Teachers' strategies of teaching primary school mathematics in a second language: A case of Botswana

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Abstract

This paper reports the results of a study of primary school mathematics teaching in northern Botswana in order to highlight the strategies teachers use in bi/multilingual classrooms. Questionnaire and interview data collection procedures were used. The findings, which are based on responses of randomly selected primary school teachers, confirmed that monolingual classes were fewer than bilingual and multilingual classes in those parts of Botswana. Furthermore, syllabus analysis confirmed the abstract nature of mathematical concepts. Teachers report to have devised strategies to overcome the difficulties imposed by this classroom situation

Keywords: Home language; Second language; School language; Main language; Teacher effectiveness; Bilingual/multilingual classrooms; Code-switching

1. Introduction

Teaching primary school mathematics in a bi/multilingual classroom and in a language, which is not, for those in the classroom, anyone's mother tongue (L1), is a professional challenge for teachers in several ways. While that language is the only lingua franca in bi/multilingual classrooms, it may be the source of learning difficulties in mathematics, yet it must be taught well to the learners (because critical assessment is in that language) and so must mathematical content. Conversely, each learner's mother tongue is the key to the world and a means of alleviating the abstract nature of classroom learning events.

Following the Revised National Policy on Education (RNPE) (Republic of Botswana, 1994), English became the medium of instruction (MoI) from standard[1] 2 onwards in Botswana. This was a change to early full English immersion from late English immersion in standard 5.

Although by 1994, no specific date for the change in policy was given except the statement "as soon as is practicable (p. 59)", some schools may have implemented the change immediately in that year. What is certain, however, is that by now every primary school must have commenced using English as MoI from standard 2 following the completion in 2001 of a new school syllabus for Lower Primary. In a situation where, for the learners, the language of learning and teaching (LoLT) is not the home language, the teacher's role as the determiner of what understanding of the content goes on in the classroom, is vital. In the teaching of a content subject such as mathematics, as elsewhere, the danger that the LoLT may disadvantage the young learner in any way is a strong reason for not even considering the use of a second language (L2) such as English in the early years.

In this paper we do not intend to castigate the choice of English as LoLT. Instead we intend to argue that *teacher effectiveness* is achievable via certain teaching strategies the teacher employs, such as when the teacher makes learning enjoyable, fun, exciting and profoundly moving; and that the use of English as LoLT enhances learning of both the English language and that of mathematics content. We feel that it was on that basis RNPE argued that using "English as medium of instruction from standard 2 will improve their (learners') performance, and urged teachers to increase the use of English in teaching mathematics and science (p. 60)". Besides English being the official, legal, and language of government in Botswana, it is also an important criterion for admission into higher education. For instance, in order to qualify for admission to study for any program at the University of Botswana, English is one of the required subjects passed at grade C (60–69%) or better for 'non-science-based programs', and grade E (40–49%) or better for 'science-based programs' (University of Botswana Calendar, 2003–2004). In addition, English and mathematics knowledge provide access to higher education and jobs for the individual. English and mathematics are therefore highly regarded by learners, their parents, and teachers.

Our meaning of *teacher effectiveness* is grounded in the notion that effective teachers recognize the sociopolitical influences such as language policy, language attitudes, the domains of use for the target language, the status of that language, and so on, that affect classroom teaching and learning. English is perceived as a vital resource for effective teaching of mathematics. We further accept that effective teachers seek to overcome limitations to effective teaching arising from these influences in general, as well as those from whole-school factors peculiar to the school setting and to members in a classroom, and so, the teacher's response to them varies from individual to individual and from one school to the next.

2. Review of literature on communication in mathematics classrooms

> I protest packaging Mathematics as an unceasing puzzle. Mathematics is only about "solve this equation", or "simplify". Without a doubt, it is frustrating to be told to simplify something that someone has only deliberately made difficult—to show off perhaps. Let me be told the purpose of solving this or that, and then I will set to. Thus the need to revisit the way Maths is sold (Monitor Education Forum, 2003).

The above sentiment appearing in a newspaper's education column captures the wide concern with how mathematics is communicated in second language classrooms. Several lines of investigation have emerged. One line has been to assess the impact of the use of English on mathematics teaching and learning. Arthur (1994) observed how opportunities for exploratory talk that led to making meaning were foiled by the use of English in a standard 6 mathematics classroom in Botswana.

Another line of investigation has been the attempt to determine the factors (such as the teacher's desire to complete the syllabus, the teacher's desire for high pass rates in the examinations, the school's lack of facilities for practical work, or the individual abilities of the learners, and so on) that influence the strategies teachers use

in teaching mathematical content. Investigating secondary school mathematics teaching strategies in Lesotho, Polaki (1996) reports how the teachers' strong desire to attain high pass rates in the public examinations led teachers to adopt the following largely teacher-centered strategies: teach-example-exercise, question-and-answer, exposition, consolidation and practice, guided discovery, problem solving, investigation, group work, and practical work. Primary school teachers in Lesotho were also reported to have a preference for 'teach-example-exercise' as it was believed to be very effective in preparing students for the examination (Polaki, 1996). According to Moru cited in Polaki (1996) textbooks and past examination papers became major resources for teaching mathematics due to the strong desire to attain high pass rates. In such situations mathematics teaching and learning are viewed as processes involving nothing more than the attainment of correct answers using correct procedures. Writing about mathematics elementary classrooms in which the LoLT was the mother tongue, Burton (1992) echoes the same observation. She further observes that lessons are more often characterized by teacher presentations and independent silent work than by group discussion.

