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# Code-switching strategies in science lessons in Kenyan primary schools: an analysis of their contribution to the meaning making process.

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## Abstract

This study investigates how teachers in a rural Kenyan primary school use code-switching to help pupils to understand scientific concepts. The study takes place in a teaching and learning environment where English is the 'official' language of teaching beyond year three but where it is accepted by the education ministry that the English proficiency of most of the pupils may not be sufficient for them to fully access the science curriculum. It is, therefore, also accepted that teachers may use three languages, English, Kiswahili and Kigiryama, in the classroom, to explain scientific ideas.

The study begins by considering some of the barriers to learning science concepts experienced by those who are taught in a second language. There is then an exploration of code-switching strategies as observed by other researchers, many of which have been recorded within science lessons in other Kenyan primary schools. This study then uses observational and interview methods to investigate the actual use of code-switching within the lessons of standard four and five pupils at the target school. These observations, combined with those of other researchers, are then used to produce a typology of code-switching interventions commonly used by teachers during science lessons at the school at Mida Primary School.

Following this a second literature review outlines a framework of the key features of explanation, clarifying how teachers use language to explain scientific concepts. The code-switching typology and this framework are then utilised to enable the analysis of six transcripts of science lessons at the target school. The analysis is carried out with the purpose of examining the contribution that each code-switching intervention makes to the meaning-making process. Some implications for teacher training are presented concerning how actual teacher behaviour, with respect of their use of code-switching, compares with what might be expected if trained for a planned use of code-switching when explaining scientific concepts. Also included in the study is a brief examination of other contextual factors that might affect the use of code-switching by teachers in science lessons and the implications that these might have on teacher training for the effective use of code-switching. Finally, some suggestions for further research and an evaluation of the approach taken in this study are presented.

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# CHAPTER 1.

# BACKGROUND AND PURPOSE OF THE STUDY.

## 1.1 The problem addressed in this study

This is a study of how teachers in a Kenyan primary school utilise code-switching to communicate effectively in order to help pupils construct meaning for scientific concepts. In most Kenyan primary schools communication in science teaching is complicated by the fact that pupils are learning their science in a second language. The complexity of the learning environment is further added to if credence is given to the notion that scientific language (and its utilisation) can itself be considered as a distinctive language and therefore requiring special attention.

When teaching and learning take place in a language other than the mother tongue a variety of barriers to learning present themselves. The extent to which these barriers can be overcome will be a major determining factor of the effectiveness of the educational process. The impetus for this research was the recognition that Kenyan primary schools typically have a multilingual dimension where Mother-tongue, Kiswahili and English all interact to produce special teaching and learning conditions which necessitate the utilisation of special teaching and learning strategies if scientific vocabulary and concepts are to be clearly related and understood.

The communication and development of meaning associated with important vocabulary is a complex issue in most science lessons but is more so in a multilingual setting. In such an environment there can be a requirement for meaning to be negotiated between cultures as well as between languages. These considerations present significant challenges for teachers. This insight leads to general questions like:

- How do teachers of science currently utilise language in order to negotiate meaning in such a situation?
- Which strategies might be most effective in achieving the aims of the teacher?
- Do teachers of science receive training in respect of these second language-learning issues?

- What kind of research instrument might help to identify successful teaching strategies in this situation?
- What suggestions for developments in practice might arise from the conclusions of any study?

## 1.2 The aims of the research

Meaning-making helps pupils to make sense of scientific ideas by helping them to understand how ideas relate to each other. In the process of doing this much emphasis is placed on scientific vocabulary because these words are the labels for the key scientific ideas. This study recognises that, for any given scientific word, there are two major elements which must be conveyed and learned. Firstly, there are the surface or lexical features Baker (1996, p.152) of the word, i.e. the phonological features, (what the word sounds like), and the morphological features, (what the word looks like). The pupil requires understanding of these two representations of the word, if he or she is to recognise it upon hearing it, saying it, reading it or writing it down. Secondly, there are the conceptual features of the word, i.e., the ideas and understandings that the word represents.- *the meaning of the word.*

In order for an individual to effectively utilise any word they must have a complete understanding of the lexical features, (phonology and morphology) and the conceptual features, (the meaning) of the word. In terms of vocabulary development for any purpose, development of understanding of the lexical and conceptual features of the word, are, then, critical and inter-related. We do not, for instance, have a complete understanding of a word if we can, recognise it upon hearing it, saying it, reading it and writing it down but do not know what it means. Equally, we may recognise an artefact or phenomenon but know no spoken or written words which represent it.

If we consider conceptual understanding of a particular scientific word, and we accept a constructivist theory of learning, (i.e., that new knowledge is learned by building upon networks of prior conceptual understanding, incorporating new information in new arrangements) we encounter difficulties when we attempt to convey the meaning embedded in that word, across languages. The problem for science teachers and learners from different cultures is that much scientific theory has been established relatively recently

within a limited number of cultural groups, e.g., Western (European/North American), Japanese, Russian/Soviet etc. These ideas have, often, not been well conveyed to developing countries. As Seddon and Waweru identify.

> One key factor, which is consistently identified, is that many scientific concepts, which emanate principally from western cultures, are not part of traditional cultures in many developing countries. As a result it is sometimes impossible to translate these concepts directly from English into some local languages. In these circumstances, it would seem impossible to teach or test such concepts using the vernacular language.
>
> (Seddon & Waweru, 1987)

Different cultural groups, even within the same nation, have been found to have different understandings of the same scientific concepts, and, therefore, present different teaching and learning challenges in respect of those same fundamental concepts (Layton, Jenkins, McGill and Davey, 1993). In multilingual countries these inconsistencies in understanding between different cultural groups are complicated by the language issue. There are often no direct translation equivalents for terminology from the language and culture of science into the mother tongue and its culture. Merritt *et al* (1992, p. 112) identify that there is, then, a requirement for teachers to do two things:

1. to translate, where possible, between languages at the lexical and conceptual levels.
2. to translate in cultural terms, making links between a concept from the culture of science and established understandings of related concepts from the home culture.

### 1.3 The Target School

This study takes place in a state primary school (referred to as the target school) situated approximately 80 km north of Mombasa. It is a rural school with approximately 500 pupils aged between 5 and 13 years. The school's catchment area falls entirely within

one geographical/language area. This is a region populated by the Giryama tribe and, hence, the mother tongue of all pupils is Kigiryama[1]. The relationship between Kigiryama, the mother tongue of the pupils at the target school, and Kiswahili, the national language, is important in that it is a much more intimate relationship, as will be shown later, than between mother-tongue and Kiswahili as experienced by pupils in other parts of Kenya.

### 1.4 Code-switching

One key teaching tool used in meaning-making in bilingual or multilingual classrooms is code-switching. As a general definition for spoken language, (a more detailed definition is given in Chapter 4) code-switching happens when an individual uses two or more languages when speaking. Code-switching is a common practice within schools where elements of the educational process are conducted in a language other than the mother tongue. In some circumstances, e.g., within rural Kenyan primary schools, code-switching operates against or despite 'official' education policy. In order to manage the development of competence in English and Kiswahili within the national population, a language of instruction policy determines how these languages are used in schools.

> Officially, the language of instruction from the fourth grade on is English. In the linguistically heterogeneous urban districts, English *or* Kiswahili may be used as the medium of instruction for the first three years of school. In the more linguistically homogeneous rural districts, the local language may be used as the medium of instruction until the end of grade three. Local languages are not formally taught after this grade. Kiswahili is taught for all eight years of the primary cycle, though, like English, it is often not very well known by those who teach it.

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[1] Kigiryama – Kigiryama has a variety of alternate names e.g. Giriama, Giryama, Agiriama, Nika, Kinyika. (SIL International, Internet WWW page Languages of Kenya, 2002, SIL International, Internet WWW page Giryama: a language of Kenya, 2002, SIL International, Internet WWW page Giryama: a language of Tanzania, 2002, UCLA Language Materials Project, Internet WWW pages *UCLA Language Materials Swahili Language*, 2002, Ali, H., O. *A brief history of the Swahili language*. Internet WWW page Swahili Language History, 2002) Within the context of this thesis the term Kigiryama will be utilised on all possible occasions outside of quotations from other work.

(Cleghorn, 1992, p. 313)

In many ways the use of code-switching is a pragmatic response by teachers to a situation where they recognise that pupils have not developed sufficient proficiency in the official language of instruction in order to fully access the curriculum. As stated earlier, Language of Instruction Policy currently states that pupils in rural schools should be taught science exclusively in English from standard 4, age 8, upwards. However, Abagi and Cleghorn (1990, p. 66) found that teachers in the rural schools that were studied remarked that the policy of teaching exclusively in English from the 4th grade onwards was "difficult if not impossible" to implement since 35 minutes of English per day prior to that grade was insufficient to provide the level of English comprehension needed to understand the lessons. They also found that teachers thought that mother tongue instruction helped to generate interest in lessons and that teachers thought it easier to explain "foreign" or abstract concepts in the mother tongue.

Although there is recognition that code-switching is common practice in Kenyan and other African classrooms, (Cleghorn (1992, p. 313) and Ndayipfukamiye (1994, p. 79)), there is little 'official' consideration of its role in the meaning making process and hence its importance for developing knowledge, understanding and improved language skills. Some authors recognise that code-switching is such a fundamental part of the teaching and learning process in such classrooms, particularly for concept rich subjects like science, that, "it should be explicitly accounted for in decisions about teaching methods and language policies", Ndayipfukamiye (1994, p. 91). This study is a stepping-stone towards a more detailed assessment of how code-switching is currently used in Kenyan primary science classrooms, whether or not there is a uniform approach within and across schools and districts, what are the most successful strategies and which successful strategies might not be being utilised.

Emerging from this study will be an instrument which can be used to analyse the contribution that teacher code-switching interventions make to explaining scientific concepts.

## 1.5 The research questions

The specific research questions for this thesis are outlined below.

1) How can the code-switching interventions used in science lessons in standards 4 and 5 at Mida Primary School be characterised?

The intention here is to attempt to describe the various kinds of code-switching interventions that were observed in the science lessons. A desired outcome would be an extension of the kinds of code-switching interventions that have been identified and characterised by others, such as Baker (1996, p.87), Cleghorn (1992, p. 315) and Merritt *et al* (1992, p. 114) by incorporating any interventions that are evident in the science lessons but which have not been described in their typologies.

2) How are code-switching interventions used to support the meaning-making process in science lessons in standards 4 and 5?

The intention here is to examine how the described code-switching interventions were utilised by teachers in order to help pupils understand the meanings of scientific words and concepts. This involves analysing sections of transcripts to describe how code-switching interventions are used to help explain the meanings of important scientific words and/or supporting concepts. This will involve the development of a framework which helps to show how science teachers explain scientific concepts in lessons and then shows how the code-switching interventions contribute to this process.

3) What are the contextual factors that might influence the use of code-switching by individual teachers?

The intention here is to provide contextual information concerning the teaching and learning situation within Mida Primary School as a background against which findings from questions 1) and 2) might be better understood. It is not intended that this be an in-depth study but something that adds to the knowledge of the situation in which the teachers find themselves. With relation to teaching this would involve assessing the teachers'

perceptions of their own language skills, their language backgrounds and any training or preparation they might have received for delivering science lessons in a second language. In respect of learning it will involve ascertaining what pupil determined factors influence the utilisation of code-switching, e.g., teacher perceptions of pupils' English language skills, any theories concerning pupil learning and language presentation issues that the teachers may have, teacher perceptions of pupil understanding within lessons.

## 1.6 Structure of the thesis

In Chapter 2, following this introductory chapter, a review of the literature will consider the barriers to learning scientific vocabulary and concepts in a second language. Chapter 3 describes the research methodology and hence, the construction and use of the research instrument itself. It will explain how data was gathered, transcribed, and analysed. It will also explain the background theory to the production of the typology of code-switching interventions.

In Chapter 4 a typology of code-switching interventions will be developed. The chapter will explain how this has been accomplished and will begin to discuss some of the difficulties inherent in attempting such a categorisation.

In Chapter 5 a structure for the analysis of how teachers use explanation to create meaning in science lessons will be developed. It will explore theories concerning how science teachers explain new concepts to pupils in the classroom. Hence, a framework will be developed which attempts to describe the kinds of teaching intervention that enable the explanation of new concepts and therefore represent vital elements of the teacher's contribution to the meaning making process. This framework will be used to analyse code-switching events within the transcripts in respect of their contribution to meaning making.

In Chapter 6 analysis of code-switching strategies utilised by three different teachers will be presented. This analysis will be conducted on relevant extracts from six transcripts of six different lessons presented to standard 4 and 5 pupils. The analysis will, for the most part, focus on how particular code-switching interventions are used to support the explanation and development of the scientific view of the key concepts of the lessons. Analysis will also examine some contextual factors which might be influencing the use of code-switching by particular teachers.

Chapter 7 will discuss the conclusions and implications of the research. This will include an evaluation of the effectiveness of the research instrument itself with suggestions for modification and improvement, a discussion of the differing patterns of use of code-switching by the teachers involved, a discussion of how the findings of this research project contribute to knowledge in this particular field, how findings might influence the teaching of science in Kenyan primary schools and suggestions for further study.

# CHAPTER 2.

# A REVIEW OF THE LITERATURE CONCERNING THE IMPLICATIONS OF TEACHING AND LEARNING SCIENTIFIC VOCABULARY IN A SECOND LANGUAGE: THE BARRIERS TO LEARNING NEW SCIENTIFIC TERMS AND CONCEPTS.

## 2.1 Basic definitions and distinctions

Some of the terminology that is used in studies of bilingualism or multilingualism can be used in different ways by different authors. For the sake of clarity it would be sensible to define exactly what is meant here by significant terms used within this thesis.

The "first language" or "L1" is considered here to be the first language that the child acquires. In this case this is Kigiryama, which is the language of the home for all of the pupils. Kigiryama is the language that the child acquires in the same way that all humans acquire their first spoken language because it is used by parents when speaking to the child at home from birth. Kigiryama is also, therefore, sometimes referred to as the mother or native tongue. Within this thesis, then, the terms "first language", "L1", "mother tongue" and "native tongue" are considered to be equivalent and interchangeable.

The "second language" or "L2" is considered here to be any language that is formally taught and therefore formally learnt (as opposed to acquired) by the child. English, then, is clearly an example of a second language or L2 for the child as English is formally taught and learned at school. Kiswahili is also formally taught and learned at school and is also, therefore considered to be a second language or L2.

Although English and Kiswahili are considered as second languages, it is recognised that the situation in respect of Kiswahili is different from that of English because of the close relationship between Kiswahili and Kigiryama. However, these two languages are not identical and experience (direct observations within lessons and teacher perceptions elicited through interviews) revealed that pupil proficiency in Kiswahili was not as well developed as in Kigiryama.

## 2.2 Engaging in the learning process as an L2 learner

Most individuals in western societies engage in their schooling in their first language. Worldwide, however, there are many students who, for one reason or another, are taught in languages other than their first. This has profound implications for the effectiveness with which teaching and learning can be pursued in any subject but, in this review it will be argued, that this is particularly so for science.

Those of us who have engaged in our schooling in our L1 appreciate that establishing understanding in this way is often not a problem-free process. When students are learning in their L2 a variety of additional barriers to learning immediately become apparent. For instance, do pupils think in L1 or L2? If pupils think in L1 but are taught in L2 how do they translate words and their associated concepts from L2 into L1 whilst retaining semantic equivalence? Do the vocabularies of L1 and L2, (both the established vocabularies of the student and the broader vocabularies of the two languages concerned) allow for transfer of meaning with equivalence? Is it possible to establish and access the same conceptual understanding using either L1 or L2? These issues will be explored in the following sections, which examine theories concerning how vocabulary develops in the first language and second languages of bilingual students. To add a further layer of complexity the implications of considering the vocabulary of science itself, as having features of a separate language, and what this means for the learner, will be discussed.

## 2.3 The establishment of meaning and cognition

There are a number of factors that affect language development including an array of environmental factors and the child's cognitive abilities. It is not surprising that one of the major factors affecting language development is the effectiveness with which the learner develops a comprehensive vocabulary. Developing an extensive vocabulary or lexicon, however, is not simply a question of learning an ever-increasing number of new words.

The relationship between knowledge of the lexical elements of language and the semantic competence that accompanies them, in terms of how these things are stored and accessed within the brain, is still a matter for debate. Lexical development is linked to memory capacity, structure and function. How the brain stores and retrieves lexical

elements and their related concepts has been the focus of much research. It is thought that, for monoglots, the lexical features (e.g. the morphologic and phonologic characteristics of words) may be stored separately from their semantic features (the meanings of the words or concepts which are associated with them).

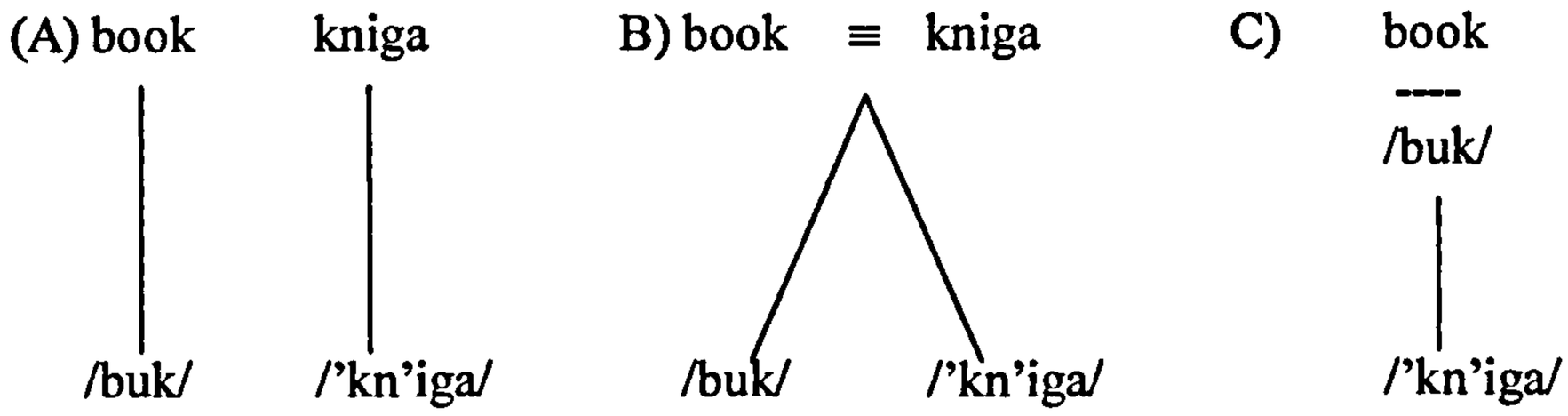
> The assumption that lexical[1] and conceptual[2] levels of representation are independent has been supported in monolingual research on word recognition and in recent work using picture naming to investigate both language production and representation. (Kroll, 1993)

We can all learn new words without knowing their meanings but if the development of our vocabulary is limited to this then we will not be able to use the words to communicate and therefore our language abilities will have improved in only a trivial way. In order for us to develop our knowledge and understanding of the world and to be able to communicate this, we must also develop our semantic awareness, i.e. we must understand the range of meanings that a new word may possess within the different contexts in which it may be used.

### 2.4 Dual lexicons and relationships between them

De Groot (1993) identifies three types of lexical organisation for bilinguals. Coordinate, compound and subordinative lexical organisations are represented below in diagrams A), B) and C) respectively. In each of the diagrams below the phonological (lexical) representation for each word, in the relevant languages, is shown at the bottom of the diagram. The lexical representation accesses the conceptual representations at the top of the diagrams in different ways for different kinds of bilingualism.

**Figure 2.1 A diagrammatic representation of types of lexical/semantic organisation for bilinguals**




(de Groot, 1993, p.28)

The English word 'book' and its Russian equivalent (or cognate[3]) 'kniga' are used to show how the lexical features and their related concepts may be stored in memory. In coordinate bilingualism (Type A) the lexical and conceptual memory resources for these words are independent, i.e., the L1 lexical item */buk/* is linked to one conceptual resource and the L2 lexical item */'kn'iga/* is linked to a different conceptual resource. The two lexical and conceptual systems are independent of each other though. It is suggested that this type of bilingualism develops where the two languages are learned in two entirely different cultural contexts where, the concept of a book, for instance, is sufficiently different to be treated by the coordinate bilingual as two different objects. This could happen where there is strict separation between contexts in which L1 and L2 are used. L1 may, for instance, be used within the home exclusively and L2 used exclusively outside of the home.

In compound bilingualism (Type B) there is only one conceptual resource. The lexical terms */buk/* or */'kn'iga/* will both access this conceptual resource and therefore the individual recognises these terms as being cognates. It is thought that this type of bilingualism may develop when students are taught in schools where the meaning of a word in the L2 is related to the meaning of the equivalent word in L1 **or** where the bilingual has developed his or her dual language skills within a home where two languages are spoken interchangeably by the same people and in the same situations (de Groot, 1993, p. 30).

Subordinative bilingualism, (Type C) de Groot (1993, p. 28) considered to be a feature of lexical/semantic accessing where L2 has not been mastered completely and so the

individual is still learning. Here, it is thought, the new word in L2 is linked to its L1 equivalent and the concept match is made via the L1 translation rather than directly from the L2 lexical form. Here there is considered room for error if the L1 translation is not an adequate match with the L2 word and extra process performances are required to access meaning. Dornic (1980) observes that the extra effort involved with understanding text in a foreign language has quite acute detrimental effects on learning.

> Apparently, decoding, (comprehending the meaning) in the nondominant (second) language is slower. In addition, prolonged verbal and intellectual activity in the nondominant language causes mental fatigue and impairment of the short-term memory. Even on tasks in which bilinguals performed equally well in their dominant and nondominant languages, they *perceive* more difficulty, stress and fatigue when using their second language.
>
> (Dornic, 1980)

Clearly subordinative and coordinate representations are less effective for learning in L2 and, according to de Groot (1993) have been given less consideration in the research literature, in favour of compound bilingualism, since the different systems were first proposed by Weinreich (1953). De Groot goes on to argue that bilinguals may operate all three structural systems with different bilinguals occupying different positions on a continuum that ranges from purely compound to purely coordinate depending upon when they learned their L2 and how proficient they have become. De Groot also identifies that word type is important in the determination of how a lexical element will be stored within memory, suggesting that concrete words (those that describe material objects as opposed to an abstract state, quality or action) and cognates are likely to be stored in a compound structure, whilst abstract words or noncognates are more likely to be stored in a coordinate form. Words which a learner has just been exposed to and has not fully acquired may be stored in a subordinative format (de Groot, 1993, p. 46). A final important point is:

> ...that concreteness and cognate status *per se* are not the determinants of representational form. Rather the degree of

> meaning similarity between the words within a translation pair may ultimately determine the bilingual representational form.
>
> (de Groot, 1993, p. 46)

Kroll (1993) supports this view and identifies that results from research using tasks which emphasise the surface attributes of language, e.g. morphology, support the 'independent or multiple memory' model (Coordinate bilingualism) because there is a lack of transfer of such features between languages. Where research has utilised tasks that emphasise 'semantic or conceptual' attributes the common conceptual memory model (Compound bilingualism) is supported because words in different languages do 'prime' each other.

Potter (1984) has proposed two models of cross-language connection, Word Association and Concept Mediation. According to Kroll:

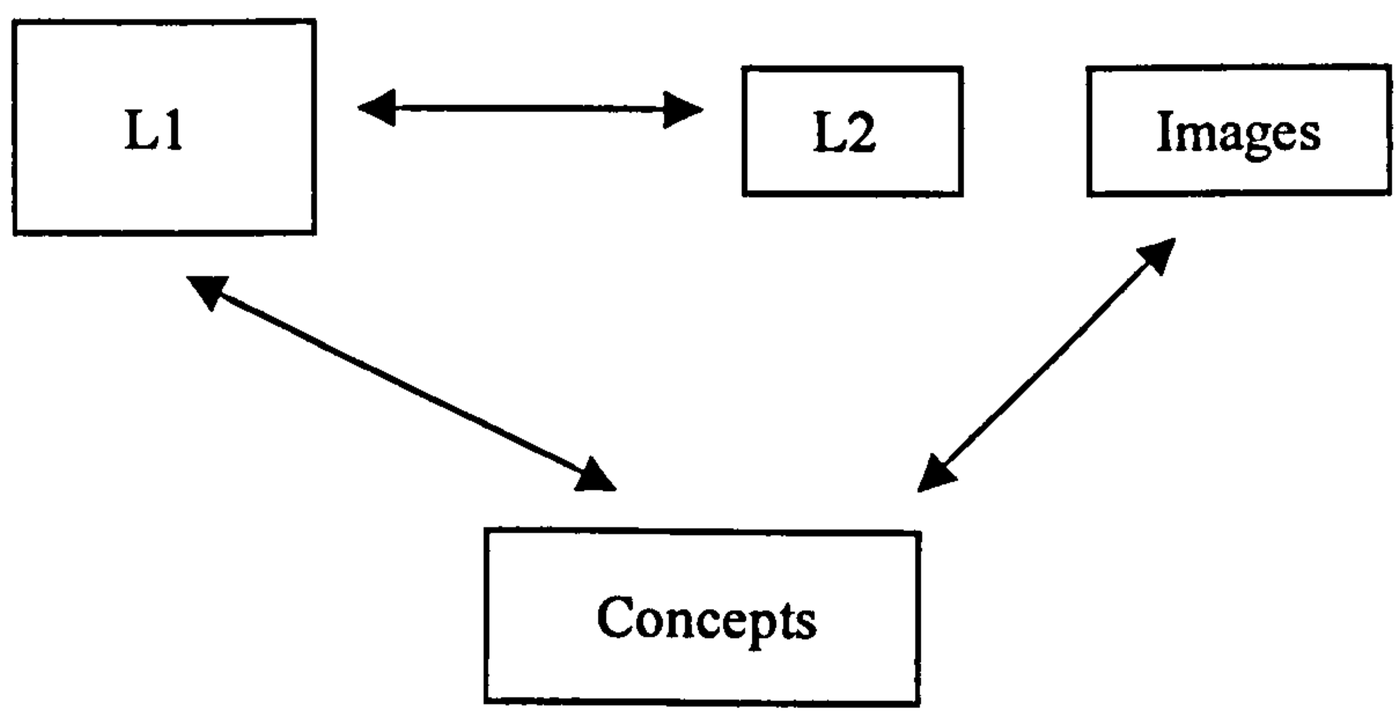
> The word association model proposes that the second language makes contact with the first language at the lexical level by way of cross-language word associations. Access to concepts from L2 words is therefore mediated through the first language by activation of translation equivalents in L1. In contrast the concept mediation model proposes that each language has independent access to a common conceptual representation.
>
> (Kroll, 1993, p. 65 + 66)

It is suggested that bilinguals utilise both of these models to negotiate meaning between languages. The word association model being utilised where there is limited sharing of meanings between translation equivalents in the two languages e.g., between two abstract words. Word association (lexical-level) interaction is also thought to be important where L2 learners are novices i.e., these learners rely on a subordinative process for translation. It is thought that at the earliest stages of L2 learning lexical-level mediation of meaning is dominant but that this reliance on the surface features of language for translation diminishes as fluency is attained and is replaced by the concept mediated model. At this stage the learner has direct access to conceptual information about L2 words without first needing to translate them into L1. Kroll suggests, though, that both systems remain

available for use and even for the fluent bilingual the word association model may offer the only route to understanding when learning words with meanings which reside outside of the scope of their common conceptual resource (Kroll, 1993).

Diagrammatical representations of the two models are shown below which include an illustration depicting the relationship between information presented in the form of an image of some sort. Here it is shown that this kind of information **must** be mediated via the common conceptual resource before it can be negotiated in lexical terms.

