods per week: .....

School starting time: .....

School closing time: .....

Are there days on which school ends at a different time?: .....

What is the closing time on these days: .....

School breaks: .....

Do you have any extra-mural activities going on during school time?: .....

If yes, state the days and time: .....

Will there be any exams/tests for grade 4 pupils in the second term?: .....

Grade 4 exam/test period in the second term: .....

Number of exam days: .....