Code-switching which refers to a change by a speaker or writer from one language or language variety to another (Richards et al., 1985) is likely to be a far more successful transition strategy for the teacher to use in teaching mathematics in the primary school. A study of primary school teaching in Burundi demonstrated how this strategy enabled teachers to ensure understanding and proposed that there should be more tolerance of code switching in both spoken and written discourse, adding that the use 'of dual lingual textbooks at the primary level, particularly in the transitional year' be considered (see Ndayipfukamiye, 1994). Setati (2002) presents further support for code-switching particularly when proficiency in the LoLT was still developing during the learners' early years of school. However, Akindele and Letsoela (2001) and Adler cited in Setati (2002) identify code-switching as a dilemma for the teacher because the LoLT is the language in which final assessment is made, it should be used as much as possible, yet, when the LoLT restrains, the teacher resorts to code-switching.

School administrators complain much about code-switching even though this may be a common feature in their own communication. Perhaps the difficulty for administrators is determining how much code-switching is desirable and effective, because if openly condoned, over reliance on it could result in misuse. Some studies (Akindele and Letsoela 2001; Nyati Ramahobo and Orr, 1993) have portrayed the perception that code-switching is a form of compensatory strategy for some linguistic deficiency in the teacher. If teachers use it to overcome their personal linguistic deficiency, administrators have a strong reason to discourage it in the classroom. Other studies reviewed extensively by Setati (2002), however, reveal that code-switching is an additional teaching resource, a support which allows mediated learning via exploratory talk to occur while learners continue to develop proficiency in the LoLT. Many such studies were conducted within South Africa, where multilingual classrooms are becoming the norm rather than the exception due to that country's ongoing changes in historically racially segregated schools and also due to the new language policy which recognizes eleven languages.

One such study is by Kamwangamalu and Virasamy (1999). They report the successful use of an adaptation of code-switching called *peer-tutoring strategy* in which Zulu-speaking children sitting in the same class with Indian (English mother tongue) children help less proficient English-as-a-second language (ESL) learners in the class using Zulu. Their report showed that the tutor (the pupil teacher) and the tutees (the pupil learners) did not only gain in academic achievement, but there was also improvement in social behavior, attitudes, and self-esteem as well. Lessons became more participatory and less teacher-centered, the tutor's confidence grew, and the tutees perceived the tutor's level of linguistic proficiency as easily attainable. A peer tutoring strategy therefore has the potential of making linguistic diversity a resource for teaching and learning.

Cook (1991) says that code-switching can be exploited as part of actual teaching methodology

when the teacher knows the students' L1; that code-switching is inevitable in the classroom if the teacher and students share the same languages; and that this should be regarded as natural. According to Baker (1993) and Jacobson cited in Cook (1991) code-switching can be developed as a teaching method which gets teachers to balance the use of the two languages at specific points within a lesson, for instance, switching to L1 when a new concept is met, or to praise, to quote someone, to emphasize a point, or to tell off a misbehaving member of the class. Akindele and Letsoela (2001) note that code-switching has its merits and demerits depending on how well prepared for the lesson the teacher is.

Additionally, there is a need for teachers to admit that mathematics is a new language in itself for the learner, even when rendered in the mother tongue. According to Burton (1992), 'paying attention, and looking and listening carefully, repetition and additional practice sheets alone' are inappropriate responses to difficulties in mathematics. Setati (2002) points to the fact that there is register specific to mathematics. It includes words, phrases, symbols, abbreviations, and ways of speaking, reading, writing, and arguing. Mathematics English is therefore different from ordinary English.

The insights from the literature reviewed were helpful in investigating what strategies teachers actually used in teaching mathematics in Botswana's rural schools. In many rural schools where English is the LoLT, English is foreign because it is only heard, spoken, read, and written at school. English is not encountered additionally such as is the case in metropolitan centers where advertisements, newspapers, magazines, or television and radio may provide further experiences with English beyond the classroom.

The studies reviewed in the foregoing paragraphs point to a gap in the study of specific strategies teachers use to overcome language differences in the classroom in order to maintain their effectiveness in the teaching of mathematics. Code-switching, for example, and even peer tutoring, are best suited to bilingual classrooms where the teacher and pupils share a common language but use a different language as LoLT. This study sought to investigate strategies used in classrooms where the teacher's home language may not be the language of all the pupils in the classroom.

3. Research context

In Botswana, school goers have diverse linguistic backgrounds, both in terms of their first language and in terms of their exposure to English. For most of them English is L2 after Setswana. For these learners, a program called *breakthrough to literacy* (known as 'Breakthrough to Setswana') is in place for them to make the early transition from oracy to literacy and numeracy in Setswana before gradually transiting into English by the second year of primary school.

There are, however, many others for whom on arrival at school both Setswana and English are new languages. This category of children is also at different stages of readiness for transition from oracy to literacy and numeracy in any language. There may be some, for example, who have not seen their L1 in its written form (and will rely on the teacher, if s/he can, to provide the breakthrough to literacy and numeracy in that language). There are others who, prior to commencement of schooling, can count numbers orally in English, a common phenomenon attributable to the dominance of English in informal mathematics conversation in southern Africa. A small number of learners may have had exposure to English at home from parents, older siblings, playmates, or from pre-school. Early transition from oracy to literacy and numeracy in English for this category of learners is less problematic. A substantial number of learners, however, encounter English for the first time at school in standard 1. The syllabus no doubt attempts to accommodate all these vast profiles of learners, whose ages range between 6 and 15 yr.

