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Research proposal

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1. Introduction

A central purpose of education involves helping children move along the 'mode continuum' (Gibbons, 2003, after Halliday) from common-sense ways of thinking and talking about things towards more formalised and systematic ways of doing so. Gibbons, taking the systemic functional view of language as a semiotic system – a system of signs and symbols used for communicative purposes - observes that "children have to learn to use language for a range of purposes and in a range of cultural and situational contexts" (2003, p. 250).

My proposed study will focus on the ways in which Grade 4 mathematics teachers use classroom talk to support their learners' linguistic and conceptual development in the context of learning mathematics. I want to explore how they help their learners move from what Vygotsky termed 'everyday' and 'spontaneous' concepts towards the more 'academic', 'abstract', 'scientific'[1] mathematical concepts likely to predominate as these children move on up through the grades.

My study represents an attempt to bring together insights from the teaching and learning of *both* numeracy and literacy as I explore the use of talk as a meditational tool in two Grade 4 mathematics classrooms. Throughout my nearly three decades of involvement in teacher education my contributions have been in the areas of sociology of education, multicultural education, and – for the past 10 to 12 years – English language teaching, with particular emphasis on English as a *second* language (or as is the term used in South Africa's [SA] Department of Basic Education's [DBE] curriculum policy documents, English as a *first additional* language [EFAL]). A central concern in my own teaching is trying to find ways of making the teaching/ learning environment more equitable. Clearly language is a major contributory factor to the inequalities plaguing SA's educational landscape (Reddy, 2006; Fleisch, 2008), not least being its impact in terms of epistemological access to mathematics (Setati Phakeng, 2014).

I have recently spent time familiarising myself with some of the (extensive) work that has been done by the mathematics education community on the place of language in mathematics teaching and learning. From this I have become interested in the synergistic potential to be found in using insights from language and literacy

[1] After Kozulin, in the Introduction he wrote for Vygotsky's revised and expanded version of *Thought and language* (2013, p. xviii)

development research to work at the literacy/numeracy interface. I have been struck by some intriguing and apparently serendipitous parallels in the mathematics and language/literacy education literature[2]. It is in this 'space' that I wish to locate my study. In working in this space I will draw mainly on three areas of theoretical construct. These are Vygotsky's cultural historical (or socio-cultural) theory of learning (2012); aspects of Halliday's systemic functional linguistics (SFL) view of language as a social semiotic resource (a systemic resource for meaning) (1985); and Bernstein's work around the different speech codes children bring to school, and his ideas relating to recognition and realisation rules (1964, 1990; 2000).

2. Contextualising the study

This study is being undertaken during a time of continuing turbulence on the educational landscape. Despite SA's post-Apartheid Government's commitment to social transformation via increased educational equity, surveys such as those by Fleisch (2008) and Spaull (2013) illustrate that we are a long way off realising this goal. The most recent Annual National Assessments [ANA] results (DBE, 2013) reveal that, if anything, the gap between our 'haves' and 'have-nots' has widened. I reflect briefly on aspects of these ANA results in Section 5.

The proposed sites for my study are the Grade 4 mathematics classrooms in two township schools in the Eastern Cape serving children lower down SA's SES [socio-economic status] ladder. Innumerable studies have attested to a quite intractable correlation between low SES and low educational attainment (amongst others Pretorius & Naude, 2002; Chall& Jacobs, 2003; Hart & Risley, 2003; Rothman, 2003; Hoff, 2005; Hoadley, 2007; Freebody, 2007; Aikens & Barbarin, 2008; Caro, McDonald & Willms, 2009; Graven, 2013). Both classrooms operate within relatively complex sets of circumstances (elaborated on in Section 13).

Only a small percentage of SA's learners enjoy the luxury of learning through their home language (see Table 5, p. 13).English is the language of preference. In its promulgation of SA's new Language in Education Policy [LiEP] (1997), policy makers, anxious to actualize democratic principles, gave schools the right to choose which of the country's eleven official languages to use as their language of learning and teaching [LoLT]. There are many who believe our LiEP "errs on the side of

[2] By way of example of this synergy, see Appendix ('rope metaphor' diagrams).

allowing too much choice" (Desai, 1999, p. 46), and the language choices made in many SA schools clearly show how the Government's democratic intentions have been "undermined by prevalent social beliefs as to the value of particular languages" (McKay & Rubdy, 2009, p. 10-11). In the lead up to the introduction of the new LiEP the late Professor Ken Hartshorne cited Hawes' observation that "language policies for education are … seldom, if ever, decided on educational grounds alone" (1995, p. 206), and so, despite research evidence showing a good correlation between "mother tongue education and scholastic achievement" (DBE, 2010, p. 5), many black SA parents chose English as their children's LoLT. Granville et al. (1997) note Ndebele's argument that choices are not always free, rather they are "structured in dominance and … determined by 'pragmatic necessity' "; hence the widely-held "perception that 'access to English' is what their children need, in order to succeed in our society" (Granville et al., 1997, unpaged).

The majority of SA learners thus face the dual challenge of trying to *master* English, while at the same time learning *through* English, plus, then, the fact that mathematics, too, is a' language' (Zevenbergen, 2000; Tobias, 2003; Setati, 2005; Schleppergrell, 2007) adding another layer of linguistic and conceptual complexity to the teaching/ learning terrain.Speaking of her own experiences in learning mathematics, Setati Phakeng notes, "Reflecting back on my own learning of mathematics in English, the greatest difficulty was learning in a language in which I was not fluent." This led, she said, to a lot of reliance on rote-learning (Setati Phakeng & Moschkovich, 2013, p. 121).

Schleppergrell notes that "a key challenge in mathematics teaching is to help students move from everyday, informal ways of construing knowledge into the technical and academic ways that are necessary for disciplinary learning" (2007, p. 140). While many of SA's black African teachers are competent bilinguals (or, indeed, multilinguals), the fact of their not being native speakers of English may make it less easy for them to guide learners towards these more 'technical' and 'academic' ways.

3. The research focus

My decision to focus on talk (oral language) is fuelled by the recognition that – as is so aptly put by Douglas Barnes - "learning floats on a sea of talk" (cited by Simpson, Mercer and Majors, 2010, p. 1). These writers note that there has been a resurgence of interest in the value of classroom talk as a pedagogical

device (2010, p. 1).A particular advantage of talk is that, unlike, for example, writing, talk "is easy[3] and impermanent. We can *try out an idea and change it*[my emphasis] even as we speak. Exploratory talk … provides a ready tool for trying out different ways of thinking and understanding" (Barnes, 2010, p. 7).

Fisher, Frey and Rothenberg (2008) regard talk, or, as they term it 'oracy'[4], as "the foundation of literacy" (unpaged). This I believe to be especially true in the earlier primary level grades where children's reading and writing proficiency is still relatively limited, and oftentimes painstakingly slow. Graven (personal communication, February 14, 2014) notes that encouraging children to communicate their mathematical thinking verbally rather than letting them routinely work things out either by using pencil and paper, or by coming to write up solutions on the chalkboard, is a useful way of maintaining a brisk pace and thereby helping children remain focussed on the task at hand. CAPS allocates ten minutes daily to 'mental mathematics' in the intermediate phase as a means of increasing children's fluency and efficiency with number facts, calculation strategies and number concepts (DBE, 2011, pp. 34-36).

A particular realisation of mental maths currently being trialled by the Rhodes University South African Numeracy Chair's [SANC] project team is 'Number Talks' (after Parrish, 2010; 2011). Parrish describes Number Talks as opportunities for children to "collectively reason about numbers" [through] "classroom conversations and discussions around purposefully crafted computation problems" (2010, pp. xviii; 5). In other words, Number Talks encourage children to engage in the kind of exploratory talk identified by Barnes (2010, above) where 'different ways of thinking and understanding' about a particular mental maths task can be tried out in a safe, non-judgmental environment. The Grade 4 teachers at both of the proposed sites for my study are participating in this trial. Examples of such 'purposefully-crafted' Number Talk tasks were shared with local teachers at the SANC project's recent

[3] In describing talk as "easy", Barnes is probably not writing of situations where learners are learning through a second, or additional, language as in the case of many SA learners.