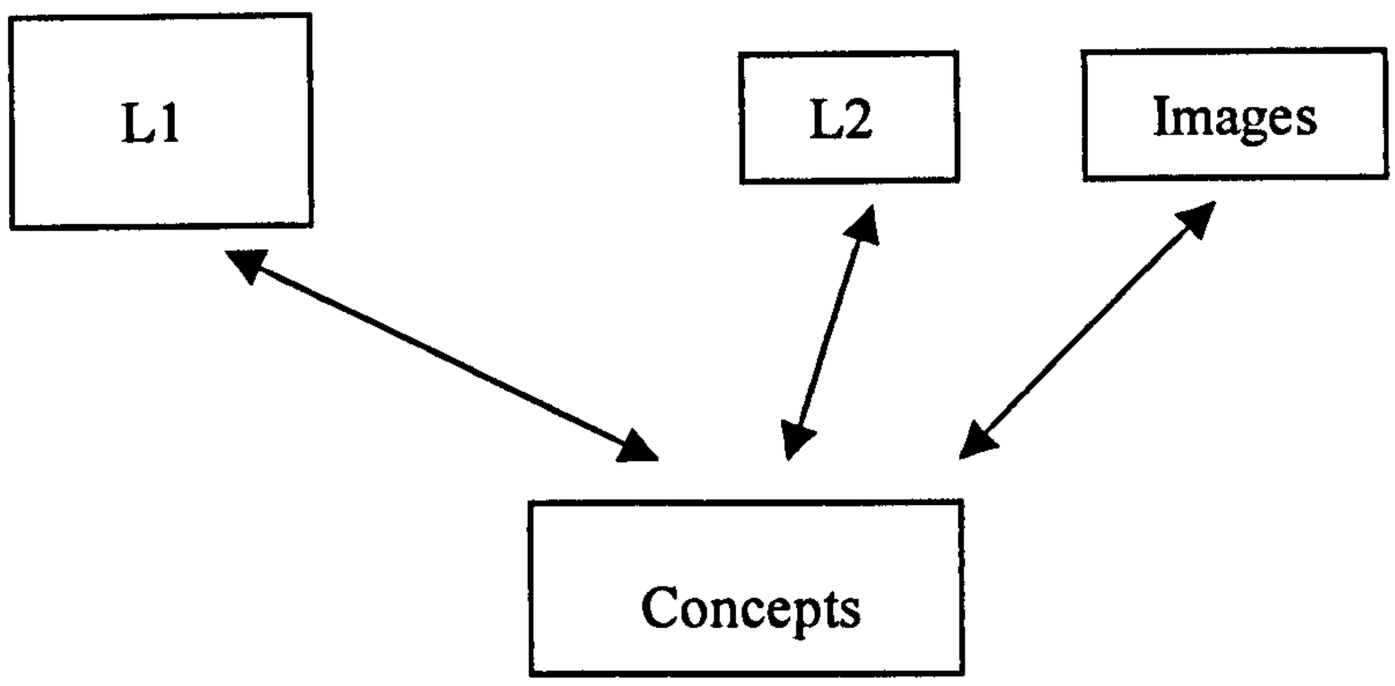
**Figure 2.2 The word association model of cross-language connection**




(Kroll, 1993, p. 66, adapted from Potter *et al,* 1984)

In the word association model we can see that words presented in L2 can only access conceptual representations via L1. In the concept mediation model below we can see that both L1 and L2 words can access conceptual representations directly.

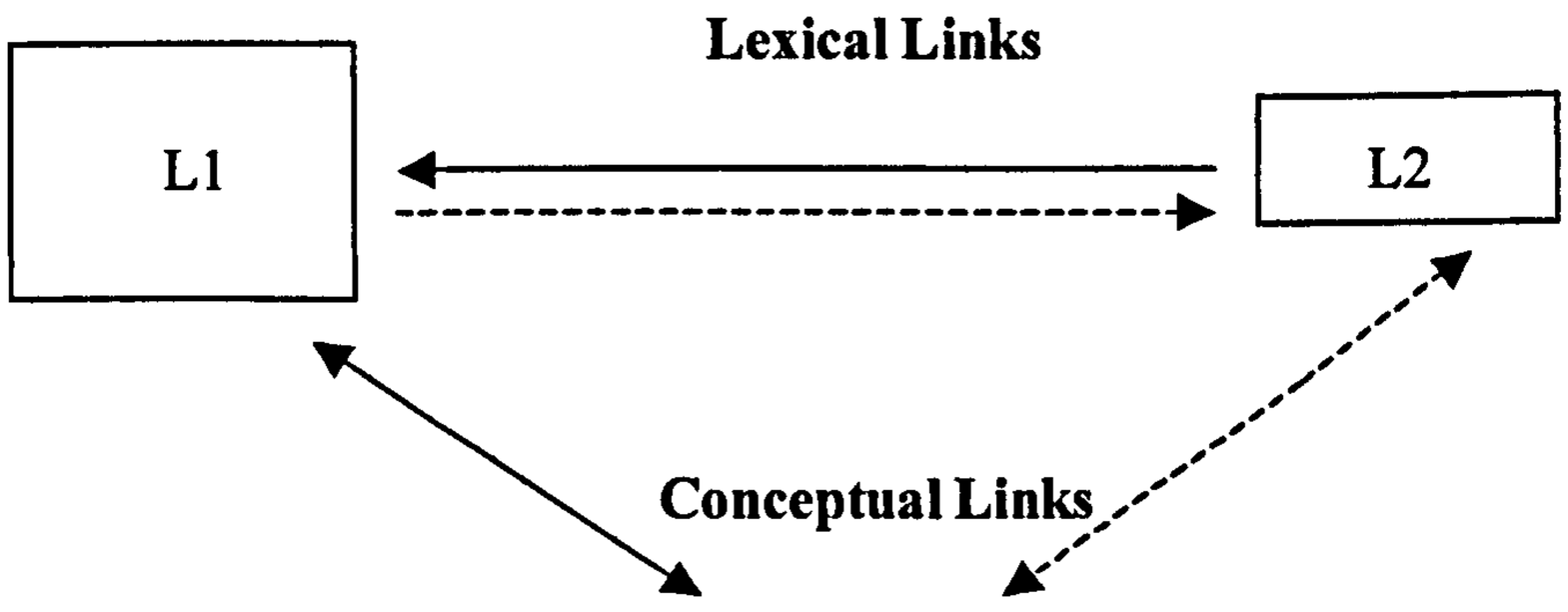
**Figure 2.3 The concept mediation model of cross-language connection**




(Kroll, 1993, p. 66, adapted from Potter *et al,* 1984)

Kroll and Stewart (1992) produce a revised model of the bilingual lexical and conceptual memory representation that combines the word association and conceptual mediation processes for L2 learners.

**Figure 2.4 A combined word association and conceptual mediation model of cross-language connection**




(Kroll, 1993, p. 69, adapted from Kroll and Stewart, 1992)

In presenting this model Kroll makes a number of assumptions/statements concerning directions and strengths of interactions between the various memory representations.

1. For most bilinguals the L1 lexicon will be substantially larger than the L2 lexicon (hence the larger box).
2. The strength of the connections between L1 and L2 lexicons and the lexicons and conceptual memory are thought to vary as a function of L2 fluency and language dominance.
3. L2 to L1 connections are assumed to be stronger than L1 to L2, (hence the dotted lines from L1 to L2) perhaps because of the direction in which vocabulary is often taught and because the larger size of the L1 lexicon means that there are more mappings from L2 words than vice versa.
4. This asymmetry means that translations from L2 to L1 may proceed more readily than from L1 to L2
5. Conceptual mappings are stronger from L1 than L2, (hence the dotted lines from L2 to concepts).
6. Translation from L1 to L2 is therefore more likely to require conceptual mediation.
7. L2 words will initially be mapped to L1 to gain access to concepts.

(Kroll, 1993, p. 70)

Compound bilingualism, which allows for concept mediation between languages, is a superior form of dual language representation, particularly when learning concept rich subjects like science. It is vital, though, that concepts which are accessed from either language are true representations of the meanings of the words used to access them. In the case of bilinguals, the teaching and learning of science should aim to develop compound representations of concepts and their related lexical items in L1 and L2.

Achieving compound bilingualism is not a straightforward process. In learning science pupils are exposed to many new words and new ways of using words that they thought they already knew. Seemingly similar words in different languages actually cover different semantic fields (ranges of meaning) e.g., Ellis and Beaton identify that,

> The French distinguish between *balle* – a spherical object that can be caught with one hand and *ballon* – that requires both hands; the English translation ball is insufficient to represent and distinguish these meanings. Terms for colour, temperature, divisions of the day, kinship and parts of the body are all semantic fields that are divided up in different ways in different languages.
>
> (Ellis and Beaton, 1995, p. 112)

Ellis and Beaton comment that where there is 1:1 mapping of meanings words in new languages are easy to learn. If this is not the case then a different range of lexical terms must be utilised to describe an L2 word in L1. Ellis and Beaton (1995, p. 112-113) note that a common problem with L2 learners is that they " relied on a *semantic equivalence hypothesis*", when learning new words hence assuming that the meaning of the L2 word was identical to one in their L1. Learning new words becomes a "labelling" exercise. Unfortunately many of the "equivalents" do not share identical semantic fields and new lexical constructions in L1 are required to describe the word. In order to enable compound representation of scientific terms, for bilingual learners, some sort of active language-learning programme will be a vital component of any teaching process.

## 2.5 Science language as a distinct language

To compound these difficulties concerning semantic equivalence in different languages, many authors consider that, even for monolinguals, modern science teaching has, to a great extent, become an exercise in language teaching because of the uniqueness of the language of science itself. It is argued that if pupils are to become effective scientists then they need to learn the skills associated with accessing the language of science. Lemke refers to pupils being able to "talk science" in the classroom.

> "Talking science" does not simply mean talking about science. It means doing science through the medium of language. "Talking science" means observing, describing, comparing, classifying, analyzing, discussing, hypothesizing, theorizing, questioning, challenging, arguing, designing experiments, following procedures,

> judging, evaluating, deciding, concluding, generalizing, reporting, writing, lecturing, and teaching in and through the language of science.
>
> (Lemke, 1990, p. ix)

Some authors consider that the learning of scientific vocabulary and language idiosyncrasies is akin to learning a foreign language. Osbourne (1996, p. 274) says of learning physics that it is "more akin to the learning of a foreign language than it is to the learning of historical facts". This is equally true of the other sciences. Yager (1983, p.577) identifies that, "Some initial investigations of the nature of textbooks have suggested that typically more new words and terms are introduced than one would expect to find in a similar time frame as foreign languages are studied."

Rosenthal suggests that this is not a problem for L2 learners claiming that the vocabulary of science is foreign to both L1 and L2 learners.

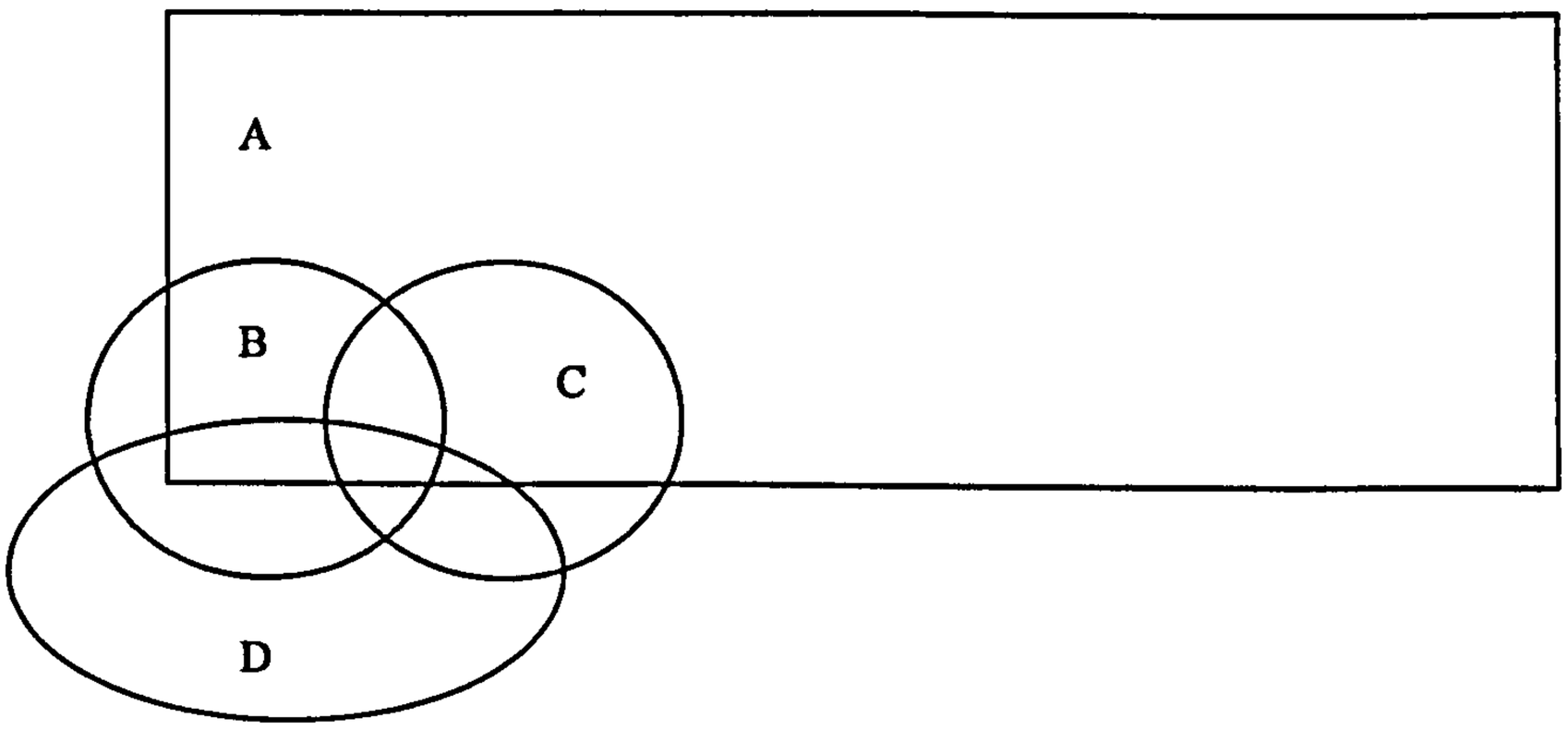
> A fifth misconception about science instruction for LEP students is that the technical and scientific words make the discipline particularly difficult. If anything the language of science is 'foreign' to both native and non-native speakers of English.
>
> (Rosenthal, 1996, p. 30)

Rosenthal's stance avoids some important issues concerning how the L1, L2 and scientific lexicons relate to each other in semantic terms. If we consider a monolingual's understanding of a broad concept such as metals we find that there are different fields of understanding depending upon whether we consider the understanding of what a metal is from a scientific point of view or from the layperson's point of view. This is the case for two reasons, firstly, the understanding in layperson's terms is dependent upon the general cultural inputs to the understanding of metals whereas the scientific perspective results from the cumulative inputs from the culture of science. Secondly the layperson will use different language to explore or describe metals or issues surrounding them than the scientist. Everyday speech is often generalised, variable, exaggerative and may relate to fiction as well as fact. Science language is specific, often fixed in meaning, measured and

related to fact. Science language will also cover issues associated with any particular concepts that are outside the bounds of what would normally be considered by the layperson in association with metals e.g., thermal conductivity. Therefore two semantic fields concerning the meaning of metals and issues associated with them emerge which overlap but are by no means identical. A monolingual person must understand both of these fields to gain a scientific and everyday understanding of metals.

The situation for the bilingual is more complex still in that their everyday understanding of metals will be constructed from a different cultural perspective. Therefore this semantic field will contain some different concepts and therefore some words that may have no equivalents in the second language or scientific semantic fields. It is impossible to accurately represent how these fields of understanding might relate to each other but the following diagram is an attempt.

**Figure 2.5 A diagrammatic representation of how the semantic fields for words associated with the concept 'metals' might relate to each other when science is taught in a bilingual setting**




Rectangle A represents the total conceptual vocabulary[4] of the learner.

Circle B represents the L1 semantic field associated with metals.

Circle C represents the L2 semantic field associated with metals.

Circle D represents the scientific semantic field associated with metals.

It is not intended in this diagram that the relative sizes of the fields have great significance but only to show how meanings associated with the concept of metals might relate between L1, L2 and the language of science and how all of that might relate to the child's total understanding of the world. Besides the overlaps between the semantic fields it is also important to note that there may be everyday knowledge concerning metals in the L1 and L2 that resides outside of the child's current understanding. There will also be a large amount of scientific understanding which is outside of the child's current understanding because the child is a novice learner and because what is known, in a scientific sense, about metals represents a vast semantic field which even a specialist may not have a total grasp of.

The significance of this for the bilingual learner is that:

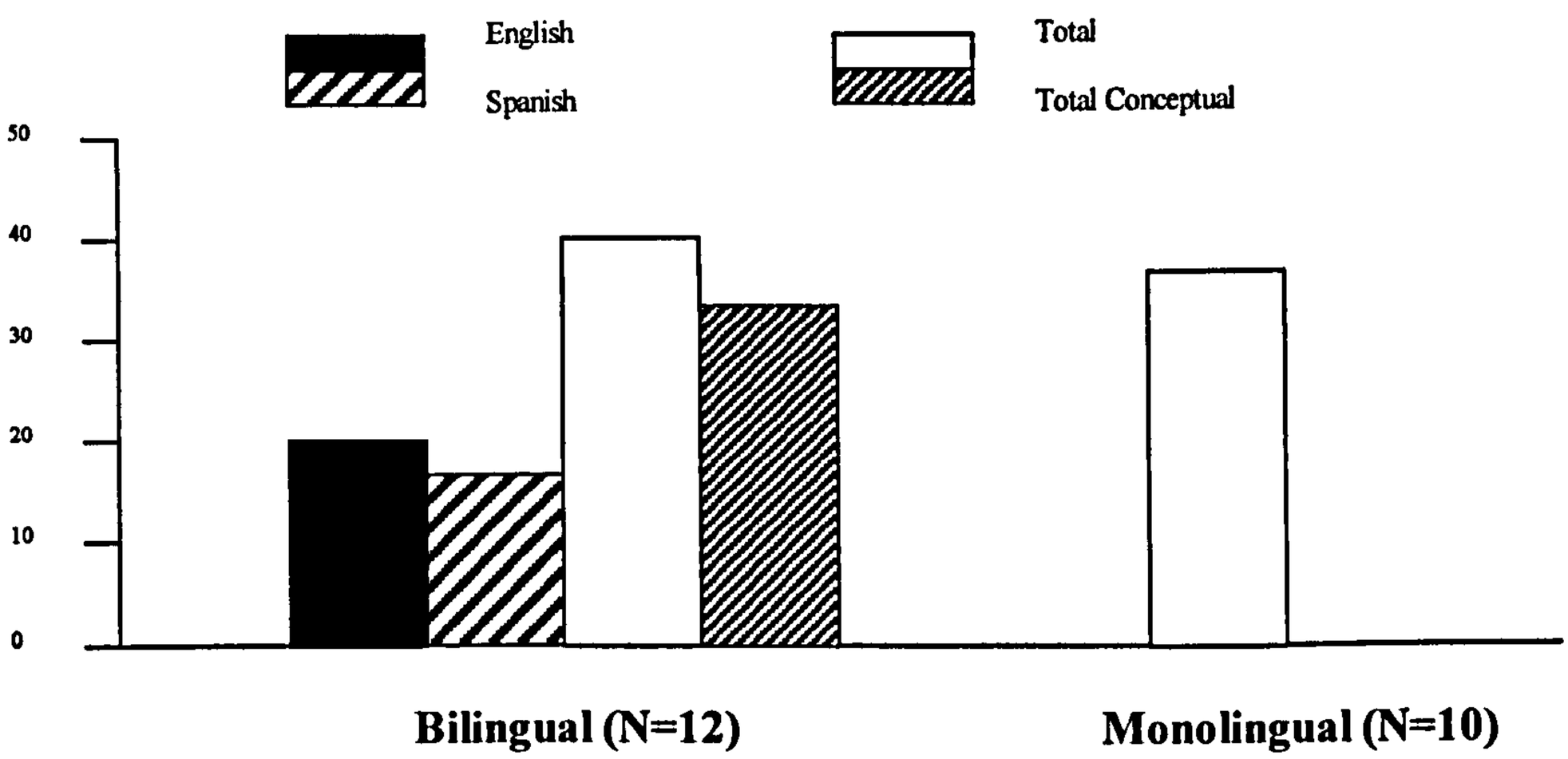
a) their understanding of the concept of metals is potentially more complex than a monolingual's.
b) if teaching takes place in only one language (say L2) the connections between the other language (L1) and scientific understanding, and therefore potential access points for enabling scientific understanding, are ignored.
c) if b) above is the case, knowledge and understanding concerning metals, for instance, in L1 become marginalized and are not incorporated into and therefore do not contribute towards the total understanding of what a metal is.

These points again emphasise the need to utilise L1 and L2 to achieve compound representation of scientific vocabulary.

There are also some important issues concerning the maximum size of a student's functional lexicon at any particular age that have significance for effective learning. Aburdarham (1987, p. 19) identifies that a number of authors have concluded that the lexical development for bilinguals is inferior to that of monoglots. Aburdarham argues that this is a result of studies into lexicon size which consider one language only and that when the lexicons of both languages are considered together the bilingual lexicon is at least equal to that of monoglots.

These findings appear to be confirmed by the research findings of Pearson, Fernandez and Oller (1995, p. 31-57), who studied the lexical development of Spanish-English bilingual infants and toddlers in comparison to monolingual English and Spanish children. The following bar chart illustrates the relative sizes of the lexical and conceptual vocabularies of the bilingual and monolingual children studied.

**Figure 2.6 A comparison of the relative sizes of the lexical and conceptual vocabularies of monolingual and bilingual children**




**Bilingual and monolingual percentiles averaged across ages (Production)**

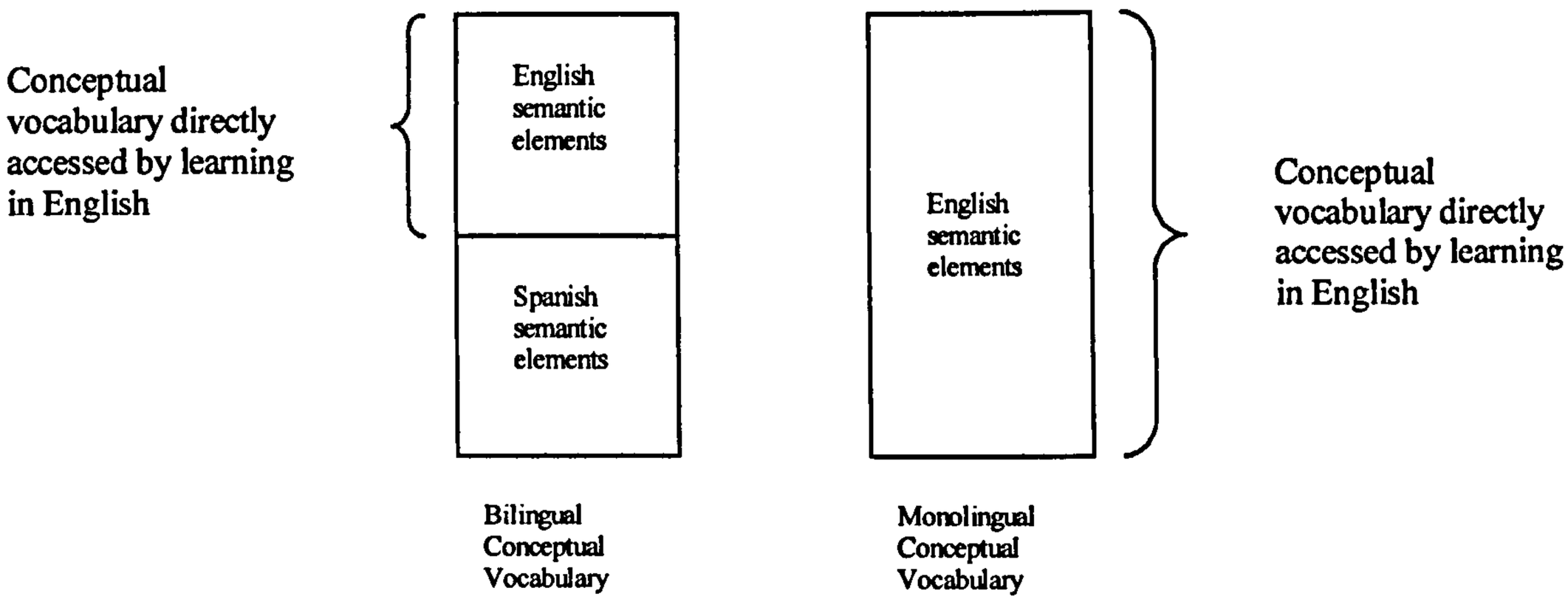
(From Pearson, Fernandez and Oller, 1995, p. 44)

Although the authors urge caution concerning the small sample size, the results seem to indicate that the combined bilingual lexicon is about equal to the monolingual. Furthermore the size of the bilingual total conceptual vocabulary is also very similar in size to the monolingual total conceptual vocabulary (See Pearson, Fernandez and Oller, 1995, p. 39-43, for details of how total lexicon size and conceptual vocabulary size are calculated).

This information seems to suggest that there is no linguistic deficit suffered by bilinguals in terms of conceptual vocabulary size. For bilingual pupils learning in a single language, say English, however, the composition of the total conceptual vocabulary is a

source of disadvantage because it represents the sum of L1 and L2 conceptual vocabularies. Therefore any particular scientific concept can only be explained or understood through direct access (access without the need for any form of translation or concept mediation) to perhaps half of the total conceptual lexicon. See figure 2.7 below.

**Figure 2.7 A diagrammatic representation of monolingual and bilingual total conceptual vocabularies**




This means that a bilingual, learning in only one of his or her languages, either has fewer words with which to explore and understand any particular concept or has to undertake an additional performance (translation or concept mediation) in order to access conceptual elements from the other language.

## 2.6 Summary

It is clear that a compound multilingual understanding of important vocabulary items and associated concepts is preferable. Compound multilingual understandings (equivalent understandings in any language) mean that pupils can use concept mediation (accessing lexical resources from conceptual resources, or vice versa, with equal ease within and between any languages that the pupil is proficient in) in order to more easily construct meaning by considering, comparing, organising and reorganising networks of associated concepts. Compound multilingual understandings also allow pupils to access conceptual understandings associated with their larger bilingual or multilingual conceptual

vocabularies. How teachers develop compound multilingual understandings of scientific ideas will be critical to enabling pupils to construct deeper meaning for scientific ideas.

Analysis must, therefore, consider how code-switching contributes to the development of compound multilingual understandings of scientific concepts. For instance, when teachers introduce new scientific words it will be important to consider what they do in order to make meaning for these words when there are no words with semantic equivalence available in Kiswahili or Kigiryama. Also, do teachers introduce new words in such a way that pupils will be able to develop strong connections from L1 to L2, as well as from L2 to L1?

---

[1] Lexical memory representations – Memory resource associated with storing understanding of the morphologic and phonologic characteristics of words.
[2] Conceptual memory representations – Memory resource associated with storing the semantic characteristics of words.
[3] Cognate – Words from different languages which have equivalent meanings.
[4] Total conceptual vocabulary – total number of concepts with lexical representations.

# CHAPTER 3.

# RESEARCH DESIGN AND METHODOLOGY.

## 3.1 Reviewing the research questions

In order to be clear about the aims of the study, it would be helpful at this point to restate the research questions. They are as follows:

1. How might the code-switching interventions used in science lessons in standards 4 and 5 at Mida Primary School be characterised?
2. How are code-switching interventions used to support the meaning-making process in science lessons in standards 4 and 5?
3. What are the contextual factors that might influence the use of code-switching by individual teachers?

## 3.2 Research design

### 3.2.1 The type of study

Case study has been chosen as the research approach in this project because of a number of strengths that the approach offers, particularly to an individual researcher. Firstly, case study allows for a particular aspect of a problem to be studied in some depth, by an individual, in a relatively short time period (Bell, 1999). Case study will allow for the 'empirical investigation' (Robson, 1997, p. 52) of a variety of interactive factors that will influence the ways in which code-switching is used in science lessons (Bell, 1999). In respect of the intent to gather information from multiple sources, case study is a flexible and interactive approach that can be modified to accommodate unexpected opportunities or limitations on location. Case study will offer an opportunity to construct model(s) for explaining actual practice in this school which could be used later as a template, against which, practice in other schools could be investigated. It will also allow for the initial development of the research instrument within a less complex environment whilst recognising that the form that emerges is intended to have the flexibility for effective use in more than one location.