Our concern with *teacher effectiveness* in the learner's formative years of learning of mathematics stems from the fact that language proficiency and mathematics achievement are related. Secondly, in Botswana, state-run education has become increasingly accessible to the vast majority

of pupils resulting in mixed ability and multilingual classes. There is also the likelihood that these classes are large. Generally, the teacher–pupil ratio in Botswana's primary schools is about 1:30 on average but it is not uncommon to see classes with above the norm especially in the urban schools. A crowded and mixed-ability bi/multilingual mathematics class using a LoLT that is new to the learners, places very high demands on the teacher and may result in 'alienation, emotional disengagement from pupils, withdrawal from professional commitment and reduced tolerance for slow learners' (Chimbganda and Kasule, 1999). However, because of the policy of Universal Primary Education (UPE) currently in place in Botswana, the problem of large multiligual mixed-ability classes is unlikely to change in the foreseeable future. It is therefore imperative to continually seek means of achieving teacher effectiveness in the prevailing difficult circumstances, which may be further compounded by the language differences that exist between the teacher, his/her pupils, and the teaching materials.

3.1. The problem of study

It is hypothesized in this study that teachers always seek to attain effectiveness in their teaching and will introduce a range of teaching techniques that will bring about the realisation of effective teaching. It is also hypothesized that a teacher who is deployed in areas that speak a different main language from his/her own, has difficulties identifying which methods can make him/her effective in teaching mathematics to young learners. The main focus of this study, therefore, is to find out what teachers who find themselves in bi/multilingual classrooms are doing about the problem.

4. Method

The study follows an exploratory cross sectional survey design. The development, pre-testing, and finalization of the interview guide and questionnaire were concluded with the help of copies posted to select areas. The pre-testing gave some indication of the length of time it would take to conduct the interviews and for respondents to complete the self-report questionnaire. The main strength of both these self-report techniques was that they would allow the teacher's voice to resonate on the central issue of the study, namely, the strategies the teacher employs so as to overcome language barriers.

From our review of literature on research methods, we noted that for a more complete understanding of the social phenomena being studied, more than one source of data is more informative than a single source (Bogdan and Biklen, 1998). This is because none of the two self-report techniques we chose to use is bias-free. For example, the large volume of data that interviews yield carries the risk of distorting phenomena. Huberman (1994) for example, admits that although developing a generalized model on the basis of large numbers of interviewees may reflect general patterns in the data, the resulting model may not be an accurate portrayal of any other interviewee. If used alone therefore, interviews lead to a disturbing assumption that there is a transparent and unproblematic relationship between "the word and the world" (Burman and Parker, 1993). Secondly, what one hears from interviews may not be what the truth is. In using the questionnaire, however, we were aware of its general limitations particularly that of giving generic insights based on a composite analysis of large numbers of teachers but may not be an accurate portrayal of the individual teacher's classroom circumstances. These insights were helpful in our option for using the two self-report techniques so as to cross check the accuracy of informants' responses on both instruments, while the analysis of the standards 1–4 mathematics syllabus helped in confirming the increasing linguistic demands for the learner as more and more classroom mathematics becomes less and less context-bound.

4.1. Research setting

The study was conducted in primary schools in four outlying districts of Botswana, namely: Chobe, Ngamiland, Ghanzi, and Kgalagadi. Our expectation was that in these districts, classrooms

would consist of speakers of a language different from that of the teacher. We wanted to hear views and understand the experiences of teachers who teach in these areas. We thought this was important because when teachers graduate from Primary Colleges of Education and the University of Botswana, they are deployed anywhere in the country without consideration of language differences of the communities.

4.2. Data collection

An in-depth desk review of the primary school mathematics syllabus (Ministry of Education, Botswana, 2000), and two self-report techniques, namely, a questionnaire (see Appendix A.), and an interview guide (see Appendix B.) are the instruments used in this study. The questionnaire was used primarily to seek information on what respondents have to say about the task of teaching primary school mathematics in multilingual classrooms. It also sought to establish the linguistic composition of the class, its size and level in addition to personal information on the teacher's gender, highest qualifications, and years in teaching. All together 140 copies of the questionnaire were posted to at least five schools in each district.

The other source of data was the interview. We used semi-structured interviews. Of the 90 teachers who responded to the questionnaire, 15 teachers were randomly selected for interview using an interview guide. The interviews lasted for 30–45 min per individual and were audio-taped for analysis.

4.3. Data analysis

We first analyzed the standards 1–4 syllabus in order to characterize the increasing linguistic demands for the learner as more and more mathematics content becomes less and less context-embedded in the classroom more so because L2 is being used. The in-depth analysis of the syllabus was done first by critically assessing the linguistic demands arising from such classroom mathematical skills as: the use of mathematical symbols, adding, subtracting, multiplying, performing mental computations, whole number, estimating, converting, and so on. All these mathematical concepts are learnt in de-contextualized classroom situations via L2. A comparison was then made with the outdoor mathematical skills which learners acquire prior to coming to school. To capture this developmental learning process, Cummins and Swain (1986) use a vertical continuum at the bottom end of which is *cognitively undemanding* communication, and at the extreme top end is *cognitively demanding* communication. Using the range of topics in the syllabus we developed vertical and horizontal continua similar to Lemmer's (2002) to produce Fig. 1.

