

# Language and Learning Science in South Africa

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South Africa is a multilingual country with 11 official languages. However, English dominates as the language of access and power and although the Language-in-Education Policy (1997) recommends school language policies that will promote additive bilingualism and the use of learners' home languages as languages of learning and teaching, there has been little implementation of these recommendations by schools. This is despite the fact that the majority of learners do not have the necessary English language proficiency to successfully engage with the curriculum and that teachers frequently are obliged to resort to using the learners' home language to mediate understanding. This research investigates the classroom language practices of six Grade 8 science teachers, teaching science through the medium of English where they and their learners share a common home language, Xhosa. Teachers' lessons were videotaped, transcribed and analysed for the opportunities they offered learners for language development and conceptual challenge. The purpose of the research is to better understand the teachers' perceptions and problems and to be able to draw on examples of good practice, to inform teacher training and to develop a coherent bilingual approach for teaching science through the medium of English as an additional language.

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## Background

South Africa is a multilingual country with 11 national languages – nine indigenous languages and the two former colonial official languages of English and Afrikaans<sup>1</sup> – recognised as official languages in the Constitution of 1996 (Constitution of the Republic of South Africa, 1996) (Table 1).

Despite these provisions, English has expanded its position as the language of access and power since the democratic elections of 1994, with the relative influence of Afrikaans shrinking, and African languages effectively confined to functions of 'home and hearth'. McLean and McCormick (1996: 329, in Mazrui, 2002: 269) suggest that the constitutional recognition of 11 official languages in South Africa is largely 'intended and perceived as a symbolic statement and that for instrumental purposes, English remains the dominant language in South Africa'.

Prior to 1996 English and Afrikaans were the official languages and schools could choose between the two as media of instruction after an initial period of

**Table 1** Official languages of South Africa

<i>Official languages</i>	<i>Home language speakers</i>
Zulu	22.9%
Xhosa	17.9%
Afrikaans	14.4%
Sepdi	9.2%
English	8.6%
Setswana	8.2%
SeSotho	7.7%
Xitsonga	4.4%
SiSwati	2.5%
Tshivenda	2.2%
IsiNdebele	1.5%
Other	0.6%

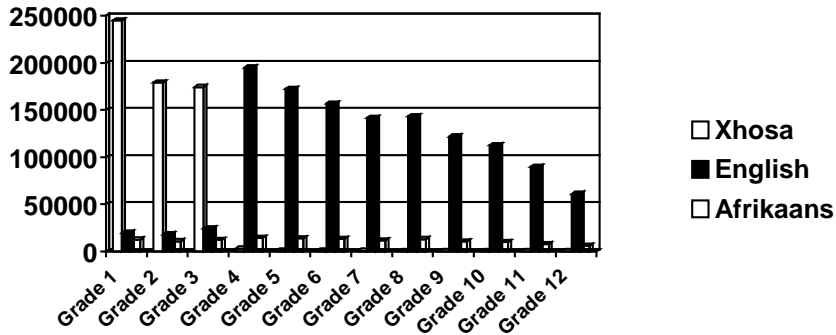
Source: Census 1996 in Statistics South Africa, 2000

instruction through the learners' home language. In effect this meant that most English and Afrikaans speakers (mainly white and 'coloured' learners) learnt through the medium of their home language, while African language speakers learnt through the medium of an additional language, usually English, from the beginning of Grade 5.

The new Language-in-Education Policy (LiEP) of 1997 (Department of Education, 1997) obliges each school to decide on their own language policy, in terms of the language of learning and teaching (LoLT) and languages to be taught as subjects: learners have to learn at least two official languages as subjects and one of these should be the LoLT; school language policies should promote 'additive bilingualism', defined as maintaining home languages while providing access to and the effective acquisition of additional languages. Although the LiEP encourages the use of learners' home languages as LoLT, it appears from several small-scale research projects (Probyn *et al.*, 2002; Vinjevd, 1999) that the trend in African township and rural schools<sup>2</sup> has been towards introducing English as LoLT even earlier than before, either in Grade 4 (the beginning of the Intermediate Phase in the new curriculum) or straight from Grade 1.

In the Eastern Cape Province, for example, where this research was conducted, Xhosa is the home language of 83.8% of the population and English speakers comprise only 3.7%.<sup>3</sup> Nevertheless, as Figure 1 indicates, English is the LoLT for the majority of learners from the beginning of Grade 4.

This is despite the fact that the majority of African learners in township and rural schools (over 80% of learners) have little exposure to English outside the classroom, apart from television and popular music. Research confirms the common sense assumption that African learners use their home language in their homes and communities (PANSALB 2000; Probyn *et al.*, 2002; Strauss, 1999: 22) and demographics suggest that they have little direct contact with home language English speakers, as these comprise only 9% of the population. It appears that the



**Figure 1** Learners' language of learning and teaching, Eastern Cape 2001

Source: EMIS, 2001

majority of learners have limited access to reading materials: a national survey<sup>4</sup> found that only 10% of parents bought newspapers and magazines; more than 50% indicated they had access to fewer than 10 books (Strauss, 1999: 25); and 83% of schools have no libraries (Bot & Shindler, 1997: 80–1).

The resulting poor English language skills of the majority of learners in township and rural schools mitigate against teachers and learners strictly adhering to English. There is a gap between learners' English proficiency and the linguistic demands of learning through the medium of English and likewise there is a gap between the intended and enacted language policies, with a range of bilingual classroom practices evident (see Macdonald, 1990; Probyn *et al.*, 2002, for a full discussion of this). Outside the major metropolitan areas of Gauteng province where township schools are truly multilingual, the typical linguistic scenario is that of a school community where the majority of learners and teachers share a common home language (Heugh, 2002: 185). For instance, in the Eastern Cape, 88% of Grade 8 learners and 82% of Grade 8 teachers are Xhosa home language speakers (EMIS, 2001). Research evidence is that in such schools the lingua franca amongst teachers and learners is their common home language, with the use of English confined to the classroom (Probyn *et al.*, 2002).