### 3.2.2 Potential weaknesses of the case study approach

One of the concerns with the use of case study is that of the generalisability of the conclusions to other similar situations (Robson, 1997, p. 72). In other words, can the findings from a case study of code-switching practices in one Kenyan primary school, with a particular set of influencing factors, be taken as representing the general situation in other Kenyan primary schools which will have different sets of influencing factors? This study accepts that its outcomes cannot be taken as representing standard practice or be typical of behaviours found in other primary schools with different background factors but will be a study of code-switching practices within the target school as a case in its own right. The data, therefore, will be treated as representing a single case and not a sample of some larger population, hence acknowledging the uniqueness of certain aspects of the language profile and behaviour of the teachers of this particular school. However, it will provide insights and conclusions which will be 'relatable' to other sites. Bassey (1981, p. 85) considers 'relatability' to be more important than generalisability in respect of the outcomes from case studies. Relating the findings from this study to other situations will provide a basis for understanding practice in different circumstances.

In any small-scale study there will also be a need for pragmatism in terms of such issues as sample size and sample selection. This study is no exception, for instance, negotiation of which lessons could be observed had to be accomplished whilst at the school and in reference to the constraints that existed at the target school at that time. The *sample,* referred to in this section, is the group of teachers who were observed in the classroom. The size of this sample was limited, due to the relatively small size of the school and the fact that only one school could be studied. Initially observations were planned across the school from standard 4 upwards. Audio and video recordings were in fact made in standards 4, 5, 6, 7 and 8.

Once transcription began, however, a decision was taken to limit the number of classes for which observations would be transcribed and analysed. This was partly due to time issues associated with translation, transcription and analysis of the data but also, and more importantly, reflecting the recognition that code-switching strategies are of far greater importance and have a much bigger impact upon pupils learning in standards 4 and 5.

The main factor that influenced the size of the sample, therefore, was the age range/year groups studied. As standard 4 is the year when the teaching is first conducted in English (having previously been taught in Kigiryama) it is the year when code-switching is most important (because pupil English proficiency is not considered sufficient to allow pupils full access to the curriculum) and most frequent. As pupil English language skills develop through standards 4 to 5 and onwards up through the school the need for and frequency of code-switching events diminishes.

The number of classes (standards) observed determined the number of lessons that were observed, coded and analysed. Six single lessons were observed. These were broken down into four singles with the same standard 4 class and two singles with the same standard 5 class. Three teachers were involved with delivering these lessons. Teacher A delivered two single lessons to standard 4 in week 1. Teacher B delivered two single lessons to the same standard 4 class in week two and Teacher C delivered the two single lessons to standard 5 in week 2. All single lessons were 35 minutes in length. The table below describes the lesson topics and delivery arrangements.

**Table 3.1 A record of the lessons and teachers observed**

| Week | Teacher | Class | Duration | Transcript | Topic |
|---|---|---|---|---|---|
| 1 | Teacher A | Std. 4 | 1 single | 1 | Seed structure |
| 1 | Teacher A | Std. 4 | 1 single | 2 | Functions of seed parts |
| 2 | Teacher B | Std. 4 | 1 single | 3 | Structure of a maize seed |
| 2 | Teacher B | Std. 4 | 1 single | 4 | Factors affecting the germination of seeds |
| 2 | Teacher C | Std. 5 | 1 single | 5 | Classification of plants |
| 2 | Teacher C | Std. 5 | 1 single | 6 | Classification/structure of plants |

For reasons detailed below, only one comprehensive and some partial interviews were completed and transcribed.

Other considerations in respect of potential weaknesses in the case study approach, e.g., ensuring objectivity, validity etc will be dealt with via procedural considerations later in this chapter and in other relevant chapters.

## 3.2 Data sources and the rationale for choice

Four main data sources were accessed for use in this study. These sources were chosen to enable observation of actual classroom practice in relation to code-switching in science lessons, to allow for consultation with teachers regarding their analysis of code-switching interventions that had been recorded in lessons and to investigate background issues which might affect code-switching like teacher language proficiency, training and relevant issues in respect of education policy and its implementation. The data sources accessed were

- Structured observations.
- Post observation interviews
- Teacher language profile self-assessments
- Additional contextual information compiled on site

The table below describes how the data sources were then used in analysis in order to provide answers to the three research questions. Further information on precisely how the data from each source was treated in the analysis can be found in chapters 4, 5, and 6.

**Table 3.2 A summary of how data sources were used to address relevant research questions**

| Data source ➡ / ⬇ Research questions | Lesson observation transcripts. A | Post observation interviews. B | Teacher self-assessments. C | Contextual information from other sources. D |
|---|---|---|---|---|
| **1. How might the code-switching interventions used in science lessons in Kenyan primary schools be characterised?** | Data source used to develop and improve the code-switching typology. Initial typology of code-switching interventions applied to transcripts. Cycle of analysis and restructuring used to progressively extend and refine typology. | Data source used to develop and improve the code-switching typology. Teacher observations in respect of code-switching interventions used to extend or refine typology by confirming or rejecting intervention types. | | |
| **2. How are code-switching interventions used to support the meaning-making process in science lessons in standards 4 and 5?** | Data source used to test and refine combined use of code-switching typology and analysis framework. Code-switching typology and meaning-making framework applied to data from transcripts to analyse how code-switching contributes to meaning-making. | Data source used to help confirm or reject outcomes from application of typology and analysis framework to observation data | | |
| **3. What are the contextual factors that might influence the use of code-switching by individual teachers?** | | Data source used to gain teacher perspectives on e.g., pupil language proficiency, Language of Instruction Policy in practice, teacher perspectives on the use of code-switching. | Data source used to provide background information in respect of teacher language proficiency, training issues r.e. code-switching, teaching background. | Data used to provide background information in respect of teacher language proficiency, training issues r.e. code-switching, teaching background. |

### 3.3.1 Structured observation of code-switching interventions in science lessons

The major data-gathering method used at the study site was structured observation. This is one of an order of observation techniques available with participant observation (which maximizes the involvement of the observer in the situation being observed) being at one extreme and structured observation (which maximizes the structure of the observation itself and, perhaps, though not so in this case, removes completely the observer from the immediate situation under scrutiny*)* at the other. Structured observation generally involves the use of some kind of categorization or coding scheme. The advantage of using observational methods is that they attempt to measure what *is* going on in the actual situation. This contrasts with interviews or questionnaires where researchers frequently examine what people *believe* to be happening, and with experiments where reconstructions of 'real world' conditions are often attempted.

Smith identifies a number of behaviourally orientated phenomena, which lend themselves to examination using observation codes.

**Table 3.3 A list of behaviours which could be investigated using observation codes**

| | |
|---|---|
| 1 *Non-verbal behaviours* | Bodily movements not associated with language. |
| 2 *Spatial behaviours* | The extent to which individuals move towards or away from others. |
| 3 *Extra-linguistic behaviours* | Covers aspects of verbal behaviour other than the words themselves. This includes speaking rates, loudness and tendency to interrupt or be interrupted. |
| 4 *Linguistic behaviours* | Covers the actual content of talking and its structural characteristics. |

(Smith, 1975, p. 203ff)

As the research task involves examining the nature of the linguistic interaction between a teacher and a group of pupils working within a classroom for a period of time, it is clear that structured observation is an appropriate method. The reason for choice in this study was that it is a research method that provides direct observations of code-switching interactions within the classroom in a short time period.

### 3.3.2 Post observation interviews with teachers in relation to code-switching interventions.

Post observation interviews, were used in order to help in:

- Identifying incidences of code switching during the lessons.
- Informing discussions as to the intended purpose of code switching at that point.
- Informing discussions as to the expected outcome of code switching at that point.
- Informing discussions relating to any other aspect of teacher behaviour which might relate to code switching, e.g., if code switching appears to be more frequent for any particular class and why this might be.

Results from interviews were used as one way of helping to categorise the various types of code switching utilised within each lesson thereby helping to develop the typology of code-switching interventions.

### 3.3.3 Teacher language profile self assessments

Individual language profiles were assembled by asking teachers to complete a language self-evaluation sheet in respect of their own perceptions of their language proficiencies in English, Kiswahili and Kigiryama. The aim of establishing a language proficiency profile for the teachers was to try to provide some understanding of teacher skills in speaking, understanding (spoken language), reading and writing in the three relevant languages (English, Kiswahili and Kigiryama). Abagi and Cleghorn, for instance, identified the problems that many primary school teachers have in using English. In their study they found that *only 3 of 40 teachers (7%) reported "no difficulty" teaching via English* (Abagi and Cleghorn, 1990, p.67).

It was intended, therefore, that the information gained from the self-evaluations could be used to provide a broader picture of language skills across the school and, for those engaged specifically in the teaching of science to pupils in standards 4 and 5, to try to make a comparison between their perceived language skills and the ways that each teacher utilised language in their lessons. All teachers available, at the time of a debriefing session

conducted after all classroom observations had been concluded, completed the self-evaluations (9 out of a possible 14 teachers). All of the teachers observed teaching standards 4 and 5 were included in this sample.

### 3.3.4 Compilation of additional contextual information

In addition to the classroom observation and language profiles described above, involving observation of linguistic interaction in the classroom, teachers were asked to complete questionnaires concerning their language background, training backgrounds and teaching histories. The aim of gathering this information was to attempt to assess whether there was any perceivable link between the way that teachers use language in the classroom, their own language background and any training/experience they might have gained during their careers. In effect these issues would require in-depth investigation in their own right. It was felt, though, that such an enquiry into these aspects would offer valuable contextual information against which any evaluation of the main research data could be made in a more informed manner.

The intent, in respect of the language background element of the questionnaire, was to try to establish the area of Kenya that each teacher had been brought up in and what they, therefore, regarded as being their mother-tongue. It is common for teachers to be posted to different districts that perhaps, have different linguistic profiles from the area from which the teacher originates. Or, perhaps for personal reasons (marriage etc.), a teacher will move to different part of Kenya where his or her mother-tongue is not used. Knowing which teachers were Kigiryama speakers as their mother-tongue was considered to be an important issue in to the project.

There were also questions relating to what training or preparation teachers had been given, either as initial teacher training or as INSET in respect of making provision for pupil's learning in a second language. Obura (1985), identifies that Kenya does not yet offer training that would heighten teacher awareness of which language use procedures might be most effective under any given circumstance. The intention here was to see if the situation that Obura had encountered in relation to second language teaching strategies still prevailed.

## 3.4 Administration of instruments.

### 3.4.1 Structured observation.

In each lesson an audio-record was made of all teacher and pupil utterances. In each case the teacher wore a tie microphone attached to an audio-recording device carried in the teacher's pocket. The quality of recording was such that all teacher and pupil utterances were clearly recorded. Each lesson was also video-recorded using a camera placed at the back of the classroom. Video recording concentrated predominantly on the teachers' oral contribution to the lesson but also catalogued any additional inputs utilised by the teacher to support scientific explanations during the lesson e.g., writing of key vocabulary on the blackboard, production of diagrams use of visual prompts, use of physical resources, etc.

#### 3.4.1(i)Observer effects and validity issues

As the observer was present in the classroom as the lessons were being delivered there was a danger of observer effects influencing the behaviour of the teacher and pupils. As Martin and Bateson point out:

> The observer's presence may introduce subtle bias even though the subjects appear well habituated. For example some behaviours (such as play or sexual behaviour), or some individuals (such as juveniles) may be more affected than others by the observer's presence.
>
> (Martin and Bateson, 1986)

In fact, there were to be two areas of concern in respect of observer effects in this study. Firstly, there was the obvious possibility that the observer's presence in the classroom would cause teachers and pupils to behave differently. It had, for instance, been suggested previously by another primary school teacher that in such circumstances the teachers would "teach to their sweat" in order to impress the observer.

However, a relationship and rapport has been built up with the staff and pupils in the target school over a number of years, (approximately 10) which, it is thought, will facilitate the accumulation of accurate, relevant data by going some way towards overcoming these

observer effects. Prior interactions with the target school had also helped to build a body of knowledge concerning the ways in which science is taught and the resources available to teachers and pupils and to establish a better understanding of the language profile of the school.

How the observer's presence did, in reality, affect the behaviour of the teachers and pupils in the observed classes is difficult to gauge. There had, however, been a number of previous observations conducted at the school in almost identical circumstances using almost identical methods (i.e., the observer sitting at the back of the science lesson with a video camera and/or audio recorder). It was hoped that this had helped to habituate teachers and pupils to the observer's presence and that therefore this would be an issue of limited significance.

Secondly, there were potential effects due to teachers consciously or unconsciously attempting to satisfy the perceived needs of the observer. For instance, the focus of the observations was teacher code-switching and the use of code-switching (to Kiswahili and Kigiryama) in order to help explain concepts to pupils. If this intention had been explicitly communicated to teachers prior to teaching it is possible that they might have used more Kiswahili or Kigiryama than usual in order to satisfy a perceived requirement of the researcher. The simple solution to this was not to tell teachers about the precise focus of the research. However, this might not have been justifiable from an ethical point of view.

> The withholding of information or the misleading of participants is unacceptable if the participants are typically likely to object or show unease once de-briefed. Where this is in any doubt, appropriate consultation must precede the investigation. Consultation is best carried out with individuals who share the social and cultural background of the participants in the research, but the advice of ethics committees or experienced and disinterested colleagues may be sufficient.
>
> (British Psychological Society, 1991)

The issue of concern here was associated with the strictness of interpretation of the language of instruction policy and teachers feeling that they were operating against the

authority of the policy by code-switching rather than teaching entirely in English. However, discussions with teachers at this and other primary schools prior to this study (in the previous year), with the head teacher, governors, school inspectors and District Education Officer had established that implementation of the policy had moved on from the position when it had been first developed. It was now accepted, particularly for schools in rural settings, that code-switching was a necessary (vital) element of instructional practice. There was therefore no conflict between practice in the classroom and national expectations. All stakeholders in the educational process were unconcerned about the use of code-switching.

Hence, the study of code-switching in the classroom did not itself present any ethical issues in respect of potential damage to the interests of the teachers involved from any outcomes. The only issues for consideration were the minimalisation of observer effects due to the teachers being aware of prime focus of the study and respect for the teachers right to know the focus of the research. In order to satisfy both of these considerations, teachers were told prior to observation that the intent was to study language-use within science lessons without being specific about which aspects of language-use were under scrutiny. This approach, also discussed prior to observation with the project supervisors, offered a solution, which it was felt, limited observer effects but did not compromise the ethical integrity of the interaction.

However, post observation interviews with some teachers included many questions concerning why teachers had made particular code-switching utterances. It is recognised that the emphasis placed on this kind of interaction with pupils would have alerted teachers to the focus of observations prior to the delivery of any subsequent lessons. It would not, perhaps, have then been a surprise to observe an increase in code-switching events in lessons taught after such interviews. However, during a final debrief all teachers were asked whether or not they felt that the presence of the researcher, or any other factor, had influenced or modified the way that they taught. In particular, did the teachers feel that the presence of an observer had caused them to use more or less Kiswahili or Kigiryama during lessons? There was a unanimous negative response to this question. Further, the teachers stated that there was already a well-recognised necessity for using mother-tongue with pupils, particularly at standards 4 and 5, and that the code-switching events had been determined by the teacher's perceptions of the needs of the pupils at the time.

### 3.4.1(ii) Limitations/problems.

The limitations and problems associated with the structured observation will be explored in the evaluation at the end of the thesis.

### 3.4.2 Post observation interviews

It was intended that post observation interviews would be conducted as soon after the completion of the lessons as possible, i.e., the same day or the following day if lessons occurred late in the day. In each case, stimulated recall, (replaying of significant sections of audio or video tape to the relevant teachers) was used to remind teachers of the code-switching intervention itself and significant events leading up to and following the intervention. The teacher would then be questioned as to what they felt were the reasons for the code-switching at that particular point. The relevant extracts of video and the teacher responses were audio-taped so that later transcription could match comments with the correct part of the lesson. Given that it was impossible to predict the kind of code-switching event that would occur in lessons, tightly planned interview questions were not prepared in advance. The aim of the interviews was to allow the teachers to give their impression of why they had code-switched and what they felt had been achieved by doing so.

### 3.4.2(i)Limitations/problems

In respect of teachers revealing their intentions when using different code-switching strategies, there were again two problems. Firstly, the limited time and resources available for conducting the research meant that there was insufficient time to conduct comprehensive interviews with all teachers. As discussed earlier, the intention was to interview teachers post observation concerning their reasoning in respect of code-switching episodes. It was also necessary, at this time, to translate and transcribe any Kiswahili or Kigiryama used during the lesson. In practice the translation and transcription took so much time that the teacher became tired and the 'interview' had to be terminated. Attempts were made to conduct the interviews on the following day but even this proved to be impossible

because there was a necessity for further lesson observations to proceed and teachers had ongoing teaching commitments or were called away on training courses.

Secondly, teacher interviews, post-lesson observation, which could take place and which were intended to reveal the intentions behind particular code-switching events were often not entirely successful in delivering detailed explanations of such intentions. Although there were many occasions when teachers could be absolutely explicit about their motives concerning a particular code-switching event, they sometimes found it difficult to express their reasoning in respect of the strategies that might have been utilised only a few minutes earlier. It seemed that they had a tacit understanding of their own actions and reasons but that they found these difficult to express.

### 3.4.3 Teacher language profile self-assessments

Teachers were asked to gauge their own proficiency in speaking, understanding (speech), reading and writing using a seven-point scale similar to that used by Abagi and Cleghorn (1990, p.67). The two extremes of the scale were termed "no ability" and "no difficulty" and the teachers were asked to circle the number on the scale that they felt best described their proficiency level in each of the skill areas. The self-evaluations were distributed at the end of a debrief, itself conducted at the termination of the lesson observation programme. Care was taken to ensure that clear instructions were given regarding the structure of the evaluation sheets and their completion.

#### 3.4.3(i)Limitations/problems

It is accepted that, in order to make a precise measurement of teacher language skills, it would be necessary to administer a range of detailed tests. Neither the time nor the expertise was available for doing this within this study. However, the self-evaluations were not intended to give precise measurements of teacher language proficiency but to offer some contextual information against which to consider the data collected from the main area of research.

### 3.4.4 Compilation of additional contextual information

Again, because the information gained from this element of the research was only intended to provide context for the main body of research, no detailed structuring or piloting of the questionnaire were attempted. Questions were concerned with such issues as when teachers had completed their initial teacher training, what they considered to be their specialist subjects, what training they might have received in respect of second language learning issues and when, etc,. In most cases a one word answer or a circling of a relevant time period were all that was required for completion. The questionnaires were distributed with the language self-evaluations sheets at the end of the debrief. Again, care was taken to ensure that clear instructions were given regarding the structure and the methods of completion.

Opportunities for interviewing educational professionals associated with the school but working outside of it, although actively sought out, had to be exploited with reference to whether or not and how they presented themselves.

**3.4.4(i)Limitations/problems.**

Again, it is accepted that the informal nature of the design of the questionnaire might make some of the evidence gained unreliable. However, this is not considered to be a serious issue as the questions were not of a complex nature and were intended only to provide supporting information.

## 3.5 Transcription

Each lesson was transcribed, with the teacher who delivered the lesson translating any Kiswahili or Kigiryama utilised during the lesson. This was felt to be particularly important because it is sometimes not possible to produce literal translations of Kiswahili or Kigiryama. In circumstances where it was not possible to complete transcription and translation with the teacher responsible for the lesson, this was accomplished later with the help of an alternative teacher from the target school.

All transcriptions were recorded in a spreadsheet. Columns arranged left to right recorded utterance number, the utterer (teacher or pupil[s]), the utterance, and then notes in

respect of each utterance, e.g., a record of any non-oral activities of the teacher or teacher interview responses, respectively.

Utterances presented in English were recorded in black, those in Kiswahili were recorded in red and those in Kigiryama in gold. Information in respect of each individual utterance, then, was presented in a row with successive utterances recorded in successive rows working down the spreadsheet. Following any Kiswahili or Kigiryama utterance, there is a translation presented in blue.

In most circumstances, a teacher utterance is concluded when the next pupil utterance begins and vice versa. Sometimes, teachers interrupted their own utterances by, for instance, pausing to gather their thoughts, pausing to wait for a pupil response, distributing lesson resources, writing on the blackboard, etc. In such circumstances, utterances before and after the interruption were recorded separately. Hence, on the transcription sheets, there sometimes appears to be several teacher utterances directly following each other. This was not an issue in respect of pupil utterances as these were, in almost all circumstances, very short, usually a single word.

# CHAPTER 4

# DEVELOPING A TYPOLOGY OF CODE-SWITCHING INTERVENTIONS.

The focus of this chapter is the development of a code-switching typology as a first step in determining how such interventions contribute to the meaning-making process in science lessons. The typology will be developed from a combination of strategies previously identified by other researchers which have been documented in relevant literature, and strategies that have emerged from the data collected through classroom observations in this project.

## 4.1 Defining a code-switching intervention within the context of the target school

Answering the first research question involves, in part, the development of a typology of code-switching interventions used by teachers in the science lessons. The construction of this typology began with the understanding that it was intended as a means of categorising different kinds of code-switching intervention. In order to do this, the first thing that is required is a definition of what represents a code-switching intervention. Here, the language of instruction policy (Cleghorn, 1992, p. 313), which establishes English as the language of delivery for science teaching from the beginning of standard 4 onwards, provides an excellent guideline. Due to this stipulation English can be considered to be the base-line teaching language. A code-switching intervention is, then, any example of a teacher utterance that is delivered in a language other than English. Essentially, such a typology would attempt to describe the *kinds* of utterances that were presented in Kiswahili or Kigiryama during science lessons. Following this initial categorisation, the intention would be to see how such interventions were being used to help support meaning-making.

## 4.2 Developing a theoretical structure for the typology

In many ways developing a typology of code-switching interventions is similar to developing a coding scheme for use in structured observation of classrooms. Robson (1997) offers some advice in constructing coding categories for recording observational data which

are recorded in figure 4.1 below. In applying the above considerations, it must be remembered that the intention is to develop a typology and not a strict coding system.

It is recognised that individual teacher interventions often have more than one aim. For instance, if a teacher provides an alternative mother tongue word, by using a question to elicit it from one of the pupils, then, at a fundamental level we have a question, but this question also emphasises/reinforces an important word and thereby helps to explain the scientific point of view. Within this project, then, where the contribution of code-switching to the development of the conceptual line is being considered, each code-switching intervention is also considered in respect of how it contributes to meaning making, i.e., how the teacher is using the intervention, as a part of a longer term strategy, to help explain scientific ideas. Doing this will provide a more complete characterisation of each intervention with respect to its contribution to the development of the conceptual line. Therefore, a further analysis structure has been developed (see chapter 5) to analyse how each code-switching intervention contributes to the creation of meaning.

**Figure 4.1 Considerations in developing a coding scheme.**

Note : If there is an existing scheme which appears appropriate, consider using it or adapting it.

The categories should be devised to provide information relevant to the research questions in which you are interested (your preliminary exploratory observation should help in clarifying the question). To be straightforward and reliable in use it will help if they are :

a **Focused.** Only looking at carefully selected aspects of what is going on. Simply because you can observe it doesn't mean that you have to code it; ask yourself 'what use will the data be?'

b **Objective.** Requiring little inference from the observer.

c **Non-context-dependent.** The observer's task is more difficult if the category to be used in coding an event depends on the context in which it occurs (however, if such contextual information is essential to answer the research question, then the observer will have to live with it).

d **Explicitly defined.** Through a detailed definition of each category, with examples (both of what falls within a category and what doesn't).

e **Exhaustive.** Covering all possibilities so that it is always possible to make a coding (to be compatible (a) above it may be necessary to have a large 'residual' or 'dump' category)

f **Mutually exclusive.** A single category for each thing coded (if the system has both (e) and (f) characteristics it is commonly referred to as an MEE system - a Mutually Exclusive and Exhaustive System). Note, however, that in some situations it may be simpler to have an event multiply categorized.

g **Easy to record.** Just ticking in a box rather than requiring recall of which of a large number of categories to use. Observers will, though, need to be completely familiar with the category system if they are to use it properly.

(Robson, 1997, p.213)

In developing the typology for this instrument Robson's considerations were observed in the following ways:

**Focus**

Focus was established by only categorising utterances which were examples of code-switching. These code-switching events were themselves categorised in relation to what type of utterance they were, e.g., statement, closed-question, open-question, etc. Any utterance which could not be categorised, (e.g., inaudible utterances and exclamations such as "Eeeh" which are not identifiable as a 'word' in any of the languages considered here) was coded under a 'residual utterance' category.

**Objectivity**

Objectivity was maintained by establishing a set of definitions for each utterance category. Utterances were only placed within a category if it was clear that they were an exact fit. Any indefinite utterances were recorded as members of the 'residual' category.

**Non-context dependence.**

In the development of the typology, the context within which utterances were made was ignored when placing utterances in categories. Development of the typology concentrated only on what type of utterance was being made, e.g., question, statement, directive etc, not on how or in what circumstances each was being used.

**Explicit definition.**

Definitions for categories are published in the table "A categorisation and description of code-switching interventions", found later in this chapter and which includes examples that fall within each category.

**Exhaustivity.**

Exhaustivity was achieved by incorporating as many distinct categories as were appropriate from the data available and then including the 'residual utterance' category to accommodate any utterance which did not fit within them.

**Mutual exclusivity.**

Mutual exclusivity was achieved by developing definitions of forms of intervention which could only include one type of utterance so that if an utterance was coded in one category it could not, by definition, also appear in another. As the categories are both mutually exclusive and exhaustive the coding system is an MEE system.

## 4.3 Identifying relevant code-switching categories

There is a useful literature concerning code-switching strategies, to consult for examples that might have relevance in the science classroom. Three authors were particularly helpful in this respect. Baker (1996), for instance, identifies thirteen 'purposes or aims' of code-switching in general speech. The typology constructed in this project is not intended to reflect purpose, nevertheless, Baker's list represents a useful starting point for reflecting upon code-switching in the classroom even if the majority of examples were, ultimately, rejected as not relevant.

**Figure 4.2 A list of 'purposes or aims' of code-switching in general speech**

1. Code-switching to provide **emphasis** of a particular point in a conversation.
2. Code-switching to provide a **substitute** word when an adequate one is not known in a language. For example a University student in Kenya may switch from Kikuyu to English to discuss geometry with his younger brother. 'Atiriri *angle* niati *has* ina *degree eighty;* nayo *this one* ina mirongo itatu'.
3. Code-switching **to express a concept that has no equivalent** in the culture of the other language.
4. Code-switching to **reinforce** a request. For example, a teacher may repeat a command to accent or underline it. "Please be quiet", "Open your books".
5. Code-switching as a repetition may be used to **clarify** a point. Some teachers in some classrooms explain a concept in one language, and then explain it again in another language believing that repetition adds reinforcement and completeness of understanding.
6. Code-switching to **communicate friendship or common identity.**
7. Code-switching when **relating a conversation** held previously, in the same language.
8. Code-switching as a means of **interjecting** into a conversation.
9. Code-switching to **ease tension and inject humour** into a conversation.
10. Code-switching often relates to **social distance.** For example, when two people meet, they use the common majority language (e.g. Swahili or English in Kenya).

As the conversation proceeds and roles, status and tribal identity are revealed, a change to a regional language may indicate that boundaries are being broken down.

11. Code-switching to **exclude** people from a conversation.
12. Code-switching may be used to indicate a **change of attitude** during the conversation.
13. Code-switching may be use regularly in some bilingual situations **for certain topics** (e.g. money), reflecting that a certain language is considered the language of commerce or education etc.