Questionnaire data were analyzed on two levels: firstly, to confirm whether respondents' personal data (such as *qualifications, teaching experience*, and *distribution by gender*) mirrored that of the larger population of primary school teachers in Botswana. At the second level, data were analyzed to establish *classroom characteristics by language*, and subsequently, the *strategies used to effectively teach mathematics in that class*. We then analyzed the interview recordings. The audiotapes were played back several times so as to capture the interviewee's individual views on the issue of using English in teaching primary school mathematics before we analyzed the strategies teachers adopted as a consequence of the language classroom situation. We first identified coding units that addressed the effects of language in teaching primary school mathematics.

5. Findings

5.1. Syllabus analysis

It is apparent that even when the context-embedded setting is maintained, the linguistic demands on the learner become increasingly complex (see Fig. 1). The range of outdoor mathematical skills rely on games learners play using their L1 in very familiar and less rigid settings. Therefore, these skills are not challenging to learn. However, the classroom mathematical skills appearing to the right of Fig. 1, demand greater linguistic proficiency because they are

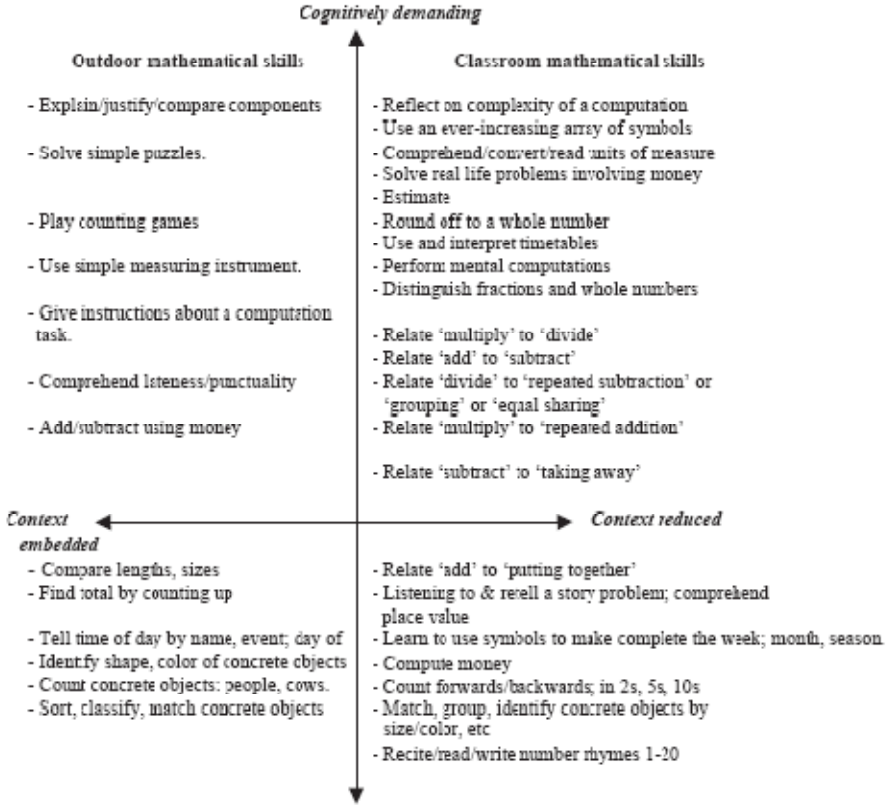

Fig. 1. The cognitive demands of language in elementary mathematics classrooms.

learnt in rigid classroom setting via L2. Unfortunately, the fact is that classroom learning of mathematics gradually becomes increasingly context-reduced and consequently, becomes more and more cognitively demanding to learn from standard 2 onwards. Our expectation was that the sample of teachers in this study would confirm our observations from the syllabus so as to suggest the strategies they employ.

5.2. *Questionnaire analysis*

5.2.1. *Personal details*

On the basis of *qualifications, teaching experience*, and *distribution by gender*, the responses of this study sample are generalizable as representing the views of many other primary school teachers in Botswana because the data on personal details mirrors that of the larger population of teachers. Out of a total of 140 questionnaires sent out, 90 were returned. By *qualification*, 11 respondents said they were degree (B. Ed) holders, 22 had a diploma (Dip Ed), 51 had a certificate (PTC), three had a higher certificate, one had a lower certificate and another one had the elementary certificate. One respondent was silent on qualification. By *experience*, out of the 90 respondents, 41 had taught for between 11 and 20 yr, 24 for between 1 and 10 yr, 18 for 21–30 yr, and four for 31–40 yr. Three were silent on teaching experience. In terms of *distribution by gender,* the national pattern of more female teachers than male was reflected with 57 female respondents and 16 male. Unfortunately however, 17 did not indicate their gender.

The findings on qualification and experience helped in making two important assumptions: that since all the respondents were experienced trained teachers, they were bilingual by training in both the Setswana and English languages, and were therefore familiar with the professional challenge

of teaching mathematics using a LoLT that was not the learners' home language; and that they were therefore conversant with various strategies for remaining effective teachers in their teaching of primary school mathematics.

5.2.2. Classroom characteristics by language

Questionnaire data showed that on the basis of the languages pupils in the classrooms spoke; mathematics is taught in three types of classrooms namely:

Monolingual classrooms (27 cases): classrooms reported by respondents as having pupils who have one common home language.

Bilingual classrooms (36 cases): classrooms in which pupils were reported as speaking two distinct home languages, so that English is the lingua franca for some members of the class.

