

Learning Science through Two Languages in South Africa

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1. Background

South Africa is a multilingual country with eleven national languages - nine indigenous languages and the two former colonial languages of English and Afrikaans¹ - recognised as official languages in the Constitution of 1996 (Constitution of the Republic of South Africa, 1996).

Official Languages	Home Language Speakers
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%

Table 1

(Census 1996 in Statistics South Africa, 2000)

Despite these provisions, since the democratic elections of 1994 English has expanded its position as the language of access and power 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 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.

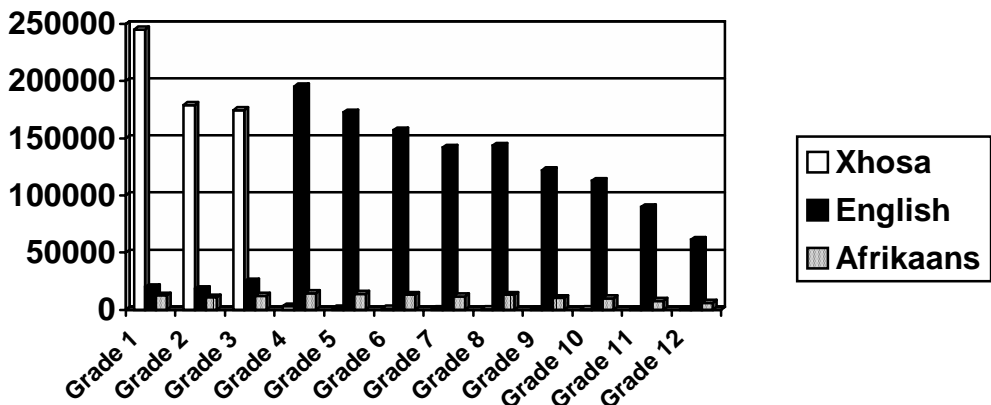
The new Language-in-Education Policy (LiEP) of 1997 (Department of Education, 1997) obliges each school to decide on their own language policy, in terms of the language of learning and teaching (LoLT) and languages to be taught as subjects: learners have to learn at least two official languages as subjects 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

¹ Afrikaans developed in South Africa from the colonial language of Dutch.

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, Murray, Botha, Botya, Brooks, Westphal, 2002; Vinjevold, 1999) that the trend in township and rural schools has been towards not only retaining English as LoLT, but introducing it even earlier than before, either to bring the switch to English in line with the beginning of the Intermediate Phase in the new curriculum (Grade 4) or to start with English as LoLT from Grade 1.

In the Eastern Cape Province for example, where this research was conducted, the main language, Xhosa, is the home language of 83,8% of the population and English speakers comprise only 3,7%². Nevertheless, as the graph below indicates, English is the LoLT for the majority of learners from the beginning of Grade 4.

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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 (Probyn et al, 2002; PANSALB 2000; Strauss, 1999: 22) and demographics suggest that they would have little direct contact with home language English speakers, as these comprise only 9% of the population. It appears that the majority of learners have limited access to reading materials: a national survey³ found that only 10 percent of parents bought newspapers and magazines; more than 50 percent indicated they had access to fewer than 10 books (Strauss, 1999:25); and 83 percent of schools have no libraries (Bot and Shindler, 1997: 80-81).

In fact the linguistic contexts in the majority of schools in township and rural schools, mitigate against teachers and learners strictly adhering to English and instead there is a gap between the intended and enacted language policies, with a range of bilingual classroom practices evident. Outside the major metropolitan areas in the province of Gauteng, where township schools are truly multilingual, the typical linguistic scenario is that of a school community where 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).

² 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).

³ 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' socio-economic backgrounds.