Two small-scale research studies (Probyn, 1995, 2001) confirm anecdotal evidence that in such schools, even inside the classroom learners tend to use their home language with their classmates and to a greater or lesser extent with the teacher, depending on the teacher's personal views on the matter. The relative amounts of English and home language used by teachers in these studies differed quite markedly between teachers. As is widely reported in South Africa (Adendorff, 1996; Macdonald, 1990; National Education Policy Investigation, 1992; Setati *et al.*, 2002) and in other contexts where a former colonial language is used as the language of learning and teaching (for examples see Arthur, 1994 in Botswana; Lin, 1996 in Hong Kong; Martin, 1996 in Brunei; Merritt, 1992 in Kenya; Ndayipfukamy, 1994 in Brundi), teachers codeswitched from English to the learners' home language, for a range of purposes: to explain new concepts, to clarify statements or questions, to emphasise points, to make connections with learners' own contexts and experience, to maintain the learners' attention with question tags, for classroom management and discipline, and for affective

purposes. However, it appears that many teachers still regard codeswitching as illicit, as sign of failure rather than a legitimate classroom strategy; for example, a teacher referred to 'smuggling the vernacular into the classroom' (Probyn, 2001). (For further discussion of this see Adendorff, 1996; NEPI, 1992: 49; Setati *et al.*, 2002). This has implications for the collection of authentic classroom data for research, as teachers are likely to use less of the learners' home language when they are being observed, if they feel it is not acceptable practice.

Thus for many township and rural learners, the oral language of the school and classroom is their home language, whereas the language of reading, writing and assessment is English. The difficulty for many such learners is to bridge the gap and acquire not only proficiency in English, but also the kind of cognitive academic language proficiency (see Cummins, 2000) required for academic learning and meaningful engagement with the curriculum.

These difficulties were highlighted in the report of the Third International Mathematics and Science Study<sup>5</sup> conducted in 1999, which found that:

The majority of South African pupils cannot communicate their scientific conclusions in the languages used for the test (i.e. English and Afrikaans which were the medium of instruction and are the languages currently used for matriculation examinations). In particular, pupils who study mathematics and science in their second language tend to have difficulty articulating their answers to open-ended questions and apparently had trouble comprehending several of the questions. (Howie, 2001)

This report was widely publicised and provided a welcome focus on the problems of language and learning for the majority of learners, a problem that has received scant attention from policymakers and teacher trainers (Joint Education Trust, 1997: 26–9; National Education Policy Investigation, 1992: 4; Probyn, 1995, 2001) and yet has huge implications for questions of access and equity – two of the principles guiding educational transformation in South Africa since 1994.

Given the problems in teaching and learning through the medium of English as an additional language, it might seem surprising that schools have not taken up the recommendations of the LiEP for strengthening the position of African languages in the curriculum, particularly as languages of learning and teaching. However, a number of factors that have little to do with the realities of classroom teaching and learning strongly direct schools towards retaining English as the LoLT. These include the social, economic and political power of English in the country, the under-development of African languages as languages of science and technology, the link of African languages as media of instruction with the apartheid education system<sup>6</sup> and a lack of learning materials in African languages.

The preference for English as LoLT expressed by many teachers, parents and learners is not unequivocal. Research indicates that African languages are deeply valued for reasons of culture and identity (Barkhuizen, 2001; De Klerk, 2000; Probyn, 1995). Nevertheless the linguistic theories underpinning notions of additive bilingualism (see Cummins, 2000) in the Language-in-Education policy, that propose a strong role for home languages as a basis for the acquisition of additional languages, are not widely circulated or understood

and therefore are seldom considered by schools when decisions about school language policies are made.

Given that English is likely to remain the LoLT at least in secondary schools, teacher training in how best to cope seems a matter of urgency. As indicated, research has shown that teachers have a range of coping strategies, including codeswitching to the learners' home language for a range of purposes. Rather than taking a deficit view of such bilingual classroom practices, it would seem that a closer study of what teachers actually do with language in the classroom could inform the development of training for teachers, to include the strategic and planned use of the learners' home language to support concept development and language learning in classrooms.

## **Research**

### **Purpose**

Recent research has stressed the need to base teacher development on teachers' definitions and perceptions of the problems of practice: 'Any serious attempt to improve the quality and effectiveness of teaching and learning in schools must start from an understanding of what people in classrooms do at present' (Cooper & McIntyre, 1996: 1). Therefore the purpose of this research was to understand the perceptions, practices and problems of six teachers teaching Grade 8 science through the medium of English as an additional language. This understanding should inform a teacher development programme that would seek to help teachers achieve a greater awareness of the role of language in learning and to develop classroom strategies that would assist learners both to acquire language and to develop conceptual understanding.

### **Research context**

The research was conducted in township schools around Grahamstown, a small university town of approximately 120,000 inhabitants, situated in the Eastern Cape province of South Africa. As in the rest of the Eastern Cape, Xhosa is the home language of the great majority of teachers and learners in these schools, and for all of the learners and teachers who participated in the research. Grade 8 was chosen to tie in with the TIMMS-R (1999) results and because it is the first year of secondary school, when learners' problems with the language medium are likely to be most acute.

The six Grade 8 teachers were volunteers who were interested in participating in the research project. The teachers were located at four different schools. These varied in size from 670 to 1400 learners from Grade 8 to 12 and with pupil-teacher ratios ranging between 29:1 to 38:1. The six classes visited varied in size from 35 to 52 learners. Three of the schools were in new, modern buildings and the fourth in a building that had been condemned as unfit for schooling but had been taken over by the school concerned as it had previously had to conduct classes after hours in a primary school building. This meant that they had very little furniture – the science classroom had a collection of desks and tables but very few chairs, so learners stood or sat on tables.

The teachers all noted that most learners came from poor, illiterate backgrounds. Most lived in the surrounding township but some came from farms in

the area and travelled to schools in the township every day. Although the schools all charged minimal fees to pay for resources not supplied by the Education Department, many parents could not afford to pay even these relatively small amounts. Thus schools had very limited resources and had problems in maintaining equipment such as photocopiers. None of the schools had received science textbooks for Grade 8 although this was the year that the new curriculum was introduced in Grade 8. Teachers B, C and F in the one school shared one textbook between them; Teacher D borrowed a textbook from the researcher; Teacher E borrowed textbooks from teachers in other schools and photocopied extracts; Teacher A preferred to use worksheets and would ask learners to contribute R5 (approximately 50 pence) per term to contribute to the costs of photocopying and would pay for the balance himself. The teachers had very little science equipment in their schools apart from Teacher A who had participated in a number of science teaching projects, which had led to donations of equipment.

#### *Teachers' training and experience*

Two of the teachers who had qualified over 25 years ago had two-year teaching diplomas and the other four teachers with experience ranging from four to 10 years, had three-year teaching diplomas from teacher training colleges. Teacher C was not qualified to teach science and had not taken science at school to Grade 12, but had done some 'engineering science' when training to teach at a technical college.