[4] Fisher, Frey and Rothenberg (2008) credit Wilkinson with adopting the use of the word 'oracy' in relation to the role oral language plays in literacy development. As these writers explain, Wilkinson defined 'oracy' as "the ability to express oneself coherently and to communicate freely with others by word of mouth" (1965, cited in Fisher, Frey and Rothenberg, 2008, unpaged).

Numeracy Inquiry Community of Leader Educators [NICLE][5] session (25 February 2014)[6].

Raising mathematics teachers' awareness of the role of language in mathematics teaching and learning, and of how especially crucial it is that children be given opportunities to *engage verbally*[7] is, in fact, a key priority for NICLE[8].Towards this end, the Grahamstown SANC has so far organised two public lectures by influential members of the mathematics education community in which the speakers (Dr Lynn Webb and Professor Mamokgethi Setati Phakeng respectively) have specifically addressed issues around language (in particular the issue of multilingualism in mathematics)[9].

Although talk constitutes a "child's first, most important, and most frequently used structured medium of communication … the primary means through which each individual child will be enabled to structure, to evaluate, to describe and to control his/her experience" (Cregan, 1998,cited by Shiel, Cregan, McGough, & Archer, 2012, p. 34), studies of patterns of talk in the classroom reveal that there is substantial "asymmetry" in teacher-learner talk (Mercer & Dawes, 2008, p. 55). Overwhelmingly, it is teachers who do the talking. This, as Wells notes, is distinctly at odds with the pattern of adult-child interactions he found in his longitudinal study of differences in language at home and at school where, if anything, the asymmetry was in the other direction (1986, p. 86). The predominance of teacher-talk appears to be a particularly prevalent feature of many of SA's township schools. Hoadley, for instance, cites Chick's finding of teachers "adopting authoritarian roles and doing

[5] NICLE is a development programme specifically geared towards the needs of primary school mathematics teachers.

[6] Materials from NICLE's February 2014 workshop session on Number Talks can be accessed at http://www.ru.ac.za/sanc/nicle/nicle2014/nicle1-14/index.html

[7] Research (Levine et al., 2010; Chang, Sandhofer & Brown, 2011; and Gunderson & Levine, 2011) shows that talk in the home involving numbers in the pre-school years is a strong predictor of children's future achievements in mathematics.

[8] In 2011 Graven noted that in many of the classrooms she visited teachers tended to emphasise listening at the expense of talking, and on occasions a child was scolded for not having listened attentively enough if they asked a question (personal communication, March 12, 2014).

[9] Dr Webb's presentation was titled '*Using language as a resource in multilingual mathematics classrooms*' (4 September 2012); Professor Setati Phakeng's presentation was titled 'Mathematics in multilingual classrooms in South Africa: From understanding the problem to exploring solutions' (7 February 2014).

most of the talking, with few pupil initiations, and with most of the pupil responses taking the form of group chorusing" (2012, p. 3). The work of Chick to which Hoadley refers dates back to 1996, but classroom videos from Year One of the SANC project (Graven, 2012) indicate that such patterns persist. Teacher talk appears to be a deeply engrained aspect of teachers' *habitus* (after Bourdieu, 1966).Wells, in distinguishing between 'monologic' (teacher talk) and 'dialogic' (teacher/learner talk) classroom interactions, makes the convincing, indeed perhaps unchallengeable, case that "education requires both" of these forms (2007, p. 263). Alexander, however, in his exploration of what he termed the 'emerging pedagogy' of the spoken word in five overseas countries[10] (2005), found the monologic form the prevailing mode in most of the classrooms included in the two English-speaking countries surveyed (America and England). He observed that, although "classrooms are places where a great deal of talking goes on, talk which in an effective and sustained way engages children cognitively and scaffolds their understanding is much less common than it should be" (2005, p. 2).

4. Changing views around the role of language in teaching and learning

The extent to which the predominance of teacher talk has come to be seen as problematic is in part a function of our changing views on the nature of knowledge and on optimal conditions for its acquisition[11]. Writing some fifteen years ago about these changes to our theories of teaching and learning, Anna Sfard (1998) observed somewhat wryly: "The field is in a state of perturbation, with prospects of a new equilibrium not yet in sight" (p. 4).

A core goal of educational reform in SA post-1994 has been to move our teachers away from behaviourist-dominated conceptions of teaching and learning whereby teachers are metaphorically perceived as the providers of knowledge and learners the passive recipients thereof. Sfard captures this distinction well in her discussion of what she termed the *'acquisition'* and *participation'* metaphors. Whereas the older (acquisition) metaphor conjures up images of "the human mind as a container to be filled with certain materials and about the learner as becoming an owner of these

[10]As part of his comparative study of the relationship between culture and pedagogy, Alexander investigated the extent to which dialogic teaching methods were used in five countries: America, England, France, India and Russia.

[11] In light of Sfard's distinction between 'acquisition' and 'participation' (which I go on to discuss in the next paragraph), I have used this word advisedly.

materials", in the newer (participation) metaphor "learning a subject is … conceived of as a process of becoming a member of a certain community" (1998, pp. 5-6). Much remains to be done in helping members of SA's teaching community deepen their understanding of socio-constructivist views of knowledge, knowing, teaching and learning, in order that learners may be more actively-engaged participants in "*working on* [their own] *understanding*" (Barnes, 2008, p. 3). Writing of some earlier lesson analyses, Barnes noted that teachers used predominantly closed questions (Barnes, Britton & Torbe (1990), cited by Barnes, 2010)[12], a practice he labels "right answerism" (p. 7). Such questions, he argued, afford little opportunity for learners "to think aloud … to talk their way into understanding" (Barnes, 2010, p.9). Interestingly, Barnes notes that the few lessons where he and his team recorded such opportunities being afforded learners were in *mathematics* [my emphasis] and science lessons.

In specific relation to mathematics, Lerman (2000) highlights how the opening up of discussion around the absolutism/fallibilism dichotomy led to challenges to "the traditional mathematical pedagogy of transmission of facts" (p. 22), ultimately leading to a 'social turn' whereby ideas about "meaning, thinking, and reasoning" are viewed as much more 'situated' "products of social activity" (p. 23) (as opposed to being seen simply as the outcome of detached, and ostensibly objective logical reasoning). A similar movement has occurred in literacy circles whereby conceptions of what literacy is, of how it is to be used, and of what value is to be placed on it, vary across different social contexts. Brice Heath's classic '*Ways with words*' research (1983) illuminates this point clearly. Her ethnographic study demonstrated that the different patterns of language socialization children bring into the classroom can profoundly affect their educational attainments (1983, p. 349).The patterns that children bring to the classroom may then be echoed in the pedagogical patterns of the classroom. Hoadley (2006, p. 2) observes that "school and classroom processes potentially amplify differences between students, disadvantaging the working class". In a subsequent paper, focussing more specifically on mathematics pedagogies, Hoadley compares the teaching of mathematics in grade 3 classrooms across the SES spectrum. Her analysis demonstrates how different teaching styles in the different

[12] Barnes's observation about the predominance of closed questions echoes findings from a great many other studies, *inter alia*, my own small scale investigation of a local Grade 5 teacher's use of questions (Robertson, 2008).

social-class settings give rise to "differential access to specialized school knowledge, in this case that of mathematics" (2007, p. 703). She then makes the distinction between the 'transmission' and the 'acquisition' of mathematical knowledge, and notes that whereas learners in middle-class contexts"were learning to abstract, to 'read' the field; in the working-class schooling settings, context-dependent and concrete operations predominated" (2007, p. 703). She concludes that children's "potential for acquiring … the specialized knowledge of mathematics, is seriously undermined in [by] the pedagogy" that predominates in lower SES classrooms (2007, p. 704). This pedagogy is underpinned by a particular type of talk. Drawing on Bernstein's work with speech codes, Hoadley shows that the types of pedagogy operating in these two kinds of setting are largely a function of the language codes available (to both teachers and learners). This provides further testimony to the strong relationships between language and literacy learning, and the learning of mathematics.