Two small scale research studies (Probyn, 1995; Probyn 2001) confirmed anecdotal evidence suggesting that inside such classrooms learners tend to use their home language with their classmates and in group discussions, and to a greater or lesser extent, with the teacher, depending on the teacher's particular views on the matter. The relative amounts of English and African language used by teachers in the classroom appear to differ quite widely between teachers. It appears that teachers code-switch 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 code-switching as illicit, as sign of failure rather than a legitimate classroom strategy (Adendorff, 1996; NEPI 1992: 49; Setati et al 2002). A teacher referred to 'smuggling the vernacular into the classroom' (Probyn 2001). (This also 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 beyond the first three grades, is frequently their home language, whereas the language of reading and writing and assessment at school is English. Bridging the gap and acquiring 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, is the difficulty for many such learners.

These difficulties were highlighted in the report of the Third International Mathematics and Science Study⁴ 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 policy makers and teacher trainers 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 described 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. There are several reasons for this. Some of these relate to the timing of the LiEP and the capacities of School Governing Bodies (consisting of parents, teachers and learners) responsible for making decisions about school language policies. Other reasons relate to the power and status of English relative to indigenous languages, neo-colonial attitudes and socio-economic imperatives.

The introduction of the Language-in-Education Policy was preceded by the introduction of a new outcomes-based curriculum in 1997, which overshadowed the LiEP in terms of resourcing and publicity. In addition the education system was underperforming as a result of years of wilful neglect under apartheid and struggling to cope with the educational transformation introduced by the new government in a number of policy documents. In many township and rural schools, a high proportion of parents are functionally illiterate⁵, limiting their capacity for participation in school policy decision

⁴ Third International Mathematics and Science Study-Repeat 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).

⁵ In the Eastern Cape, 50% of adults are considered functionally illiterate with seven years of schooling or less.

making. Thus many schools have simply not made any formal decisions about language policies and by default the status quo has remained (Vinjevoold, 1999; Probyn et al. 2002).

Schools that have made formal decisions about their language policies appear to have been driven by the perception that English provides access to education and economic success - 'English puts bread on the table' with the accompanying assumption that 'time on task' is the basis for successful acquisition (Probyn et al, 2002). This is reinforced by the entrenched perception of English as the language of education. As Pennycook (1994) notes:

As English spread into Africa through trade, missionary work and education, it developed close ties with religion, intellectual work and politics. As the definition of what it meant to be 'educated' came to be seen increasingly in terms of Western education, and , therefore, in terms of ability in English ..., speaking English and being and intellectual came to be almost synonymous.

(ibid:261)

Attitudes towards the use of African languages as media of instruction have been negatively influenced by the language policies under the apartheid government which in 1953 extended the use of mother tongue as medium of instruction for African learners from the first four to the first eight years of schooling - not for any pedagogical purposes but rather to further their policies of separation and discrimination. Thus the notion of African languages as media of instruction has been tainted by this link to an oppressive and discriminatory political system (Heugh, 1995: 43; NEPI, 1992: 13).

A further factor has been that township schools perceive that they are losing learners to previously 'white' schools in the suburbs because their parents want them educated in English and in order to counter this trend are offering English medium instruction from Grade 1. In fact, a research study by De Klerk (2000) indicated that although access to English was one of the factors motivating township parents to send their children to formerly white schools, they were also motivated by the expectation that these schools would provide better resourced and more stable learning environments.

Currently publishers are not producing learning support materials in indigenous languages beyond the Foundation Phase. They are not able to do so without the demand to make such publishing economically viable; and yet this places a further constraint on individual schools in terms of choosing an indigenous language as LoLT beyond the third grade.

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.

Thus a combination of factors on the ground, which have little to do with the realities of classroom teaching and learning, and learners' linguistic resources, strongly direct schools towards retaining English as the medium of instruction.

In South Africa academic opinion remains sharply divided as to the choice of LoLT. There is a strong body of opinion which strongly supports the use of indigenous languages as LoLT (see Heugh, 2002); others pragmatically accept the power and status of English and seek to find ways of strengthening the teaching of English as an additional language so that learners are better able to engage with the curriculum (Vinjevoold 1999). The newly developed Language-in Education Policy Implementation Plan, proposes measures to revitalise the LiEP and suggests that although the long-term goal of home language LoLT is retained, for the short and medium term, English is likely to remain the LoLT beyond the Foundation Phase (Grades R-3) for the majority of learners for whom it is an additional language.