**Table 2** Teachers' training and experience

<i>Teacher</i>	<i>A</i>	<i>B</i>	<i>C</i>	<i>D</i>	<i>E</i>	<i>F</i>
Training	2-year diploma training college	3-year diploma training college	3-year diploma training college	3-year diploma training college	3-year diploma training college	2-year diploma training college
Teaching experience	25 years	4 years	7 years	10 years	8 years	26 years

#### *School language policies*

None of the schools had school language policies drawn up according to the Language-in-Education Policy (DoE, 1997), but in all of them English was the accepted LoLT in that it was the language of writing, textbooks and testing. There were no explicit rules or guidelines regarding classroom language use and it was left to teachers to work things out for themselves, although it was understood that they should not 'present a lesson in Xhosa from beginning to end'. All of the teachers said that they preferred English as the LoLT – even Teacher C, who used Xhosa for 85% of the lesson. The reasons they gave were that English was an international language; it was the language used for tertiary education; it provided access to employment; and there was a lack of resources and scientific terminology in Xhosa.

#### **Research methods**

Four lessons for each of six Grade 8 teachers were videotaped: one pilot video to iron out technical problems and to acclimatise teachers and learners to the

presence of the researcher and video camera; and three consecutive lessons which were then transcribed. Teachers were interviewed about their perceptions and attitudes towards teaching through the medium of English as an additional language. They were also helped to reflect on their lessons, using the videotapes and lesson transcripts for stimulated recall so as to make explicit their existing classroom practice. The interviews were audio-recorded.

### **Analysis**

The teacher interviews were transcribed and then collated and analysed for commonalities and differences. The lesson transcripts were coded and analysed for the opportunities they provided learners for concept development and learning the target language, English. In particular, the following aspects of classroom language use were examined:

- the relative use of Xhosa and English by teachers and learners and reasons for codeswitching;
- the cognitive challenge of the lesson content as indicated by teachers' questions and learners' responses;
- the support for second language learning provided by teachers.

### **Research Findings**

This paper focuses on the classroom practices of the teachers. The approaches by teachers A, B, C and F could be broadly described as more teacher-centred and those by teachers D and E as more learner-centred in that they were structured around group activities. Teachers D and E were trying out what they understood were learner-centred approaches in line with the new curriculum, which was introduced in Grade 8 in that year, but indicated that they did not feel very confident in what they were doing.

#### **Language input by teachers**

The graph in Figure 2 illustrates the range of language input by each of the teachers over three science lessons. This was calculated by doing a word count of whole class talk in the three lesson transcripts for each teacher. This provides some indication how much whole class teacher talk learners were exposed to, and the relative balance of Xhosa and English. The teachers' words were counted for their whole class talk and when they spoke to groups loudly enough for the camera to pick up – and therefore for other learners to hear. As in the TIMSS Videotape Classroom Study (1999), the purpose was to '... capture the experience of a student who is paying attention to the lesson as it unfolds' (U.S. Department of Education, National Centre for Education Statistics, 1999: 16). Private talk that was too quiet for the camera to pick up (and for most learners to hear) was not included in the analysis.

To put this into context, Figure 3 shows the whole class talk teaching activities of each teacher, as an approximate proportion by minutes of the total lesson time. The balance of time, shown as 'Other lesson activities', was made up of: writing on the chalkboard – for example when the teacher was preparing a

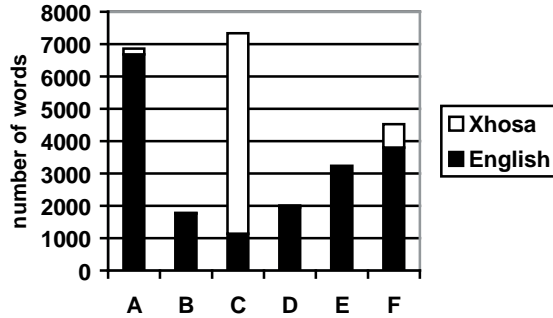


Figure 2 Teachers' use of English and Xhosa for whole class talk

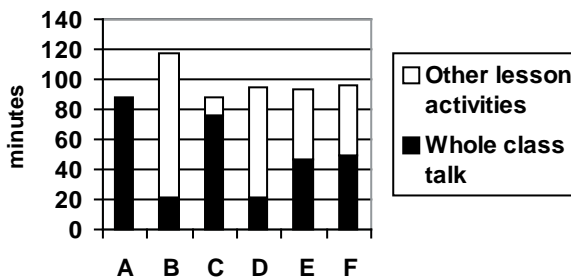


Figure 3 Whole class talk per total lesson time

diagram or drawing for a lesson activity (as in classes B, C and F where the teachers shared one textbook); group work; individual seatwork; or learners reporting back on group activities. However there was some overlap between teachers' whole class talk and 'other lesson activities': for example teacher A maintained a public running commentary while monitoring group practical work – praising, exhorting, helping – as the practical work followed a lock-step pattern, with all learners doing the same activity; whereas teachers D and E tended to speak privately to groups who were discussing different problems. Likewise, when learners were reporting to the class on group discussion or activities, teacher D tended to remain silent, unless learners obviously needed help; whereas teacher E intervened extensively – eliciting responses and asking probing questions. This appeared to be because learners in Class E had difficulties with the questions they had to answer in group activities – which came from a textbook – and they were being rushed to finish within the lesson period; whereas learners in Class D were reporting on their own ideas about an issue close to their own experience, i.e. how electricity had changed the lives of people – and their discussions were allowed to continue into the next lesson.

All of the teachers except teacher C presented their lessons in English and codeswitched to Xhosa occasionally. It should be noted, however, that teacher B and teacher E both said in the post-lesson interviews that they had 'totally changed' their way of teaching for the videoed lessons. They would normally have used much more Xhosa in their lessons but felt that it was 'not allowed'.



This was despite the fact that they were videoed for four consecutive lessons, and repeated assurances by the researcher that they should teach as they normally would. By contrast, teacher C seemed unaffected by the researcher's presence, as 85% of her whole class talk was in Xhosa. She presented her lesson in Xhosa and the English she used was short chunks read straight from the textbook. For example:

**Teacher:** And then kengoku kuthiwe [now it says] 'The maggots help to break down the dead plant or animal material'. Neh [not so]? Kuthiwa ngoku eza maggots zona into eziyenzayo zithi-break down eza dead plants okanye i-animal material. [It is said that those (maggots) break down those dead plants or animal material] Sihamba sonke mabet-hunani [People are we still together]?

**Learners:** Yees.

She felt strongly that learners should understand the content but was not able to articulate any strategies for helping learners to bridge the gap between her oral Xhosa presentation and their need to read and write and be assessed in English. She felt this was the responsibility of the English teacher.