5. Concerns for South African learners' numeracy and literacy achievements

My proposed investigation of the ways in which talk may be used to support the development of literate and numerate thinking in the mathematics classroom is situated within the broader context of current profound concerns around SA learners' poor numeracy and literacy achievements, particularly as these relate to the vast SES divides that typify our country.

As the findings of international, regional, national and local assessments demonstrate, SA learners' numeracy and literacy achievements are below what might be expected or at least hoped for relative to the considerable investment – in both financial and human terms – that our country continues to make towards improving our learners' educational circumstances and outcomes. SA learners' underperformance in international, regional and national surveys such as PIRLS and SACMEQ is well-documented (see, inter alia, Howie, et al., 2008; and Hungi, et al., 2010). In this introductory contextualising section, therefore, I have chosen to focus on our recent DBE's Annual National Assessments [ANAs].

Some ANA findings

The DBE instituted its ANA strategy in 2011.This involves standardised nation-wide testing of all learners in grades 1-6 and (from 2012) 9. All children in the Foundation [FP] and Intermediate Phases [IP] and in their last year of the Senior Phase [SP] thus

participate in the ANA testing process. Tables 1 and 2 show some ANA outcomes across 2011-2013.

Table 1: Average % marks in Mathematics by grade (2011-2013)

Phase/ Grade		2011	2012	2013	2013	2011-2013	
					GTN	Average	Phase Average
FP	1	63	68	60		63,6	53,6
	2	55	57	59	-	57	
	3	28	41	53	47,8	40,6	
IP	4	28	37	37	-	34	32,1
	5	28	30	33	-	30,3	
	6	30	27	39	35,9	32	
SP	9	n/a	13	14	12,8	-	-

(Data derived from Department of Basic Education [DBE], 2012; 2013)

Table 2: Average % marks in Language by grade (2011-2013)[13]

Phase/ Grade		2011	2012		2013		2013		2012-2013			
							GTN		Average		Phase Average	
		Language	HL	FAL	HL	FAL	HL	FAL	HL	FAL	HL	FAL
FP	1	59	58	-	60	-	-	-	59	-	55,5	-
	2	52	55	-	57	-	-	-	56	-		
	3	35	52	-	51	-	42,7	-	51,5	-		
IP	4	34	43	34	49	39	-	-	46	36,5	46,6	37
	5	28	40	30	46	37	-	-	43	33,5		
	6	28	43	36	59	46	51,1	50,6	51	41		
SP	9	n/a	43	35	43	33	32,1	39,1	43	34	-	-

(Data derived from DBE, 2012; 2013)

What comes through in the data in these two tables is the marked fall off in children's numeracy and literacy performance as they proceed up the grades. If one compares the fall off between foundation and intermediate phase average marks in both areas, one sees that it is notably steeper for mathematics (53,6% down to 32,1%) than for language (55,5% down to 46,6%)[14]; a range differential of 21,5% and 8,9% respectively. It seems likely that this differential is in part a consequence of the fact of the children having to contend with the double load of (a) more challenging mathematical tasks and (b) less careful attention to the scaffolding of the vocabulary

[13] Commenting on the improvement in ANA results between 2011 and 2012, particularly the 17% improvement in the Grade 3 language results, Spaull (2012) questions the validity of these results, arguing that "changes of this magnitude are simply not possible, locally or internationally." At the same time, however, he emphasized that, despite its flaws, the DBE's ANA initiative was an "important and worthwhile" aspect of the Ministry's endeavours to improve quality of educational provision in SA (Spaull, 2012).

[14] This direct comparison is of course not strictly valid given the incompleteness of the language data relative to a separation out of the HL and FAL results.

and syntactic structure of the actual language in which these tasks are presented to them. This latter point is currently being investigated by Sibanda (2013).

This fall off between foundation phase and intermediate phase is by no means a unique SA phenomenon. In specific reference to reading literacy, for instance, Chall, (1983) noted that most children of normal intelligence progress through the earlier stages of reading development in a similar way, but that once the controlled and scaffolded reading typically found in the early grades (Grades 1 through 3 normally) gives way to texts that are "more varied, complex, and challenging linguistically and cognitively" (Chall & Jacobs, 2003, unpaged), unevenness in children's achievements begins to emerge. Increased text complexity is often accompanied by an expansion in the number of subject areas making up the curriculum (as is the case for SA learners moving into Grade 4). Encounters with new knowledge areas and a less highly controlled vocabulary and syntactic load can place considerable strain on learners. Chall and Jacobs labelled this fall off the 'fourth-grade slump' (2003, unpaged), noting that such a slump is more prevalent amongst low SES children (Chall & Jacobs, 2003, unpaged).In his analysis of the crisis in SA's primary school education, Fleisch (2008) too, drew attention to the marked 'bimodal distribution' of achievement in literacy and numeracy across the different socio-economic and racial sectors of our society. More recently, Graven (2013) noted that our country "provides an 'extreme' case of performance gaps between high and low SES learners even while political will and resource allocation for redressing inequality are identified as a national priority" (unpaged). I have constructed the following two tables to show some poverty-related achievement differentials through the 2013 ANA results.

Table 3: Average % marks in HL and FAL by grade and quintile [Q][15](2013)

Phase/ Grade		2013					
		HL		Range	FAL		Range
		Quintile			Quintile		
		Q1	Q5		Q1	Q5	
FP	1	57,6	75,7	18,1	-	-	-
	2	52,4	70,6	18,2	-	-	-
	3	48,5	59,8	11,3	-	-	-
IP	4	40,9	61,7	20,8	36,7	54,8	18,1
	5	35,2	63,8	28,6	33,5	59,5	26
	6	46,6	70,5	23,9	43,3	59,2	15,9
SP	9	32	54,6	22,6	30,4	47,5	17,1

(Data derived from DBE, 2013)

Table 4: Average % marks in Mathematics by grade and quintile (2013)

Phase/ Grade		2013		
		Quintile		Range
		Q1	Q5	
FP	1	56,6	68,6	12
	2	55,5	70,6	15,1
	3	49,6	66,6	17
IP	4	31.8	52,9	21,1
	5	28,7	50,8	22,1
	6	34,6	54,3	19,7
SP	9	11,7	26,7	15

(Data derived from DBE, 2013)

The data on range across Q1 and Q5 show how markedly the equity gap widens as the mathematics results move up the grades. Overall the equity gaps are larger in IP than FP. Reverting to the points made earlier in relation to the 'fourth grade slump', for many SA learners, the transition to grade 4 is made the more challenging because they are also moving from home language to English as the dominant LoLT for mathematics. Thus the 'double load' to which I referred above, is – for many of our children – in fact a *treble* load.