This research is based on the view that the majority of learners in secondary schools are likely to be learning science through the medium of English as an additional language, in the short and medium term and possibly in the long term too. Teachers have had no training in how to teach effectively through the medium of an additional language (JET, 1997:26-29; NEPI, 1992:4; Probyn 1995, 2001)

and such training would seem to be overdue. An earlier research study indicated that teachers have a range of strategies for teaching through the medium of English as an additional language, including code-switching to the learners' home language for a range of reasons (Probyn 2001). 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 science classrooms.

Cummins (2000) suggests that second language learners will acquire language and content most successfully when they are challenged cognitively but provided with contextual and linguistic supports. However, as Wong-Fillmore (1986) points out, 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' (*ibid*: 653).

2. Research

2.1. 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 and 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, and for this understanding to inform a teacher development programme that would seek to help teachers develop 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.

2.2. 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. It was decided to focus on secondary schools as it seems likely, for all the reasons outlined in the background section of this paper, that at least for the immediate future, secondary schools in townships and rural areas are likely to remain English medium. Grade 8 was chosen to tie in with the TIMMS-R 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 4 different schools. These varied in size from 670 to 1400 learners and with pupil teacher ratios of 29:1 to 38:1. The 6 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 as it had previously been platooning with a primary school. 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 townships every day. Although the schools all charged minimal fees to pay for resources not provided by the Education Department, many parents could not afford to pay even these minimal amounts. Thus schools had 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 80 US cents) 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.

2.2.1. Teachers' training and experience

Teachers' training and experience						
Teacher	A	B	C	D	E	F
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

Two of the teachers who had qualified over twenty-five years ago, had 2-year teaching diplomas and the other four teachers with experience ranging from 4 – 10 years, had three year teaching diplomas from teacher training colleges. One of the teachers was not qualified to teach science and had not done science for matric, but had done some 'engineering science' when training as an 'electricity' teacher.

2.2.2. School language policies

None of the schools had school language policies drawn up according to the Language-in-Education Policy, but in all of them the accepted LoLT was English in that it was the language of textbooks and testing. There were no explicit rules or guidelines regarding classroom language use and it was left up 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 it was an international language; the language used for tertiary education; it provided access to employment; there was a lack of resources in Xhosa; and a lack of scientific terminology in Xhosa.

2.3. 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; and about 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. In addition, learners completed questionnaires regarding their home and school language practices and their language attitudes.

2.4. Analysis

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

- the uses of Xhosa and English to mediate understanding of science concepts and the learning of English;

- the uses of language for learning in explanations, class discussions, group discussions, reporting back, reading and writing;
 - the development of the cognitive academic language skills required by the discourse of science.
- The learners' questionnaires were collated and analysed.

3. Research findings

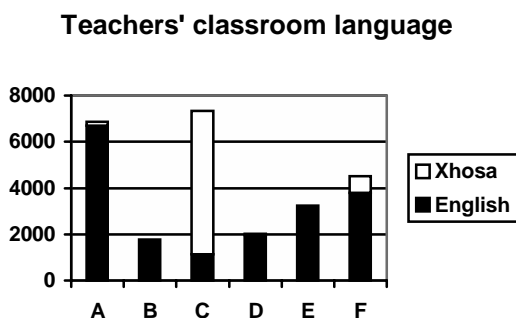
This paper will focus on the classroom practices of the teachers. The teachers' perceptions and practices, and the data from the learners' questionnaires, were consistent with the general picture presented in the background section of this paper.

The lessons were analysed for the opportunities they presented learners for language learning and cognitive challenge.

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 (C2005 was introduced in Grade 8 in that year) but indicated that they did not feel very confident in what they were doing.

3.1. Language input by teachers

The following graph illustrates the range of language input by the teachers in their classrooms. This was calculated by doing a word count of lesson transcripts, for whole class talk (not talk to small groups or individuals).