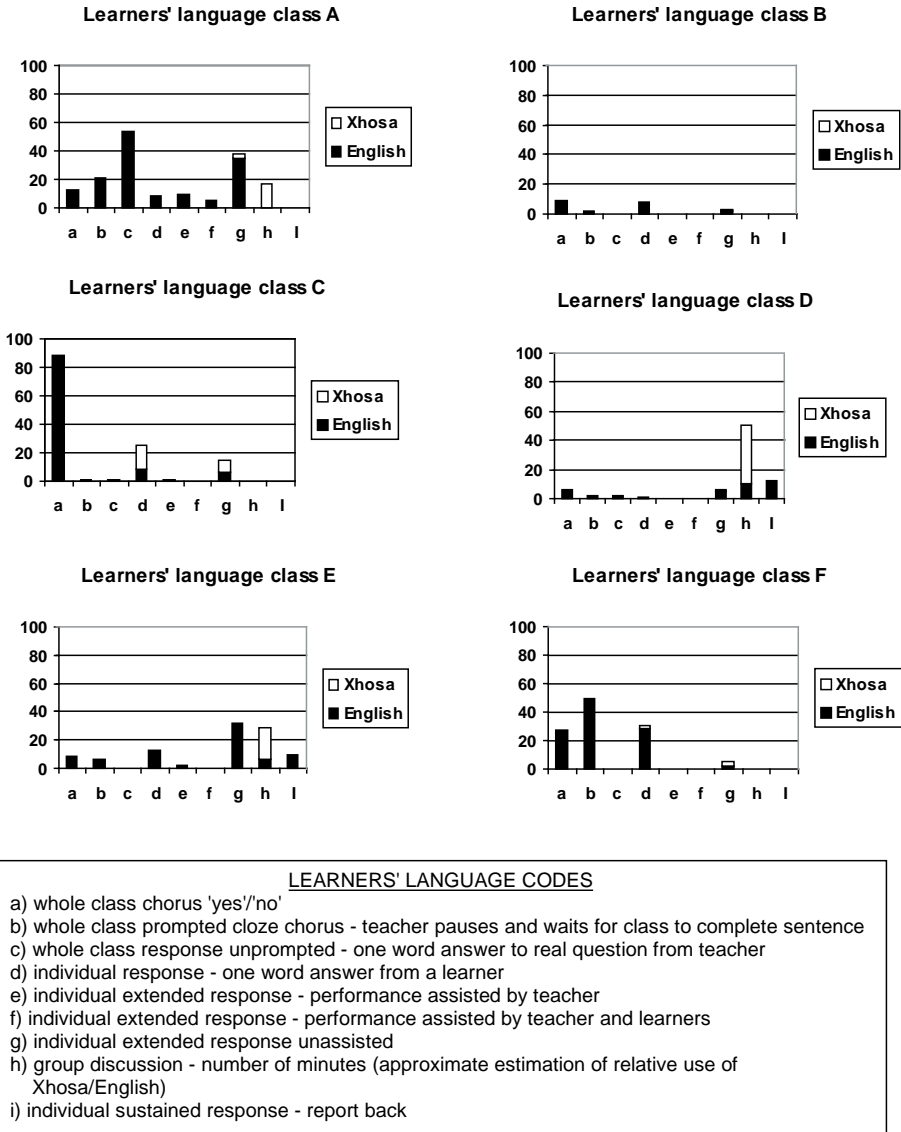
Teachers differed not only in terms of their relative use of Xhosa and English, but also in the amount of whole class talk – for example, teacher A spoke 6858 words in three lessons as opposed to Teacher B who spoke only 1781 words. This would have implications for learners' language learning, given that teachers are the main source of 'comprehensible input' for learners.

### Language production of learners

The graphs in Figure 4 illustrate the differences between the language production of learners in the different classrooms.

As can be seen from the graphs in Figure 4, there were very different patterns of language output by learners in the six classrooms.

- Categories (a) and (b) are responses to prompts by the teacher, that require a low level of cognitive engagement and serve the purpose of maintaining the learners' attention, usually during whole class exposition by the teacher. In Class C, category (a) was the main type of response given by learners.
- Category (c), a whole class response to a real question by the teacher, is usually a prelude and prompt to further questions by the teacher and individual elaborations and/or explanations by learners. In Class A this was the most frequent response (54) by learners and is closely followed by extended responses (categories (e), (f), (g) = 49). Only in Class D were there any other such responses (2). This indicates the whole class, interactive teaching style of Teacher A.
- Category (d) – one word individual answers – occurred in all the classes, with the greatest number in Class F. It is notable that in Class C, these responses were mostly in Xhosa.
- Categories (e), (f), and (g) all refer to extended answers by learners, with (e) and (f) scaffolded by the teacher or by the teacher and other learners. As noted, there was a relatively high incidence of these responses in Class A



**Figure 4** Learners' classroom language

(49), with very little if any in Classes, B, C, D and F. In Class E, there were 34 such responses. This could be regarded as the most challenging type of response, requiring both cognitive and linguistic processing without the opportunity for prior rehearsal.

- Category (h) refers to group discussion and was evident in classes A, D and E. This was quantified in terms of approximate minutes. The ratio of Xhosa to English is a rough estimate: in Class A, where learners were doing practical work with electric circuits, all the discussion appeared to

be in Xhosa; in Classes D and E, learners discussed a problem in Xhosa and prepared a group report in English.

- Category (i) refers to extended sustained reporting back by learners, who usually read out the reports in English. This took place in Classes D and E.

The relationship between the relative amounts of teacher talk and the amounts of learner talk is interesting: although Teacher A's lessons were dominated by whole class teacher talk, this elicited the most learner talk of all the classes. This confounds the notion that teacher fronted lessons necessarily reduce learner talk. Teacher C also did a lot of talking but the learners in her class did relatively little talking. The difference between their practices emerges in the kind of teacher talk and in particular, the kinds of teacher questions directing the classroom discourse.

### **Teachers' questions**

Teachers' questions that gave rise to learners' responses in categories (c) to (h) were coded and analysed for cognitive challenge. These are summarised in graphs in Figure 5.

Very different patterns emerged. Of course it should be noted that one question may yield more than one answer; and the fact that teachers ask higher order questions does necessarily mean that learners can engage with such questions. A skilful teacher will 'calibrate' (Bruner, 1986) questions to bring them within the 'zone of proximal development' of a particular learner (Vygotsky, 1962). Nevertheless this data does provide some indication of the levels of cognitive challenge in the different lessons.