6. Learning through an additional language

As noted, the research I propose to undertake will be located within two primary schools at the lower end of SA's SES spectrum. The children are also amongst the estimated 79,1% of SA Grade 4s who have English as their main LoLT (Department of Education's *2007 Annual School Survey*, cited in DBE, 2010, pp. 13; 16); this,

[15] SA schools are classified into five quintiles depending on the relative affluence of a school's catchment area. Using census data, catchment areas are assessed in terms of the income, unemployment rate and level of education of the communities different schools serve. Quintile 1 represents the poorest schools; Quintile 5 the least poor schools (Kanjee & Chudgar, 2009).

despite the fact of English being the home language of only 9,6% of the SA population[16](Statistic SA, 2012, p. 22). Motala and Dieltiens (2011, p. 11) note that SA's 1997 Language in Education Policy (LiEP) "tends in practice to privilege English (and Afrikaans), despite a rhetoric of equality regarding the other nine official languages". Consonant with the points made in Section 2 about the hegemony of English, Table 5 illustrates the scale of this hegemony by showing how dramatic was the increase in the use of English as LoLT from Grade 4 upwards according to the DBE's 2007 survey[17].

Table 5: Percentage of learners using English as LoLT (Grades 1-12) (2007)

Grade	1	2	3	4	5	6	7	8	9	10	11	12
%	21,8	23,8	27,7	79,1	81,1	81.6	80,6	80,9	80	81,2	82	81,4

(Data derived from DBE, 2010, p. 16)

These figures suggest that such is the power of English, that those who make decisions about their schools' language policies are unable to fully pay heed to the epistemic implications of an English LoLT. In addition to the mastery of, for example, the language of mathematics, children need to simultaneously work towards ensuring their proficiency in English (at either HL or FAL level)[18].

In the CAPS documents mathematics is described as "a language that makes use of symbols and notations to describe numerical, geometric and graphical relationships" (2011, p. 8), although, of course, the language of mathematics extends way beyond symbolic and notational representations. Amongst the specific (and essential) mathematical skills that learners need, the CAPS documents list the following: "correct use of the language of Mathematics", "number vocabulary", and "the ability to listen, communicate, think, reason logically and apply the mathematical

[16] Of the total SA population of nearly 51 million people, Census 2011 identified just 4 892 623 (less than 10%) as first language speakers of English (Statistic SA, 2012, p. 22).

[17] In this same survey, the DBE also reported an increase in the number of SA learners learning through their home language in the foundation phase in the period 1998-2007. While only 55% of learners were learning through their home language in 1998, by 2007 this percentage had risen to 80% (DBE, 2010, p. 17). With the emphasis placed on the importance of home language for initial numeracy and literacy development by SA's most recent curriculum reform initiative (Curriculum and Assessment Policy (CAPS)), this percentage may well increase further, a desirable increase, fully consistent with Heugh's observation that SA's LiEP is based on "the internationally accepted principle of mother tongue education in the context of a bilingual or multilingual framework" (2000, p. 3).

[18] An anomaly in the LiEP is that if schools opt for a 'straight for English' policy (as is the case with one of my proposed research sites), they are required to follow the English *home language* curriculum, even where learners are not in fact native speakers of English.

knowledge gained" (DBE, 2011, pp. 8-9), all of which are heavily language dependent.

7. Contextualising this study within CAPS

SA's teachers have been forced to grapple with several cycles of post-1994 curriculum reform. In writing about conceptions of curriculum, Catherine Cornbleth (1985) distinguished between what she called 'technical project' and 'social process' views, and noted that with the latter "the focus shifts from intentions and planning to realization" (p. 36). In line with this latter view, she subsequently used the phrase 'curriculum as contextualised social process' (1990, p. 13), later arguing that context "powerfully shapes teaching and thus students' opportunities to learn" (Cornbleth, 2001, p. 74). The DBE's Curriculum and Assessment Policy [CAPS] represents the most recent curriculum revision, the upshot of the failure of the NCS and RNCS to significantly achieve educational redress.

In its review of the implementation of the National Curriculum Statement [NCS], a task team identified the proliferation of guideline documents on curriculum implementation as a source of teacher stress and uncertainty, and recommended that, to "help address the complexities and confusion created by curriculum and assessment policy vagueness and lack of specification, document proliferation and misinterpretation" (Department of Education [DoE], 2009, pp. 7-8), these be replaced with single, phase-based policy documents for each learning area and subject. The outcome of this was CAPS, and its subsequent phasing in from 2011[19].

One of the general aims identified in the introductory sections of SA's *NCS CAPS Intermediate Phase, Grades 4-6: Mathematics* is the need to produce learners who are able to "communicate effectively using visual, symbolic and/or language skills in various modes" (DBE, 2011, p. 5). In the Specific Skills section it is stated that "to develop essential mathematical skills the learner should:

- develop the correct use of the language of mathematics
- develop the number vocabulary, number concept and calculation and application skills

[19] The schedule for the phasing in of the NCS was stipulated as follows:
- January 2012 in Grades R – 3 and Grade 10;
- January 2013 in Grades 4 –6 and Grade 11;
- January 2014 in Grades 7 –9 and Grade 12 (DBE, n.d., p. iv).

- learn to listen, communicate, think, reason logically and apply the mathematical knowledge gained" (DBE, 2011, pp. 8-9).

Subsequent references are made in the document to the requirement that learners develop the ability to 'describe', 'discuss' and 'explain' under the five key mathematical Content Areas (Number, operations and relationships; Patterns, functions and algebra; Space and shape (geometry); Measurement; and Data handling).

Capabilities (referred to as 'skills' in the document) such as 'describing', 'discussing' and 'explaining' invite reflection upon Cummins's distinction between BICS and CALP (n.d., p. 1)[20]. These capabilities more closely align, I believe, with the latter (cognitive academic language proficiency), than with what might be seen to constitute simple, everyday sorts of discussion skills (basic interpersonal communication skills). My concern here is that SA's pre-CAPS Languages Learning Area NCS specifications included a learning outcome (LO) explicitly requiring language teachers to attend to aspects of learners' CALP development (Department of Education [DoE], 2002a), but this particular aspect seems to have been somewhat side-lined in the CAPS curriculum simplifying and streamlining process. The particular learning outcome to which I am referring is LO5: "*Learning and thinking:* use of language to think and reason, and access, process and use information for learning" (DoE, 2002b; 2002c). As Table 6 shows, whereas six learning outcomes (LOs) were listed for the original NCS (Grades R-9) for home and first additional languages, just four language skills are listed in the *CAPS Intermediate Phase, Grades 4-6: English First Additional Language* [EFAL] document.

Table 6: Comparison of 'Language Learning Outcomes' and 'Language Skills'

English First Additional Language			
NCS/RNCS (2002-2010)		**NCS CAPS (wef 2011)**	
LO1	**Listening**	Skill 1	**Listening and Speaking**
LO2	**Speaking**		
LO3	**Reading and Viewing**	Skill 2	**Reading and Viewing**
LO4	**Writing**	Skill 3	**Writing and Presenting**
LO5	**Learning and Thinking**		
LO6	**Language Structure and Use**	Skill 4	**Language Structures and Conventions**

[20] Cummins built on Skuttnab-Kangas and Toukomaa's distinction between social and academic language (1976, cited in Cummins, n.d., p.1) to derive the two acronyms BICS and CALP (Cummins, 1979, cited in Cummins, n.d., p.1).

Two things in particular strike me as potentially problematic here. The first is the collapsing of the distinction between 'listening' and 'speaking', both of which I see as being just as important as the two skills more traditionally associated with becoming literate (namely reading and writing). My second area of concern is the loss of LO5: *Learning and Thinking* (use of language to think and reason, and access, process and use information for learning). The collapse of six LOs into four skills carries the risk that language teachers – however inadvertently –may neglect the need to give systematic and sustained support to the development of aspects of their learners' meta-cognition and verbal processing. The ability to understand and use spoken language beyond the BICS level (Cummins, n.d.) is a critical element in literacy and numeracy development. This then makes it the more important that mathematics teachers consciously recognise the need to work on their learners' metacognitive development in relation to the language and concepts of mathematics, most especially in contexts where there is a disjunction between the classroom LoLT and the learners' home language(s).