All of the teachers except Teacher C presented their lessons in English and code-switched 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 despite repeated assurances by the researcher that they should just teach as they normally would, and the fact that they were videoed for four consecutive lessons. This points very strongly to the feeling amongst some teachers that code-switching is illicit and to the tension between achieving the twin goals of content and language learning. It also points to the difficulties in classroom research of reactivity and raises the question as to what extent researchers can ever obtain truly authentic classroom data. On the other hand, 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 mabethunani* [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.

3.2. *Language production of learners*

The graphs in Addendum A illustrate the differences between the language production of learners in the different classrooms. Learners' responses were coded and counted as follows:

- a) whole class chorus 'yes'/'no' in response to an attention check by the teacher
- b) whole class prompted cloze chorus - teacher pauses and waits for class to complete sentence
- c) whole class response unprompted - one word answer to real question from teacher
- d) individual response - one word answer from a learner
- e) individual response - extended answer (sentence or more) assisted by teacher
- f) individual response - extended answer (sentence or more) assisted by teacher and learners
- g) individual response - extended answer (sentence or more) on own
- h) group discussion - number of minutes (very approximate judgement of relative Xhosa/English usage)
- i) individual sustained prepared response - report back

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

- Categories a and b are responses requiring a low level of cognitive engagement that are prompted by the teacher and serve the purpose of maintaining the learners' attention, usually during whole class exposition by the teacher. In class C category a is the main 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 is the most frequent response (54) by learners and is closely followed by extended responses (categories e, f, g = 49). Only in Class D are there any other such responses (2). This indicates the whole class, interactive style of teaching by 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 is a high incidence of these responses in class A (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 of prior rehearsal.
- Category h refers to group discussion and is evident in classes A, D and E. This was quantified in terms of time taken. 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 and this took place in classes D and E. This was usually read out by the learner in English.

The relationship between the relative amounts of teacher talk and the amounts of learner talk is interesting: although Teacher A did a lot of talking, it was the learners in his class who did the most talking. This confounds the notion that teacher fronted lessons necessarily exclude 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.

3.3. *Teachers' questions*

Teachers' questions that gave rise to learners' responses in categories c to h were coded and analysed for cognitive challenge, using the following categories:

TEACHERS' QUESTIONS: CODING

- q1 recall/review/general knowledge/report
- q2 collect information
- q3 investigate (practical)
- q4 organise information (classify, compare, transfer information)
- q5 infer, interpret, apply knowledge (induce, deduce, predict, give reasons)
- q6 give own opinion

Very different patterns emerged. These are summarised in graphs in Addendum B. Of course it should be noted that one question may yield more than one answer; and the fact that a teacher ask a higher order question does necessarily mean that learners can engage with such questions. A skilful teacher will 'calibrate' (Bruner, 1986, 1996) 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 these classes, 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 was rushing though the activities, in order to finish. Both seemed more preoccupied with their own performance, rather than the learners learning, as Furlong and Maynard (1995) suggest is the case with beginner teachers. Here they are not beginner teachers, but rather experienced teachers who are 'starting over' with the new curriculum, and have the impression that their existing practice and experience is no longer valid.

3.4. *Opportunities for reading and writing*

The table in Addendum C 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 and prepared worksheets for his learners; teachers D and E had both borrowed textbooks for themselves. Teacher A used the chalkboard for consolidating concepts in a systematic way, as reference throughout the lesson and as an interactive resource by calling up learners to work on the chalkboard.

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.

3.5. Teachers' support strategies

The supporting strategies that teachers practised in the videoed lessons and were able to articulate in the interviews, are listed below:

3.5.1. Code-switching

Teachers

- switched to Xhosa if they saw the learners were not understanding a new concept or word;
- encouraged learners to use Xhosa if had problems answering in English;
- taught new concepts in Xhosa and then translated into English;
- used more English with whole class teaching but tended to switch to Xhosa when talking to learners in small groups, or individually;
- used Xhosa to emphasise a point;
- used Xhosa to discipline learners and classroom management;
- used Xhosa question tags e.g. 'ne' [*okay?*] 'andithi' [*isn't it so?*];
- added a Xhosa pre-fix to English terms e.g. 'i-carbon dioxide', 'i-cell';
- switched to Xhosa when using examples from learners' everyday experience.