As can be seen, in Class A there was a much greater incidence of higher order questions than in other classes. In Classes B, C and F, lower order questions requiring recall, review of work, or prior knowledge predominated. In Classes D and E higher order questions were evident but with a lower incidence – largely because these formed the basis for group discussions, rather than whole class question and answer, as in Class A. In the reporting back by learners in Classes D and E, it did not seem that concepts were thoroughly consolidated. In the one case, the teacher said that he felt he 'should not talk too much with the new curriculum'. In the other case, the teacher rushed through the activities, in order to finish by the end of the period. Both seemed more preoccupied with their own performance, than the learners' learning – as Furlong and Maynard (1995) suggest is the case with beginner teachers. Here they were not beginner teachers, but experienced teachers who were 'starting over' with the new curriculum, and felt that their existing practice and experience were no longer valid.

### **Opportunities for reading and writing**

The table in Addendum A illustrates the opportunities for reading and writing in the observed lessons. Opportunities for reading were severely limited by the fact that none of the schools had science textbooks for Grade 8. Teachers B, C and F from the same school shared one textbook. Teacher A did not use textbooks but prepared worksheets for his learners; Teachers D and E had both

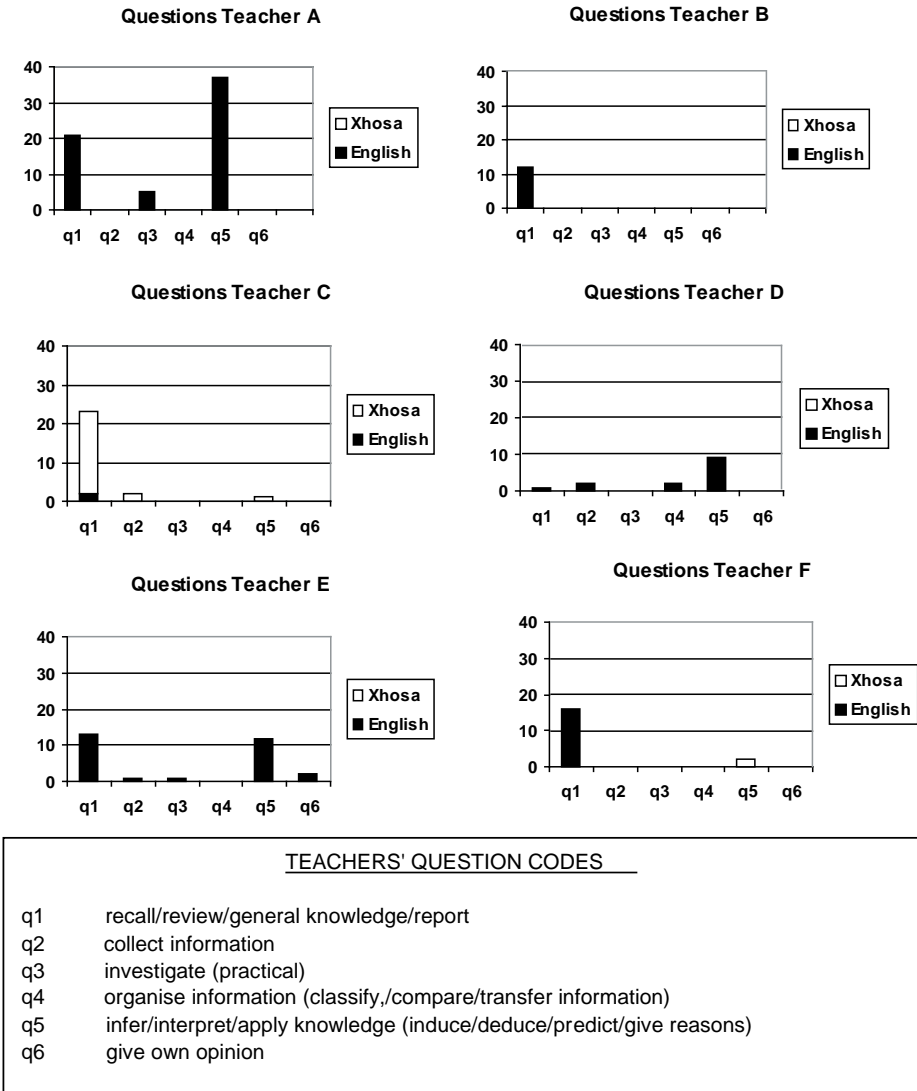


Figure 5 Teachers' questions

borrowed textbooks for themselves and provided learners with photocopied extracts to work with in groups. Teacher A used the chalkboard for systematically consolidating concepts in short notes, which learners could read and refer to throughout the lesson.

Little extended writing was done by learners in the recorded lessons. Learners did write notes in preparation for group presentations in Classes D and E, but as there was one scribe per group, this writing experience was limited. Teacher C concluded her third lesson by saying that she would give the learners notes to copy in the following lesson.

## Teachers' support strategies

The supporting strategies that teachers practised in the videoed lessons and were able to describe in the interviews, are described below.

### *Codeswitching*

A strategy used by all teachers was that of codeswitching. Generally teachers tended to teach new concepts in Xhosa and then translate these into English; they would also switch to Xhosa if they saw the learners were not understanding a concept or word; they used Xhosa to emphasise a point; they all used Xhosa for classroom management and discipline; they used Xhosa question tags, for example 'ne' [okay?] 'andithi' [isn't it so?] as attention checks; and they frequently added a Xhosa prefix to English terms e.g. 'i-carbon dioxide', 'i-cell'; they would switch to Xhosa when using examples from learners' everyday experience; and teachers tended to encourage learners to use Xhosa if they had problems answering in English. As the graph in Figure 2 shows, five of the six teachers used more English with whole class teaching, but they tended to switch to Xhosa when talking privately to learners in small groups, or individually. Teacher C by contrast, taught entirely through the medium of Xhosa with short chunks of English read from the textbook. She said this was because 'I just want my kids to understand what I'm teaching. So I know they are feeling comfortable in Xhosa'. However she was not able to explain how learners would bridge the gap between oral home language use and written English for testing.

### *Language support strategies*

All of the teachers provided language support by using the chalkboard for notes, diagrams and illustrations. As mentioned, teacher A consolidated new concepts by recording them on the chalkboard in a systematic manner, where they served as a record and reference point throughout the lesson. He also used the chalkboard as an interactive resource by calling up learners to work on it.

Five of the six teachers encouraged learners to speak English where possible and helped learners to extend their English vocabulary, and sometimes they used pictures or real life examples to illustrate new terms. In addition to these strategies, teacher A consciously simplified and modified his own vocabulary; he used English synonyms to convey the meaning of new words; he repeated new terms and got learners to repeat new words and phrases aloud; and he modelled and scaffolded extended answers by learners.

Teacher A reported that he avoided using textbooks, to discourage rote learning, and instead used worksheets to make learners 'think, observe and record'.