8. Theoretical framing: Some assumptions about language and learning

A contribution that this thesis hopes to make is to develop rich insights gained by bringing together three socio-cultural and socio-linguistic theories of learning. My sense is that these cohere well insofar as they all acknowledge the centrality of language, but at the same time each has the potential to provide me with insights from slightly different perspectives.

Vygotsky proposed a close "reciprocal" / "interfunctional" relation between thought and language (Kozulin, in Vygotsky, 2013, p. xlvii), as well as an essential relationship between talking and thinking. He argued that understanding emerges through social interaction and dialogue (Renshaw & Brown, 2007) in a cultural context. Vygotsky was also amongst the first scholars to highlight the importance of cultural experience, hypothesizing on the central role played by cultural symbols (*inter alia* language, books, pictures and other man-made objects) in a child's cognitive development. He argued that these cultural symbols not only affect the *content* of a child's learning, but more importantly, the actual *process* of learning: "When the child learns a language, for example, he does not simply discover labels to describe and remember significant objects or features of his social and physical environment but ways of *construing* and *constructing* the world" (Wood 1998, p. 17).

For Vygotsky, "systems for representing the world [i.e. various cultural symbols] are not just things that we think *about*; they determine *how* we think" (Wood, 1998, p. 41), and this 'construing' and 'constructing' process, he argued, is most powerfully achieved in the *zo-ped*[21] (zone of proximal development [ZPD]) where "a child's empirically rich but disorganised spontaneous concepts "meet" the systematicity and logic of adult reasoning" (Kozulin, in Vygotsky, 2013, p. l). Vygotsky argued that children's spontaneous concepts provide "the necessary, *but not sufficient* [my emphasis], conditions for progress toward more powerful forms of thinking" (Renshaw & Brown, 2007, p. 533). Unlike Piaget, who believed that development generally precedes learning (Wood, 1998; Fernyhough, 2008, p. 228), Vygotsky embraced the counter view that well-planned and mediated learning has the potential to in fact 'accelerate' development (Alexander, 2005, p. 6).

Renshaw and Brown provide an example of such a transition (progression) taken from a mathematics curriculum developed by the Russian psychologist Davydov. Davydov was greatly influenced by Vygotsky's work, and one of his key preoccupations was to devise strategies for moving children relatively rapidly in their ZPDs away from purely empirical understanding of mathematics towards more theoretical levels of mathematical understanding (Schmittau & Morris, 2004). Below I depict Davydov's envisaged progression of children's everyday comparisons of quantity towards more formalised, mathematical, and symbolic (algebraic) representations of quantity.

Children's existing words for quantity	**Same**	**bigger**	**smaller**
↓	↓	↓	↓
More precise comparative language	**Equal**	**more than**	**less than**
↓	↓	↓	↓
Abstract representation	**a=b**	**a>b**	**a<b**

***Figure 3*: Progressing from everyday description to abstract representation (after Davydov)** (adapted from Renshaw & Brown's written description, 2007, p. 533)

In terms of his work on the different speech patterns (language codes) across the social classes in Britain, the sociologist, Basil Bernstein argued that language was one of the central obstacles facing working-class learners: difficulty in fully understanding and using the kind of elaborated code of speech found in most

[21] This, according to Kozulin, is the term Vygotsky used to describe the ZPD (that difference (gap) between what a child can learn on his/her own (without help from more knowledgeable others) and what this child could learn through interacting with knowledgeable others in the course of daily socio-cultural interactions).

classroom contexts prevents them from fully accessing the types of abstract thinking that tend to predominate in the classroom (Bernstein, 1964). "As a child progresses through a school," Bernstein argued, "it becomes critical for him to possess, or at least be oriented toward, an elaborated code if he is to succeed" (1964, p. 67).

A number of researchers have used Bernstein in their classroom analyses. Hoadley and Muller (2009), for example, cite a particular study Bernstein had used to illustrate the linguistic styles of children from different socio-economic backgrounds. It was an experiment on children's choice of criteria in classifying foodstuffs[22]. Whereas working-class children mostly used context-dependent principles, referring to personal, particularistic and everyday meanings (e.g. 'My Mum makes us yummy roast potatoes!'), middle-class children inclined towards general, non-context-dependent principles (e.g. a food category) in the first instance (e.g. 'A potato is a root vegetable') (Hoadley & Muller, 2009, pp. 70-71). Cooper (1998) shared a similar example, taken from mathematics. He notes that work using Bernstein's concepts of 'recognition' and 'realisation' rules have helped to uncover social class differences in the way children respond to mathematical problems. Drawing on the work he did on children's responses to mathematics test items, Cooper expressed concern that working-class children were perhaps being discriminated against because they showed a "tendency to interpret formal educational contexts as legitimate arenas for the employment of everyday knowledge when such use is actually 'inappropriate' " (1998, p. 511). By contrast, middle class children displayed a better metacognitive sense of what was needed to "produce 'legitimate text' " (1998, p. 520) in the ways they responded to mathematical problems. Both Cooper and Hoadley and Muller echo Bernstein's finding that whereas middle class children appear to have access to the restricted as well as the elaborated code, working class children tend to operate almost exclusively with a restricted code. It is important to note though Hasan's point (elaborated upon in my next paragraph) that this – while initially the case - need not be seen as 'terminally' the case.

Throughout his life, Bernstein worked assiduously at unpacking "the inner logic of pedagogic discourse and its practices" (2000, p. 4), and the ways in which these are communicated, and continue to contribute to differences in educational attainment

[22] Holland, J. (1981). Social class and changes in orientations to meaning. *Sociology,15*, 1–18.

across social strata. Ruqaiya Hasan put Bernstein's theory to the test in Australia, analysing how the way working-class and middle-class mothers interacted verbally with their children contributed to their children's 'mental dispositions' (2002). Her findings corroborated those of Bernstein, though she did draw attention to an important point, made by Bernstein himself, which many overlook. This was that, while the mental dispositions children develop in the home undoubtedly impact on the ways in which they subsequently relate to school knowledge, it is not *inevitable* that such forms of consciousness become fossilised. New speech encounters in new environments may well lead to the appropriation of, and here she quotes directly from Bernstein's 1971 text (*Class, codes and control, Volume 1*), "very different speech systems or linguistic codes" (2002, p. 547). South African research (e.g. Hoadley, 2006, 2007, and 2012; Hoadley & Muller, 2009) is saying the same thing.

Bernstein's early efforts to characterise the precise nature of the link(s) between language and learning have been influential, but have also received some criticism[23]. Bernstein himself made significant modifications to his earlier thoughts[24].His ideas continue, however, to offer some valuable insights into the struggles learners face when language gets in the way of their being able to fully engage with, and participate in classroom dialogue. This is doubly the case in contexts such as the proposed site for my own investigation where, not only are the children from mainly socio-economically deprived circumstances, but they are also not native speakers of English. This said, the point that Hasan alerts us to – namely that the early mental dispositions children bring to school should not be seen as deterministic (2002) – is extremely important.

Writing about Halliday's contributions to our understanding of how language works as a semiotic system, Foley (1991) explains that Halliday saw a child's progress towards recognising and then realising the full meaning-making potential of language as being achieved through learning from more competent others, and that

[23] For instance, the American socio-linguist William Labov argued that Bernstein was contributing to a 'deficit' portrayal of working class children. Labov contended, rather, that it was *teachers' attitudes* towards learner's non- standard use of English that was the most significant contributory factor to children's failure (2005).

