LANGUAGE USE IN A MULTILINGUAL MATHEMATICS CLASSROOM IN SOUTH AFRICA: A DIFFERENT PERSPECTIVE

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This paper presents an argument that language-use in multilingual mathematics classrooms in South Africa is as much a function of politics as it is of cognition and communication. It draws from a wider study focusing on language practices in intermediate multilingual mathematics classrooms in South Africa. In the study the notion of cultural models (Gee, 1999) is used as an analytic tool to describe and explain the language practices in a multilingual Grade 4 mathematics classroom where learners learn in English, a language that is not their main language. The main argument of the paper is that in a context like South Africa, where mathematics and English have symbolic power, and where procedural discourse dominates over conceptual discourse in mathematics teaching and learning, a practice is forged wherein it is difficult to move mathematics beyond procedural discourse.

INTRODUCTION

This paper explores the complex relationship between language and the teaching and learning of mathematics in multilingual classrooms in South Africa. Learning mathematics has elements that are similar to learning a language since mathematics, with its conceptual and abstracted form, has a specific register (Pimm, 1987, 1991). Mathematics, however, is not a language like French or Xhosa, therefore communicating mathematically requires the use of an ordinary language, the language in which mathematics is taught and learned. A majority of learners in multilingual mathematics classrooms in South Africa learn in a second language. In these classrooms the language of learning and teaching (LoLT) is English, one of the eleven official languages in South Africa. How is mathematics learning enabled or constrained in these multilingual classrooms? What kinds of mathematics discourses are dominant and why? Embedded in these questions are pedagogical issues about language and learning, and political questions about language and mathematics and about language-in-education policy (LiEP).

In this paper I draw on a wider study to explore the above questions. I begin with a brief description of the current language-in-education policy (LiEP) and the school mathematics curriculum context in South Africa. Through this description I highlight the dominance of English as a LoLT and the emphasis on mathematical communication in the school mathematics curriculum. I then point to research done in relation to language and communication in bi/multilingual classrooms. This discussion will highlight the significance of language as power in mathematics education settings, and thus the need for research into the relationship between language and the teaching and learning of mathematics in South African classrooms to consider the political aspects of language. These discussions provide a theoretical context for what follows: a description and analysis of a research project focusing on language practices in intermediate multilingual mathematics classrooms. From these empirical and theoretical discussions I present the main argument of the paper that in a context like South Africa, where mathematics and English both have symbolic power, and where procedural discourse dominates over conceptual discourse in school mathematics assessment, a practice is forged wherein it is difficult to move mathematics beyond procedural discourse.

THE CURRENT LANGUAGE-IN-EDUCATION POLICY (LIEP) AND THE SCHOOL MATHEMATICS CURRICULUM CONTEXT OF SOUTH AFRICA

The current language in education policy recognises eleven official languages. Previously I have argued that while this policy is intended to address the overvaluing of English and the undervaluing of African languages, in practice English still dominates (Setati & Adler, 2001; Setati, Adler, Reed and Bapoo, 2002). Although it is the main language of a minority, English is both the language of power and the language of educational and socio-economic advancement, that is, it is a dominant symbolic resource in the linguistic market (Bourdieu, 1991) in South Africa. The linguistic market is embodied by 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). In this paper I consider what this dominance of English mean for communicating mathematically in multilingual classrooms where learners learn in English, a language that is not their main language?

According to the South African school mathematics curriculum, learning to communicate mathematically is central to what it means to learn mathematics (DoE, 1996, 1997). Learners are expected to participate in a variety of mathematical talk and written practices, such as explaining solution processes, describing conjectures, proving conclusions, and presenting arguments. The official description of the mathematics learning area emphasises the role that language plays in the expression, development and contestation of mathematics.

This focus on the communication of mathematics raises questions about the language used for communication and how mathematics teachers find a balance between initiating learners into ways of communicating mathematics and making language choices in their multilingual classrooms.