(Adapted from Baker 1996, p.87)

The first five categories in Baker's list (particularly 2, 3 and 4) are easily recognisable from within the code-switching strategies that occur in science lessons at Mida Primary School. However, concerns in respect of the need to account for context when considering purpose, in respect of individual code-switching interventions, meant that it was impossible to use these categories without modification.

Cleghorn (1992), studied the use of English and indigenous languages for "creating contexts for understanding" in three rural schools in Kenya. Cleghorn found, for instance, that three types of inter-language exchange occurred in Kenyan primary classes.

**Figure 4.3 Cleghorn's list of code-switching interventions observed in science lessons in three rural primary schools in Kenya**

a. code switching for simple repetition
b. single-word switching to provide critical vocabulary labels (local language to English) or to insert locally equivalent terms and concepts (English to local language)
c. word and phrase switching to provide more elaborate explanations (local language), with critical vocabulary and phrases (English) that were likely to appear on examinations.

(Cleghorn, 1992, p. 315)

Whilst Cleghorn's list does emerge from a study of code-switching within science lessons and, as such, includes recognisable examples from preliminary observations at Mida Primary School, it covers only a limited range of possibilities. There does not, for instance, appear to be a reference to code-switching during questioning. Questioning is such an important part of the meaning-making process in most science lessons that it would be unrealistic to think that they would not be utilised in Kenyan primary classrooms and that code-switching would not play a part in questioning.

Merritt *et al* (1992, p. 114), in a study of teaching in three primary Kenyan schools, identified 4 types of code-switching between English, Kiswahili and mother-tongue.

**Figure 4.4 Merritt *et al's* list of code-switching interventions observed in science lessons in three primary schools in Kenya**

*Type I consists of reformulation across codes, with no new information and no new instructions.* This usually occurs in a regular sequence: from English to Kiswahili to mother-tongue, suggesting a probable intent to make the content progressively more easily understandable. *Or* to be more insistent that some response on the part of the student(s) is required.

*Type II consists of codeswitching as the content of the activity or the textual information is moving along.* Here there is always something new, some progression in the discourse, that is contained in the codeswitched message. It seems that the non-English code is used not so much to clarify what might have been said in English, but rather as a communicative strategy to focus or redirect the attention of the students by changing modality.

*Type III consists of translation or word substitution within a sentence.* Here the pattern seems to ensure that the content of some portion of the lesson is clear. Sometimes it seems to be a technique for teaching or reinforcing the meaning of English words.

*Type IV consists of interactional particles:* discourse markers, classroom management routines and terms of address:

*Discourse markers:*

| | |
|---|---|
| Dholuo: | *Koro* (roughly 'now then' or 'so then') |
| Kiswahili: | *Haya* (roughly 'O.K. then') |
| English: | O.K; All right; Now |

*Classroom management routines:*

| | | |
|---|---|---|
| Dholuo: | *Kendo* ('again') | |
| Kiswahili: | *Jaribu* ('try') | *Sauti kubwa* ('big voice') |
| | *Tena* ('again') | *Mwingine* ('someone else') |
| English: | Try | Speak loudly |
| | Again | Someone else |

*Terms of address:*

| | |
|---|---|
| Dholuo: | woud/nyar ('son of/daughter of') |
| Kiswahili: | kijana Roughly 'young man') |
| English: | my sister, our brother, my friend, my dear friends, etc. |

(Merritt *et al,* 1992, p. 114)

Merritt's list and study broaden the range of code-switching interventions and account for aspects of the teaching role beyond that of the teacher as the 'explainer of concepts', e.g., the role of the teacher in the language development of the pupils. Helpfully, much of the data was gained from within science lessons. There is, however, again no reference to code-switching in, for instance, questioning and, except in some brief examples no explanation as to exactly how the code-switching is used to develop meaning.

It was, then, apparent from the start that the categories could not be exhaustive if they only included examples from the lists of Baker, Cleghorn and Merritt *et al*. Therefore, initially, a combination of relevant items from Baker's, Cleghorn's and Merritt *et al's* lists were used to construct a typology with the intention that it would be extended to include code-switching interventions apparent in the lessons that were not evident in their lists. An initial table of forms of intervention was drawn up which included categories for open and closed questions. This table was applied to analysis of the data with modifications being made to the table as required. In this way, categories within the typology were developed as the transcription and analysis proceeded. The resulting typology has, therefore, emerged from a lengthy process involving application of the typology to the data and restructuring of the typology in the light of new information over many cycles.

## 4.4 The development of the intervention typology

A number of versions of the code-switching typology have been constructed, tested and rejected or modified during the process of developing the typology utilised in analysis in Chapter six. Original versions attempted to identify code-switching interventions which were presented at single word, phrase, sentence and extended text (more than one sentence) levels. Although these versions helped to identify specific types of intervention, they failed when applied to analysis of code-switching interventions consisting of more than one sentence because, often, each sentence within the extended text represented a different type of intervention. One sentence could, for instance, provide a cognate or definition whilst the next presented a question. It was then, impossible to categorise an extended text code-switching event as one type of intervention.

In subsequent versions, attempts were made to order code-switching intervention types with respect to the contribution that it was thought that each made to the meaning making process. Individual code-switching intervention types were ordered as making a high, intermediate or low input to the meaning-making process. This approach was abandoned due to the subjective nature of the ranking system (there was no theoretical or evidential framework to support the placement of interventions in particular positions within the ranking). In practice, it was found that the contribution that each type of intervention made varied depending upon the context within which the intervention was presented. Interventions which were placed low down in the ranking, e.g., closed questions (because it was thought that closed questions offered little opportunity for pupils to consider the range of their knowledge and formulate more complex responses based on more detailed understandings of relationships between concepts) often made high contributions to meaning-making, if used skilfully. Another version tried to rank interventions in respect of the support provided to dialogic rather than authoritative discourse between teacher and pupils, in the mistaken assumption that dialogic interaction would always lead to better pupil understanding.

The final typology was assembled in recognition that it was important that the typology identified the type of intervention but did not attempt to describe how each contributed to the meaning-making process in isolation. The idea being that each code-switching intervention type could be considered as a distinct kind of tool available to

teachers in their efforts to help pupils construct meaning. How each contributed to the meaning making process would depend upon how the teacher used that kind of intervention at that particular point in the discourse. In certain circumstances, e.g., cognate provision, a part of the primary purpose of the intervention is implicit in its description, but when these interventions are considered in context it is clear that there are other facets to the functions of these interventions than just offering a word in mother-tongue with semantic equivalence to an English counterpart.

In order to better understand the teacher's use of particular interventions it would be necessary to identify a theory of explanation against which actual teaching could be analysed in order to make sense of actions (with the focus on code-switching to help meaning-making) in the classroom. As an analogy, the construction of meaning (meaning-making) could be considered to be akin to the construction of a structure e.g., a building. The theory for explanation will describe the strategies that are used by the builders (teachers and pupils) to successfully assemble the structure, e.g., survey of ground area first, foundations dug and established second, scaffolding to support the structure third etc. Teacher interventions would then represent basic tools at the disposal of the teacher for enabling the construction of the structure. Obviously, teachers could select and utilise a variety of tools in order to accomplish the same job. It is likely that different teachers would select different tools depending upon a variety of factors. This approach, therefore, could allow some consideration of the effectiveness of tool choice for particular jobs. Code-switching interventions are tools which allow the teacher to include all of the pupils in the construction process in a way that would otherwise not be possible because of the language barrier. Analysis would consider the point within construction that tools are used and how they are used. This 'theory of explanation' is detailed in Chapter five and is based around the premise that the structure under construction is the 'scientific story' or scientific way of viewing things. The typology that has been used in the analysis presented in Chapter 6 is presented in the following table "A typology of code-switching interventions", with each the linguistic features of code-switching interventions categorised, with examples.

**Table 4.1 A categorisation and description of code-switching interventions.**

| No. | Linguistic feature | Intervention description and examples |
|---|---|---|
| 1 | Closed question | Questions to which there can only one correct answer, e.g., "Kwa Kigiryama tunasema ni nini?" (In Kigiryama, what do we call these?) (Not those providing contextual links) Included in this category are questions to which there can only be two possible responses, e.g., "Ndio hvyo?" (Is that not so?) |
| 2 | Open question | Questions to which there can be more than one correct answer, e.g., "Maana yake ni nini?" (What is the meaning of this?) in reference to the meaning of 'Germination'. (Not those providing contextual links) |
| 3 | Thought completion prompt | Incomplete statement or sentence incorporating oral cues intended to stimulate pupils to utter words or parts of words that complete it, e.g., Tuna weza kuzigawanya tena hizi green plants katika makundi mwingine (intonation on mwingine and pause) mawili", (We further divide these green plants in to how many groups, another ….. two) |
| 4 | Confirmation or rejection | Teacher confirms or rejects pupil response but with no repetition, e.g., "Ndio", (Yes). |
| 5 | Repetition | Repetition of pupil response. (Exact repetitions containing no added or deleted Kiswahili or Kigiryama) |
| 6 | Contextual link | Statements, questions or words linking discourse to a familiar context, e.g., "What do you think will make these seed germinate in the shamba?". |
| 7 | Discourse link | Using, often single, words, to provide a linking thread through the discourse, e.g., "sasa" (now). |
| 8 | Cognate provision/definition | Provision of Kiswahili or Kigiryama words of semantic equivalence to English words or providing definitions of unknown English words, e.g. Moisture = Umande (Kiswahili) = Mnyevu (Kigiryama) |
| 9 | Rhetorical question | Question immediately answered by the teacher, e.g., "ile miti ile tunaikatakata na tunaizika wapi? Ndani ya mchanga.", (We take the cuttings and plant them where? In the soil.) |
| 10 | Direct lecturing | Lecturing only in Kiswahili or Kigiryama. |
| 11 | Direct lecturing | Lecturing in Kiswahili or Kigyriama that is a repetition of original lecturing in English. |
| 12 | Discourse directive | Any directive that manages pupil contributions to discourse, e.g., "Wanyoshe mkono" (raise your hands) for controlling the order and extent of pupil contribution or "Ndio", (Yes) whilst pointing at a pupil to elicit a contribution from them. |
| 13 | Activity directive | Any directive that organises the physical placement of pupils, the sequence of lesson activities, pupil engagement in activity, or management of 'off task' pupil behaviours e.g., side talk. (Not discourse or language development related), e.g., "Kila mutu ama yake?" (Everybody has got one? – in reference to seeds pupils are observing) |
| 14 | Speech directive | Any directive intended to develop pupil oral language skills, e.g., "Sema" (Say) asking pupils to repeat a particular word or part of a word, or "Tena", (Again), asking pupils to repeat the word or part of a word again. |
| 15 | Any other utterance type | Any utterance which cannot be coded in any of categories 1-14 above. |

**Figure 4.5 A typology of code-switching interventions**

**Primary functions** and types **of teacher code-switching intervention.**

| **Eliciting** | **Responding** | **Making links** | **Conveying information** | **Managing** |
|---|---|---|---|---|
| 1) Closed questions | 4) Confirmation or rejection of pupil response | 6) Contextual (external) | 8) Cognate provision/definition | 12) Discourse directives (Controlling talk) |
| 2) Open questions | | | 9) Rhetorical questions | |
| 3) Thought completion prompts | 5) Repetition of pupil response | 7) Discourse (internal) | 10) Direct lecturing (Kiswahili or or Kigiryama only) | 13) Activity directive (Controlling activity) |
| | | | 11) Direct lecturing (Repetition of of English lecturing in Kiswahili or or Kigiryama). | 14) Speech directive (Controlling language development) |

Interventions in this list can be re-categorised in groups of similar types of intervention as shown in the table below.

## 4.5 A more detailed review of categories

The following intervention types were either confirmed as being utilised by teachers in science lessons or were introduced to the typology because they emerged as new types from the observation data. Some examples of how particular interventions were used in the lessons have been presented. These are not intended to be exhaustive but to offer a view of an intervention in context.

### 4.5.1 Questioning interventions

**Open and closed questions.**

Reference to lesson transcripts confirmed the relatively frequent use of code-switching interventions in the form of open and closed questions. These were apparent from the beginning of lessons where, for instance, in the case of the lesson 'Factors affecting the germination of seeds', the teacher used the open question "What's germination?", early in the lesson in order to assess the pupil understanding of the term germination. No pupils responded and so the teacher, in a clear reference to the earlier open question in English asked "Maana yake ni nini?", (What is the meaning of this?) It was clear, then, that questioning interventions in Kiswahili were used to assess pupil prior and emerging understanding of scientific concepts.

Closed questioning strategies were used more frequently in what seemed to be an attempt to assess pupil ongoing understanding of concepts under discussion. These were apparent throughout the lesson, for instance, in the lesson 'Structure of a maize seed', pupils were asked (in reference to the appearance of a bean and a maize seed), the teacher asks "Are they the same?" in English and then "Ziko sawa sawa"? (Are they the same) in Kiswahili. Here closed questioning is used with reference to a particular artifact. More frequently than this though, closed questioning was used as a means of checking to see if pupils were keeping up with the scientific story. In such circumstances the pupils would be told something and then asked "Ndio hvyo?", (Is that not so?). Invariably, pupils answered "yes" to this question so that this seemed to represent the 'expected' response. For this reason, such questions were considered to be closed.

**Rhetorical questions.**

The use of rhetorical questions emerged as an unexpected code-switching intervention. Typically, a teacher would ask a question which related to a scientific concept but would then immediately answer it. It became clear, therefore, that this was primarily a way for teachers to transmit information.

**Thought completion.**

Thought completion prompts were another intervention type that emerged from the observation data. They are used relatively frequently and involve the teacher presenting an incomplete statement with a (universally recognised and understood) pause and intonation cueing pupils to utter the missing word or part of a word, often in synchrony with the teacher. In this way pupils were encouraged to complete the thought of the teacher. As these kinds of interventions request an oral input from pupils they are treated as questions. The teacher is, in effect, asking the pupil, "what is the correct word or part of a word for completing the gap in this sentence?". In this respect these interventions are like oral cloze procedure activities. These interventions can occur in English, Kiswahili or Kigiryama. In all cases pupils respond in the language that the teacher uses to present the intervention.

### 4.5.2 Responses to pupils

**Confirmations and rejections of pupil responses.**

Observation data revealed that teachers confirmed or rejected pupil responses to open and closed questions in a number of ways. For instance, it could be done by the teacher simply saying "yes" or "no" in Kiswahili or Kigiryama. A teacher might reject by ignoring a pupil's response.

**Repetition of pupil responses.**

Alternatively, the teacher could confirm or reject through an intervention which repeated the pupil response. If the teacher were repeating in order to confirm or reject then the repetition served to emphasise and reinforce the pupil response as either right or wrong.

This, inclusion of emphasis or reinforcement was seen as being different from teachers simply acknowledging the correct answer by saying yes or no. It added importance to the pupil response as if marking a key idea and indicating to pupils that it was central to the understanding of the scientific explanation. Sometimes teachers also repeated pupil responses in a tentative manner as if repeating it helped them to more carefully consider the response. For these reasons confirmations using yes or no (or equivalent indicators of rightness or wrongness) were treated as separate types from those where a repetition of a pupil response was uttered by the teacher.

### 4.5.3 Linking interventions

**Contextual links**

A contextual link is a use of language which helps pupils to place discussion concerning scientific ideas in a familiar setting. Typical of this is the use of the term 'shamba' (the name of the small farms that all pupils live on) by the teacher in the lesson 'factors affecting the germination of seeds'. The use of this term here helps pupils to visualise seeds and events in relation to seed germination in the context of their regular encounters and experience with seeds on the shamba. In this respect, these are generally links to somewhere or something outside of the lesson that is readily recognised and understood by the pupil and are therefore considered to be 'external' links. Contextual links are used regularly and frequently in lessons, as a way of helping to maintain the context within which the pupils are encouraged to think about the ideas presented by the teacher. As with cognate provision there is a degree of identification of function implicit in identification of this type of intervention. Cognate provision can be closely related to contextual linking in that cognates can also offer contextual links.

**Discourse links.**

Discourse links are 'internal' links between different sections of the scientific explanation or meaning-making process. They are often short (one word) interventions like "lakini", "but" which may indicate that an initial statement should be considered in reference to a statement following the use of the word 'but', or "sasa", "now", which can indicate that a

particular phase of the explanation is complete and meaning-making is moving on to a new phase.

### 4.5.4 Clarification interventions

**Cognate provision**

In this study cognates are considered to be Kiswahili or Kigiryama words which offer semantic equivalence to some unknown English word. The use of cognates is not surprising and was identified in the literature review prior to lesson observation and confirmed in practice. Where cognate provision also provides a contextual link, e.g., in the use of the term 'shamba' as discussed above, its first appearance in discourse is considered to be providing a cognate. In the lesson ' factors affecting the germination of seeds' the initial use of the word shamba is linked to the idea of a garden. Subsequent use is considered as being an example(s) of a contextual link because the pupils already know the meaning of the word.

In some circumstances, possibly when an exact cognate does not exist, the teacher defines a word. This can be done by using a few words to describe the word or there may be a more lengthy examination of the meaning perhaps by drawing on analogies.

**Direct lecturing (Form 10)**

Direct lecturing is any statement or series of statements which convey scientific information. There is no attempt to engage in discussion with pupils and in this respect it is authoritative in nature. The teacher uses the statements to inform pupils concerning some information that they have in respect of the scientific basis for events or phenomena. It is not unusual for rhetorical questions to appear amongst extended sections of direct lecturing as these are also interventions which convey information. In form 10 interventions the direct lecturing is presented in Kiswahili or Kigiryama before or instead of any attempt to present the information in English. Many examples of these interventions, and type 11 interventions, were found in the transcript data.

**Direct lecturing (Form 11)**

Form 11 direct lecturing interventions are identical to form 10 except that the information has first been presented in English so these interventions are repetitions.

### 4.5.5 Management interventions

**Discourse directives.**

Directives tell pupils what the teacher expects them to do and therefore are 'control' interventions. Discourse directives help the teacher to manage pupil contributions to discourse. Typical of these are interventions like "Wanyoshe mkono", "put up your hands" before answering, or "Wewe", "you", whilst pointing at or otherwise indicating a pupil to answer a question, or "Huko nyuma", "From the back", indicating that the teacher would like a response from pupils from the back of the room.

**Activity directives.**

Activity directives help the teacher to control what pupils do in a lesson rather than what they say. Typical of these are interventions like "Angalia hapa", "Look here", directing pupils to look in a particular direction or at something, or "Tutangojea", "We shall wait", in reference to a need to wait to see if seeds germinate in an experiment, or "Tutakuwa tukichungulia", "We shall be monitoring", in reference to the same experiment, or "Zi hesabu", "Count them" whilst asking pupils to count plant parts, etc.

**Speech directives.**

Speech directives were categorised separately in recognition of the importance of the language development role of the teacher within science lessons. Teachers expect to and are expected to develop English and Kiswahili language skills whilst teaching science. Teachers actively pursue this goal, not just by explaining the meanings of unknown words, but, by directing pupils to speak important words in order to practise their phonological representations. Speech directives, therefore, aim to control some aspects of the development of pupil language skills. Frequent examples are "Sema", "Say" a particular

word or part of a word. Sometimes using the word sema will set off a lengthy pattern of repeating the word after the teacher has said it. On other occasions the word "Tena", "Again", will be used to encourage the pupils to repeat saying a word.

## 4.6 Checking reliability

It is important that any coding system or typology can be utilised by the same or different researchers on all future occasions and produce identical results. If a system can do this it is reliable. There are a number of formal tests (Bell, 1999) that could be applied to the use of the typology in order to check reliability. As Bell points out, there are advantages and disadvantages with all tests and they are not always necessary. In respect of this typology reliability was established by presenting the typology, descriptions of code-switching interventions within the typology (with examples), a transcript and a completed analysis of the transcript using the typology, to the supervisor for this project for checking. Due to the very high level of agreement emerging from this test there was no further need to modify categories or descriptions of code-switching interventions. There was some minor and agreed modification to the positioning of code-switching interventions within the typology in order to better reflect their purpose, e.g., the category 'rhetorical questions' was transferred from the 'eliciting' section to the 'conveying information' section within the typology. This was done because, although initially presented as questions, the purpose of these interventions is to convey information because the teacher immediately supplies the correct response, i.e., there is no real intention to elicit a response from pupils.

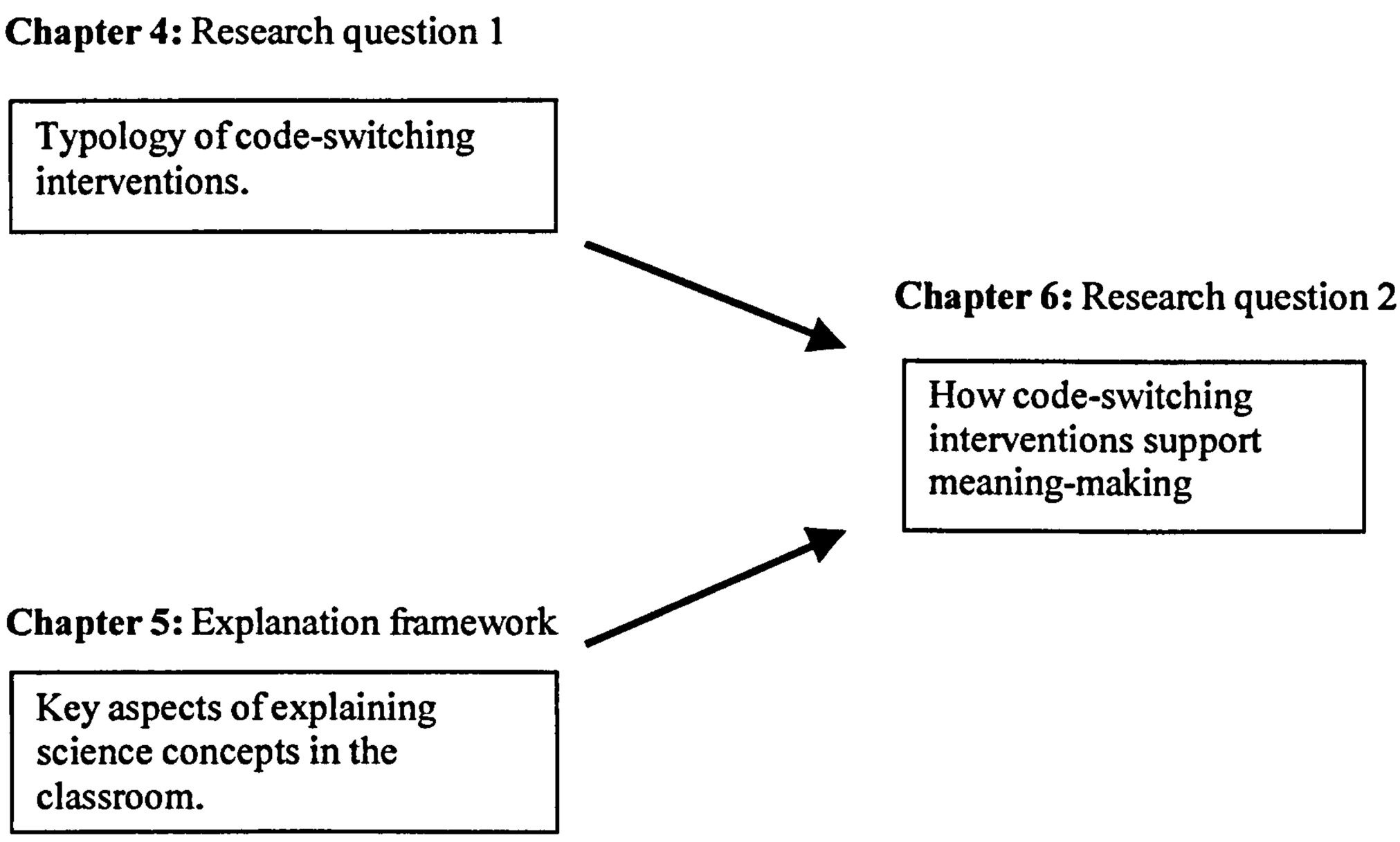
# CHAPTER 5

## KEY ASPECTS OF EXPLAINING SCIENCE IN THE CLASSROOM.

### 5.1 Analysing the contribution of each code-switching intervention to meaning making in science lessons.

The typology of code-switching interventions developed in chapter 4 provides answers to research question 1. In order to answer research question 2 a new framework must be developed, in this chapter, through which individual code-switching interventions can be analysed as to the contribution that each makes to the meaning-making process. In order to construct this framework it will be necessary to identify and organise the key aspects involved in explaining science concepts in the classroom. Research question two will then be answered by identifying how each code-switching intervention from within the typology is used to contribute to the meaning making process as set out in the new framework.

**Figure 5.1 The process for analysing the contribution of each code-switching intervention to meaning making in science lessons.**



## 5.2 A broad theoretical focus concerning teaching and learning and the role of the teacher

### 5.2.1 The importance of words and concepts

In order to understand how teachers help pupils to learn, it is important to understand how words operate as representatives of concepts and the greater meaning that can be created when groups of related concepts are correctly organised on the intrapsychological plane. Language is a powerful tool for learning because of this meaning-making power of words. This meaning making resource of language is called semantics. Lemke has this to say about semantics and its value in terms of helping to construct understanding.

> ...language is not just vocabulary and grammar: Language is a system of resources for making meanings. In addition to a vocabulary and a grammar, our language gives us semantics. The semantics of a language is a particular way of creating similarities and differences in meaning. We need semantics because any particular concept or idea makes sense only in terms of the relationships to other concepts and ideas. This web of relationships of meaning is woven with the semantic resources of language. (Lemke, 1990, p. ix)

Thus learning is about establishing meaning. This is true at a seemingly fundamental level i.e., for individual words or simple concepts, and at a more complex level where more involved concepts or relationships between concepts must be interpreted. For the most part this is accomplished by establishing, within our minds, meanings for words and groups of words.

Vygotsky emphasised the part played by words in enabling learning and their central place as the mediators of thought. Of vital importance to the process of thinking and learning is the establishment of meaning through use of the "word".

> To begin with the word must have meaning, i.e., a relation to a thing, there must be an objective relation between the word and what it means. If this is absent, further development of the word is

impossible. Then this objective connection between the word and the thing must be functionally utilised by the adult as a means of communication with the child. Only then does the word become meaningful for the child itself. Thus the meaning of the word first objectively exists for others and only afterwards begins to exist for the child himself. All the main forms of speech communication between the adult and the child later become mental functions.

(Vygotsky, 1986)

Here, as well as the importance of words and their meanings for thinking and learning, Vygotsky also identifies the social nature of the learning process and because what is being learned is a part of the relevant society's culture it is often referred to as a 'socio-cultural' theory of learning.

### 5.2.2 The social nature of learning

One of the roles of the teacher is to present information in a way which enables the process of meaning making within the child. Of the range of semiotic communication tools (words, diagrams, gestures, etc,) available to a teacher, Vygotsky insists upon the primacy of linguistic means in the development of higher mental processes (Tharp and Gallimore, 1988). It is important to understand that within the socio-cultural theory of learning semiotics, words, diagrams, dances etc, do not in themselves have meaning. That is, they do not come with meaning built in but that meaning has to be made for each. It is the process of creating this meaning which leads to learning.

Vygotsky identifies two stages of cognitive development and describes them in the "general genetic law of cultural development", which he formulated as follows:

any function of the child's cultural development appears on the stage twice, on two planes, first on the social plane and then on the psychological, first among people as an intermental category, and then within the child as an intramental category. This equally

> applies to voluntary attention and logical memory, formation of concepts and development of volition.
>
> (Vygotsky, 1986)

Here, Vygotsky asserts that the creation of meaning is a social process in that first the learner is exposed to meanings on the social plane, (the *interpsychological* plane - because it involves exchanges between people), primarily by the use of language. That is, the learner becomes engaged in discourse with some authority or 'expert' in the particular field of learning in question. This could be a teacher, a coach, an instructor, a group of other learners, a parent, a computer programme, a book, a television programme, etc, i.e., some representative of the wider society who can, whether as an individual or a group, present and interpret the understanding of society for that field of learning.