[24] Bernstein argued, for example, that "We need to examine the social assumptions underlying the organisation, distribution and evaluation of knowledge … the power relationships created outside the school penetrate the organisation, distribution and evaluation of knowledge through the social context" (1972, p. 217).

this "tutelage" constitutes "a vicarious form of consciousness" (p. 24). (The parallels here with Vygotsky's ZPD idea are clear.) Halliday (1985, cited in Foley, 1991) identified language as serving a number of meaning-making functions (or metafunctions), each requiring attention to particular aspects of discourse. In relation to the *interpersonal* function (to do with relationships with others) learners have to attend to the *tenor* of the discourse. (Are they, for example, interacting with peers, or with someone senior to themselves?). In relation to the *ideational* function (to do with making sense of the world), learners would need to attend to the *field* of discourse. (Is this a soccer game, or a mathematics lesson?). Finally, in relation to the *textual* function (to do with choices about what style of language is appropriate for a given situation) learners would need to attend to the *mode* of discourse. (Are they communicating verbally, or visually through the use of gestures, or in written form?) Foley sums this up as follows: "The essential character, therefore, of language is functional: it constructs the identity of a social situation" (1991, p. 25). The significance of Halliday's systemic functional approach to analysing language is that it alerts us to "differences of orientation to meaning and acting" (Foley, 1991, p. 27) which, if linked to Bernstein's ideas around the effects that early socialization have on children's speech patterns, helps in our analyses of classroom talk and how it enables or restricts learners' mathematical sense-making.

9. A perceived gap

A lot of research has focused on the contribution that classroom talk makes to learners' sense-making of ideas and concepts, as well as on appropriate strategies for analysing classroom talk (*inter alia* Mercer, 2001, 2004, & 2010;Barnes, 2008; Mercer & Dawes, 2008; Gibbons, 2003; Renshaw & Brown, 2007). There has also been a lot of research on the place of language in teaching and learning mathematics (*inter alia,* Adler, 1998; Barwell, 2003, 2005& 2011; Campbell, Davis & Adams, 2007; Moschkovich, 1999, 2002, 2005, 2007a & b, 2009; Setati, 2005, Setati& Adler, 2000, Setati, Chitera & Essian, 2009). I have not yet found much in the professional and academic literature, however, with an explicit focus on language usage at the literacy/numeracy interface. Hoadley has done some work in this area (2006; 2007; 2012), drawing mainly on Bernstein's ideas, and – to a lesser extent – on Vygotsky. A scan through the contents pages of the *South African Journal of Childhood Education* revealed relatively little research work at this interface. Although my

search can in no way be described as 'exhaustive', I have thus far found only one paper and one doctoral thesis which specifically signal this interface[25], neither of which are local. I therefore plan to explore further possibilities for dialogue between what research has helped us learn about ways for developing learners' literacy (particularly in contexts where this is happening through a second (or additional) language), and research which looks at ways of developing learners' numeracy. I see opportunity for some synergic strengthening of both sets of insight.

10. Research goal and questions

The purpose of the research is to explore the nature of talk in the selected Grade 4 classrooms and to examine how talk is used to support learners' numeracy development through the primary medium of a first additional language (English). It is important here to recognise that, because the learners are not yet proficient in their additional language, they are not yet able to simply use this language as a resource for learning; they are also in the actual process of acquiring it. Rather than viewing this transition period in deficit terms, however, a more positive view would be to see these children as 'emergent bilinguals' (Garcia & Kleifgen, 2010, p. 2), eminently capable of functioning in their home language while they are in the process of developing their proficiency in English.

The research questions are:

- What is the nature of talk in the observed mathematics lessons?
- What are the patterns of teacher-learner oral interactions in the observed lessons?
- In what ways, if any, do the teachers use their learners' emergent bilingualism?
- What informs the participating teachers' classroom talk practices during their mathematics lessons?
- What do the participating teachers identify as enabling/ constraining factors in relation to teacher-learner oral interactions during mathematics lessons?

In terms of making a theoretical contribution, I will investigate how the different analytical frames of Vygotsky, Bernstein and Halliday might complement each other in relation to this analysis of classroom talk.

[25] [Hopkins (2007); Antonysamy (2011).]

11. Analytical tools drawn from the theoretical/analytical framework

Focusing on the role language plays in supporting children's numeracy development, I propose using both socio-cultural and socio-linguistic perspectives for my theoretical and analytical framework in this study. I will draw on Vygotsky's ideas regarding the role of language in cognitive development. In addition, I will draw on the socio-linguistic ideas of Bernstein and Halliday, using Bernstein's recognition and realisation rules to classify the language choices made (by both teachers and learners), as well as Halliday's metafunction categories and discourse types to help me describe the ways in which language is used in the classroom. Both Bernstein and Halliday argued that, given that learning is "inherently a semiotic (meaning-making) process" (Halliday, 1993, p. 94),it is best seen as a form of language learning, but that"differences in the use of language aris[e] out of a specific context[s]" (Bernstein, 1972, p. 213). Also important here will be to observe and classify instances where either teachers or learners draw on their home languages in their respective processes of 'making-meaning'. Mercer (2001, pp. 254-255)emphasises that a socio-cultural analysis of classroom meaning making processes would need to take account of the view that language serves the following three important functions:

- It is a *cognitive tool* for accessing, using, and evaluating knowledge
- It is a *cultural tool* for sharing and storing knowledge, and for making it available to future generations" (p. 254)
- It is a *pedagogic tool* enabling more capable others to provide "intellectual guidance" (p. 245) to children.

From the socio-linguistic perspective then, language is seen as both a tool for, and an object of teaching and learning. Teaching and learning take place through "a dialogical, cultural process" (Mercer, 2001, p. 245). Learners' understandings are developed and shaped through their interactions with teachers and fellow learners in a cultural context. Figure 4 (from Fernyhough, 2008) illustrates this triadic relationship. He explains that P1 and P2 represent "the different perspectives accommodated in the dialogue" (p. 238). Thick lines represent each individual's perspective on the 'meaning making' activity

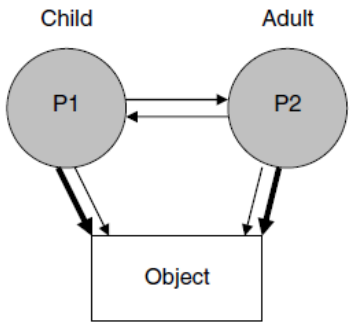

Figure 4: Fernyhough's representation of triadic intentional relations in dialogue(2008, p. 238)

underway. Thin lines represent their perspective on the other person's perspective. Fernyhough's framework, drawing on Vygotsky's ideas about 'inner' and 'outer' speech, represents this particular aspect of dialogic thinking (2008, p. 238).

Of particular significance here is the nature of the mediation happening in the ZPD. As previously noted, mediation, for Vygotsky, involves the use of tools (of which language is the most important) to achieve a learning goal (Lantolf, 2000). Because no classroom activity can be seen as occurring in a vacuum, the shared history of any 'community of practice' (after Lave & Wenger, 1991) will always impact on the nature of classroom interactions. And finally, because successful classroom interaction is to an extent dependent on shared knowledge and understanding, breakdowns may occur where - for whatever reason - learners are not fully familiar with the language and/or culture of the classroom. Part of a teacher's role therefore is to attempt - through dialogue - to reconcile differing interpretations (perspectives) of 'meaning' (as is illustrated in Fernyhough's framework, above). Part of my research will focus on observing how this unfolds in the selected Grade 4 classrooms.

12. Research design and methods

The research will be located primarily within a qualitative, interpretive paradigm (Patton, 1990; Maxwell, 1996). I hold to the interpretive view that participants in any social context act according to the meanings they ascribe to that context, hence Haralambos, Holborn and Heald's assertion that "social action can only be understood by interpreting the meanings and motives on which it is based" (2000, p. 971). At the same time, I acknowledge the problematic nature of a view of 'reality' as being primarily socially constructed (as opposed to externally given). I will need to take account also of the external constraints (*inter alia*, language policy issues, school and other management structures, our country's socio-political history and socio-economic patterning) impinging on the 'reality' of whatever patterns of mathematical talk I observe in the Grade 4 classrooms. I am aware too of the need for a high degree of reflexivity on my own part.