TEACHING AND LEARNING MATHEMATICS IN BI/MULTI-LINGUAL CLASSROOMS

The complex relationship between bilingualism and mathematics learning has long been recognised. I will not rehearse the discussions here as they have been described in detail elsewhere. Dawe, 1983; Zepp, 1989; Clarkson, 1991; Stephens, Waywood, Clarke & Izard, 1993; Setati, 1998; Adler 2000 and Setati & Adler, 2001 have all argued that bi/multilingualism per se does not impede mathematics learning.

Most research on the teaching and learning of mathematics in bi/multilingual classrooms has presented the learners' main languages as resources for learning mathematics (e.g. Addendorff, 1993; Adler, 1996, 1998, 2001; Arthur, 1994; Khisty, 1995; Merritt, *et al*. 1992; Moschkovich, 1996, 1999, 2002; Setati, 1996, 1998; Setati and Adler, 2000; Ncedo, Peires & Morar, 2002). These studies have argued for the use of the learners' main languages in teaching and learning mathematics, as a support needed while learners continue to develop proficiency in the language in which they learn mathematics at the same time as learning mathematics. All of these studies have been framed by a conception of mediated learning, where language is seen as a tool for thinking and communicating (Mercer, 1995).

Language, however, is much more than a tool for communication and thinking; it is always political (Hartshone, 1987; Reagan & Ntshoe 1992; Mda, 1997; Friedman, 1997; Heugh, 1997; Granville; Janks; Mphahlele; Reed; Watson; Joseph and Ramani, 1998; Gee, 1999). It is one way in which one can define one's adherence to group values. Decisions about which language to use, how, and for what, are not only pedagogic but also political. This political role of language is not dealt with in the literature on bi/multilingualism and the teaching and learning of mathematics.

In the study reported in this paper the work of Gee (1999) was central in exploring and explaining the language practices of teachers in multilingual mathematics classrooms not only from the pedagogic and cognitive point of view but also the political. His work was particularly relevant because he sees language as always political. He argues that when people speak or write they create a political perspective; they use language to project themselves as certain kinds of people engaged in certain kinds of activity. The teachers' decisions about which language to use, how and when do not only reflect curriculum and pedagogic decisions, but also the political context of their practice together with the identities and activities they are enacting.

In the study described in this paper the notion of cultural models (Gee, 1999) was used as an analytic tool to explore and explain the language practices of teachers in multilingual mathematics classrooms. Gee uses this notion of cultural models in socio-linguistics as one of the tools of discourse analysis. He describes cultural models as our 'first thoughts' or taken-for-granted assumptions about what is 'typical' or 'normal' (1999: 60). They do not reside in people's heads, but they are embedded in words, in people's practices and in the culture in which they live. They are learned from and shared with other humans through the media, written materials and through interaction with others in society.

THE STUDY

The study was qualitative and initially involved six intermediate phase mathematics teachers. The findings presented in this paper are from an analysis of one teacher's data. Her name is Kuki[1]. She is multilingual and shared a main language (Setswana) with her Grade 4 class in which she was observed. Data was collected over two years and it included: teacher interviews, lesson observations, learner interviews, a focus group interview and a reflective group conversation with teachers. The classroom observation data presented in this paper are drawn from an analysis of Kuki's lesson 5[2]. To enable a rigorous and focused analysis the transcript for Kuki's lesson 5 was divided into 9

[1] Kuki is her real name and it is used at her request. For a detailed discussion on methodological issues that emerged in the study see Setati (2000). At the time of the study Kuki had a Senior Primary Teachers' Diploma (SPTD) and a B.A degree. She had been teaching for 10 years.

[2] Lesson 5 is selected for focus in this paper because the richness of Kuki's language practices and mathematical communication were best illustrated in her teaching during this lesson.

stanzas[3]. The following questions were asked for each stanza to guide the analysis of the cultural models that source Kuki's language practices: What cultural models are relevant? How consistent are the relevant cultural models? Are there competing or conflicting cultural models at play in Kuki's language practices during teaching? What could have given rise to Kuki's cultural models? To guide my exploration of Kuki's cultural models, and to ensure a focus on language practices, I paid specific attention to the language(s) and mathematics discourse used in each stanza.