### *Other support strategies*



Some teachers used practical demonstrations – for example teacher E used a wheelbarrow to illustrate force and teacher A removed an electrical bulb in the classroom to illustrate a feature of a parallel circuit. All of the teachers related new concepts to learners' own experience and contexts. In addition, teacher A used analogies: for example, a water pipe to illustrate the flow of electricity through a circuit. He also used body language, role-play and humour to help learners remember new concepts.

### Teacher A

Although many of the strategies described were shared by some or all of the teachers, teacher A showed a very wide range of teaching strategies, relative to the other teachers. He was one of the two most experienced teachers, with 25 years teaching experience; in addition he was very knowledgeable about his subject and had been involved in many science teaching projects. The following annotated transcript (Table 3) illustrates the kinds of support strategies he used. Further examples are included in Appendix 2.

In this lesson extract, the learners were reporting back on experiments they had done in groups with electric circuits. The teacher had drawn a diagram on the chalkboard of an electric bulb connected to a cell.

Table 3

T:	<u>Do you think the bulb will really light up there now?</u>	<i>Inferential question</i>
Ls:	Yees.	
T:	Why? Why? Because look ( <i>pointing to diagram on</i> <i>ard</i> )	<i>Probing</i>
		<i>Uses chalkboard</i>
	This part of the wire inside the bulb is not connected to the wire coming to the negative and positive. Why do you think the bulb will actually light? Try. Think. Think hard. Think, think	
T:	Think about, think about, think about, think about, <u>think about this part</u> . Think about this part now right. Think about the <u>metal</u> part of the bulb. Who got it right? Who can explain it?	<i>Gives clue</i>
T:	Okay. Suppose I do it this way ( <i>rubbing off wire on diagram and redrawing it in different position</i> )	<i>Rephrases and calibrates question – scaffolds thinking</i>
		<i>Uses chalkboard</i>
	You agree that way, <u>ne</u> [ <i>okay</i> ]? That the bulb will light up?	
Ls:	Yees.	<i>Xhosa question tag</i>

**T:** (*tracing on diagram*) Because the current will have to move from the positive, right up there through the bulb and into the negative, right across there. *Uses chalkboard*  
But now I've changed the connection you know there (*rubbing out wire on diagram and redrawing it*).



I've made it this way. You said the bulb will now light up?

Teta isiXhosa [*Speak isiXhosa*]. Yes? (*pointing to learner*). *Code-switches to encourage participation*

**L1:** IBulb ayizokulighter [*The bulb will not light.*]

**T:** He says the bulb will not light. He says the bulb will not light. Oh I've got some hands up now. Yes (*pointing to another learner*)? *Translates*

**L2:** Izakulighter, mfundisi [*The bulb will light, teacher*].

**T:** The bulb will light. Okay. Why? . . . Why? Why? *Translates; asks*

**L2:** Ngoba la gas uthe nca ecangcini [*Because the wire is stuck to the metal*]. *probing question*

**T:** Because . . . okay try that now in English. Because . . . this . . . yes . . . follow me. This . . . *Scaffolds rephrasing in English*

**L2:** This . . .

**T:** This wire . . .

**L2:** This wire . . .

**T:** is . . .

**L2:** is . . .

**T:** (*makes circular gesture with hand to class*)

**L3:** (*calls out*) is connected

**T:** Good, good! Is . . .

**L2 & class:** is connected

**T:** Is connected to (*learner sits down*) . . . to the . . .

**Class:** cell

**T:** To the . . . noo to the . . . This wire is connected to the (*pointing to diagram then indicates metal on bulb at front of class*)

**L:** (*indistinct*)

- |               |  |                           |
|---------------|--|---------------------------|
| <b>T:</b>     | to the <u>cangci</u> [ <i>metal</i> ]  | <i>Code-switches</i>      |
| <b>Class:</b> | ( <i>laughs loudly</i> )   | <i>to teach new</i>       |
| <b>T:</b>     | Nooo. No look here, to the . . . metal.  | <i>vocabulary and for</i> |
| <b>Ls:</b>    | Metal  | <i>emphasis</i>           |
| <b>T:</b>     | To the <u>metal</u> , to the <u>metal</u> here ( <i>indistinct</i> ). Good, good, good, good! <u>Icangci</u> [ <i>Metal</i> ] to the <u>metal</u> . So the whole of this <u>metal</u> , the whole of this <u>metal</u> here conducts electricity. So no matter where you put the . . . no matter where you put the wire, as long as this wire is connected you know to these ( <i>indicating on bulb</i> ) . . . the <u>metal</u> outside here. Then the current of electrical energy will light up. | <i>Repeats new word</i>   |

## Discussion

The interviews with teachers and classroom observations confirmed other research findings in South Africa (Howie, 2001; Macdonald, 1990; National Centre for Curriculum Research and Development, 2000; National Education Policy Investigation, 1992; Probyn, 1995, 1998; Strauss, 1999), namely that the language of learning and teaching frequently creates a barrier to learning where it is not the learners' home language. Teachers reported that learners had very little exposure to English outside the classroom and so did not reach the 'threshold levels' (Swain, 1996: 92) required to engage meaningfully with the curriculum. This 'L2 proficiency gap' (Johnson & Swain, 1994 in Swain, 1996: 92) is a problem for the majority of African learners in South Africa and indeed in other post-colonial countries that have adopted a former colonial language as the medium of instruction in schools (for some examples see Lin, 1996; Martin, 1996; Merritt, 1992; National Education Policy Investigation, 1992; Rubagumya, 1994; Schmied, 1991). Despite these difficulties, teachers expressed a strong preference for English as LoLT, reflecting the powerful position of English relative to indigenous languages such as Xhosa.

In interviews, teachers confirmed that they had received no training in how to teach through the medium of English as an additional language, as has been reported elsewhere (Joint Education Trust, 1997: 26–9; National Education Policy Investigation, 1992: 4). In their pre-service training the assumption was that the learners were fully proficient in English and that lessons would be conducted solely in English – with little recognition of the breakdown between language policy and practice. This appears to be a general problem in developing countries as Eisemon (1992: 37) states: 'Lack of training in teaching in second languages is a serious weakness of teacher education in many developing countries'.

These factors have serious implications for the South African government's education transformation objectives of access, equity, redress, participation and democracy (Kgobe, 1999).

Teachers referred to the tension between teaching science content and English. As Wong-Fillmore (1986) observes, there is a need to recognise that the twin goals of any bilingual programme, namely content and language learning, are from a practical point of view, in conflict. She suggests that 'it is possible to accomplish both goals at the same time, but to do so requires that the competition between these two sets of instructional objectives be recognised and resolved' (p. 653).