The research will be a case study (Stake, 1995), the case being classroom talk across the two sites. Collecting case study data involves firstly, asking questions and paying close attention to the answers; and secondly, observing events and carefully documenting significant features of such events (Bassey, 1999, p. 81). My main methods of data collection will be interviews and lesson observation. Interview data

will be captured via audio recording. Observation data will be captured videographically, complemented by detailed field notes. Audio and video recordings will be transcribed (either partially or in full, depending on what is appropriate in each instance).

I propose to start with open-ended interviews with both teachers to explore their views and practices as regards the role of talk in helping learners' mathematical development. In particular, I will probe their views the place of language in the context of their Grade 4 mathematics teaching/learning. I will then begin a series of lesson observations, partly with a view to detecting congruence and/or dissonance in the teachers' practice and stated views, but - more importantly - to observe use of language in mediating learners' engagement with mathematical tasks.

Since my unit of analysis is classroom talk, transcriptions of the talk taking place in these lessons will provide the most crucial sources of data relative to the first three of my research questions. I have read several papers on strategies for analysing classroom talk. These include studies of patterns of classroom interaction (Zevenbergen); studies on the nature of talk (Gibbons, 2003; Mercer, 2001, 2002, 2004 and 2010; Mercer & Dawes, 2008; and Renshaw & Brown, 2007); and various studies on teachers' use of questions (Gall, 1970 and 1984; Mehan, 1979; Wong-Fillmore, 1985; Brock, 1986; Brualdi, 1989; Alexander, 2000 and 2005; and Sadker, 2002). I anticipate that here there will be three different sets of teacher-learner talk: whole class talk, small group talk, and teacher engagement with individual learners. Analysis of talk will be both grounded and literature-led.

I propose also to make use of the stimulated recall interview technique (after Nunan, 1992, p.94-96; see also Gass & Mackey, 2000) to follow up on salient aspects emerging from the observations of each teacher's mathematics lessons. To achieve stimulated recall, I will re-play with each teacher selected segments of video recording from her lessons and engage with her on aspects of these.

It is my intention that, through these various methods of data collection, I gather sufficient data in sufficient depth and detail to allow for 'thick descriptions' (after Geertz, 1973). My use of more than one data source will, I hope, provide opportunities for triangulation against which to assess my findings for trustworthiness.

13. Site/Sample selection

As noted in Section 2, the sites selected for this research are two township schools in the Eastern Cape. Both are fee-paying state schools in Quintile 3. Both are purposive samples (Cohen, Manion & Morrison, 2011, p. 153) in that they have been chosen on the basis of their Grade 4 mathematics teachers being participants in the NICLE project. They are also convenience samples (Cohen, Manion & Morrison, 2011, p. 155) in that they are readily reachable from my place of work. More importantly, however, they represent what Graven identified as 'opportunity samples' (personal communication, March 11, 2014) in that I too have recently joined NICLE, and as such now have the opportunity to engage with, and work alongside the two teachers, in a co-learning capacity. Because I am not part of the NICLE co-ordination team, I expect teachers should not be too influenced by my presence in their mathematics classrooms. Both teachers have already indicated their willingness to allow me into their classrooms to observe their Mathematics lessons during the 2014 third school term. I have obtained permission from their respective school principals.

None of the learners in these two Grade 4 classrooms is learning through their home language. School A's language policy parallels that recommended in CAPS, namely mother tongue education through the foundation phase years, with a transition to English as the main LoLT in Grade 4. Because the school's policy predates CAPS, it is likely, however, that the learners currently in Grade 4 here would only have started learning English as a subject in Grade 2[26] (following the EFAL curriculum).School B has a modified 'straight for English' language policy, whereby, while there is certainly emphasis on mother tongue for early literacy learning, the school prides itself on having English as the main LoLT from Grade 1. Given this, I anticipate that – officially at least – the school would be expected to follow the EHL curriculum. Children in both thus face the dual challenge of *mastering* English, while at the same time learning their mathematics *through* English. Both Grade 4 teachers, although competent bilinguals (isiXhosa and English), are not native speakers of English. This is likely to influence the way they guide their learners towards engaging with the language both of the classroom generally, and – specifically – the language of mathematics. Finally, the fact of both schools being township schools, suggests that,

[26] With the introduction of CAPS, schools such as School A and B are now required to start teaching English as a subject from Grade 1.

even though both are fee-paying (School B is slightly more expensive than School A), most if not all the children they serve come from homes lower down the SES scale than would be the case of, for example, a former Model C school.

Working towards supporting the children's numeracy development prospects, both schools have been selected to be part of the SANC's programme. In the 2012 *Final Report: School Functionality* it is explained that participating schools are selected on the basis of their perceived 'functionality'. As the report notes, notions of school functionality are controversial and require sensitive interpretation (p. i), but, on the basis of seven key characteristics, the SANC team has identified these two schools as amongst those that have potential to derive benefit by input from the project[27].

A final point I need to mention is that I have not chosen two schools for comparative purposes. Rather I hope that these two sites are at once sufficiently similar and sufficiently different that they will generate a richer perspective around the issue of mathematics classroom talk in a predominantly second language teaching learning environment.

14. Validity/ethical issues

Ethical considerations and procedures for this case study will conform to the University's requirements, including seeking permission from the Department of Basic Education to carry out the work.

I have outlined to both the school principals and the Grade 4 teachers what the research will involve. The principals have, as noted, given their permission for the conduct of my research in their schools, and both Grade 4 teachers have expressed their willingness to have me observe and video them teaching their mathematics lessons, and to interview them during the research period about their beliefs and practices in this regard. My positioning alongside both teachers will be as a co-learner and co-member of NICLE, sharing with them a desire to better understand the ways in which classroom talk 'works' to mediate learners' numeracy development.

[27] The Report notes that in the case of significantly *dysfunctional schools*, "only radical management interventions are likely to have any effect at all" while in the case of *highly functional schools* Numeracy Chair interventions would most likely be superfluous (2012, p. iii). In decisions around appropriate schools in which to make interventions, the Report notes that schools lying between these extremes represent the "ideal targets for the Numeracy Chairs Programme" (2012, p. iii).

I will work carefully with both teachers to ensure that there is no breach of confidentiality pertaining to the identities or performances of individual learners or teachers, and intend to reassure them that they have the right to withdraw from the research at any time. I will ensure also that the children's parents (or caregivers) are fully briefed regarding my research plans. I will write to each child's caregiver (in both isiXhosa and English) requesting permission to video the mathematics lessons during the data-gathering period. I will include here the assurance that they are free to meet with me or telephone me at any reasonable time should they wish to do so. I will also assure them that if they are reluctant to grant permission for their child to appear in the video recordings, I will take steps to exclude the child's image from all such recordings. I will also assure the school authorities as well as children's caregivers that all identifying data will be kept under lock and key, and shared only with my supervisor, unless I have their express permission to do otherwise.

I will give each teacher the opportunity to go through the relevant lesson observation and interview transcripts with me to ascertain whether they feel I have captured things accurately, and whether there is anything in the transcripts which might cause discomfit. This member checking, or "respondent validation" (Nisbet & Watt, as cited in Cohen, Manion & Morrison, 2012, p. 299) will be an important element in ensuring the integrity of my data. Maxwell identified it as "the single most important way of ruling out the possibility of misinterpreting the meaning of what participants say and do" (2009, p. 244).

Regarding validity, it is seldom the nature of interpretive case studies that they allow for generalization. With reference to case study research, Eysenck emphasised that the value of looking "carefully at individual cases [lay] not in the hope of proving anything, but rather in the hope of learning something" (cited by Flyvbjerg, 2006, p. 224). It is my hope that this proposed case study investigation of teachers' use of classroom talk in mathematics lessons may resonate in significant ways (Bassey, 1999, p. 65) with others involved in similar circumstances. Cresswell and Miller (2000, p. 129) note that 'thick description' is one way of helping others assess the extent to which findings resonate with (or 'relate' to) other settings.