Teacher C taught entirely though Xhosa with some English phrases read from the textbook: 'I just want my kids to understand what I'm teaching. So I know they are feeling comfortable in Xhosa.'

3.5.2. Language support

Teachers

- encouraged Grade 8 learners to speak English;
- helped learners build their vocabulary;
- used the chalkboard for diagrams and illustrations.

Teacher A also

- modelled and scaffolded extended answers by learners;
- used a lot of repetition - got learners to repeat words aloud;
- got learners to do 'writing, writing, writing' to remember what was taught;
- avoided textbooks and rote learning;
- used worksheets to make learners think, observe and record;
- simplified/modified vocabulary;
- directly taught vocabulary and used English synonyms to convey the meaning of new words;
- insisted learners who brought messages to his class should speak English;
- consolidated concepts by writing them up on the chalkboard.

3.5.3. Other strategies

Teachers

- used pictures or real life examples to illustrate new words;
- used practical demonstrations - for example used a wheelbarrow to illustrate force; removed an electrical bulb in the classroom to illustrate a feature of a parallel circuit;
- related concepts to learners' own experience and contexts.

Teacher A also

- used analogies - a water pipe to illustrate the flow of electricity though a circuit;
- used body language and role play;
- used humour to help learners remember.

3.6. Teacher A

Although many of the strategies listed 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 illustrates the kinds of support strategies he used. Further examples are included in Addendum D.

In this lesson, the learners are reporting back on experiments they did with electric circuits. The teacher has drawn a diagram on the chalkboard of an electric bulb connected to a cell.

T: Do you think the bulb will really light up there now?

Inferential question

Ls: Yees.

T: Why? Why? Because look (*pointing to diagram on chalkboard*)

Probing



Uses chalkboard

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, think about this part.

Gives clue

Think about this part now right. Think about the metal part of the bulb. Who got it right? Who can explain it?

T: Okay. Suppose I do it this way (*rubbing off wire on diagram and redrawing it in different position*)

Rephrases and calibrates question – scaffolds thinking



Uses chalkboard

You agree that way, ne [*okay*]? That the bulb will light up?

Xhosa question tag

Ls: Yees.

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.

But now I've changed the connection you know there (*rubbing out wire on diagram and redrawing it*).

Uses chalkboard



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 *Scaffolds rephrasing in English*
me. This ...
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*)
T: to the cangci [*metal*] *Code-switches to teach new vocabulary and for emphasis*
Class: (*laughs loudly*)
T: Nooo. No look here, to the ... metal.
Ls: Metal
T: To the metal, to the metal here (*indistinct*). Good, good, good, good! Icangci [*Metal*] to the metal. So the whole of this metal, the whole of this metal 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 (*indicating on bulb*) ... the metal outside here. Then the current of electrical energy will light up. *Repeats new word*

4. Discussion

The interviews with teachers and classroom observations confirm other research findings (Howie, 2001; Macdonald, 1990; NCCRD, 2000; Probyn, 1995, 1998; Strauss, 1999) that the language of learning and teaching frequently creates a barrier to learning when it is not the home language of learners. This is the case for the majority of African learners in South Africa. In addition 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 (NEPI, 1992:4; JET, 1997:26-29). This has serious implications for the government's education transformation objectives of access, equity, redress, participation and democracy (Kgobe, 1999).

Teachers demonstrated a wide range of practices with regard to their own language input, 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 code-switching 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.

It would appear from the measures of language input by the teachers, the language production by learners, and the cognitive challenge of the lessons, 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, being extended cognitively with contextual and linguistic supports, as suggested by Cummins (2000). This would seem to corroborate research by Wong-Fillmore (1985) that compared classes that worked well for language learning with those that did not, in a 5 year longitudinal study in 40 classrooms. Wong-

Fillmore found that, contrary to the popular belief that more 'open' (learner-centred) classrooms are best for language learning, in fact the most successful classes for 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 language learning, as learners did not get enough English input and English language practice.