After meaning has been created for, for instance, a word, event or concept, that meaning is, so this theory of learning goes, internalized and fixed within the cognitive structures which already exist within the individual (the *intrapsychological* plane). The existing structure itself may have to change in order to accommodate this new information and in the future the position and status of the information newly integrated may be altered, in relation to the structure, in the light of other new information. Thus items of knowledge acquire a large amount of their meaning due to how they relate to other information within the cognitive structure.

Internalization is essential to the development of understanding then, but it is important to note that it is not just a process of taking information from the social plane and recording it unchanged within the cognitive plane. In other words internalization is not like making an audio or video recording of some outside event, fixing it into some memory resource so that later it can be reproduced in an identical form. With internalization the child reinterprets the information for him or herself in relation to what he or she already knows about matters relating to that subject and thus incorporates it into the cognitive structure in some modified form. It is this process of modification in relation to existing knowledge which is an indication of understanding. As Tharp and Gallimore put it:

> Thus, individual consciousness arises from the actions and speech of others. However, children reorganize and reconstruct these experiences. The mental plane is not isomorphic with the external plane of action and speech. As the

external plane is internalized, transformations in structure and function occur.

(Tharp and Gallimore,1988 p. 29)

### 5.2.3 The teacher's role

Vygotsky forwarded a theory of learning which involves the idea of *assisted performance*. Unassisted performance represents what a child can achieve in a particular area of learning without assistance from others. This will give an assessment of a child's current level of development with respect to this learning area and is a common method of diagnosing a child's level of ability and future learning needs. This unassisted level of attainment can be compared and contrasted with what a child might achieve with the assistance of an adult or, perhaps, a group of more able peers. The difference between the performance of a learner when assisted and unassisted, within any given task, Vygotsky called the Zone of Proximal Development.

> ...the distance between the actual developmental level as determined by individual problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers. (Vygotsky, 1978)

A vital part of the role of the teacher involves guiding pupils across the ZPD. The following sections describe and consolidate theories of how teachers might do this for groups of pupils. It begins by identifying what Scott (1998, p56) refers to as the "Teaching Narrative" or "Teaching Performance".

## 5.3 Constructing a framework for the analysis of key aspects of meaning-making in the science classroom

### 5.3.1 The teaching performance

Scott (1998, p. 56) has "developed a framework, based on empirical research", in which he identifies five forms of pedagogical intervention utilised by teachers when working with whole classes. Scott says that,

> These five forms of intervention are conceptualised as forming a 'Teaching Narrative' or teaching performance through which the teacher directs and sustains interactions in order to make the scientific view available to students. The concept of the Teaching Narrative is intended to provide an overarching theoretical structure which acknowledges the fact that teaching and learning science in the classroom occur over an extended time line with beginning and end points, and involve the teacher in laying a 'language trail' from students' starting points towards the learning goal of the scientific view.
>
> (Scott, 1998, p. 56)

Three important points are illustrated here. Firstly, there is recognition that the scientific point of view is rarely a discrete, isolated entity that can be revealed and learned from within the confines of a single lesson. Rather, the scientific point of view is one which is constructed over long time periods. This idea that knowledge is constructed over long time intervals is in keeping with Mercer's (1995, p.70) reference to the 'long conversations of teaching and learning'.

Secondly, there are start and endpoints to the process. These are partly determined by the teacher, but in doing so there must be reference to the current level of pupil knowledge which will determine the starting point, whilst the end point is likely to be determined by the teacher with reference to such issues as the demands of the curriculum, time, pupil ability etc.

Thirdly, that what the teacher is involved in doing can be considered to be a performance or an act in which the teacher 'directs and sustains interactions in order to make the scientific view available to the pupils'. This emphasises the social nature of the process where the teacher's role is, perhaps, akin to the conductor of an orchestra in which the input of individual instruments is managed in the classroom by different kinds of social/teaching interaction, e.g., questioning/assessing, conferring, accessing knowledge from different sources, demonstrating, lecturing, focussing attention, identifying significant points, etc. The teacher is not engaged in any simple kind of information transfer. In referring to this as the teaching performance Scott suggests that it takes the form of a *teaching narrative*. Such language suggests that the teaching involves the effective delivery of some kind of a story. The 'effective delivery' being aimed at allowing all of the pupils to perceive/access the main elements (concepts) of the story and to accommodate them within their current cognitive structures in respect of the issues under discussion. Scott's framework is shown below.

**Figure 5.2 The teaching narrative, major strands and forms of pedagogical intervention.**

**TEACHING NARRATIVE**

| | | | | | |
|---|---|---|---|---|---|
| **Major Strand** | *Developing scientific knowledge* | | *Supporting student meaning making* | | *Maintaining the narrative* |
| **Forms of Pedagogical Intervention** | 1. Developing the conceptual line:<br>▪ Shaping ideas<br>▪ Selecting ideas<br>▪ Marking key ideas | 2. Developing epistemological line. | 3. Promoting shared meaning | 4. Checking student understanding | 5. Maintaining the narrative |

(Scott, 1998, p. 56)

We can see that Scott identifies 3 major strands in the teaching narrative, *Developing scientific knowledge, Supporting student meaning making* and *Maintaining the narrative.* Within each of these three strands a number of 'forms of pedagogical intervention' have been described. Scott states that the first major strand, *Developing scientific knowledge*, is "directed towards making scientific knowledge available on the interpsychological plane". This strand is itself divided into two forms of intervention. *Developing the conceptual line* includes interventions aimed at 'Shaping ideas', 'Selecting ideas', and 'Marking key ideas'.

*Developing the epistemological* line involves helping pupils to understand the nature of scientific knowledge in relation to the concepts being discussed e.g., how science has arrived at current theory, how that theory might relate to conflicting theories from areas other than from science (like religion), or indicating that scientific knowledge is not fixed but has evolved over time and will do so again in the future and thereby restating that this is just one of many ways of looking at things. [Scott, however, notes that few examples of this kind of teacher intervention were recorded in the classroom-based research from which the framework was developed. He does state that the teachers frequent contrasting of the 'old (everyday) and 'new' (scientific) ways of explaining' (1998, p.57) represents an epistemological marker.]

*Supporting student meaning making* is accomplished through two forms of intervention *Promoting shared meaning* and *Checking student understanding* and involves making the scientific story available to *all* pupils and then checking the understandings that they subsequently develop. Scott lists the following examples of strategies that teachers might utilise to *Promote shared meaning*:

- Presenting ideas to the whole class,
- Sharing individual student ideas with the whole class,
- Jointly rehearsing an idea with a student in front of the whole class,
- Providing a spoken commentary to make explicit the thinking behind a specific activity they are engaged in.

In order to *Check pupil understanding* Scott suggests that a teacher might:

- Ask for clarification of student ideas,
- Check individual student understanding of particular ideas
- Check consensus in the class about certain ideas.

In the final strand *Maintaining the narrative* there is again reference to consideration of the content of the science lesson, the science point of view, as the 'science story'. Interventions in this strand are directed towards keeping pupils informed as to how the story is structured, how it will be delivered, where they have progressed to in the story so far, where they will be going next, etc. As Scott puts it this is "talk *about* the narrative rather than 'talking the narrative'".

Here then we have some ideas concerning the nature of teacher interventions which enable the delivery of the scientific story. Many of these ideas can be applied to consideration of the use of code-switching interventions within the lessons. However, given that one of the major concerns of this thesis is how code-switching helps develop conceptual understanding, it would be helpful to explore in more depth what is meant by the scientific story and how it is used to help make scientific concepts available on the interpsychological plane.

### 5.3.2 Considering the scientific 'view' as being analogous to a story

A number of authors (Sutton, 1992, Arnold and Millar, 1996 and Ogborn *et al*, 1996) have observed that the scientific point of view can be considered as analogous to the plot of a story. These authors recognise that the scientific point of view is frequently different to the views that learners currently hold about the phenomena or concepts they are studying in science lessons. Learners often begin from a 'common sense', 'spontaneous' or 'everyday' understanding of scientific phenomena that can be very different from the understandings that are accepted by the scientific community. If we asked a child to present his or her understandings about a particular physical/natural phenomenon prior to teaching we might receive an account that was plausible, (given the experiences the child had been exposed to in order to develop these understandings) but not in agreement with the

scientific view. We might, for instance, term the child's account 'the child's story', 'the learners' story' or the 'common sense story'. The ideas, presented by the science teacher, which may be radically different from the learner's current understandings, can be likened to the presentation of an alternative 'story', the *scientific story*.

It is important to understand that the science teacher may not present the scientific story in a science lesson in exactly the same way that an English teacher, for instance, might present a story in an English lesson. Nor is it suggested that a story is being used to contextualise a topic or part of a topic. It is the core ideas and the way that the scientific community has developed those ideas that represent the framework of the story. Hence, the reference in this thesis to the scientific view being analogous to the *plot* of a story. Arnold and Millar state:

> By the term "story" we do not wish to imply the use of a narrative as the context for development of scientific ideas, as in the work of Bransford and his colleagues on anchored instruction (Cognition and Technology Group at Vanderbilt University 1992). Our use of the term is intended to convey the complex and interrelated ideas which constitutes the accepted scientific explanatory framework for a particular domain of science education. The "story" that all matter is composed of invisible particles which behave in certain ways, or that diseases are transmitted by microscopic organisms, are examples. This usage of the term " story" corresponds closely to that of Sutton (1992).
>
> (Arnold and Millar, 1996. p. 250).

Sutton (1992) has identified the importance of the story as providing the central framework about which the *talking* part of the science lesson can evolve. He says that, in order to involve the pupils in debate about the story, it is important that the story is presented as a set of ideas about which there can be some discussion. They are not presented as fixed facts only to be memorised but not challenged. Sutton says:

> It is important that what I have called a **'Story'** or **Statement** ..... is not seen as an account of fact, but as an expression of thought by some *person* who can be identified or at least envisaged. It offers a point of view, a kind of explanation, a way of talking about the topic. It forms the principle part of the lesson.
>
> (Sutton, 1992, p. 73)

So science lessons can be considered to be like scientific stories in respect of their alternative *account* for natural phenomena, as presented through the scientific point of view. The story has a particular theme and incorporates some fundamental ideas/concepts that science/scientists have developed over time. Concepts, upon which the alternative account relies, and the understanding of them, are, therefore, central to the understanding of the scientific story. In order for scientific concepts to be understood they have to be explained. *Explanation* is, therefore, fundamental to the development of the conceptual line.

Ogborn *et al* (1996) use the idea of "scientific explanations as analogous to stories" as the basis for their theoretical framework concerning how language is used to develop scientific explanations in the classroom. Ogborn *et al* ask themselves the question "What makes a scientific explanation something that *explains?*" Their response highlights the way that a story might be used in an effective scientific explanation of why, for instance, it rains.

> If I ask why is it raining and you tell me that water is falling from the sky, I have been told only what raining *is*. If you tell me that it is raining because it rains a lot in April, I have been told only that it is usual and needs no further explanation. But a story about a depression coming across the Atlantic bringing wet air with it begins to do the job. Such an explanation tells how something or other comes about. This makes a scientific explanation very much like a story, even though it may not be told like a story.

(Ogborn *et al*, 1996, p. 9)

There are some clear features within such a scientific explanation that we can relate to stories as we would normally recognise them. Ogborn *et al* go on to identify these key features of scientific stories:

> Some vital features of a story are that:
>
> - There is a cast of protagonists, each of which has its own capabilities which are what makes it what it is.
> - Members of this cast enact one of the many series of events of which they are capable.
> - These events have a consequence, which follows from the nature of the protagonists and the events they happen to enact.
>
> (Ogborn *et al*, 1996, p. 9)

If we consider "a story about a depression coming across the Atlantic bringing wet air" (Ogborn *et al*, 1996, p. 9) which causes rain, then we immediately have some characters or 'protagonists' within the story to consider, i.e., a depression, an ocean, wet air and rain. We can begin to understand that these characters can/will have certain effects and can affect each other in particular ways for particular reasons. There is time referencing. Particular characters will do particular things at particular times. This gives the story some history because a *sequence* of events has occurred and *consequences* flow as one event has an effect which causes another event and so on, in time order. Put together we have the elements of an unfolding story which begins to explain *what* [protagonist] *did what* [event] *to what* [protagonist], *when* [time reference] *and why* [consequence]. This represents a system for the creation of meaning, for making sense of scientific phenomena, for explaining scientific concepts and understandings.

### 5.3.3 The 4 main parts to meaning-making in explanations.

A vital component of the development of the conceptual line is the 'making available of scientific concepts on the interpsychological plane' (Scott, 1998, p.57). The making available of scientific concepts on the interpsychological plane is considered, within this thesis, to be a major objective of code-switching and hence it will be considered in greater depth by referring to the work of Ogborn *et al* (1996). Ogborn *et al* have developed a theoretical framework for describing how teachers *explain* scientific concepts in the classroom. These explanations involve making such concepts available on the interpsychological plane and, as Scott identifies, contribute to the development of the conceptual line. Ogborn *et al* present a "theoretical framework" or "language for describing explanations" in the classroom which has three main parts:

- Scientific explanations as analogous to 'stories'
- An account of meaning-making in explanation, itself with four main parts:
  - creating differences
  - constructing entities
  - transforming knowledge
  - putting meaning in to matter
- Variations and styles of explanation

(Ogborn *et al*, 1996, p. 8)

The following tables (developed from the theoretical frameworks of Ogborn *et al*, 1996, p. 11-16) show, in more detail, the four main parts of meaning-making in explanation. Subsections, within each part, identify and describe (in italics) the focus of teacher interventions in each part.

**Figure 5.3 The focus of teacher interventions when creating differences**

**Creating differences**

**1. Checking student understanding**

*Establishing the current status of student understanding (common view) and determining that there is something different the students need to know, an alternative perspective (the scientific view).*

**2. Establishing differences between the common and the scientific view**

*Making students aware that the scientific view offers an (perhaps radical) alternative to their current view. Explaining the resources that a student will require in order to understand the scientific point of view.*

**3. Generating a learning appetite**

*Motivating students to want to 'cross the gap' between what students know now and what the scientific community 'knows'. Inspiring, pointing out curriculum or examination requirements, coaxing, demanding, rewarding, punishing etc.*

(developed from the theoretical frameworks of Ogborn *et al*, 1996, p. 11-13)

Following the creation of differences the entities that form the basis of scientific concepts must be constructed. The following table identifies and describes the focus of teacher interventions when entities are constructed.

**Figure 5.4 The focus of teacher interventions when constructing entities**

**Constructing entities**

**1. Describing protagonists**

*Describing the protagonists that play a part in the scientific story, e.g., if a teacher were explaining thermal conductivity they might need to describe atoms (or molecules), bonds and heat energy.*

**2. Revealing protagonist capabilities**

*Revealing the capabilities of protagonists, e.g. (from the above example) atoms can move, bonds join atoms in solids, heat energy can be acquired by atoms, etc.*

**3. Explaining how protagonists affect each other**

*Explaining what protagonists can do to each other e.g., heat energy can make atoms move, bonds can transfer movement from one atom to the next, bonds prevent (up to a point) atoms from moving too far out of position, more heat energy means more movement of atoms etc.*

**4. Talking entities into existence (Describing, labelling, defining)**

*By engaging in discourse and supporting activities (see next two sub-sections) which describe protagonists, reveal their capabilities and explain how they affect each other, entities can be constructed. The above example can be used as the basis for explaining how heat can be transferred from atom to atom down a bar of metal. The concept of thermal conductivity has been explained by talking in to existence entities involved in this concept.*

(developed from the theoretical frameworks of Ogborn *et al*, 1996, p. 13&14)

The 'entities' constructed here are, according to Ogborn *et al*, all 'new chunks of meaning', they go on to say:

> Just like real objects, abstract or formal ones get meaning from what they can do, what can be done to or with them, and what they are made from.

(Ogborn *et al*, 1996, p. 14)

The point is also made that these entities become thinking tools. They are not just facts about the way that things are, they themselves become ways of thinking about scientific concepts, instruments for the further exploration of scientific ideas, enablers of future understanding.

**Figure 5.5 The focus of teacher interventions when transforming knowledge**

**Transforming knowledge**

1. **Use of narrative to transform knowledge e.g. stories, personal experience, etc.**

*The use of stories within lessons to explain concepts or the development of concepts, perhaps, by the scientific community.*

2. **Use of analogy**

*Presenting equivalent, corresponding or similar examples to illustrate a concept, perhaps, in a more familiar way e.g., analogies of heat transfer by radiation, conduction and convection might use throwing, passing from student to student, or walking with a book from the front of the class to the rear, respectively.*

3. **Use of metaphor**

*Imposing meaning by use of 'figures of speech'. Use of non-literal language to evoke an image e.g., roaring flames, antagonistic muscles, igneous rocks etc.*

(developed from the theoretical frameworks of Ogborn *et al*, 1996, p. 14&15)

Ogborn *et al*, suggest that scientific ideas are transformed in a number of ways. Firstly, scientific understandings and explanations change over time. What we know and understand today is different from what we understood and knew in the past. This is reflected in the scientific and technological artefacts that surround us and represents one form of transformation. Ideas created in the scientific community are transformed to make them suitable for presenting to children within schools (in the construction of curricula and textbooks, etc). Teachers also transform knowledge in the ways that they reinterpret and present this information within the classrooms. The interventions within the box above,

essentially, represent some important strategies that teachers use in order to effect these presentational transformations. Pupils also transform knowledge when they modify their understanding on the intrapsychological plane.

**Figure 5.6 The focus of teacher interventions when putting meaning into matter**

**Putting meaning into matter**

1. **Use of practical activities.**

*Use of experiments or demonstrations designed to demonstrate a feature or process.*

2. **Use of images or other sensory input**

*Use of diagrams, photographs, video, computer generated graphics to demonstrate a feature or process.*

*Experiencing phenomena through use of other senses e.g., smelling a gas, tasting (e.g., starch turning into sugar – bread in the mouth), touch, hearing.*

(developed from the theoretical frameworks of Ogborn *et al*, 1996, p. 15&16)

Ogborn *et al*, describe these activities as attempts to show scientific ideas in action. They make the point that scientific theories often defy our everyday observations and consequent perception of the world. The sun, for instance, appears to be travelling around the earth when viewed, as we are forced to view it, from the earth's surface. Use of an Orrery can demonstrate the principle in a way that allows us to stand outside of the solar system and hence see the scientific idea in action.

### 5.3.4 A framework for characterising approaches to explaining scientific concepts in the Kenyan primary classroom

The role of the teacher in whole class teaching situations is to present new knowledge in such a way that the process of internalisation can happen as easily as possible for the largest possible number of pupils, then to check that the pupils have transformed their knowledge base accurately. The teacher's role in this process can involve language-based teaching approaches aimed at making the information 'psychologically real' for the pupil, i.e., placing scientific theory within contexts that are familiar to the pupil by the use

of language. When teachers use stories, personal experience, discussion, cultural referents etc, the whole point is to anchor theory within some mutually understood language-based framework. Analogy may use language to compare an abstract scientific theory, with which the pupils may not be familiar, with a representative model that they understand more completely because they have had some experience of it. Metaphors incorporate words which pupils have experience of and which construct mental pictures for them (see Sutton, 1992, p. 24-5 for a discussion of the importance of metaphor in science language and teaching).

"Putting meaning in to matter" i.e., the use of practical demonstrations, experiments (as they are generally used in school science), etc are simply ways of enabling the visualisation of some aspect of scientific theory in action. Memory of these experiences helps pupils to attach a *mental image* of the concepts operating as suggested by theory within their knowledge framework on the intrapsychological plane. Because having access to mental images of concepts in action is so important for enabling understanding of concepts I would also include the use of photographs, diagrams, videos, graphical computer presentations, in fact any image that illustrates a theory or concept working, in this category.

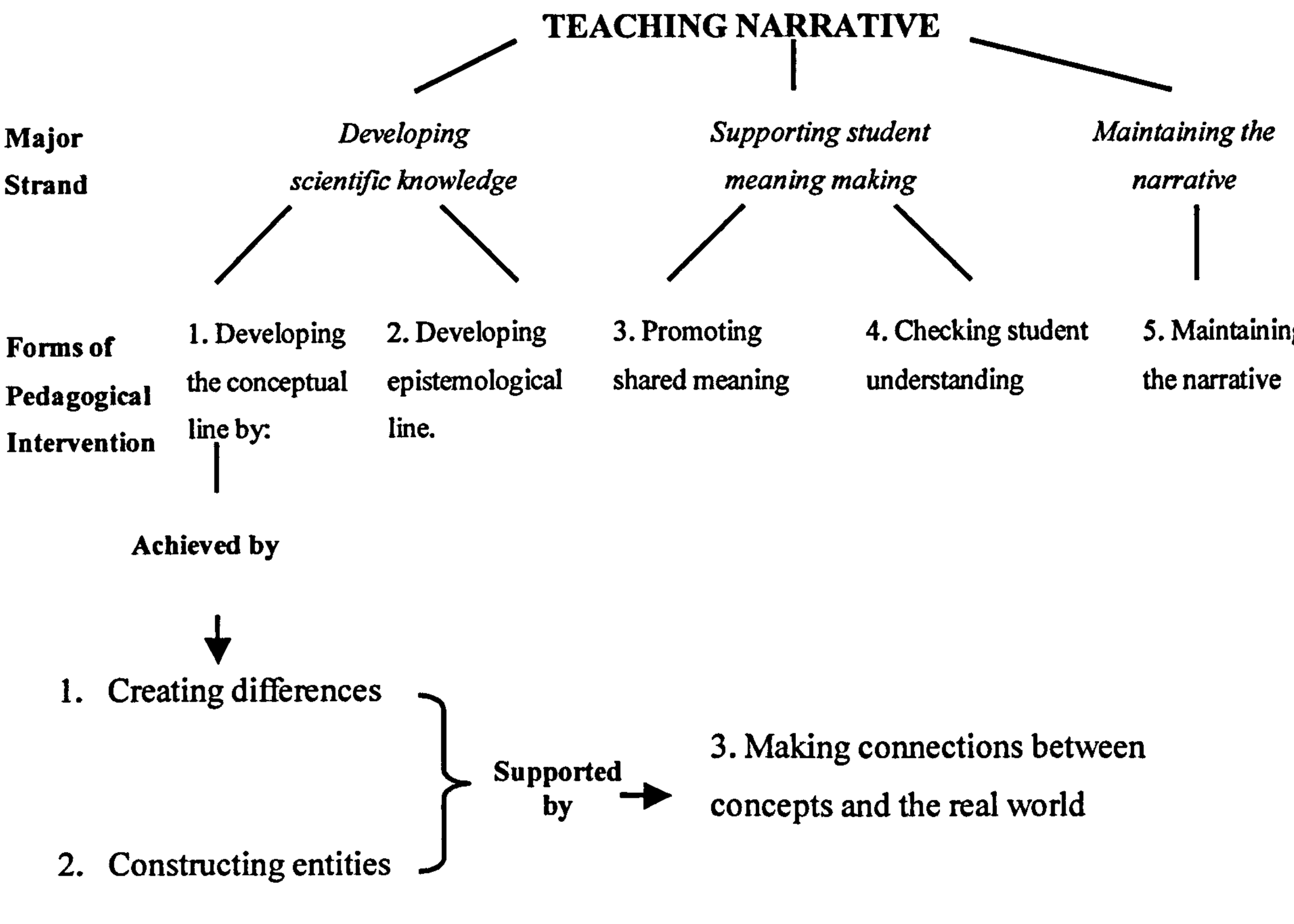
Presenting scientific concepts in ways that make them more accessible to pupils through the use of language or images helps pupils to transform knowledge on the intrapsychological plane. Hence, I have incorporated the two categories "transforming knowledge" and "putting meaning in to matter" into one category, "Making connections between concepts and the real world", with two sub-branches that highlight the language and image focused approaches. This single category is shown in the table below.

**Figure 5.7 The focus of teacher interventions when making connections between concepts and the real world**

| **Making connections between concepts and the real world.** |
|---|
| A. Primarily through the use of language.<br>1. Using narrative to present knowledge e.g. stories, personal experience, cultural referents etc.<br>2. Using analogy<br>3. Using metaphor<br>B. Through the presentation and translation of images.<br>1. Providing a commentary for explaining practical activities, demonstrations or experiments.<br>2. Providing a commentary when using images – diagrams, photographs, pictures, models, etc. |

The resulting framework for analysing explanations in science classrooms has been assembled by combining and modifying the theoretical frameworks presented by Scott and Ogborn *et al* as shown in the figure below.

**Figure 5.8 A framework for the analysis of key aspects of meaning-making in the science classroom.**




(Developed through the combination and modification of frameworks from Scott, 1998, p. 56 and Ogborn *et al*, 1996, p. 11-16)

This framework will be used in chapter six to analyse the contribution made by each code-switching intervention to the meaning-making process as described at the beginning of this chapter. Its reliable use in analysis has been checked via the same mechanism and at the same time as the reliability of the code-switching typology as described at the end of Chapter 4.

# CHAPTER 6

# ANALYSIS OF CODE-SWITCHING INTERVENTIONS IN LESSON TRANSCRIPTS.

## 6.1 Introduction

The analysis presented in this chapter is intended to demonstrate the effective utilisation of the instrument and to identify how different code-switching interventions contribute to the meaning making process. Initially, the instrument was applied to produce a detailed analysis of one transcript (transcript 4) which is presented. Summary tables of findings produced by application of the instrument to the remaining 5 transcripts are also presented. Transcript 4 was chosen because it included the most complete post observation interview data from the teacher of all transcripts. The information gained from this interview adds considerably to analysis of the function of the code-switching interventions used in the lesson.

The lesson also addressed scientific theory with a large section where theory was applied to a practical context when a planned experiment was discussed with pupils. Incorporated prior to presentation of the analysis of transcript 4 is context information with respect to teacher B who teaches the lesson. This contextual information is intended to provide some answers to the remaining research question stated below.

3. What are the contextual factors that might influence the use of code-switching by individual teachers?

There is discussion of further contextual information later in the chapter along with summary tables of the information gained from the self-assessments and questionnaires.

## 6.2 Analysis of the lesson transcripts

### 6.2.1 A detailed analysis of transcript 4. Teacher B

Teacher B's specialist subject is science. He has been teaching in primary schools for twenty-three years. Teacher B has had training in English as a second language teaching

strategies during his initial teacher training and received INSET in this area 4 years prior to this study. Teacher B's mother tongue is Kichonyi and he rates his English, Kiswahili and Kigiryama proficiency very highly in all aspects on the self-assessments. He uses Kiswahili and Kigiryama less frequently than many of his colleagues in science lessons.

**Table 6.1 Summary of teacher B language proficiency self-assessment**

| Teacher B<br>Skill/Language | English | Kiswahili | Kigiryama |
|---|---|---|---|
| Understanding | 6 | 6 | 7 |
| Speaking | 6 | 6 | 6 |
| Reading | 6 | 6 | 6 |
| Writing | 6 | 7 | 6 |
| Scale for assessment | No ability | 1 2 3 4 5 6 7 | No Difficulty |

### 6.2.2 Lesson title and theme

The following lesson was titled "Germination of seeds". This title was written on the blackboard at the beginning of the lesson. The lesson was taught by teacher B to class 4x on 28/02/01 during period 6. It followed a series of lessons on the structure and functions of various parts of maize and bean seeds.

Despite the more limited nature of the title, this lesson was aimed at investigating, by discussion, the factors which affect seed germination. For the purposes of this lesson, the factors that affect seed germination are water, warmth and oxygen (air). Note that the process of germination and factors that affect it are studied at their most basic level. There is no intention of breaking germination down into sub-processes or to study the biochemistry of the process. All pupils are familiar with seed germination in practice from their experience of growing plants on their family farms (shambas). The protagonists in the story are detailed in the following table. Note that the protagonists and capabilities described in the table are as depicted by the teacher in the lesson itself and may or may not represent currently accepted scientific theory.