THE FINDINGS

The table below gives a summary of the discourses and language(s) used, together with the cultural models that were active in each of the stanzas in Kuki's lesson 5. The table is followed by a discussion, with empirical evidence on how Kuki used the mathematical discourses, the LoLT and the learners' main language in her lesson 5.

Table 1: Discourses, Languages and Cultural Models in Kuki's Teaching

Stanza	**Maths discourses**		**Non-maths discourses**		**Languages used**		**Cultural Models** **Dominant model: ENGLISH IS INTERNATIONAL**								
	Procedural	Conceptual	Regulatory	Contextual	English	Setswana	English is the language of authority	Learners' main language is the language of solidarity	Learning mathematics is about communication	English is the LoLT	School is about English	Learners' main language is the language of conceptual discourse	English is the language of procedural discourse	English is the language of mathematics	Procedural discourse is the discourse of assessment
1			√		√	√	√	√							
2	√				√		√		√				√		
3			√			√		√							
4				√		√				√	√				
5				√		√				√	√				
6	√				√				√				√	√	
7		√				√						√			
8		√				√						√			
9	√		√		√	√		√					√	√	√

Procedural discourse refers to discourses that focus on the procedural steps to be taken to solve the problem and conceptual discourse refers to discussions in which the reasons for

[3] Stanzas are 'clumps' of tone units that deal with a unitary topic or perspective, and which appear (from various linguistic details) to have been planned together (Gee, 1999: 89).

calculating in particular ways and using particular procedures to solve a mathematical problem also become explicit topics of conversations (Cobb in Sfard *et al.*, 1998: 46). These two discourses are both crucial in mathematics learning and develop different kinds of mathematical knowledge. Thus fluency in mathematical discourse requires ability to engage in both procedural and conceptual discourses. Regulatory and contextual discourses are non-mathematical. Regulatory discourse refers to discussions that focus on regulating the learners' behaviour. Contextual discourse focuses on the context of the task.

As summarised in Table 1, Setswana was used in seven out of nine stanzas in Kuki's lesson. However, it was used largely for the non-mathematical discourses (regulatory and contextual). Mathematically, English was dominant. English was used in four stanzas and three of those were in procedural discourse. The power of mathematics in Kuki's class was thus through procedural discourse and in English. Below is an example of how procedural discourse typically occurred in Kuki's class. This example is appropriate because it shows how Kuki not only used procedural discourse in her class but how she also encouraged her learners to use it.

<u>Stanza 2</u>

(The teacher, Kuki chooses Mpho to do the solutions of the following problems on the board: 113 X *22 and 141* X *22 with the first group.)*

12 Mpho: two times three?
13 Group: six
14 Mpho: two times one?
15 Group: two
16 Mpho: two times one?
17 Group: two
18 Mpho: two times three?
19 Group: six
20 Mpho: two times one?

TH	H	T	U
	1	1	3
	□	2	2
	2	2	6
+ 2	2	6	
2	4	8	6

The interaction in the above stanza is in English, abbreviated and procedural. It is dominated by the kind of talk that Arthur termed 'final draft' (1994). This occurred in all the stanzas in which English was used for mathematical discourses (Stanzas 2, 6 and 9) suggesting that the fact that the interaction was in English contributed to the form of the mathematical discourse. The mathematical discourse that took place in stanza 2 is categorised as procedural discourse, because the learners' discussion focussed on a particular procedure and not on why that particular procedure was used and why it worked. Mpho decided on the procedure and then asked the learners questions that would give answers to calculations like 'two times three'. She did not ask them which procedural process to follow. She assumed that all the learners in the group knew and understood the procedure that was to be followed, and also that there was only one procedure to be followed. This is evident in the stanza because the group members did not ask Mpho to justify the procedure she was using, and there was also no discussion of other procedures that could be used to solve the same problem. Mpho transformed the task from one in which the learners were supposed to decide on the procedure for calculating *113* x *22* and *141* x *22,* to one in which they completed particular steps of a given procedure. So the task as done on the board by Mpho involved simple multiplication, and addition of single-digit numbers. For example see utterances 12, 14, 16. Procedural discourse was dominant also in Kuki's assessment of her learners. This was evident in the learners' books and a test she gave during lesson 5. In the extract below, from the reflective interview, Kuki explained why she encouraged procedural discourse.