As was noted in these findings, where learners have opportunities for extended group discussion, there is indeed engagement by all the learners in the class, but the language used in groups is largely their mother tongue, so this does not directly facilitate the acquisition of English. The extent to which learners were indeed cognitively extended in their groups in classes D and E is perhaps questionable - in the absence of additional learning materials and sources of information it appeared from the reporting back in classes D and E that their existing knowledge was restated rather than extended. Further research into group discussions seems necessary in order to establish what kind of learning is happening.

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 Vinjevoold (1999), that little reading and writing happens in 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 display a wide range of teaching strategies that appear finely tuned to the language competencies of the learners, supporting their language development while extending them cognitively, as proposed by Cummins (2000).

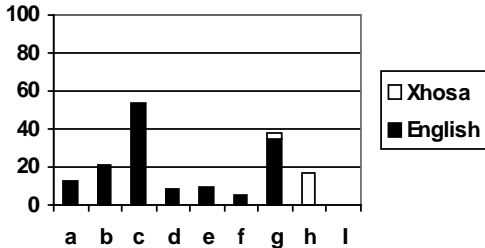
Much of the training for the new curriculum has cast teacher-centred practice as 'traditional' and to be abandoned in favour of the 'new' learner-centred approaches. This apparent dichotomy has not been helpful to teachers as it negates existing good practice and has given many teachers the impression 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 access to the curriculum for the majority of the learners in South Africa.

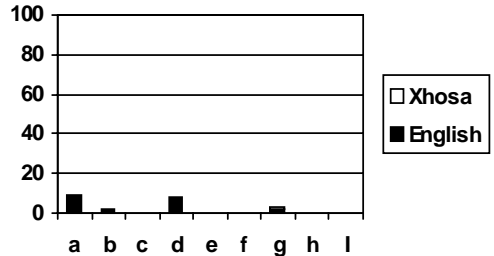
ADDENDUM A

LEARNERS' CLASSROOM LANGUAGE

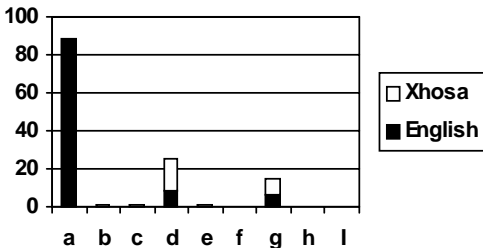
Learners' language class A



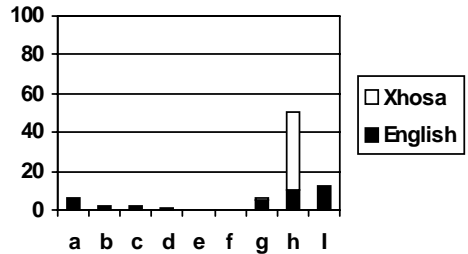
Learners' language class B



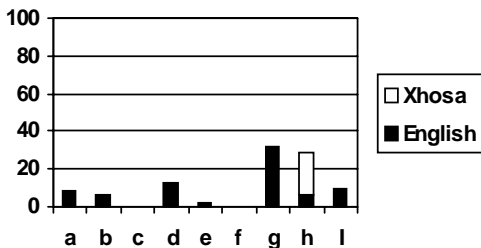
Learners' language class C



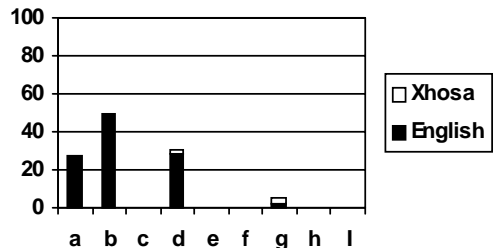
Learners' language class D



Learners' language class E



Learners' language class F



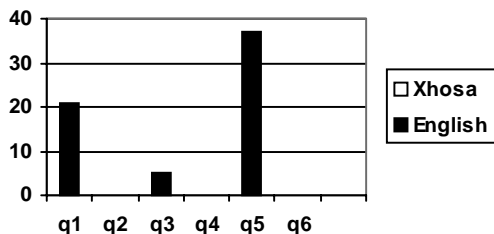
LEARNERS' LANGUAGE CODES

- a) whole class chorus 'yes'/'no'
- b) whole class prompted cloze chorus - teacher pauses and waits for class to complete sentence
- c) whole class response unprompted - one word answer to real question from teacher
- d) individual response - one word answer from a learner
- e) individual extended response - performance assisted by teacher
- f) individual extended response - performance assisted by teacher and learners
- g) individual extended response unassisted
- h) group discussion - number of minutes (approximate estimation of relative use of Xhosa/English)