**Table 6.2 A description of protagonists presented in the scientific story in the lesson "Germination of seeds"**

| Protagonist and (entity type) | Capability | Affect on other protagonists |
|---|---|---|
| Seed (physical – living organism) | Can grow into a young plant | Absorbs water, warmth and oxygen. Is the focus for the process of germination. |
| Small leaves (physical – living organism) | Can grow out of the seed | Changes appearance of seed. |
| Germination (process) | Will transform seed into a young plant. | Transforms the seed into a young plant. Uses water and oxygen. |
| Water (physical – non-living material) | Can be absorbed | Enables germination. |
| Warmth (physical – state) | Can warm seed | Enables germination. |
| Oxygen (physical – non-living material) | Can be absorbed | Enables germination. |

### 6.2.3 The structure of the scientific explanation within the lesson

This lesson was of 35 minutes duration. Within it 241 separate teacher utterances were recorded. Three distinct sections have been identified within the lesson and are detailed below.

Section 1: From utterance 1 to 89. This section is concerned, predominantly, with creating differences in respect of pupil understanding of the process of germination and factors which may affect it and the scientific story in relation to the same. There is some construction of entities, and some making connections between the concepts considered and the real world. Essentially, however, this section is an exploration of what pupils do or do not know already about germination and a revelation of a scientific view which differs

radically from the pupil view. This section, then, sets up the rest of the lesson. It provides the reasons why the lesson must be pursued.

Section 2 : From utterance 88 to 162. This section is concerned, predominantly, with the construction of entities with support coming almost exclusively from making connections between concepts and the real world through the use of language-based means. Here, the teacher uses analogies from pupil experience outside of school, within little stories, to convey the meaning of important vocabulary hence helping to better describe protagonists and make-meaning.

Section 3 : From utterance 163 to 233. This section is concerned, predominantly, with the construction of entities with support coming almost exclusively from the making of connections between concepts and the real world through the use of image-based means. Here, the teacher uses diagrams extensively to describe an experiment to explore the factors which affect germination. The expected results of the experiment are discussed and illustrated and a promise is made to conduct it in the following lesson.

Each section will now be analysed in respect of, firstly, how the teacher uses English to introduce and explain the scientific view. This will be done by identifying the various types of code-switching event from within the typology and then referring to the framework for explanation in order to provide the context for more accurate analysis of particular code-switching events which occur within each phase of the explanation. Throughout the analysis examples of code-switching from the typology which identifies their primary purpose are recorded in bold. The secondary purpose, as identified by analysing the use of these interventions with reference to the meaning making framework developed in Chapter 5 is recorded in italics.

## 6.3 Section 1 : Creating differences.

### 6.3.1 Using questioning strategies to explore pupil understanding

In utterance 1 Teacher B tells the class that the lesson is about the "germination of seeds" and he writes this on the blackboard (see figure 6.1).

**Figure 6.1 Transcript from a section of the lesson "Germination of seeds", utterances 1-7**

| No. | Speaker | Utterance in :- English Swahili Giriama | Post observation interviews - Teacher comments *(*Swahili, Giriama). Interviewer comments/statements. *Other classroom observations.* |
|---|---|---|---|
| 1 | T | Ok. Now today we want to see something about germination. Germination of seeds. Say "Germination of Seeds". | *"Germination of seeds", written on the board* |
| 2 | P's | Germination of seeds | |
| 3 | T | Germination of seeds | |
| 4 | P's | Germination of seeds | |
| 5 | T | Germination of seeds | |
| 6 | P's | Germination of seeds | |
| 7 | T | Now we are looking at Germination. What's germination? Who can tell me germination? What does it mean? What does germination mean? | *A brief silence following these questions - no pupil response.* |

If utterances 1-8 are examined (see also page 84), it can be seen that, as the discourse between the class and Teacher B develops, pupils do not understand this introduction as no clear explanation of the term germination is forthcoming from the pupils. It is not understood from the point of view of the pupils not being familiar with this English terminology nor from the conceptual viewpoint i.e., although pupils are aware that plants 'grow' from seeds, they do not understand the range of scientific concepts that are represented by the term 'Germination'. This introduction, then, represents an example of Teacher B 'making a promise' (Ogborn *et al,* 1996, p. 29) to the class. Teacher B is confident that the process of germination represents new knowledge to the pupils. He, thus, begins his lesson by making a statement concerning the new knowledge and understanding that is to be considered during the lesson and is, hence, *creating differences*.

Understanding the pupils' limited English proficiency and lack of familiarity with the terminology, (see teacher interview comment at utterance 8 in figure ii]) Teacher B begins the necessary process of English language development. In utterances 2-6 he encourages the pupils to practice the phonological representation of the term "germination of seeds" in order to develop pupil English speaking skills. This practice also begins to *construct entities* in respect of the scientific term 'germination' as a first step in a more

detailed explanation which will occur later in the lesson. However, if the pupils are to be able to discuss a concept they must have spoken terms that label it. The pupils have been given the *label* (name) of the process they are to consider during the lesson. They have also been allowed to practise using it so that they can be proficient users of it during subsequent discussions. As yet there has been no description of this process and pupils are not even told that it is a process. Nevertheless this labelling represents the beginning of *talking the entities into existence.*

In utterance 7 Teacher B continues the process of *creating differences* in respect of the scientific meaning of the term germination and the pupil's knowledge of it. The open questions, which follow the statement "Now we are looking at germination", contribute towards a number of the interventions associated with creating differences. These questions allow Teacher B to *establish the pupil view* of the process of germination prior to teaching. After all, it could be that the pupils have a thorough understanding of the concepts. The lack of pupil response, however, indicates that they may not understand this term. The questions also allow Teacher B to *generate a learning appetite* by *communicating that there are differences* between what the pupils know now and the scientific understanding that Teacher B has. This gives Teacher B the reason for presenting the rest of the lesson. If a pupil or, more reasonably, a large number of pupils were able to offer a perfect, or near perfect, account of the process of germination at this stage Teacher B would need to present a different lesson – there would be no knowledge gap to bridge.

It could be, of course, that the reason that pupils do not respond to the question is that they simply don't understand the English. Again, Teacher B is aware of their limited language proficiency and uses his first code-switching event to overcome the obstacle. Utterance 8 "Maana yake ni nini?" ("What is the meaning of this?"), presented twice, is an **open question** which itself refers to the series of open questions concerning the meaning of the term germination presented in utterance 7. Combined, they invite the pupils to reveal anything that they may know about the process of germination.

**Figure 6.2 Transcript from a section of the lesson "Germination of seeds", utterance 8**

| No. | Speaker | Utterance in :- English Swahili Giriama | Post observation interviews - Teacher comments *(*Swahili, Giriama). Interviewer comments/statements. *Other classroom observations.* |
|---|---|---|---|
| 8 | T | Maana yake ni nini? Maana yake ni nini? | They are not responding, so I am going now to talk in Swahili. What is it's meaning or the meaning of germination. I have asked the question for so long but I have asked the question and they are looking at me as if I am asking them in a language which they do not completely understand. So I have to vary my language. I wanted to find out if they knew what germination is. They know what germination is but the word to them is what they don't know. (Teacher confirmed that pupils had seen germination happening but that they would not associate the word "germination" with the process). |
| 8 | Trans. | What is the meaning of this? What is the meaning of this? | |

Hence, this is a code-switching event which offers major support to the *creation of differences* because it has the potential to reveal all possibilities in relation to the current state of pupil understanding. Teacher B clearly feels (see interview comment at utterance 8) that the pupils do have an everyday understanding of what germination is but that the English language is acting as a barrier to their engagement in discussion about it. It is likely that the pupils do not understand the scientific view of the process of germination at this stage because Teacher B fails to elicit an acceptable response with this Kiswahili question.

### 6.3.2 Using 'clarification' strategies to construct entities and lay a foundation of meaning

We have seen in the first analysis of code-switching interventions above, which help to create differences, that between utterances 8 and 13 pupils have an opportunity to reveal what they know about germination but cannot. The teacher, however, feels that pupils do understand what germination is in terms of plants growing from seeds (see teacher interview comment at utterance 8 in figure ii]). He must now clarify this and link it to the term germination because this lesson is not about what germination is but what factors can

affect germination. It is necessary that the teacher spend some time *constructing entities* in respect of the term germination, in order that the pupils have a foundation of understanding in respect of this term before they go on to consider factors which might affect it.

**Figure 6.3 Transcript from a section of the lesson "Germination of seeds", utterances 14-47**

| No. | Speaker | Utterance in :- English / Swahili / Giriama | Post observation interviews – Teacher comments (Swahili, Giriama). Interviewer comments/statements. *Other classroom observations.* |
|---|---|---|---|
| 14 | T | Germination of seeds. When we talk about germination of seeds we … Kuota kwa mbegu | Kuota Kwa Mbegu means germination of seeds. (Teacher agreed that he was confirming the subject matter for the pupils in their own language.) |
| 14 | Trans. | Germination of seeds | |
| 15 | T | (Something inaudible) Kuota | |
| 16 | P's | Eh or Yeh | |
| 17 | T | Kuota kwa (pause) | |
| 18 | P's | Mbegu | |
| 19 | T | Kuota kwa (pause) | |
| 20 | P's | Mbegu | (Teacher explains that pupils in class 1-3 are exposed to large amounts of Swahili and some "vernacular" (Giriama). So in class 4, at the beginning of the year, they do not have much language experience. So they have to be introduced slowly to learn and to understand some facts by letting English words into Swahili, letting the Swahili words into whatever you want them to understand. When you are teaching in primary school you have to start from something that you know and then you go to whatever is unknown. That is the introduction part of it. You cannot go to a class and say "this is germination" without having a recap or revision. If you are talking about vegetation from Embu or Nairobi area you have to begin with the vegetation of this area and go outwards. That is what we are supposed to do, that is the professional aspects when we teach. The problem with class 4 is that the children do not know much English language. So whatever you are trying to introduce to them in English you have to start with the Swahili aspect and then go slowly, but you have to translate and begin in the Swahili. |

| | | | |
|---|---|---|---|
| 21 | T | When you plant seeds, in your garden, after some days they germinate. They do what? | |
| 22 | P's | Germinate | |
| 23 | T | They do what? | |
| 24 | P's | Germinate | |
| 25 | T | They germinate | |
| 26 | T | Some small leaves will start coming out, isn't it? | |
| 27 | P's | Yes? | |
| 28 | T | And that is called germination now. That is called what? (pause) | |
| 29 | P's | Germination | |
| 30 | T | Germination (Uttered simultaneously with pupils) | |
| 31 | T | When you get some seeds of beans and some seeds of maize and you dig a hole on your garden or in your shamba and you put those seeds in there. After some uh….. How many days? | |
| 31 | Trans. | Garden | |
| 32 | P | Five | |
| 33 | T | Five days or four days. They will start to what? | |
| 34 | P's | Germinate | |
| 35 | T | Germinate (Uttered simultaneously with pupils) | |
| 36 | T | Small leaves, very small leaves will come (pause) | |
| 37 | P's | Out | |
| 38 | T | Out (Uttered simultaneously with pupils) isn't it. | |
| 39 | T | Now that is what we call GER-MI-NATION. GERMI (pause) | |
| 40 | P's | Nation | |
| 41 | T | Nation (Uttered simultaneously with pupils) | |
| 42 | T | Say germination again | |
| 43 | P's | Germination | |
| 44 | T | Germination | |
| 45 | P's | Germination | |

| | | | |
|---|---|---|---|
| 47 | P's | Germination | Now I am teaching also English. When I am teaching science I am also teaching English because that word to them is a vocabulary, they don't know it. So, if I want my lesson to be understood properly I have first of all to explain the terms I am using in swahili so that they understand them. After they understand the terms we know we can now go ahead with them, we are now together. But if I just continue teaching those terms even though they've no understanding they will not be able to cope with the situation. So I am acting there now as grammar teacher teaching science vocabulary and then I make them follow whatever I want them to to grasp from my topic. Now the English teacher is the person who is supposed to teach in English, explain everything in English because we are depending upon him now. Within science or maybe geography or whatever I can use swahili or whatever. But usually it is not allowed to express the word in swahili or vernacular because he is the person who is asked to ********** ???? (inaudible) on the language. |

In utterance 14 the Teacher B engages the pupils again by providing a Kiswahili 'equivalent' or cognate for the term germination. "Kuota kwa mbegu" means "Growth for seeds" but can be interpreted as 'Germination of seeds'. Essentially, the teacher is using a clarification strategy, utilising language that pupils understand to help make-meaning for the term germination. The fact that it is not an exact cognate illustrates the difficulties posed when translating from one language to another when scientific words in English have very precise meanings which may not be reflected in the generalised vocabulary of the L1. Growth is one aspect of a more complex process, germination.

This does not matter too much at this stage as germination is, essentially, about the growth of seeds, it is likely to be what pupils have experienced from their home lives in respect of seeds and it is what the lesson is going to be about. Hence, this **cognate provision** supports the *creation of differences* because it helps pupils to consider what they already know about seeds by giving some clarification of the meaning of germination and, hence, helps to begin the process of *constructing entities.*

What the pupils can gain from this is that here is a lesson about something that Teacher B knows that the pupils are very familiar with, i.e., seeds. There is, however, a special

scientific name for whatever it is to do with seeds that they will study. Germination (the process) and seeds (physical entities) are the first *protagonists* of the scientific story. Growth is a capability of one protagonist (the seed), which occurs when the other protagonist (germination) affects it.

This foundation of understanding is pursued with pupils from utterances 21 through to 47. At utterance 21 the teacher begins to support his entity construction by making connections between the concept of germination and the real world by placing the discussion within the context of a garden. "When you plant seeds, in your garden, after some days they germinate", links the scientific terminology to everyday experience. Most Kenyans, however, do not have 'gardens' as such, but smallholdings, upon which most of the families' food requirements are grown. Children play a major role in managing these 'shambas'. The word 'garden' would be a relatively foreign term, which does not properly fit these plots of farmland. Pupils would use the term 'shamba', as a matter of course. Hence, at utterance 31 the teacher, in recognition of possible misunderstandings, links the word 'shamba' to the concept of a garden, thereby again **providing a cognate** which offers clarification.

This section also involves language development because the phonological representations of new terminology are practised and simple meaning is attached. The way in which meaning is attached, i.e., by use of the Kiswahili "Kuota kwa mbegu", and the references to planting seeds in their own gardens represent examples of *making connections between concepts and the real world.* In this respect it is arguable that many cognate provision interventions are also contextual links, because, as well as translating, they may, simultaneously, make links to the everyday world of the pupils. Cognate provision can often be seen as an example of a single intervention with more than one function. The word 'shamba' is used frequently in the rest of the transcript and, as it has already been defined as a garden in utterance 31, is considered to be a contextual link to settings outside of the classroom in all further incidences of use.

### 6.3.3 Using clarification strategies to help create differences.

Having spent some time constructing the entity germination, the teacher now returns to creating differences. From utterance 48 to 65 the teacher explores the pupil understanding of factors which may affect germination.

**Figure 6.4 Transcript from a section of the lesson "Germination of seeds", utterances 48-65**

| No. | Speaker | Utterance in :- English Swahili Giriama | Post observation interviews - Teacher comments (Swahili, Giriama). Interviewer comments/statements. *Other classroom observations.* |
|---|---|---|---|
| 48 | T | Ok. Tell me, when we want to plant seeds. If you put them in your pocket would they grow? Would they grow? Do they germinate if you put them in your pocket? | |
| 49 | P's | No | |
| 50 | T | They wouldn't grow, they won't grow. Why? Why don't they grow in the pocket? You take maize seeds and then bean seeds, put them in your pocket and wait for five days. Then you look at them. Will they germinate? | |
| 51 | P's | No | |
| 52 | T | They won't germinate. | |
| 53 | P's | No | |
| 54 | T | OK, if you take them and put them in your bag, for 5 days or 3 days or 4 days .... Will they germinate? | |
| 55 | P's | No | |
| 56 | T | No. If you take them in your house and put them on the table for 5 days ... will they germinate? | |
| 57 | P's | No | |
| 58 | T | No. They can't germinate. Now if you put them now in your garden. If the rain has rained. There is some rain. You put your seeds. You put them in the ground. You dig a small hole. Put them in the hole, uhu? A small hole, you know what a hole is? | *No obvious pupil response.* |

| | | | |
|---|---|---|---|
| 59 | T | Shimo. Chimba shimo kidogo, mumepanda, nini? (pause) Mbegu. | So you were just clarifying for them that they dig a hole put the seeds in. Yeh, yeh. You dig a hole you put a seeds. Tingiza??? shimo, (You dig a hole) weka mbegu (plant the seeds). So that is Swahili and English. And you did that because when you mentioned in English that you dig a hole for the plants you could see....? Yeh I could see from their faces, it was all dark on their faces. |
| 59 | Trans. | Hole, dig a small hole and plant what? Seeds. | |
| 60 | P's | Mbegu | |
| 60 | Trans. | Seeds | |
| 61 | T | After four days, if you look at them, what will happen? | |
| 62 | P's | Germinate | |
| 63 | T | They will germinate, isn't it. | |
| 64 | P's | Yes | |
| 65 | T | They will germinate | |

During utterances 48 to 57 Teacher B uses closed questioning in English to find out if pupils think that seeds will germinate if left in their pockets, in a bag or on a table for an appropriate length of time. In all circumstances the pupils (several of them) respond "No".

Through utterances 58 to 65 Teacher B describes the planting of seeds in a shamba and asks the pupils if they think that the seeds will germinate there. The response from the pupils (several of them) indicates that they think that the seeds will germinate.

From utterance 48 to 65 Teacher B is exploring the pupil common-sense view that has developed via their personal experience of seeds and seed growth. He is, initially in English but then in Kiswahili, *making connections between concepts and the real world.* In utterance 58 he has introduced two new protagonists, rain and a hole, in relation to conditions for germination. He is beginning to make suggestions about the necessary conditions for germination. At this stage the teacher recognises a language difficulty for pupils. A "darkening" of pupil expression (see teacher interview comment at utterance 59) suggests that pupils do not understand the English word 'hole'. Hence, utterance 59 first uses **cognate provision** to clarify the meaning of the word hole. This is a more straightforward cognate provision than seen so far as 'hole' (English) and 'shimo' (Kiswahili) have greater equivalence than garden and shamba or kuota and germination. The teacher then reinforces this by providing a **rhetorical question**, "Chimba shimo

kidogo, mumepanda, nini? (pause) Mbegu." (Dig a hole and plant what? Seeds). This intervention illustrates the real purpose of the rhetorical question, i.e., to convey information. The teacher uses the question to set up the delivery his own 'correct' response, hence conveying the information he wishes to. For this reason, Rhetorical questions, although originally placed as Eliciting interventions in the typology, were re-positioned to now be regarded as **clarification interventions** because they allow the teacher to communicate information. There is a valid questioning element to these interventions too because pupils usually respond to them too, as they do in this case.

These interventions support the *establishment of the pupil view* concerning the conditions necessary for germination. It is arguable that they also support the *construction of entities* by explaining what a hole is, however, the presence of a hole does not represent an essential condition for germination and hence is not a part of the scientific view.

### 6.3.4 Using questioning strategies and links to help create differences.

In the section just described the teacher has explored pupil understanding of factors affecting the germination of seeds. He has done this in a general sense, i.e., asking if pupils think the location (pocket, bag, shamba, etc) that seeds are placed in will affect the likelihood of germination. In the next section he explores the factors more specifically. He does this by asking pupils about what it is in a certain place that will enable germination. To complete the creation of differences the teacher will identify that the scientific view recognises that there are specific factors necessary for the germination of seeds. This will end the creation of differences section and set up the construction of entities sections when these factors will be identified, contrasted with the pupil view and explored in more depth.

In utterance 66 Teacher B uses the Kiswahili term "Shamba" as a **contextual link.** Use of the word shamba offers a link to a rich source of personal experience in respect of plants and plant growth outside of the classroom. In this case this kind of linking *supports the establishment of the pupils' view* by again, *making connections between concepts to the real world,* hence helping pupils to think about seed growth from the perspective of their own experience.

**Figure 6.5 Transcript from a section of the lesson "Germination of seeds", utterances 66-87**

| No. | Speaker | Utterance in :- English / Swahili / Giriama | Post observation interviews - Teacher comments (Swahili, Giriama). Interviewer comments/statements. *Other classroom observations.* |
|---|---|---|---|
| 66 | T | Now let's see why they will germinate in the shamba and not germinate in your pocket, I've got to say, no, or on the table or in your bag. What is there in the shamba that will make these seeds germinate. | |
| 66 | Trans. | Garden | |
| 67 | T | Kwenye shamba kuna nini ambacho kitafanya hizi mbegu ziote? | I told them that if they put their seeds in the bag or on the table or in the pocket these seeds will not germinate? But then I was trying to lead them that when these seeds are put maybe in the garden, dig a small hole and put them in the garden and then when it has rained those seeds will germinate. So I am going to offer them now "what is in the shamba that will enable these seeds to grow"? The conditions, now, why does it germinate in the shamba and not in their pockets or their bags. So I am trying to lead them now to understand that there are some conditions in the shamba which can allow their seeds to germinate. But these conditions are not in their pockets, they are not in their bags, they are not in the house. So I am interested now, Kwenye shamba kuna nini ambacho kitafavya kizi mbegu ziote? What is there in the shamba that will make these seeds germinate? What conditions are there? Now, again initially, when you asked that question in English you did not get a response. No there was no response. |
| | | | So I had to change my language to Swahili and then to see. And then from there I think that they told me there is soil, there is water, there is rain and things. They did not mention air because, they do not see it. It is invisible isn't it? It is not visible so they will not say air but they will say water because of the rain and they will say soil. |
| 67 | Trans. | What is there in the garden which will make these seeds germinate? | |
| 68 | T | What is there in the shamba? Yes? | |
| 68 | Trans. | Garden | |

| | | | |
|---|---|---|---|
| 69 | P | Water | |
| 70 | T | Water. He is saying water. Somebody else? | *"Water" written on the board.* |
| 71 | P | Soil | |
| 72 | T | There is soil. What else? | *"Soil" written on the board.* |
| 73 | P | Manure | |
| 74 | T | Some body says manure. Manure yes. Somebody else? | *"Manure" written on the board.* |
| 75 | P | Rain | |
| 76 | T | Rain. Rain is like the water here. Lets just put right these. Rain is like water. Yes? Somebody else? What do you think will make these seeds germinate in the shamba? | *"Rain" written on the board.* |
| 76 | Trans. | Garden | |
| 77 | T | So we say that in the shamba or in the garden we have water or rain, somebody say we have soil and somebody said we have got manure. Now, in the pocket or in the bag or on the table, what is got there? What is there or what will be there? | So once you had asked the questions in Swahili you got a variety of answers. Now I got some answers yes. Everybody's now trying to express themselves on whatever, maybe as they have experienced. The responses that they gave to you then, I mean I couldn't hear them very clearly on the tape, did they resp..., I mean if they said water did they say maji? No they only said water but they never said maji. OK so they responded in English. They respond in English, water, yeh. And somebody said rain also, rain in English. |
| 77 | Trans. | Garden | |
| 78 | T | Is there water on the table? | *T points at water on the board.* |
| 79 | P's | No | |
| 80 | T | Is there water in the pocket? | *T points at water on the board.* |
| 81 | P | No | |
| 82 | T | In the bag? | |
| 83 | P | No | |
| 84 | T | Is there soil in the pocket? | *T points at soil on the board.* |
| 85 | P | No | |
| 86 | T | Manure? | *T points at manure on the board.* |
| 87 | P | No | |

Utterance 66 , is an **open question** presented in English with a Kiswahili **contextual link** embedded, ("What is there present in the shamba that will make these seeds germinate?") and is intended to elicit some responses from pupils with regard to their understanding of this issue. For some reason (most likely the language barrier), the pupils do not respond. This is, therefore, repeated in Kiswahili in utterance 67. Immediately, there are numerous responses from pupils which reveal their common-sense understanding of the

necessary conditions, e.g., utterance 69 "Water", 71 "Soil", 73 "Manure" and 75 "Rain". Teacher B uses utterance 76 to establish that water and rain are the same thing. He then uses a series of closed questions, in English, to confirm that the pupils understand that these conditions, although present in the shamba, are not present in the pocket, bag or on the table. Water, soil and manure, therefore, represent the pupil/commonsense view of the conditions necessary for the germination of seeds prior to any teaching. Utterance 67, the Kiswahili repetition of the **open question** originally presented in English, was central to the *establishment of this understanding of the pupil view.*

Utterances 88 and 89, in figures 6.6 and 6.7 below, are very important because they conclude the creation of differences by presenting the scientific point of view and showing that it is different from the way that pupils currently understand things. Utterance 88 "Now we can say there are certain things which are necessary for seeds to germinate", is an example of direct lecturing because it tells pupils what the scientific view is. It is an important statement with which the teacher indicates that there is a scientific way of looking at things. This view states categorically, that there are certain essential requirements for germination and it implies that these things are known to scientists and can be known by pupils.

**Figure 6.6 Transcript from a section of the lesson "Germination of seeds", utterance 88**

| No. | Speaker | Utterance in :- English Swahili Giriama | Post observation interviews – Teacher comments (Swahili, Giriama). Interviewer comments/statements. *Other classroom observations.* |
|---|---|---|---|
| 88 | T | Now we say. Now we can say there are certain things which are necessary for seeds to germinate. | |

These points are emphasised by the repetition of the **direct lecturing** in Kiswahili in utterance 89 (figure 6.7 below) and by a change in the tone of the teachers' voice (see interview comment 89) both of which help to *select* and *mark* this as a key scientific idea. It also begins to *modify* the pupil view that initiating germination is as straight-forward as planting the seeds in soil, adding some manure and waiting for some rain. Up to this point

the teacher has established that the pupils think that the essential items might be/are soil, rain and manure.

**Figure 6.7 Transcript from a section of the lesson "Germination of seeds", utterance 89**

| No. | Speaker | Utterance in :- English / Swahili / Giriama | Post observation interviews – Teacher comments (Swahili, Giriama). Interviewer comments/statements. *Other classroom observations.* |
|---|---|---|---|
| 89 | T | Kuna vitu □ulani ambavyo ni muhimu kwa mbegu kumea. | Tell me about what just happened there. Hapa, (Here), there's, em,, I was after discussing with them, now I am trying to tell them that "Kuna vitu □ulani amabvyoni mlivu kwa mbegu kumea". There are certain things which are necessary for seeds to germinate. So now I want to clarify to them the three main things necessary for germination. Now I noticed, I mean you first presented that in English and there was a change in the intonation of your voice. Yes. It sounded to me as if you were then keen to stress a particular point. Yes. This business of there needing to be certain conditions necessary for germination. Yes so now I am trying to draw their attention. I was varying my what, my sound or whatever, I was trying to vary the sound now so at least they can know. So that if I can vary the sound they can now be keen to know that something is changing, there is a change. The teacher wants us to draw our attention on some particular, particular issue. |
| 89 | Trans. | There are certain things which are necessary for seeds to germinate. | So you did that first of all by changing the tone of your voice in English. Yes. And then you switched to Swahili in order to... Draw their attention or to alert them and then I clarified the three important things for seed germination. So it was like a re-emphasis in your own language? Yeh. |

This episode is an example of the teacher drawing on the pupil's expectations (Ogborn *et al,* pg 30). Teacher B has made the pupils commit themselves to a particular answer before telling them whether or not they are right. Pupils will be aware that this has happened and, from the point where Teacher B tells them that "there are certain things

necessary for germination" will be waiting to find out if their answers are correct. These conditions are not as yet confirmed or denied in the teacher's statements, which implies that they may not be represented in the scientific view. Utterance 89 has, therefore, helped to *communicate that there are differences between the common and scientific views* and thereby helped to *generate a learning appetite*.

## 6.4 Section 2 : Constructing entities

### 6.4.1 Using clarification and linking strategies to help construct entities

There is some overlap between sections one and two. Teacher B has *created differences* by stating explicitly, that "there are certain things which are necessary for seeds to germinate", i.e., that the scientific view holds that there are strict criteria for germination, that certain fundamental things must be present. This statement also contributes to the construction of entities because it provides a basis for exploration of meaning in relation to these specific factors. From utterances 88 to 162 Teacher B uses direct lecturing to begin to list the essential factors and cognate provision to describe them. In doing this he makes connections between concepts and the real world using linguistic methods which help to contextualise the discussion for pupils. Water, warmth and air are the protagonists. By describing them and their capabilities through reference to contexts with which pupils are familiar, the teacher constructs entities and makes meaning in relation to their part in enabling germination.