> Researcher: … in your lessons … you call learners to the board, to work out problems and you emphasise that they should "talk to the class".
>
> Kuki: … in a nutshell I am trying to encourage them to communicate.
>
> Researcher: Do you encourage them to communicate in a particular way?
>
> Kuki: … kids do imitate. I think we have seen that, even at your home, if you can do something or the way you talk, if you have got a daughter they will imitate you. So I believe that kids like imitating, so maybe they are trying to imitate their teacher (Reflective interview, 1999).

Kuki's purpose was to encourage communication in her class. The above extract suggests that Kuki was not necessarily concerned with the nature of the discourse in her class as long as the learners were communicating. This view resonates with the cultural model that emerged from her interactions during the focus group interview and the pre-observation interview: *learning mathematics is about communication*. This cultural model emphasises the fact that learning is about communication and children need to talk in order to learn. While this way of talking gives the learners an opportunity to communicate, it does not teach them how to communicate mathematically. This is a weakness, particularly in a mathematics class where learners have to be initiated into the mathematics discourse in English, a language that is not their main language.

As Table 1 shows, conceptual discourse was used mainly in stanzas 7 and 8. In both stanzas the dominant language was Setswana. Below is an extract from stanza 7 which shows how Kuki typically used questioning to engage her learners in conceptual discourse in Setswana.

> Teacher: Hundred and fourty four. Mara jaanong go tlile jang gore re tshwanetse gore re di tymse ka gonne nna nka nne ka nagana gore mare why re sa re twelve plus twelve? [But now, how did you know that we are supposed to multiply, why are we not saying 12 plus 12?]

Here she was expecting the learners to explain how they knew that they had to multiply. The problem that Kuki was working on with the learners stated that, *'In the SPCA are 12 cages; in each cage are 12 dogs. How many dogs are there altogether?'* The words 'how many' and 'altogether' in the above problem suggest multiplication or repeated addition and this is what Kuki wanted the learners to highlight. The learners gave two responses. The first was that "Because re batla di answer tsa rona di be right. *[Because we want our answers to be correct]*". The second was based on the diagram that Kuki had drawn on the board to represent the context of the problem. In her explanation, which was given in English, the learner counted the dogs in each of the cages drawn. In my view, both these responses are procedural, they do not explain why multiplication was the appropriate operation to use. Kuki's use of Setswana for conceptual questions and revoicing of the learner's responses in conceptual discourse in Setswana emphasised the role of the learners' main language (Setswana) as the language of conceptual discourse; the language in which explanations and justifications are asked for and are provided.

The distribution of discourses, languages and cultural models across the stanzas mirrors the conflicting cultural models and identities that emerged in Kuki's interviews and teaching in lesson 5. Throughout the lesson analysed, Kuki switched from one language to another. Switches in discourses (mathematical and non-mathematical), cultural models and identities accompanied her language switches. As discussed earlier, both procedural and conceptual discourses are crucial in acquiring fluency in the mathematical discourse. Thus the engaging learners in conceptual discourse is important. In Kuki's case, however, conceptual discourse was not seen as valued mathematical knowledge. It was only spoken and not assessed. While assessment was not the focus of this study, it is important to note here that assessment communicates to the learners what is valuable mathematical knowledge. The absence of questions demanding fluency in conceptual discourse in the class test thus suggests their unimportance. While not deliberate, by presenting procedural discourse as valuable mathematical knowledge Kuki also gave English a higher status than Setswana because procedural discourse in her class was in English. Thus emphasising the cultural models *English is the language of procedural discourse* and thus *English is the language of mathematics.*

IN CONCLUSION

This paper has described a study in which the notion of cultural models was used as a mechanism for describing and explaining language practices in a Grade 4 multilingual mathematics class. The study has shown that in a context like South Africa, where mathematics and English both have symbolic power, and where procedural discourse dominates over conceptual discourse in school mathematics teaching and learning, a practice is forged wherein it is difficult to move mathematics beyond procedural discourse.

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