As with teachers in comparable linguistic contexts,<sup>7</sup> all of the teachers in the research responded to this conflict by codeswitching to the learners' home language to a greater or lesser extent. Teacher B's and teacher E's admission that they had used far less Xhosa in the observed lessons than they would normally have done, points strongly to the feeling amongst some teachers that code-switching is illicit. Martin (1996: 130) noted similar unease amongst teachers in Brunei. This also points to the difficulties of reactivity in classroom research and raises the question as to what extent researchers can ever obtain truly authentic classroom data.

Teachers demonstrated a wide range of practices with regard to their own language output, in terms of the amount of language they used and the relative balance of English and Xhosa; the kinds of questions they asked; and the language support strategies they practised. These varying practices elicited different patterns of responses from learners.

Five of the teachers presented their lessons mainly in English with some codeswitching to Xhosa to achieve a range of cognitive and linguistic aims. By contrast, the sixth teacher presented her lesson in Xhosa with short chunks of English from the textbook embedded in the Xhosa discourse. As none of the learners had copies of the textbook it would have been very difficult for them to link the spoken English to any written form.

Learners' language output varied from class to class in terms of amount, which language used, and cognitive challenge. With whole class teaching, in five out of the six classes, learners' responses fell mainly into categories (a), (b) and (c) – requiring the least cognitive and linguistic challenge. In the three classes where learners were engaged in group work, the 'exploratory talk' (Barnes, 1992), was conducted in the learners' home language, Xhosa, and the 'presentational talk' (Barnes, 1992) was conducted in English, with some lapses into Xhosa when communication broke down. As noted, the cognitive challenge of the group work in Classes D and E seemed questionable: in Class D, questions were of a fairly low cognitive level and learners seemed to be restating existing knowledge rather than extending their understanding; in Class E, questions were taken directly from a textbook and learners seemed confused and unable to engage with them in a meaningful way. Further research into group discussions seems necessary in order to establish what kind of learning is actually happening. Teachers' questions appeared to be the key factor in determining the cognitive challenge of the lessons and the amount and quality of learners' output.

Swain (1985) points to the importance of comprehensible output in second language learning and Cummins (2000) maintains that optimum conditions for second language learning are met when learners are cognitively challenged and receive linguistic support. In five of the six classes observed, it would seem that in terms of both Swain and Cummins's criteria, the opportunities for second language development were not optimised.

By contrast, it would seem that despite the fact that the lessons in Class A were largely teacher fronted whole-class teaching, with some practical work, in fact learners in Class A had the greatest opportunities for both cognitive and language development, as they were extended cognitively with contextual and linguistic supports, as suggested by Cummins (2000) and had opportunities for more extended linguistic output as suggested by Swain (1985). This seems to fit with research by Wong-Fillmore (1985) that found that, contrary to the popular

belief that more 'open' (learner-centred) classrooms are best for second language learning, in fact the most successful classes for second language learning were those that made the greatest use of teacher-directed activities. Classes that were 'open' in their structure were in fact least successful for second language learning, as learners did not get enough second language input from the teacher and practice in the target language.

Classroom resources were limited in most of the schools. None of the schools had received science textbooks for Grade 8, despite the fact that this was the year that the new curriculum was being introduced for Grade 8. Teacher A had micro-science kits that had been provided by an NGO, which the learners used for practical work. In class E, the teacher had borrowed two spring balances from another school, for a class of 48.

This study seems to corroborate the findings of Vinjevold (1999), that little reading and writing happens in many South African classrooms.

Although there is no possibility of generalisation from this small-scale pilot study, the findings do suggest some directions for teacher development. Much could be learnt from the practice of experienced teachers, such as teacher A, who displayed a wide range of teaching strategies that appeared finely tuned to the language competencies of the learners, and yet extending them cognitively.

Much of the training for the new curriculum has cast teacher-centred practice as 'traditional' and to be abandoned in favour of the 'new' learner-centred approaches. This apparent dichotomy has not been helpful to teachers as it negates existing good practice and has given many teachers the impression that Curriculum 2005 requires learners to be involved in group work activities to the exclusion of whole class teaching. With the majority of learners involved in learning through the medium of a second language, it would seem that more skilful front of class teaching might be necessary where the teacher can extend the learners' understanding and language skills; and provide a model and source of input of the target language.

Teachers need to be helped to work effectively within current constraints – linguistic and material. For example, developing whole class questioning skills so that teachers are able to ask more challenging questions to promote higher order thinking skills; and developing chalkboard skills so that this often under-utilised resource can be used interactively to record the lesson and serve as a record and reference point. In addition, all teachers need to understand the role of language in learning (including the importance of talk after practical work to tease out and consolidate conceptual understanding), how to develop learners' proficiency in the language of learning and teaching; how to use the learners' home language as a resource to develop conceptual understanding and as a bridge to learning additional languages; and the importance of reading and writing in developing the academic language skills needed for learning so that they are able to plan for lessons that meet the need for both cognitive challenge and language support. Such training of course should not be confined to science teachers. It is needed to develop more effective teaching across all learning areas and to seriously address the question of equity and access to the curriculum for the majority of the learners in South Africa.

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sity, Institute for the Study of English in Africa, PO Box 94, Grahamstown 6140, South Africa (m.probyn@ru.ac.za).

## Notes

1. Afrikaans developed in South Africa from the colonial language of Dutch.
2. Townships are dormitory suburbs on the outskirts of towns and cities, where Africans were forced to live under apartheid. Those Africans who did not have permission to work in urban areas were restricted to rural 'homelands'. Likewise, under apartheid, schools were racially segregated. Although now there are no racial restrictions on where people may live and schools are all non-racial, in practice it is largely the minority of better resourced previously 'white' and 'coloured' state schools that have become desegregated and the majority of African learners are still in township or rural schools that have remained unchanged demographically. This research focuses on African township and rural schools as this is the situation for the majority of learners.
3. The three major languages in the Eastern Cape are Xhosa (5,663,498 speakers); Afrikaans (579,964 speakers); and English (233,986 speakers) (Census 1996 in Statistics South Africa, 2000).
4. The Monitoring Learning Achievement survey (Strauss, 1999) tested the literacy, numeracy and lifeskills proficiency of Grade 4 learners in 400 schools in all nine provinces and collected baseline indicators of the learners' socioeconomic backgrounds.
5. Third International Mathematics and Science Study-Report was an international survey of the mathematics and science proficiency of Grade 8 learners. South African learners came last out of the 38 participating countries (Howie, 2001).
6. The Afrikaner Nationalist government came into power in 1948 and five years later extended mother tongue education for African learners from the first four years to the first eight years of schooling, as part of its separatist and discriminatory education policy. Thus current perceptions of mother tongue education are tainted by this link to the apartheid education system of the past.
7. Similarities with accounts of teachers in comparable linguistic contexts are striking, but the limited scope of this paper does not allow for any more detailed comparisons.