In utterance 92 Teacher B uses a contextual link "shamba" to help pupils *make connections between concepts and the real world.* This is aided by his pointing to the words 'water', 'rain' and soil on the board. These represent the pupil/commonsense view concerning factors necessary for germination that can be found in a shamba, i.e., in the real world. The question "Are these things enough or are there more?", presented in English suggests that there could be factors missing hence maintaining the *learning appetite.*

**Figure 6.8 Transcript from a section of the lesson "Germination of seeds", utterances 92-109**

| No. | Speaker | Utterance in :- English Swahili Giriama | Post observation interviews - Teacher comments (Swahili, Giriama). Interviewer comments/statements. *Other classroom observations.* |
|---|---|---|---|
| 92 | T | Now what is there in the shamba that can make these seeds germinate? You have told me that it is rain or water, soil and manure. Are these things enough or are there some more? Let's find out. Now, conditions necessary for germination. For seeds to germinate. For seeds to what? | *T points at Water/rain/soil and manure written on board. "Conditions necessary for Germination" written on the board.* |
| 92 | Trans. | Garden | |
| 93 | P's | Germinate | |
| 94 | T | Germinate (Uttered simultaneously with pupils) | |
| 95 | T | First of all there must be water or moisture. Water or moisture. What is moisture? I've said water, I've also said moisture. You know water isn't it? What is moisture? | *"Water" and " moisture" written on the board.* |
| 96 | P | Maji | |
| 96 | Trans. | Water | |
| 97 | T | Moisture is umande. U.. (pause | |
| 97 | Trans. | Moisture. | |
| 98 | P's | Mande | |
| 98 | Trans. | Moisture | |
| 99 | T | Umande. Umande. U... Umande. Gets your walk, maybe early in the morning and you walk in some grass. At the building there'll be some water. That is umande. | *Taps trouser bottoms when describing dew gathering from grass.* |
| 99 | Trans. | Moisture | |
| 100 | P's | Yes | |
| 101 | T | Isn't it? | |
| 102 | P's | Yes | |
| 103 | T | Au Mneyevu - Mneyvu kigiriama | Umande is a Swahili word, but some of them never knew that word, umande. Ok, so they didn't know the Swahili word for moisture. Yeh, which is umande, I told them that it is umande. Still, there was some doubts they never knew what umande was. So then I talked to them in Kigiriama and I said mnyevu. Ok. Mnyevu. So now they are laughing at me because they discovered that it was something which they knew but it was only language which was the problem. So, |

| | | | |
|---|---|---|---|
| | | | I mean that was the perfect example there, wasn't it, of the two ways that you go to the known to move on to the unknown. You did that in terms of ideas, you took them, in context, back to their homes in the morning, coming from their homes, walking through the grass, getting damp. Yeh, yeh, yeh, and they will all understand now. Which they all will have experienced. They have experienced because they walk in these small paths early in the morning and they get some sort of what, water wetting their feet in the morning due to the what, due to the, the er. Dew is what we. |
| 103 | Trans. | Or (KS) Moisture (KG) | Dew in the morning that lay there overnight. And of course you did that in language terms as well didn't you? Yes, Yes. Because they didn't understand moisture, the English. And also umande in Swahili. Umande they didn't understand. So you went right back to what they would definitely know. Yes. So if you don't get the good response in English you have to go back to Kiswahili. If you don't get the good response also you have now to work out an example which will lead them to discover what you want them to understand. |
| 104 | P's | Yes | |
| 105 | T | Eh? | |
| 106 | P's | Yes | |
| 107 | T | Umande au mnyevu, mnyevu | |
| 107 | Trans. | Moisture or (KS) Moisture (KG) | |
| 108 | T | Majimaji, majimaji | |
| 108 | Trans. | Wet or damp, wet or damp. | |
| 109 | T | So, I have said, water or moisture must be there. That is one. Another thing which must be there is what? What is that? | *T points at water/moisture written on the board. "Air" written on board.* |

The teacher first decides to deal with water and the section from utterance 92 to 109 has the purpose of constructing the entity water as a factor affecting the germination of seeds. In utterance 94, Teacher B uses direct lecturing in English to inform the pupils of one of the factors, "First of all there must be water or moisture." Realising that pupils may not understand the English term moisture Teacher B checks by asking "What is moisture?". A pupil immediately responds "Maji" (water) which, because it is not an entirely accurate description of moisture confirms that pupils do not entirely understand the term. This is a

situation where pupils do not have sufficient English or Kiswahili vocabulary to engage in discourse. The teacher, therefore uses extensive **cognate provision** in order to help clarify and make meaning for the unknown English words. In order to use all possible language resources and develop a more refined understanding the teacher uses cognates from Kiswahili and Kigiryama.

At utterance 97, therefore, Teacher B provides the Kiswahili cognate and uses **thought completion** to encourage pupils to try the phonological representation. "Water is Umande. U..(pause)", (Moisture). In utterance 99, Teacher B presents the Kiswahili cognate again, a number of times, concentrating on deliberate pronunciation so that pupils can clearly hear the correct phonological representation. Then Teacher B encourages pupils to consider their personal experience of moisture in English by telling a story, in English, about walking through the grass on the way to school and getting moisture on their legs. This tale is immediately linked to the Kiswahili word 'Umande' again. So, here we have **cognate provision** supporting the *construction of entities* via the utilisation of personal experience that has been explored in English. Reinforcement is provided at utterance 103 when the Kigiryama **cognate** "Mneyvu", (moisture) is also provided by Teacher B. The Kiswahili and Kigiryama terms are linked at utterance 107 and a similar Kiswahili term "Majimaji", (wet or damp) is used to secure the issue at 108. Finally, at utterance 109, Teacher B returns to English to summarise the point "So, I have said, water or moisture must be there."

Teacher B's post observation comment at utterance 103 shows that, once he had established that pupils did not understand, he engineered a gradual move from concepts and vocabulary that are not understood to those which are. In doing this Teacher B has successfully supported the construction of entities by *making connections between concepts and the real world* as experienced by the pupils through the telling of a short story illustrating the unknown concept.

Utterances 109 to 117 involve interactions only in English which elicit another protagonist from the pupils. At utterance 109, the teacher asks "Another thing that must be there is what?" Interestingly, one pupil immediately responds "Air". The teacher confirms, through his feedback, that air is the correct answer and "Air" is written on the board. Importantly, neither the teacher nor any of the pupils have, up to this point, mentioned air

as a possible protagonist. Either this pupil has been harbouring this response for some time or the challenging of the pupil view (soil, water and manure) by the teacher at the beginning of this section has prompted pupils to consider new possibilities. A third possibility, that perhaps the pupils were familiar with the scientific view from previous lessons or experience, lacks some credibility because it could reasonably be expected that these correct views would have been revealed earlier in the lesson. From utterance 112 to 117 the teacher also uses thought completion in English to reinforce that air is an essential requirement for germination.

In utterances 117 and 118 the teacher asks the pupils for a third requirement but gives the pupils the correct answer "warmth" after waiting some time for a response without success. "Warmth" is also written on the board. Pupils are asked to repeat the word warmth several times.

**Figure 6.9 Transcript from a section of the lesson "Germination of seeds", utterances 117-133**

| No. | Speaker | Utterance in :- English Swahili Giriama | Post observation interviews - Teacher comments (Swahili, Giriama). Interviewer comments/statements. *Other classroom observations.* |
|---|---|---|---|
| 117 | T | Air (Uttered simutaneously with pupils). And then there's another third. Third (important???) one. Is what? What? | *No response from pupils. "Warmth" is written on the board.* |
| 118 | T | What is that? What is that? What? | *No pupils response.* |
| 119 | T | Warmth. Say "warmth". | |
| 120 | P's | Warmth. | |
| 121 | T | Warmth. | |
| 122 | P's | Warmth. | |
| 123 | T | Warmth. | |
| 124 | P's | Warmth. | |
| 125 | T | OK, warmth ni nini? Warmth ni nini? Mmm, what is warmth or what is warmth ni nini? What is warmth or warmth ni nini? | |
| 125 | Trans. | Warmth, what is this? | |
| 126 | T | Hamjui? You don't know? | |
| 126 | Trans. | You don't know? | |
| 127 | P's | No | |
| 128 | T | What's this? What are we doing now? It's hot isn't it? | *T shakes front of shirt to show that he's hot.* |

| | | | |
|---|---|---|---|
| 129 | P's | Yes | |
| 130 | T | So what is hot? | *Points to a pupils for a response* |
| 131 | P | Jasho | |
| 131 | Trans. | Hot or High temperature likely to cause sweatiness | |
| 132 | T | Si Jasho | *Selects another pupil* |
| 132 | Trans. | Not hot | |
| 133 | P | Joto | |

In utterance 125 {2}the teacher checks to see if the pupils understand the word warmth. "Warmth ni nini?" i.e., "Warmth, what is this?" is an **open question** designed to allow pupils to offer any contribution they can with respect to their knowledge of warmth. There is no immediate response from the pupils. In utterance 126 {1) the teacher asks "Hamjui", "You don't know?". This is a **closed question** because the only possible responses are yes or no and as pupils have not responded to the previous question it is likely that they don't know. Many pupils respond "No". The teacher then provides a visual image by shaking his shirt front to indicate that he is very warm and says, in utterance 128, "What's this? What are we doing now? It's hot isn't it? The pupils respond "Yes" and the teacher asks "So what is hot?". The pupils then offer the Kiswahili "Jasho" in utterance 131, which means a hot or high temperature. In utterance 132 {5} the teacher responds "Si Jasho", "Not hot". This is a rejection of a pupil response but it contains a repetition of the pupil response and so is coded as a type 6 **repetition of a pupil response.** A pupil then offers the Kiswahili "Joto", "Warmth" in utterance 133. The teacher repeats the pupil response in a way which confirms. This is also coded as a type 6 **repetition of pupil response**.

During this series of interventions the teacher has accelerated the discourse outcome by providing one of the essential requirements himself. He has also used Kiswahili and Kigiryama to describe the protagonist moisture and Kiswahili to describe the protagonist warmth.

**Figure 6.10 Transcript from a section of the lesson "Germination of seeds", utterances 136-162**

| No. | Speaker | Utterance in :- English Swahili Giriama | Post observation interviews - Teacher comments (Swahili, Giriama). Interviewer comments/statements. *Other classroom observations.* |
|---|---|---|---|
| 136 | T | Now here we have said now that there are three things which are necessary for germination. If you want your seeds to germinate there must be water , there must be air, there must be warmth. | *T points at water/moisture, air and warmth on the board.* |
| 137-139 | P's | Pupils say "water", "air" and "warmth" simultaneously with teacher | |
| 140 | T | These three things are necessary. Ni mhimu kwa mbegu kuota. | Yeh, the three things, Ni mhimu kwa mbegu kuota, they are necessary for things to germinate. Ok. The three things. Ok so again it's an emphasis and a repetition. Yeh an emphasis. |
| 140 | Trans. | Things necessary for seeds to germinate. | |
| 141 | T | These three things are necessary for seeds to germinate, correct? | |
| 142 | P's | Yes | |
| | | | |
| | | | |
| 143 | T | The first one is? The first one is? Name me. The first one is? All of you. The first one is? | |
| 144 | P's | Water | |
| 145 | T | Water or? | |
| 146 | P's | Air | |
| 147 | T | The first one is water or? | *Points to "water" and then to "moisture" on board.* |
| 148 | P's | Moisture | |
| 149 | T | The other one is? | *Points at "air" on board.* |
| 150 | P's | Air | |
| 151 | T | The other one is what? | |
| 152 | P's | Air | |
| 153 | T | and the other one. The third one is? | *Points at "warmth" on board.* |
| 154 | P's | Warmth | |
| 155 | T | Warmth (Uttered simutaneously with pupils). | |

| | | | |
|---|---|---|---|
| 156 | T | So, if we have our seeds here. If we could take your maize seeds like this one, and we put them in a place where there is air, where there is water, where there is warmth, what will they do? They will? They wil do what? | *T takes some maize seeds from a cob and holds them out.* |
| 157 | P's | Germinate | |
| 158 | T | They will germinate. They will? | |
| 159 | P's | Germinate | |
| 160 | T | Germinate (Uttered simutaneously with pupils). They will? | |
| 161 | P's | Germinate | |
| 162 | T | Germinate (Uttered simutaneously with pupils). Good. | |
| | | | *Short break whilst board is wiped and next stage of lesson prepared.* |

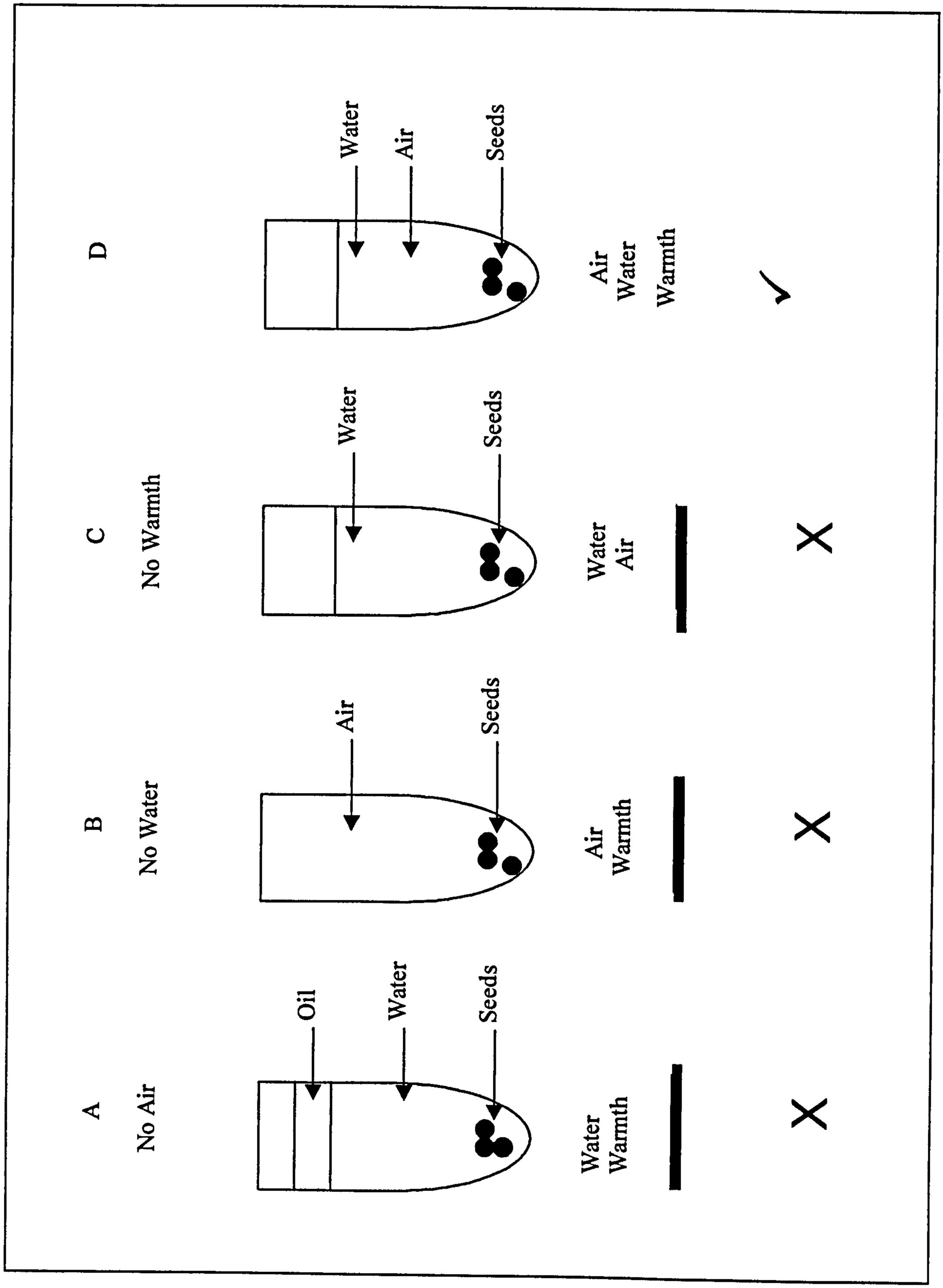
Finally, the teacher summarises the factors. He does this in English first at utterance 136. This is a direct lecturing intervention which states categorically that there are three factors to consider and that they are water, warmth and air. This is accomplished in such a way that it includes thought completion prompts and pupils also utter water, warmth and air in synchrony with the teacher at utterance 137. At Utterance 140 the teacher repeats and reinforces the first part of this direct lecturing, first in English and then in Kiswahili. The pupils are left in no doubt that three factors are necessary for germination. From Utterance 141 to 162 the teacher uses questioning strategies in English to ensure that pupils can tell him how many factors there are and that they can name them all.

## 6.5 Section 3 : Constructing entities

### 6.5.1 Using clarification and management strategies to help construct entities

In this final section the teacher uses, predominantly, English interventions from utterance 164 to utterance 233 to describe the setting up of and the expected results of an experiment that the pupils will do in the next lesson. This experiment will investigate the three factors (Air, warmth and water) said to affect the germination of bean seeds. The teacher describes the setting up of this experiment beginning with the contents of container A in the diagram in figure 6.11 below.

**Figure 6.11 Diagrammatical representation of seed germination experiment**



The teacher develops this diagram for the pupils, on the blackboard, as he moves through his explanation. He moves on to the contents of containers B, C and D respectively before writing a summary of the conditions in each container underneath each. For instance, container A is said to have water, warmth but no air. The horizontal line under each set of conditions represents a missing factor. The missing factor is written above each container e.g., container A has 'No Air', B has 'No Water', C has ' No Warmth' and D has all factors present. Finally, a set of crosses indicate that no germination results from arrangements A, B and C and a tick indicates that the seeds in D, with all factors present, all germinate. Note that this diagram is built up sequentially and in full discussion with pupils but that this discussion is conducted almost entirely in English.

Kiswahili interventions are apparent, firstly, in utterance 163 and 164, where the **cognate** "Mbeke" is provided as the equivalent for "tin". Practical equipment is in short supply in this and other schools. Improvised use of 'household' equipment is common in practical lessons. The containers (A, B, C and D) that pupils will use to set up their experiment will be tins. The teacher is using **cognate provision** to clarify this point so that pupils are not confused about vocabulary that is not fundamental to the concepts that are being illustrated. At utterance 171, a similar **cognate provision** intervention "Haya Mafuta" (This oil) is used to clarify, for pupils not understanding the English word oil, that this is the substance floated on the water to keep out air.

**Figure 6.12 Transcript from a section of the lesson "Germination of seeds", utterances 163-241**

| No. | Speaker | Utterance in :- English Swahili Giriama | Post observation interviews - Teacher comments (Swahili, Giriama). Interviewer comments/statements. *Other classroom observations.* |
|---|---|---|---|
| 163 | T | This one is a…a tin. Who knows what a tin is? Who knows what a tin is? Tin? Mkebe. | *T has drawn a round-bottomed container on the board.* |
| 163 | Trans. | Tin | |
| 164 | T | Mkebe. That is a tin. And then in this tin we put in some, some water and then we put in, what? Our….(pause) | *T draws water in the bottom of the tin.* |
| 164 | Trans. | Tin | |
| 165 | P's | Seeds | |
| 166 | T | Our seeds. | *T draws seeds in the water.* |

| | | | |
|---|---|---|---|
| 167 | T | So here we have got our water and what? Our… | *T labels water* |
| 168 | P's | Seeds | |
| 169 | T | The seeds. | *T labels seeds* |
| 170 | T | And then, here, you put in oil. There is oil there. Here I'll put oil. | *T draws layer of oil on top of water and labels.* |
| 171 | T | This oil, haya mafuta, will not allow air to go there. | *T points to oil and water indicating that the oil is a barrier to the passage of air into the water.* |
| 172 | Trans. | This/These oil | This is the stage where you were describing the experiment where you. On the blackboard yeh. You boil the water. Boil the water yeh. Get the air out of it. And then put some. Put some oil on the top. Did you ever get the feeling that some of the pupils might have felt that one of the conditions necessary for germination was having oil?Yeh, that one there is a doubt that maybe they never followed properly in that particular experiment. Er. because that one was to be done practically but we have this problem of this apparatus. Things like test tubes or whatever we don't have them in the school. And it was to get some few tins like this ones to bring to here and then maybe to put the oil or boil the water and maybe I tell the the reasons why I am boiling the water and then putting the oil, why I am putting that oil there. But then surley there is a doubt over the understanding, there is a doubt of understanding. |
| | | | Yeh I just remember when you were going back over a stage where you were asking pupils what things do we need for germination and some pupils said water some said air and I am sure I heard one say oil. Yeh, yeh, they can also take oil as something necessary for germination. This is wrong it has to be clarified later on. That is one of the kind of confusions which will come up in my lessons on a regular basis. |
| 173 | T | So there is no air here. There is only the seeds and the water. | *T points at water and seeds on diagram.* |
| 174 | T | And then you have got another tin again. In that one you have got your,… there are some seeds and also there is air. Here we have got the seeds and also there is air. But there is no water. Here there is no air. | *T draws a new tin. Labels "seeds" and "air". Writes "No water" above tin 2 and "no air" above tin 1.* |
| 175 | T | And then another tin. | *T draws a third tin.* |

| | | | |
|---|---|---|---|
| 176 | P's | (some indistinct commenst from pupils which seem to indicate that one pupil is not paying attention) | |
| 177 | T | Wacha kuandika wewe? Uh? No writing. Close the book. | *Admonishes a pupil.* So there, a pupil was not paying attention. Yeh, no, no. You used Swahili then to give like a management instruction. Yeh, yeh. You're not explaning something you are just trying to get the pupils' attention again, yeh? Stop writing "Waja Pandika", "close your book", and then we went on. Right now I've noticed often at the end of the lesson or at the beginning of the lesson, a lesson will begin or end with a stream of Swahili speech which seems to be more to do with general management of the pupils that it is with the lessons. It might be saying something like " Ok the lesson is finished now you can finish off what you're doing, you can then go out and have your lunch and we will meet back in here this afternoon for a lesson, yeh? Yeh, yeh. Would that sort of general management talk with the pupils take place in Swahili? Umm, that one, it can also take place in Swahili. So its a combination of English... And Swahili. |
| 177 | Trans. | What are you up to? | |
| 178 | T | Here, we have got more seeds. We have got water but there is no warmth. | *T draws seeds in tin and labels them. Labels "water" and writes "no warmth" above tin.* |
| 179 | T | And then we have got another tin. We have got our seeds. There is water, there are seeds, there is also air. So everything is here. Sorry there is everything there. | *T draws a 4th tin with seeds in it. T labels water, seeds and air. Begins to write "everything" and then "air" above tin but changes mind and leaves it without a title.* |
| 180 | T | Now, in these tins where do you think seeds will germinate? Let's talk about the first one. Here there is no air. We have said that for seeds to germinate there must be air, there must be warmth, there must be water. Here, will they germinate? | *Points at seeds in first tin.* |
| 181 | P's | No | |
| 182 | T | Uh? | |
| 183 | P's | No | |
| 184 | T | Here we have got water. We have got the what? | *Writes "water" beneath tin 1.* |
| 185 | P's | Oil | |
| 186 | T | Uhum? | |
| 187 | P's | Oil | |

| | | | |
|---|---|---|---|
| 188 | T | We have got warmth. One thing is not there it is missing. | *Writes "warmth" beneath tin 1. Draws a line beneath this to indicate missing condition.* |
| 189 | T | Here, we have got air and warmth. There's one thing missing. | *T writes "air" and " warmth" beneath tin 2. Draws a line to indicate missing condition.* |
| 190 | T | Here we have got water, air. There is one thing missing. | *T writes "water" and " air" beneath tin 3. Draws a line to indicate missing condition.* |
| 191 | T | Here we have got air we have got water we have got warmth. | *T writes "air" and "water" and warmth beneath tin 4.* |
| 192 | T | Now will seeds germinate? This is now A, B, C, D. | *T labels tubes 1,2,3,4 as A,B,C,D.* |
| 193 | T | Now, what child did this A? Child B did that, child C did that and child D did that. Now, in which tin did the seeds germinate? In which tin there did the seeds germinate. Who can tell us. Link what I am saying here is that the three things which are necessary for germination are air, warmth and water. Now, in those tins there, in which tin will seeds germin..tell me where, in which tins, the seeds will germinate? | *T points to tins A-D in order.* |
| 194 | P | D | |
| 195 | T | D? Is he correct? | |
| 196 | P's | Yes | |
| 197 | T | Is he correct? | |
| 198 | P's | Yes | |
| 199 | T | Now, why is he correct? Why is he correct? | *No real response from pupils* |
| 200 | T | Because? | |
| 201 | P's | Water | |
| 202 | T | because there is? | |
| 203 | P's | Water | |
| 204 | T | There is? | |
| 205 | P's | Water | |
| 206 | T | Water, what else? | |
| 207 | P | Warmth | |
| 208 | T | Warmth and? | |
| 209 | P | Air | |
| 210 | T | And Air. | |
| 211 | T | You see? So here, water is here, warmth is here. So in this tin the seeds will not germinate. | *Points to tin A. Concludes by drawing a large cross by tin A.* |
| 212 | T | Here we have got air and warmth but there is no what? There is no water. This seed will not germinate. | *Points to tin B. Concludes by drawing a large cross by tin B.* |
| 213 | T | Here, water, air but no warmth. This seed will not germinate. | *Points to tin C. Concludes by drawing a large cross by tin C.* |

| | | | |
|---|---|---|---|
| 214 | T | Here, there is air, there is water, there is warmth. These ones they will do what? | *Points to tin D. Concludes by drawing a large tick by tin D.* |
| 215 | P's | Germinate | |
| 216 | T | They will germinate. So, if you keep your seeds and all these things here are present, then they will germinate. | *Points to air, water and warmth.* |
| 217 | T | So the three things which can make seeds germinate are air, water and warmth. | *Pupils say air, water and warmth in synchrony with T.* |
| 218 | T | Is that clear? | |
| 219 | P's | Yes | |
| 220 | T | Is that clear? | |
| 221 | P's | Yes | |
| 222 | T | Are there any questions? | |
| 223 | P's | No | |
| 224 | T | Now, maybe, maybe, what I will do now is, eh, tomorrow is, tomorrow is what? I want every one of you to come with a tin, a plastic tin, like this one. A bit smaller, a bit smaller than this one. And then we shall get some water at school and we shall get some seeds. We have some seeds just here at school. And then we shall put ourselves in groups. Group A will do this one. We shall put the seeds there. | *T shows pupils a plastic bottle. He indicates diagram A on board for group A.* |
| 225 | P | Will you give the oil? | |
| 226 | T | I will give you the oil. Group B will do this one, group C will do this one and group D will do that one. We put our seeds in those conditions and then we put our seeds in the staff room or maybe in the classroom here. And then we shall wait. Tutangojea. | *Indicates relevant tins for groups B,C and D.* Simply another way of saying we will wait. Yeh, yeh, yeh. We wait for four days. |
| 226 | Trans. | We shall wait | |
| 227 | T | For how many days? | |
| 228 | P's | Five | |
| 229 | T | Five or four days. We shall be observing every day to see how it is appearing. Tutakuwa tukichungulia. | Yeh, after keeping them, Tutakuwa tukichungulia, we shall be monitoring them to see what is going on. So just clarifying for the pupils what y ou will do when you come back again. Yeh, yeh. |
| 230 | Trans. | We shall be monitoring with the teacher | **check this with Johnson. |
| 231 | T | And then when seeds are germinating we shall come here and discuss and see who's tin has germinated. And why has it germinated. That will be our experiment. So bring those things tomorrow, is that clear? | |
| 232 | P's | Yes | |

| | | | |
|---|---|---|---|
| 233 | T | Tins, and maybe you can bring some seeds if you want. Some seeds. Bean seeds. Um? Beans seeds, Kunde or Maharagwe and then maybe maize seeds. Bring them tomorrow. And then we will do that experiment. Is that clear? | Two different kinds of bean seeds? Mmm, maharagwe and kunde, they are the same. They are the same? Beans, they are all beans. Ok, so why are there two different words? Mmm, maharagwe are a bit bigger and kunde a bit smaller. |
| 233 | Trans. | Beans seeds | |
| 234 | P's | Yes | |
| 235 | T | Is that clear? | |
| 236 | P's | Yes | |
| 237 | T | Any questions? | |
| 238 | P's | No | |
| 239 | T | Ok, no questions | |
| 240 | P's | Yes | |
| 241 | T | Ok, thank you very much for listening. | |

At utterance 177, there is an **activity directive,** "Wacha kuandika wewe?", (What are you up to) is used just prior to the instructions "No writing", "Close the book", delivered in English. Although this intervention is a question, when considered with the following directives it can be seen that teacher is communicating that he wishes an individual pupil to concentrate on the discussion and not on writing. The teacher is using an activity directive to keep pupils focussed on the discussion and the diagram. From utterance 178 to utterance 222 the teacher orchestrates a discussion concerning the diagram and the conclusions that can be drawn from it in respect of factors affecting germination, entirely in English.