Multilingual classrooms (27 cases): classrooms reported to have pupils with more than two different home languages. English is a vital lingua franca for successful teacher–pupil and pupil–pupil communication.

These three categories provide a linguistic viewpoint of the professional challenge of teaching primary school mathematics. Findings indicate that monolingual classrooms are the exception while bi/multilingual classes tend to be more frequent. Multilingual classrooms displayed greater diversity in their linguistic composition. For instance, in one case four different home languages in one classroom were reported. Although in both bilingual and multilingual cases no indication of the actual number of speakers of each of the languages is given, the implied complexity of the problem for the classroom teacher is clear because the situation in Botswana is that teachers by training are bilingually prepared but only in Setswana and English. The findings confirmed our concern that a bilingual teacher preparation process, as is currently followed in the colleges and the university in Botswana, was inadequate in preparing teachers for effective teaching in bi/multilingual classrooms. Equally, teacher deployment practices that ignore language diversity of classrooms create professionally challenging situations for teachers of young learners whose proficiency in the LoLT is still developing. All responses to the questionnaire indicated that none of the learners uses English prior to coming to school nor do they use it outside the classroom.

5.3. Interview analysis

During the interviews, the 15 interviewees were undecided as to whether the teachers' L1 being different from that of their learners was an advantage or disadvantage. The reasons they advanced were diverse and reflected the conflicting views in justifying the use of English in education in Africa in general. These views are presented below.

5.3.1. The undisputed language of mathematics is English

A view that the undisputed language of mathematics is English, or that African languages are not well equipped to serve as vehicles of mathematical thought was reflected by two interviewees who said '*English explains some math terms better*' and '*most of the terms used in maths are in English and do not appear clearly in other languages*'. For these teachers, therefore, it was beneficial to use English if young learners are to learn mathematics. For instance, a standard 1 teacher said '*in most cases maths is not easy to teach in Setswana, most of its concepts cannot be easily translated*. A standard 5 teacher echoed the same view and said '*maths concepts are easy to be said in English than Setswana or Kalanga*'. These two views echo what Setati (2002) observed that unlike many African languages, English has a well-developed mathematics register, and that a multilingual learner prefers the English word even where an L1 equivalent exists. Setati's example is the Setswana/Sesotho word for an equilateral triangle (which is *khutlo-tharo-tsepa*), which is usually not used in mathematical conversation.

5.3.2. Language problems are underestimated

There was also evidence that the learners' language problems are underestimated. For instance, one interviewee denied the existence of a problem saying

> it (the language issue) does not have a bearing at all since the concepts are easily interpreted

when in full use of concrete objects/materials as well as bringing in real life situations.

A similar view came from another interviewee who said '*maths deals with figures and there is a lot of practical work*', and added almost dismissively, *it is easy to understand maths content in English'*. Another interviewee admitted that her class was multilingual but that

> the language the pupils speak and my language has nothing to do with my teaching… I use English throughout and pupils respond well.

Yet another acknowledged language as problematic in mathematics teaching and learning but implied that it was easy to deal with it: '*I build concepts from prior knowledge regardless of what language they speak'*.

5.3.3. In bi/multilingual classrooms English is the neutral language to use

Other responses reflected a view that with English as LoLT, the advantage was that all learners were equal since no one had an advantage over the other in linguistic terms. Some interviewees therefore saw English as an advantage in mathematics teaching and learning due to its neutrality and its capacity to unify (as lingua franca) even those very young multilingual learners working out mathematical problems in a multilingual classroom. One of those who thinks like this said, *'they can't use their language as I can't hear. So English be the one left'*. Another one said '*it is an advantage because we will communicate very well*'. Reflecting the privileged status of English in Africa, some respondents held English in very high esteem. A respondent teaching standard 7 said

> it is an advantage because English learnt as a second language means real learning taking place.

5.3.4. At times you need to use the mother tongue

Interviewees, who regarded their mother tongue being different as a disadvantage, saw real difficulties in the processes of teaching and learning primary school mathematics. A standard 5 teacher said '*if they do not understand, it is difficult for me to explain the concept in mother tongue'*. A standard 1 teacher said '*it is a big disadvantage because with some pupils, English is their third language after Setswana*. Similarly, a standard two teacher said '*our pupils here do not know how to speak or read, so they fail to understand*'; and a standard 6 and 7 teachers were almost unanimous in their observation that '*some maths concepts need to be elaborated in LI'* and that '*there are times you need to use their mother tongue'*. However, one respondent who shared a common language with her pupils was of the opinion that

> it was both an advantage and disadvantage… it helps to translate when all fails, but it hinders their progress in learning English… they become reluctant to learn it.

5.3.5. Teachers must adhere to the official language policy

Interviewees' views to the question 'Are your pupils ready to learn mathematics in English?' reflected the LoLT policy. Some of the reasons given by those who said 'yes' were:

> it is the language understood by all'; or 'that is the language used in school mostly'; or 'they (the pupils) are forced to communicate in English within and outside the classroom.

5.3.6. Children learn more when taught in English than in any other language

A standard 3 and a standard 5 teachers denied the presence of a teaching/learning problem in the following words: *'maths English is not that difficult'* and '*it is easy to understand the four operational terms in English'*. Three standard 7 teachers saw English as evidence of learning:

> their [the pupils'] responses show that they learn more when taught in English than in any other language'; 'some have failed the sums because instructions were given in Setswana. If it was in English they would have passed'; and 'instructions given in English are not difficult to understand.