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## Appendix 1

LEARNERS' READING						
	Teacher A	Teacher B	Teacher C	Teacher D	Teacher E	Teacher F
Chalkboard	Notes – consolidating concepts	Diagram, notes, cloze activity	Diagram pond		Notes on force AIDS	diagram
Textbooks	none	none	none	none	none	none
Photocopy from textbook				Pictures used for discussion	Force AIDS reading aloud	
Worksheet	Electricity worksheet					
Classwork books		Copied diagram in books	Copied diagram in books			Copied diagram in books
Dictionary			Looked up words in dictionaries (about 6 learners had dictionaries)			
LEARNERS' WRITING						
Notes off chalkboard		Copied diagram				Copied diagram
Filling in worksheet	(previous lesson)	Filled in diagram in books	Filled in diagram in books			Filled in diagram in books
Extended writing				Reports – one per group	Reports – one per group	
Practical work	17 min electrical circuits			Poster making	Measuring force with spring balance	

## Appendix 2

### Example 2:

- T:** So, so what happens when you increase the number of bulbs in series? What happens to the current when you increase the number of bulbs in series? Heee... (pointing to learner) Yes?
- Consolidates concepts with repetition and use of synonyms  
Uses gesture to convey meaning*
- L1:** The current becomes small.
- T:** The current becomes small. So we can therefore now say, when we increase the number of bulbs in series the current becomes
- T&Ls:** small.
- T:** Good. (writing on chalkboard) So when we increase the number of bulbs in series the current becomes small or we can say what - one word? We can say ... (pointing to learner) Yes?
- L2:** The current decrease
- T:** The current decrease - good. (writing on chalkboard) Decrease ... or another word ... beginning with a d ... the current (pushing down with hand) Hm? (pointing to learner) Yes?
- L3:** Increase
- T:** Heeh!
- Class:** (laughs)
- T:** Huh? (pointing to learner) Yes?
- L4:** The current drops.
- T:** The current drops (writes on chalkboard) .... the current goes down, or the current becomes small.
- T:** Goes down, iyehla [decreases].
- Code-switches for emphasis and to clarify meaning*
- 2.** When we increase the number of bulbs in a circuit the current becomes small/decreases/drops.
- Consolidates concept on chalkboard*

### Example 3:

- T:** Right. I would like you now to join in the second bulb there and compare the brightness of the bulb now with the brightness of the bulb before. Uzakujonga indlek ibulb zakho ezi lighter ngayo ngoku, ne. Uzicompare nangokuya ibulb ibinye [you are going to look at the way the bulbs will light now and compare them to that one bulb]. second one . . . right?
- Code-switches to clarify difficult grammatical construction*

**Example 4:**

- T:** (*softly*) Now I want you now to give me *Uses voice tone to attract attention*
- (normal voice) two things you hate about bulbs connected in series. . . Things that you think, ma [me], I do not like bulbs connected in series because one, they do this thing; two, they do this thing. Think, think, think Yes boy, try boy . . . huh? *Inferential question related to own experience*
- (high tone) Look you have it there (pointing to chalkboard), you have it here. Hmm? Think, think, think, huh? Talk, talk, talk! (pointing to learner) Yes? *Code-switches for emphasis*
- L1:** I don't like . . . *Models and scaffolds learners' responses*
- T:** . . . bulbs in series. Why?
- L1:** because it makes . . . it makes . . . it makes other bulbs not light.
- T:** I know what you are saying but . . . please correct her please. (pointing to another learner) Yes?
- L2:** I do not like bulbs . . .
- T:** . . . connected in series . . .
- L2:** . . . when . . . because when you take one out . . .
- T:** . . . or . . .
- L2:** . . . or when you fuse one bulb . . .
- T:** . . . one bulb . . .
- L2:** the whole house will not light.
- T:** the others, the whole house will look like . . . *Everyday example*
- Ls:** (giggling)
- T:** I mean how can you make the electrician to come to your home and say please I want you to make me a nice (indistinct) here and he arranges all the bulbs in series. Then in the middle of the night you put off the switch . . . your lights in the back . . . in the back room – I'm sorry – in the kitchen and all the lights in the whole house are off. I wouldn't like that! Huh? Right?
- So I also agree with you, I don't like bulbs connected in what, in . . . *Consolidates concept*
- T & Ls:** . . . series
- T:** because one bulb has a fault, is wrong, has a fault, the other bulbs will not light.

- Number two? Another thing that you wouldn't like about bulbs in series? (pointing to learner) Yes?
- L3:** I hate bulbs connected in series because in the house will be dim.
- T:** When you increase – yes he is good! – when you increase the number of bulbs, if you put one bulb in at the kitchen, put another bulb in the TV room, put another bulb in the bathroom, put another bulb in the loo . . . they all become . . . hm? (stoops with limp hands)
- Class:** (loudly) Dim!
- T:** Dim. Who wants to live in a dim house? Heh? Amagqwirha! [witches]
- Class:** (laughs)
- T:** Okay, good. Now so that's what we know about bulbs connected in what, in series. Now think, I'm going to ask you something now, please think here, ne? Please think here. (softly) Why do you think bulbs connected in series make the current come smaller?
- Now remember you had (indistinct) you did not change it, ne? Awukange uyitshinthse [you did not change it]. Right? Kodwa qho usongeza umbane, usihla, usihla, usihla [But if you add (bulbs) all the time, it goes down, it goes down, it goes down]. What makes the current to drop all the time when we increase bulbs in series? Huh?
- Think, think, think. Something begins, it's a word beginning with 'R'. It's a word beginning with 'R' . . . it's a word beginning with 'R'. Re . . . yes? (high tone) Huh? Yes, yes, yes? Yes, yes, yes, yes? Talk! Yes, yes, huh?
- L:** (calls out) Resistor.
- T:** (to learner) What's that? Yes? Resistor? No? What's that? It's re-sis-tance! Resistance.
- (to class) So when you increase the number of bulbs in series what are you increasing? The ntoni [the what]?
- Class:** Resistance
- Inferential question  
Role plays word  
'dim' – and for  
humour*
- Cultural reference – it  
is believed that witches  
live in dim houses*
- Xhosa question tag  
Inferential question –  
uses soft tone to  
attract attention*
- Recapping – code-  
switches for  
understanding and  
emphasis*
- Gives clue*
- Elicits new term*
- Code-switches for  
emphasis*



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