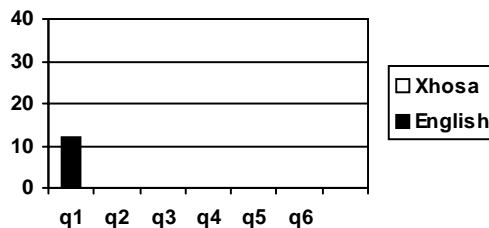
ADDENDUM B

TEACHERS' QUESTIONS

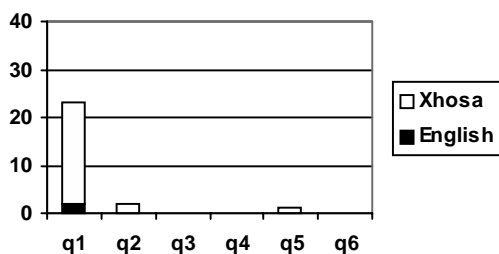
Questions Teacher A



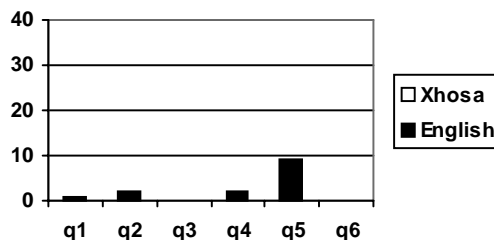
Questions Teacher B



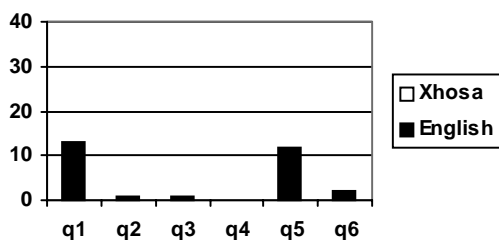
Questions Teacher C



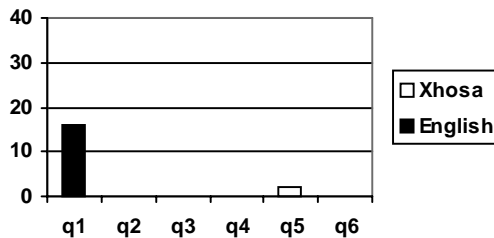
Questions Teacher D



Questions Teacher E



Questions Teacher F



TEACHERS' QUESTION CODES

- q1 recall/review/general knowledge/report
- q2 collect information
- q3 investigate (practical)
- q4 organise information (classify./compare/transfer information)
- q5 infer/interpret/apply knowledge (induce/deduce/predict/give reasons)
- q6 give own opinion

ADDENDUM C

LEARNERS' READING						
	Teacher A	Teacher B	Teacher C	Teacher D	Teacher E	Teacher F
Chalkboard	Notes – consolidat- ing 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	

ADDENDUM D

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?

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, yehla [*decreases*].

Consolidates concepts with repetition and use of synonyms

Uses gesture to convey meaning

*Code-switches for emphasis and to clarify meaning
Consolidates concept on chalkboard*

2. When we increase the number of bulbs in a circuit the current becomes small/decreases/drops.

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

(*normal voice*) two things you hate about bulbs connected in series. ...

Things that you think, mna [*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?

(*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?

L1: I don't like ...

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 ...

*Uses voice tone to attract attention
Inferential question related to own experience
Code-switches for emphasis
Gives clue - uses chalkboard*

Models and scaffolds learners' responses

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 ...

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 ...

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

Everyday example

Consolidates concept

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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