5.3.7. Early full immersion is not beneficial for all children

On the other hand, some of the reasons advanced by interviewees who regarded language differences as a disadvantage, seemed to blame the pupils for this 'unfortunate' situation. A standard 1 teacher said

> because they (the pupils) are very backward as they did not go to crash (read Crèche) schools so they need more training and most of them are 6 years.

A standard 2 teacher complained that

> they [the pupils] don't understand the language even if a teacher tries to explain, they don't have an idea.

A standard 6 teacher said *'they are not interested in speaking English'*. The reasons of those who said 'yes and no', were more sympathetic and implied that while a few may benefit from early full immersion into English instruction as early as the first year of primary school, there were some who needed late full immersion or partial immersion. One said

> in lower primary, they can use vocabulary such as add, multiply, divide. But in upper primary classes the English can be increased.

Another one said *'not in standards 2 up to 4'*. The views of head teachers on this issue are particularly significant because they teach all classes. A standard 5 teacher cautioned thus: *'but not all of them. Those who have grasped the basics are in a better position'*.

5.3.8. Public image

To the question 'can your learners now use English beyond the classroom?' interviewees were of the opinion that many learners were shy to use English unless forced to. This was expected. Questionnaire data also reported likewise. Responses to a related question whether English was a barrier to learners' understanding of mathematics, also reflected the reluctance for many people associated with education within ESL situations to admit that they have difficulties with English. Teachers do not want to appear to be opposing official policy and so, for reasons of public image, it may not be a very good thing for a school teacher to admit that his/her learners cannot learn well in English.

6. Discussion

6.1. A typology of strategies of instruction

Asked to list the strategies they use in teaching mathematics using a LoLT which is neither the learners' nor the teacher's main language, respondents provided a basis for constructing a typology of strategies of instruction. A strategies-based approach to instruction, such as that developed for teaching and reading (see Nunan, 1999), is helpful in dealing with young learners of mathematics caught in bi/multilingual classrooms. In this study, irrespective of whether they are taught in monolingual, bilingual or multilingual mathematics classrooms, the study sample of teachers, unfortunately, reported strategies without specifying classroom type. Consequently, not a very comprehensive typology emerges (see Table 1). The suggestions are merely reminiscent of the methodology courses teachers undergo at colleges of education. More importantly, they are also further confirmation of the dilemmas of being an African teacher. African teachers know that they must enhance learners' exposure to the English language, must overcome their own sense of inadequacy in that language, and must ensure that learners are prepared for higher education and the outside world, so they must not code switch; but they must ensure that learners understand and participate in classroom talk even if the teacher speaks a home language his learners do not speak. With such dilemmas it is not surprising therefore that an unclear typology emerges from this study. When the full range of strategies obtained was analyzed, it was found to fall into three broad categories as presented in Table 1 above.

6.2. How effective are these strategies?

This question would have been better answered via lesson observation. However, since no lessons

Table 1
A typology of strategies used in teaching mathematics in L2

Linguistic strategies	Games and other strategies	Organizational strategies
1. Codeswitching from English to Setswana	1. Using concrete objects	1. Group work based on ability so that the weak ones can be helped
2. Inviting questions from pupils	2. Using flash cards and playing cards	2. Giving large amounts of homework everyday
3. Teaching the language of mathematics	3. Jigsaw puzzles	3. Providing variety in teaching method and class activities
4. Translating the L1 textbook (called '*Dipalo*') into English	4. Snakes and ladders	4. Forming a Maths Club
5. Using a simpler English word wherever possible	5. Using multiple tables	5. One child solving a problem as others listen
6. Doing 'oral' maths	6. Role play in a mini shop	6. Using the solution to check the meaning of a problem
7. Using discussion	7. Pupils converting number to story problems	7. Involving the pupils when working out a problem on the board
8. Encouraging pupils to speak English	8. Participation in maths quizzes, fairs, and other competitions weekly	8. Providing different ways of getting to the answer
9. Relating a new to an old concept		

were observed, this section theoretically discusses the extent to which respondents suggestions are effective in view of the linguistic demands we established from the critical analysis of the standards 1–4 mathematics syllabus.

First and foremost, the relationship between language proficiency and academic achievement is one argument, among several others, for under-achievement and school dropout among pupils who entirely use L2 as LoLT. Cummins and Swain (1986) distinguished between L2 use in everyday face-to-face chatting with a friend, which they called *basic interpersonal communication skills* (BICS), and L2 use in academic de-contextualised situations, which they called *cognitive/academic language proficiency* (CALP); and noted how the demand for L2 proficiency increases when required for school discourse. Respondents in this study reported that none of the learners uses English prior to coming to school nor can they use English outside the classroom. With regard to English language proficiency therefore, learners in primary school have neither BICS nor CALP in the LoLT.

Despite this, in their L1 children's BICS and CALP are both very well developed by the time they arrive at school. For instance, using their L1 children demonstrate higher order thinking in counting real objects, predicting, arguing, generalizing, and hypothesizing. They can also retrieve information, as evidenced from learner's ability to unravel complex L1 linguistic items such as riddles, proverbs, and figures of speech, etc.