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Appendix

(1) THE ROPE METAPHOR AS IT HAS BEEN APPLIED TO AN EXPLANATION OF READING LITERACY

The complexity of the reading act, and the different kinds of cognition required to make it appear "simple, effortless and automatic" (Rayner et al., 2001, p. 31), is captured in the following visual metaphor from Scarborough of a multi-stranded rope (2002, p. 98). As the diagram illustrates, reading comprises two main components: the bottom-up word (and/or phrase) recognition skills, and the top-down comprehension and interpretation skills. The diagram also shows the *interactive* nature of the reading act, which, if it is to be skilled, requires the simultaneous coordination of several different elements.

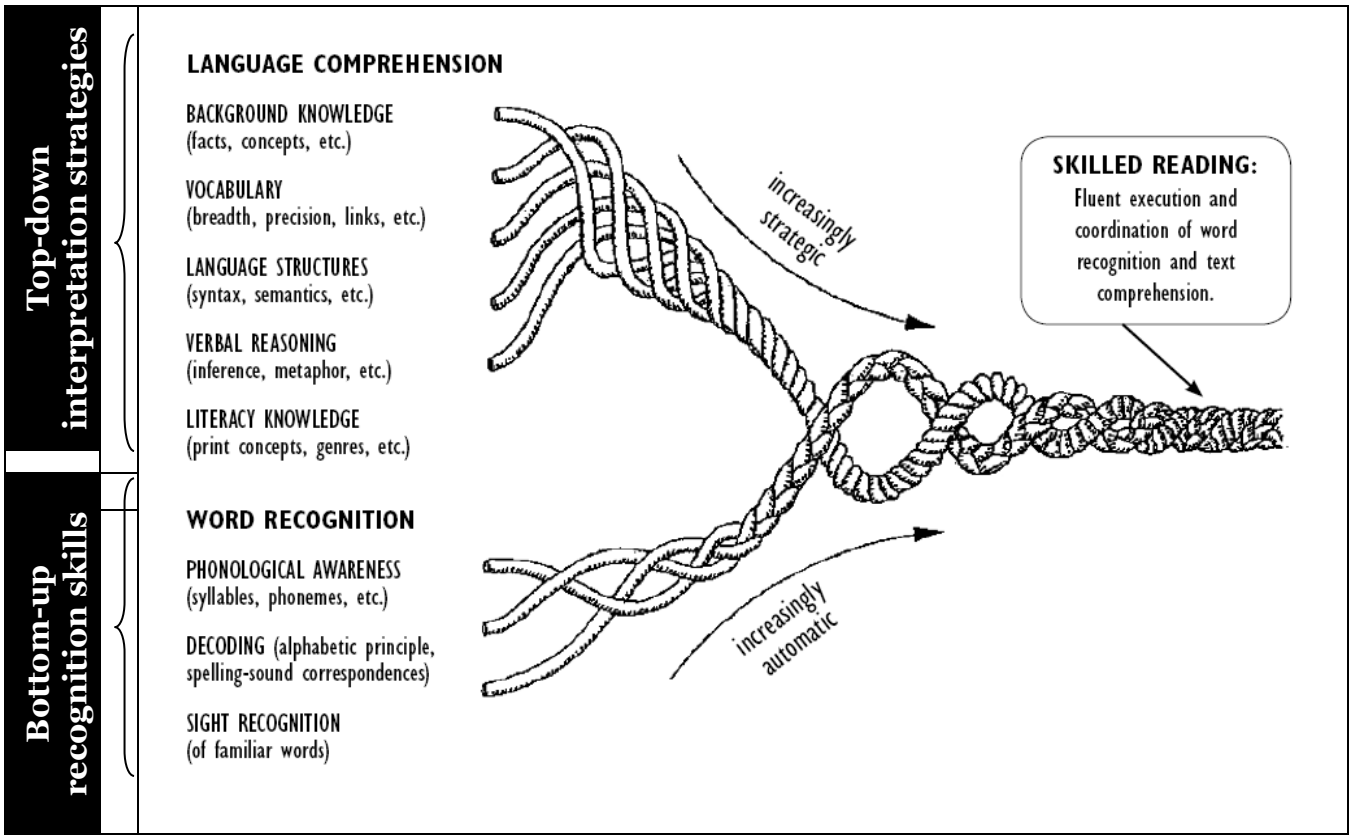

Figure 1: **Scarborough's "rope" model showing the elements that, together, constitute skilled reading** (adapted from Scarborough, 2002, p. 98)

(2) THE ROPE METAPHOR AS IT HAS BEEN APPLIED TO SHOW THE FIVE STRANDS OF MATHEMATICS PROFICIENCY[28]

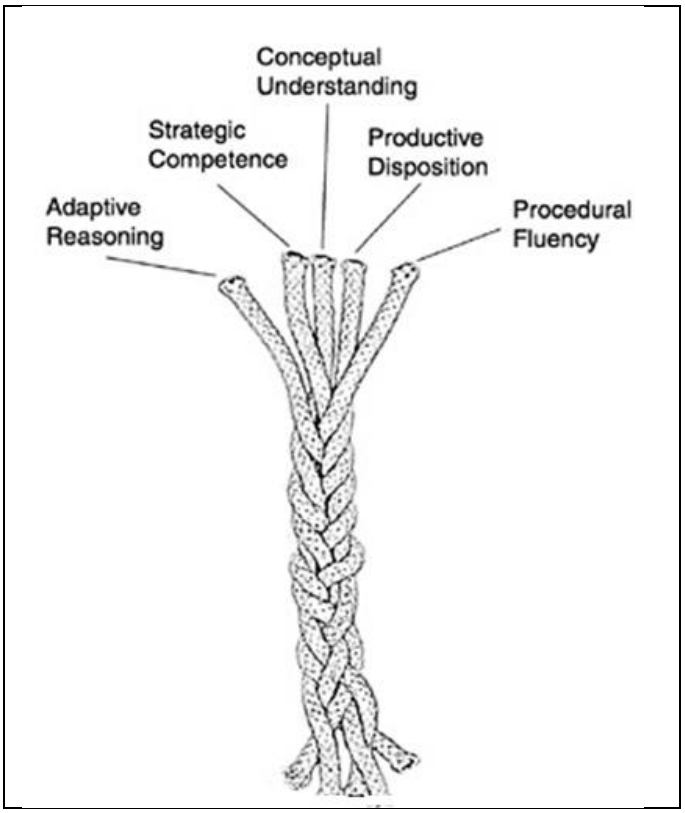

Figure 2: **Kilpatrick et al's "rope" model showing the five elements that make up mathematical proficiency** (2001)

Kilpatrick et al., (2001) identify the following five strands which, together, contribute to a learner's mathematical proficiency.

(1) Conceptual understanding, which refers to the "integrated and functional grasp of mathematical ideas", which "enables them [students] to learn new ideas by connecting those ideas to what they already know." A few of the benefits of building conceptual understanding are that it supports retention, and prevents common errors.

(2) *Procedural fluency, which* is defined as the skill in carrying out procedures flexibly, accurately, efficiently, and appropriately.

(3) *Strategic competence*, which is the ability to formulate, represent, and solve mathematical problems.

(4)*Adaptive reasoning*, which is the capacity for logical thought, reflection, explanation, and justification.

(5) *Productive disposition* which is the inclination to see mathematics as sensible, useful, and worthwhile, coupled with a belief in diligence and one's own efficacy.

[28](Diagram and accompanying explanations retrieved December 20, 2013, from http://mason.gmu.edu/~jsuh4/teaching/concept.htm)