The *linguistic strategies* proposed by the study sample of teachers are not in response to these language proficiency realities. Indeed none of the linguistic strategies suggested specifically targets multilingual classrooms, a situation reflecting the tendency to ignore those pupils whose home language differs from that of the majority. Dismissive statements from interviewees (such as '*that [English] is the language used in schools*' and '*maths concepts are easy to be said in English than in Setswana or Kalanga*') confirm this point. Within the field of second language acquisition (SLA) a view exists (the interactionist view as in Long, 1983; Krashen, 1982), however contradictory, regarding the value of classroom talk to L2 learning. According to this view, because of the need to interact in multilingual classrooms using the only lingua franca available to learners, there is greater language learning than elsewhere. However, the effectiveness of classroom discussions, another linguistic strategy proposed by the respondents in this study, is doubtful because it is

the teacher who initiates what is to be discussed, decides who must provide a response, which the teacher either commends or condemns, and decides when to put an end to the discussion. According to Sinclair and Coulthard (1975) such classroom talk is characterized by a predictable sequence, which they called the initiate-response-feedback (IRF) sequence. As Le Roux (1996) noted, the IRF framework, which is very common in many less affluent African classrooms, placed the learner in a responding role (unlike in real life where one is required to initiate and develop a discussion). The framework therefore curtailed the development of a genuine 'discussion'. The learners' opportunities for participating productively in the classroom are very limited and constrained.

In a study of the effectiveness of code-switching in the classroom, Akindele and Letsoela (2001) demonstrated how teachers in their sample made gross errors in their code-switching and translations from English to L1, which, because of the highly technical nature of the discourse, misled learners during teaching. They argued that the problem was caused by the fact that translation is a specialist skill which teacher preparation programs do not provide student teachers. Despite this problem, code-switching and translation remain the immediate resource in such classrooms even when it is clear that speaking one's language is one thing; ability to translate and explain concepts rendered in English is another. We suggest that code-switching being used by teachers after careful consultation with peers has been made so as to avoid mistranslation.

Games have a strong appeal to both teachers and learners. For very young primary school goers aged between 6 and 14 yr sitting in a mathematics class, learning the subject is certainly not the key motivational factor. To borrow ideas from Lewis and Bedson (2002), games can provide much needed stimulus and a context for a new mathematical concept. These authors also discuss a few do's and don'ts about classroom games and classroom management. A game can lose its effectiveness if it is overused, its rules are complicated, and losers suffer isolation while winners are over glorified, it is too repetitive and long, it has too much predictability, and so on. Only lesson observation on an extensive scale can confirm the effective use of games in mathematics teaching.

Games enrich the context in which mathematical concepts are encountered by young learners whose knowledge of the LoLT is limited. A very useful exposition Cummins and Swain (1986) present is the distinction they make between *context-embedded* and *context-reduced* communication referred to earlier in this paper. Context-embedded communication facilitates meaning because it enables the learners to use as scaffold the wide range of paralinguistic cues (such as body language) and situational clues (such as background knowledge of context, or hands on experiences with real objects) so as to negotiate meaning. Games can provide such scaffold. Conversely, context-reduced communication limits learners to making meaning exclusively from linguistic clues. In the absence of games, learning mathematics through an L2 implies context-reduced, abstract learning, which Mutemeri and Ngwaru (2001) discourage because 'abstract learning contradicts the way primary school pupils learn and develop'. The truth, however, is that classrooms unavoidably become increasingly contextually reduced as more and more new material is introduced to learners with the aim of completing syllabuses. Ideally, when using a LoLT that is not the learners' L1, the teacher's ability to overcome contextual classroom limitations must be demonstrated by the effectiveness with which that teacher leads his/her young learners along the *context-embedded* and *context-reduced* continuum.

Organizational strategies: Class size has a bearing on teacher effectiveness and the strategies teachers adopt. In the opinion of Lewis and Bedson (2002), a large class is one with 25 and more children. Researchers, however, do not agree on what constitutes a large or small class. The explanation by Ross and McKenna (1955) nearly 50 yr ago, that a small or large class is what the researcher or respondent thinks it is, still holds today. Indeed in this study, even the one interviewee with eight hearing-impaired pupils who use sign language said the class was too big! According to this respondent

the ratio is supposed to be 1:5 and so there are 8 in my class but they need individual teaching as they have different problems of learning.

Controlling large classes using the suggested organizational strategies as shown in Table 1 is a professional challenge facing even the most experienced teachers. In a large class, the suggested strategy of giving large amounts of homework everyday implies that class time is devoted to correcting homework in which the lecture method dominates as children listen. This is the transmission view of teaching and learning, a view where the teacher believes that 'children acquire understanding through paying attention and looking and listening carefully, (and so) repetition and additional practice sheets appear to be appropriate responses to student failure' (Burton, 1992). Participants suggested interacting with real objects as means by which individual learners learn better. In general, the main constraint with classroom games in a large class is the great demand on the teacher's ingenuity to stop the children becoming wild and uncontrollable, particularly when the materials for use are not in sufficient quantities.

Questionnaire data showed that no respondent said his/her class was very small. In all, 42 respondents said their classes were 'too big' while 44 said their classes were 'average' in size and that this was an advantage. During the interviews, the advantages of an average class were given as: *I can attend to individual children better; I can make remedial teaching;* and *no stress*. Some of the advantages were not restricted specifically to mathematics teaching as one interviewee remarked '*when marking especially composition and letter it is an advantage*'; and one interviewee linked teacher effectiveness to class size thus: '*the fewer the clearer the presentation*'.

The disadvantages of a large class were stated as: '*only few understand*'; '*makes the teacher fail to help pupils successfully*'; and '*it is not easy to identify pupils' problems*'. One said her class had 36 pupils and lamented thus: '*I want the number to be reduced to* 11 *so that I can attend to each child*'. Another complained that most of the children in her large classes were '*backward and slow learners*'. Saying this about the individual abilities of most children in their large classes suggested that this teacher had withdrawn herself from professional commitment to help her pupils learn.

7. Implications of the study

This study has shown that at the moment some very young learners are being disadvantaged as a result of speaking a mother tongue that differs from their teachers. In many respects this study also prompted the need to interpret the language in education policy on a case-by-case basis. In practice this implies having every school to develop a language policy of its own taking into consideration the peculiar home languages within the school, and their concentrations.

This study also implicitly raises the question of what can be done to minimize the difficulties teachers face in bi/multilingual classrooms. It is our view as teacher educators that a bilingual teacher preparation approach currently followed at the Primary Colleges of Education, University of Botswana, and perhaps in many other African universities, may not be thorough enough to enable teachers achieve effectiveness in multilingual classrooms. It is suggested that at least infant teachers and teachers of lower primary be prepared in the use of the learner's home language. In this way, teacher constraints will be minimized.

It is gratifying that in Botswana the official position on linguistic diversity is changing. For instance, Vision 2016 (Republic of Botswana, 1997) says in part, that no one "will be disadvantaged in the education system as a result of a mother tongue that differs from the country's two official languages". Such thinking opens new possibilities for many languages in the country whose speakers could never have imagined. The document further proclaims that "all the nation's languages must be taught to a high standard at primary, secondary and tertiary" levels of education.

It is also gratifying to note that the global position on linguistic diversity is improving. For instance, recently at a ceremony to mark, for the first time, the International Mother Language Day, UNESCO's Director General said 'favoring

the promotion of linguistic diversity and the development of multilingual education from an early age, helps preserve cultural diversity and the conditions for international understanding, tolerance and mutual respect' (Matsuura, 2000). Consequently, on the 21st February, the entire world joins to remember the children who died on this day in 1953 in Pakistan protesting in support of Mother Tongue Education. For this, UNESCO is commended. Sadly, however, in much of Africa, where the language of education is a European one, linguistic diversity still continues to be a taboo topic. UNESCO's commemoration of the day enables forums to be organized for exchanging views and experiences on this subject.

8. Conclusion

The findings of this study affirm what was empirically suspected: that teachers strive to attain effectiveness in their teaching using games, code-switching, discussions, and so on. A typology of classroom strategies was compiled from participants' responses. It is suggested that further research is needed, ideally derived from actual lesson observation, so as to develop a more comprehensive typology. How effective particular strategies are in another area of interest. For instance, it is doubtful what quality of mathematics discussion, and with what level of involvement, emerges when the LoLT is new to the learner.

The findings are also a challenge for teacher preparation where the assumption of a homogeneous language between teacher–pupil–text has always been taken for granted. A disturbing concern is that bi/multilingual classrooms cannot be wished away. Among the various strategies respondents adopted in the quest for effectiveness in their teaching, is the controversial and officially disapproved practice of code-switching. Difficulties arising from differences between the home language and the LoLT are a strong factor in a young learner's failure at school leading to massive wastage of human potential in the formative years of schooling. In our view, the study attempts to provoke documenting what strategies teachers are using in the teaching of primary school mathematics via English as LoLT. We hope the study contributes to the development of a bank of effective classroom practices that can be shared by others.

A weakness in participant–observer studies that employ self-report techniques, such as this one, often arises in data interpretation. For instance, in this study the taped interviews and open-ended questionnaire items yielded overwhelmingly large volumes of information for analysis. Some of this information was involuntarily given albeit irrelevant. A case in point was the insistent and lengthy argument respondents made that if government provided pre-school programs in these communities, the problems primary school learners encounter with English as LoLT would disappear. A further weakness is the relatively small study sample, which raises the question whether it was sufficient to derive informed conclusions from it.

Appendix A

Questionnaire

Please answer the questions below as truthfully as you can

Gender: female/male

Your highest qualifications: PTC[ ]; Dip. Ed[ ]; BEd[ ]; MEd [ ]

Other [ ] please explain:

Years in teaching: ___ Class presently taught: ___

Number of learners in your class: ___ (girls) ___ (boys)

Would you say your class is "too big", 'average", "small"?

1. On arrival at school, which home language(s) do the learners already speak? (You may mention more than one)_____
2. Is your mother tongue and that of your learners the same? Yes/no
3. On arrival at school, do the learners already speak English? Yes/no

4. Would you say English is a barrier to your learners' understanding of mathematics? Yes/no
5. In your judgment, are your learners ready to learn mathematics in English?
6. Can your learners use English beyond the classroom now? Yes/ no
7. Name some of the different strategies you use to facilitate your learners' understanding of mathematics taught using English.

Appendix B

Interview schedule guide

Please feel free to speak your mind. This information will remain confidential, and your name will not be mentioned.

1. Is your mother tongue and that of your learners the same? Is this an advantage or a disadvantage in your teaching mathematics using English? Why?
2. On arrival at school, what home language(s) do the learners already speak? (You may mention more than one)
3. On arrival at school, are the learners ready to use English?
4. (a) Would you say that your class is too big, too small, or average? (b) Is this an advantage, or a disadvantage? Please give reasons.
5. Can your learners use English beyond the classroom now?
6. In your judgment, are your learners ready to learn mathematics in English? Please explain.
7. Would you say English is a barrier to your learners' understanding of mathematics?
8. Name some of the different strategies you use to facilitate your learners' understanding of mathematics taught using English.

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