At utterance 226, when the description and results of the experiment have been fully discussed and pupils have been told what their role is in setting it up in the next lesson, another **activity directive** is used. "Tutangojea", (We shall wait) has a number of functions. Firstly, it tells pupils what they must do, i.e., wait for the results to emerge. Secondly it acts as an intervention that maintains the narrative, i.e., it helps to carry the scientific story from this lesson over in to the next. Pupils know what they will be doing, in respect of the story, in following lessons. In fact, they know that they will be continuing with the investigation over four or five days. At utterance 229, another **activity directive,**"Tutakuwa tukichungulia", (We shall be monitoring with the teacher) can be interpreted as a "we" statement because it makes it clear that the pursuit of the scientific story is a joint venture and that pupils will have the support of the teacher.

Finally, at utterance 233 two **cognate provision** interventions, "Maharagwe", (Big seeds) and "Kunde", (Small seeds) clarify the type of bean seeds that the teacher wishes pupils to bring to the lesson.

## 6.6 Summary tables of Code-switching interventions

The following series of tables show the frequency of use of types of code-switching interventions within all six transcripts. A table for Transcript 4, for which use of the code-switching interventions and their contribution to meaning making has been detailed in sections 6.3 to 6.5 above, begins the series. Tables have been broken into two columns, the first column records code-switching interventions when teachers are creating differences and the second when teachers use code-switching interventions when constructing entities.

**Table 6.3 Summary of Transcript 4: Teacher B. Germination of seeds**

| Intervention **primary function** and type | Section 1 Creating differences Utterances 1-89 | Section 2 Constructing entities Utterances 88-233 |
|---|---|---|
| | Frequency | Frequency |
| **Eliciting** | | |
| 1. Closed questions | 1 | 1 |
| 2. Open questions | 1 | 4 |
| 3. Thought completion prompts | 2 | 1 |
| **Responding** | | |
| 4. Confirmations and rejections | 0 | 1 |
| 5. Repetitions of pupil response | 0 | 2 |
| **Making links** | | |
| 6. Contextual | 5 | 0 |
| 7. Discourse | 0 | 0 |
| **Clarifying** | | |
| 8. Cognate provision | 3 | 17 |
| 9. Rhetorical questions | 1 | 0 |
| 10. Direct lecturing [KS or KG] | 0 | 0 |
| 11. Direct lecturing [E to KS or KG] | 1 | 2 |
| **Managing** | | |
| 12. Discourse directive | 0 | 0 |
| 13. Activity directive | 0 | 3 |
| 14. Speech directive | 0 | 0 |
| 15. Other utterance | 0 | 0 |

**Table 6.4 Summary of Transcript 1: Teacher A. Seed structure**

| Intervention **primary function** and type | Section 1 Creating differences Utterances 0-166 | Section 2 Constructing entities Utterances 167-355 |
|---|---|---|
| | Frequency | Frequency |
| **Eliciting** | | |
| 1. Closed questions | 12 | 34 |
| 2. Open questions | 2 | 0 |
| 3. Thought completion prompts | 1 | 5 |
| **Responding** | | |
| 4. Confirmations and rejections | 0 | 0 |
| 5. Repetitions of pupil response | 1 | 2 |
| **Making links** | | |
| 6. Contextual | 9 | 5 |
| 7. Discourse | 1 | 0 |
| **Clarifying** | | |
| 8. Cognate provision | 5 | 1 |
| 9. Rhetorical questions | 2 | 5 |
| 10. Direct lecturing [KS or KG] | 2 | 40 |
| 11. Direct lecturing [E to KS or KG] | 1 | 3 |
| **Managing** | | |
| 12. Discourse directive | 7 | 11 |
| 13. Activity directive | 3 | 6 |
| 14. Speech directive | 3 | 11 |
| 15. Other utterance | 4 | 3 |

**Table 6.5 Summary of Transcript 2: Teacher A. Functions of seed parts**

| Intervention **primary function** and type | Section 1 Creating differences Utterances 0-113 | Section 2 Constructing entities Utterances 114-297 |
|---|---|---|
| | Frequency | Frequency |
| **Eliciting** | | |
| 1. Closed questions | 5 | 0 |
| 2. Open questions | 1 | 0 |
| 3. Thought completion prompts | 0 | 0 |
| **Responding** | | |
| 4. Confirmations and rejections | 0 | 0 |
| 5. Repetitions of pupil response | 1 | 3 |
| **Making links** | | |
| 6. Contextual | 2 | 9 |
| 7. Discourse | 0 | 0 |
| **Clarifying** | | |
| 8. Cognate provision | 5 | 9 |
| 9. Rhetorical questions | 0 | 0 |
| 10. Direct lecturing [KS or KG] | 0 | 0 |
| 11. Direct lecturing [E to KS or KG] | 0 | 2 |
| **Managing** | | |
| 12. Discourse directive | 1 | 0 |
| 13. Activity directive | 0 | 0 |
| 14. Speech directive | 0 | 2 |
| 15. Other utterance | 1 | 0 |

**Table 6.6 Summary of Transcript 3: Teacher B. Structure of a maize seed**

| Intervention **primary function** and type | Section 1 Creating differences Utterances 0-71 | Section 2 Constructing entities Utterances 72-273 |
|---|---|---|
| | Frequency | Frequency |
| **Eliciting** | | |
| 1. Closed questions | 1 | 2 |
| 2. Open questions | 1 | 0 |
| 3. Thought completion prompts | 0 | 0 |
| **Responding** | | |
| 4. Confirmations and rejections | 0 | 0 |
| 5. Repetitions of pupil response | 0 | 1 |
| **Making links** | | |
| 6. Contextual | 0 | 0 |
| 7. Discourse | 0 | 10 |
| **Clarifying** | | |
| 8. Cognate provision | 1 | 4 |
| 9. Rhetorical questions | 0 | 0 |
| 10. Direct lecturing [KS or KG] | 0 | 2 |
| 11. Direct lecturing [E to KS or KG] | 0 | 5 |
| **Managing** | | |
| 12. Discourse directive | 1 | 0 |
| 13. Activity directive | 0 | 0 |
| 14. Speech directive | 0 | 0 |
| 15. Other utterance | 0 | 0 |

**Table 6.7 Summary of Transcript 5: Teacher C. Classification of plants**

| Intervention **primary function** and type | Section 1 Creating differences Utterances 0-15 | Section 2 Constructing entities Utterances 16-301 |
|---|---|---|
| | Frequency | Frequency |
| **Eliciting** | | |
| 1. Closed questions | 0 | 13 |
| 2. Open questions | 0 | 6 |
| 3. Thought completion prompts | 0 | 1 |
| **Responding** | | |
| 4. Confirmations and rejections | 0 | 0 |
| 5. Repetitions of pupil response | 0 | 3 |
| **Making links** | | |
| 6. Contextual | 0 | 10 |
| 7. Discourse | 0 | 0 |
| **Clarifying** | | |
| 8. Cognate provision | 0 | 1 |
| 9. Rhetorical questions | 0 | 2 |
| 10. Direct lecturing [KS or KG] | 0 | 12 |
| 11. Direct lecturing [E to KS or KG] | 0 | 9 |
| **Managing** | | |
| 12. Discourse directive | 0 | 0 |
| 13. Activity directive | 0 | 5 |
| 14. Speech directive | 0 | 0 |
| 15. Other utterance | 0 | 5 |

**Table 6.8 Summary of Transcript 6: Teacher C. Classification/structure of plants**

| Intervention **primary function** and type | Section 1 Creating differences Utterances 0-57 | Section 2 Constructing entities Utterances 57-250 |
|---|---|---|
| | Frequency | Frequency |
| **Eliciting** | | |
| 1. Closed questions | 0 | 3 |
| 2. Open questions | 0 | 0 |
| 3. Thought completion prompts | 0 | 0 |
| **Responding** | | |
| 4. Confirmations and rejections | 0 | 0 |
| 5. Repetitions of pupil response | 0 | 2 |
| **Making links** | | |
| 6. Contextual | 0 | 0 |
| 7. Discourse | 0 | 0 |
| **Clarifying** | | |
| 8. Cognate provision | 0 | 0 |
| 9. Rhetorical questions | 0 | 0 |
| 10. Direct lecturing [KS or KG] | 0 | 8 |
| 11. Direct lecturing [E to KS or KG] | 0 | 4 |
| **Managing** | | |
| 12. Discourse directive | 0 | 0 |
| 13. Activity directive | 0 | 0 |
| 14. Speech directive | 0 | 0 |
| 15. Other utterance | 0 | 3 |

Features of particular note which are immediately evident from these tables include the lack of any code-switching by teacher C when creating differences, and the relatively higher frequency of use of code-switching by teachers A and C in their first lessons compared to their second. The data within the tables are used to construct the graphs shown

in figures 6.16 to 6.21. These graphs are then utilised in the following sections to make more detailed comment about how code-switching has been utilised within science lessons in the school by teachers A, B and C.

## 6.7 Teacher–teacher comparisons

There is insufficient data available for making generalisable comparisons concerning the use of code-switching between individual teachers. This is because:

1. The data in the six transcripts is from two different classes. It was acknowledged by teachers that each of the classes had had different general English language proficiencies. Class five were considered to be more proficient than class 4 because they are older and have had more exposure to the language.
2. Although all lessons had a botanical focus, each lesson was aimed at a different aspect of plant biology and therefore had different language demands.

In addition, the language proficiencies of teachers A, B and C, as measured by the self-assessments, are very similar across English, Kiswahili and Kigiryama, as can be seen in the graphs below. Teachers A, B and C, in these graphs, are the same teachers A, B and C whose lessons have been observed, transcribed and analysed, with teachers D to I being other teachers at the school.

**Figure 6.13 Teacher language proficiency self-assessment: English**

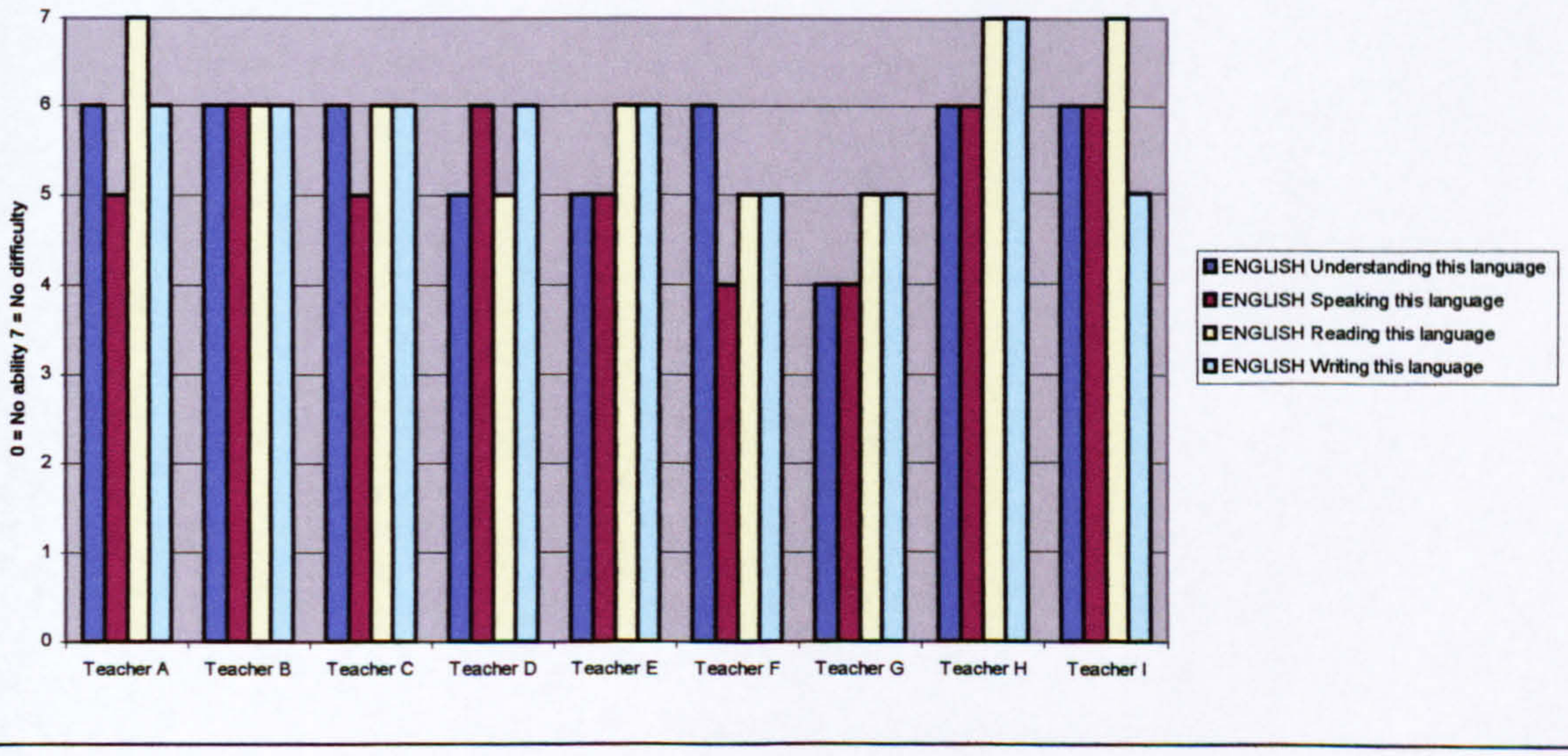


**Figure 6.14 Teacher language proficiency self-assessment: Kiswahili**

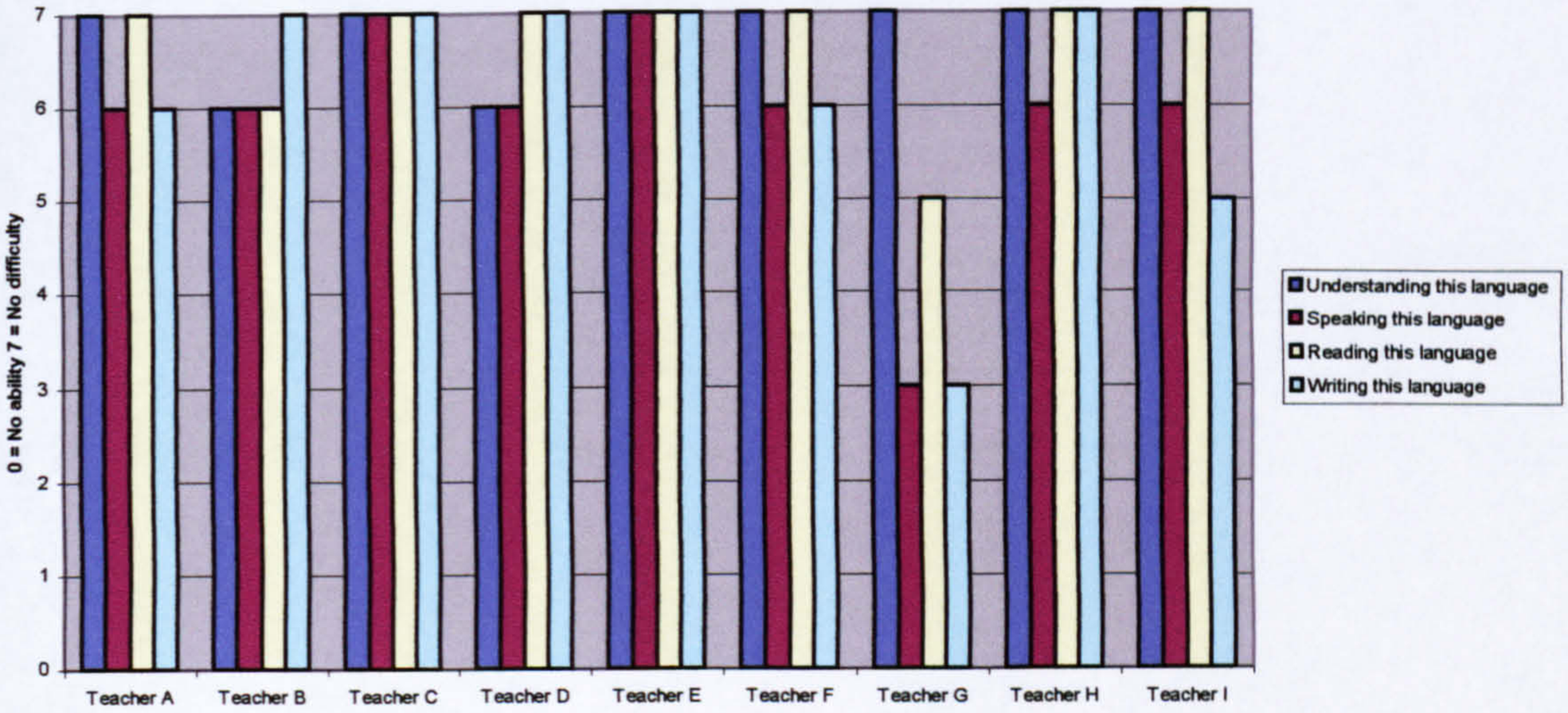
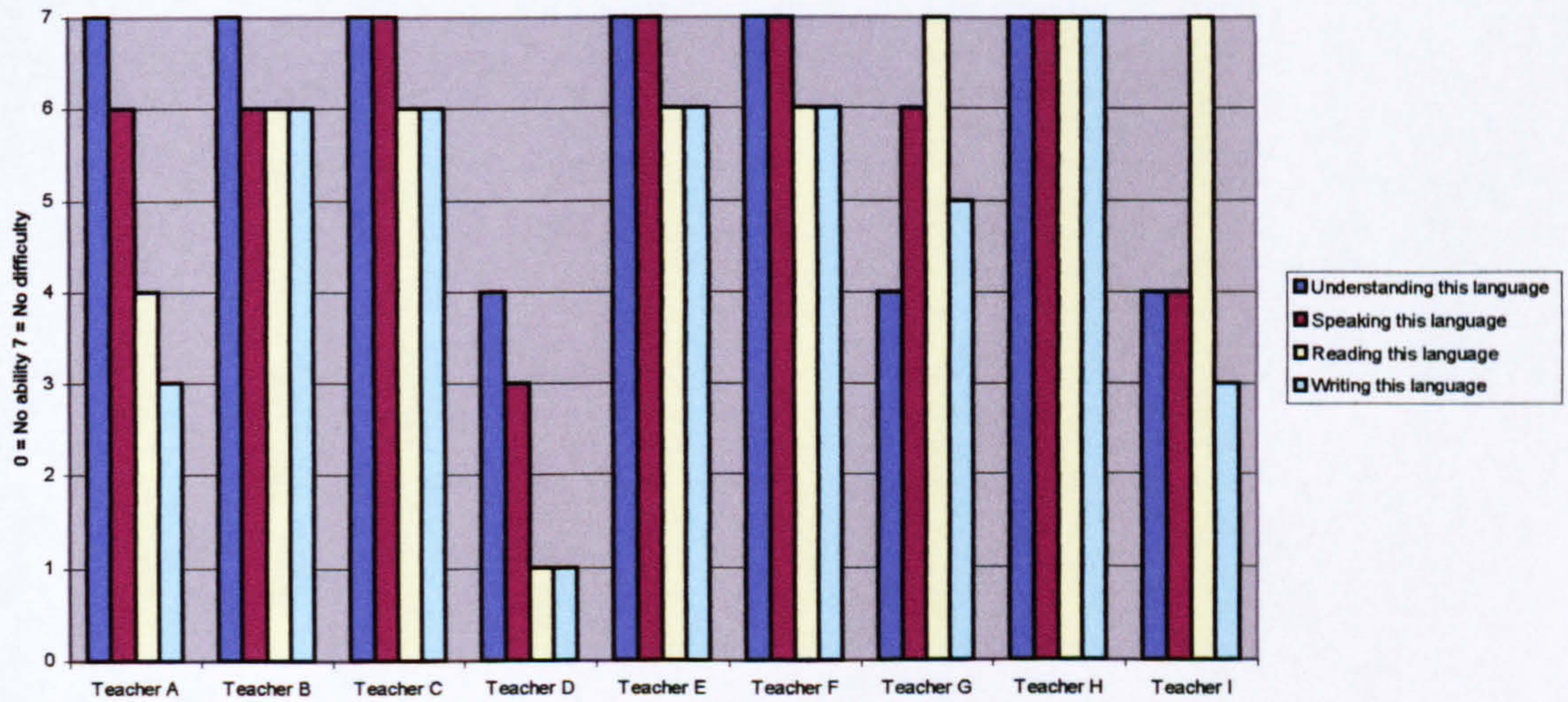



**Figure 6.15 Teacher language proficiency self-assessment: Kigiryama**




If teachers A, B and C are considered across the three language assessments it can be seen that they rate their proficiencies, across the four skills measured, very highly. The only

exception is in the case of teacher A who rates his reading and writing proficiency in Kigiryama as moderate. This is of little significance here as in no lesson was there a requirement for any reading or writing of Kigiryama.

It is not likely, then, that any differences in the use of code-switching could be related to any lack of proficiency in any of the three languages concerned. This, however, might not have been the case if the study had examined code-switching practice by all teachers included in the self-assessment of language proficiency. There is more variation in the perception of language proficiency across the nine teachers who undertook this assessment than across the three teacher whose lessons were observed. For, instance teacher G records a relatively lower perceived proficiency in English, Kiswahili and Kigiryama, whilst teachers I and, particularly D record relatively lower proficiencies in Kigiryama.

The language proficiency profile of the teachers is greatly influenced by their language acquisition backgrounds. Teachers C, E, F, G and H, all record their mother tongue as Kigiryama. All of the teachers except one have the same mother tongue (Kigiryama) as the pupils or have one from a region of or very close to the school. Teachers A and B record theirs as Kichonyi. This is one of a family of five coastal (Mijikenda) languages which also includes Kigiryama. These languages are so closely related (SIL International, Chonyi 2002) that speakers of Kigiryama and Kichonyi are thought to be able to understand both languages. Teacher D records her mother tongue as Kiswahili. Only teacher I has a mother tongue (Luhya) which differs greatly from the pupils. This teacher was born in Nairobi to parents from a different tribal group. He did, however, move to the coastal region when still a child, completing his primary education in Malindi a town approximately thirty kilometres from the target school. Teacher I, subsequently, spent all of his life living and teaching in the coastal region close to the target school. This would explain his rating his proficiency in Kigyriama as moderate with his reading understanding being very high.

The language proficiency profile of teachers is bound to have an effect on how and how frequently they use code-switching. Within the target school we can see that the mother tongue of most teachers shows a very good match to that of the pupils, hence making code-switching into mother tongue much easier for these teachers. Teacher I, however would have significantly more difficulty code-switching to Kigiryama.

## 6.8 Lesson-lesson comparisons

There is insufficient data available for making generalisable comparisons concerning the use of code-switching between lessons taught by the same teacher. This is because:

1. Transcripts are only available for two lessons for each teacher.
2. The lesson content was not identical for each lesson and therefore had different language demands.

However, there do appear to be some patterns which could be identified here as possible areas for future research. Teacher A used much more code-switching in his first lesson compared with his second. The following graphs show the provisional evidence for this.

**Figure 6.16 Total code-switching interventions when creating differences teacher A**

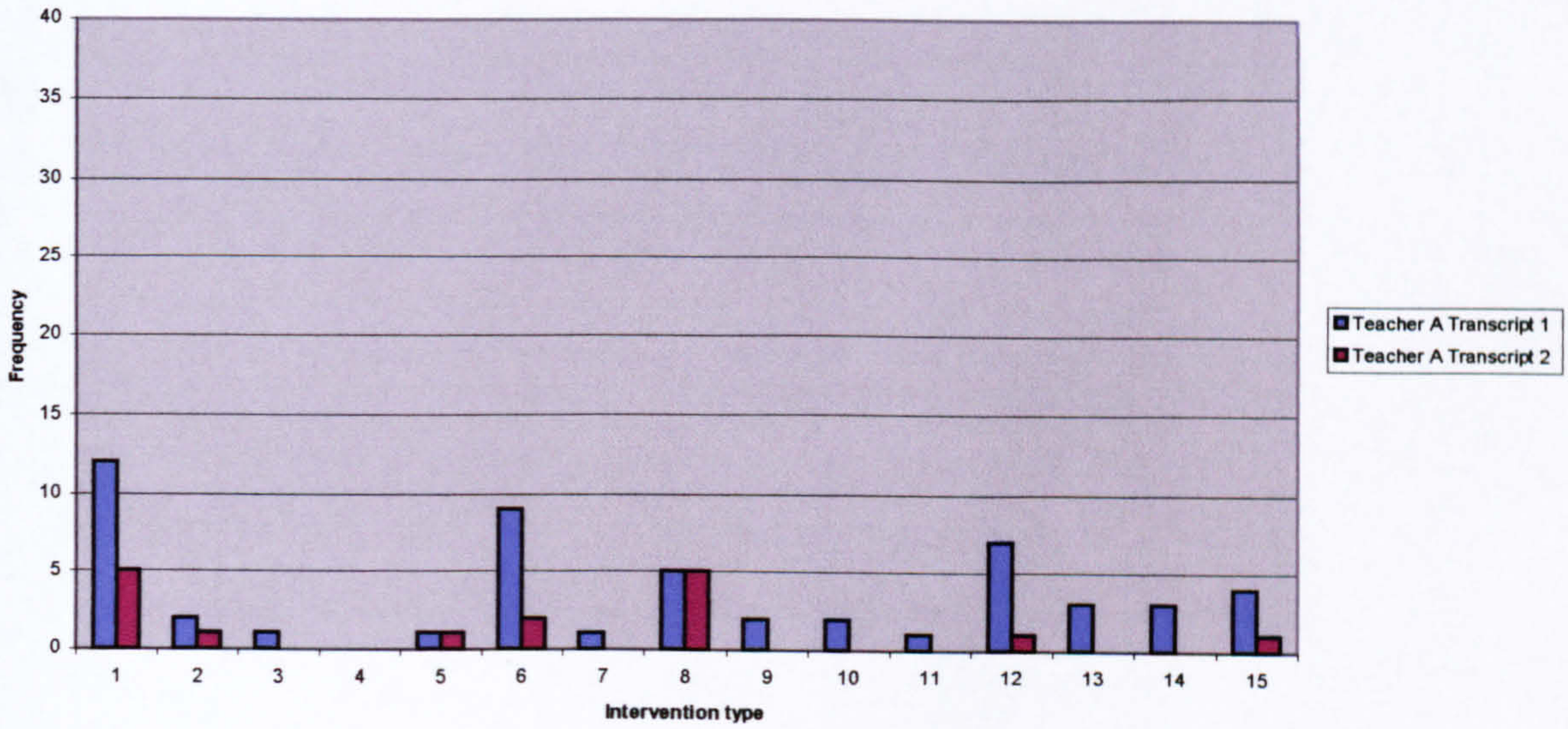
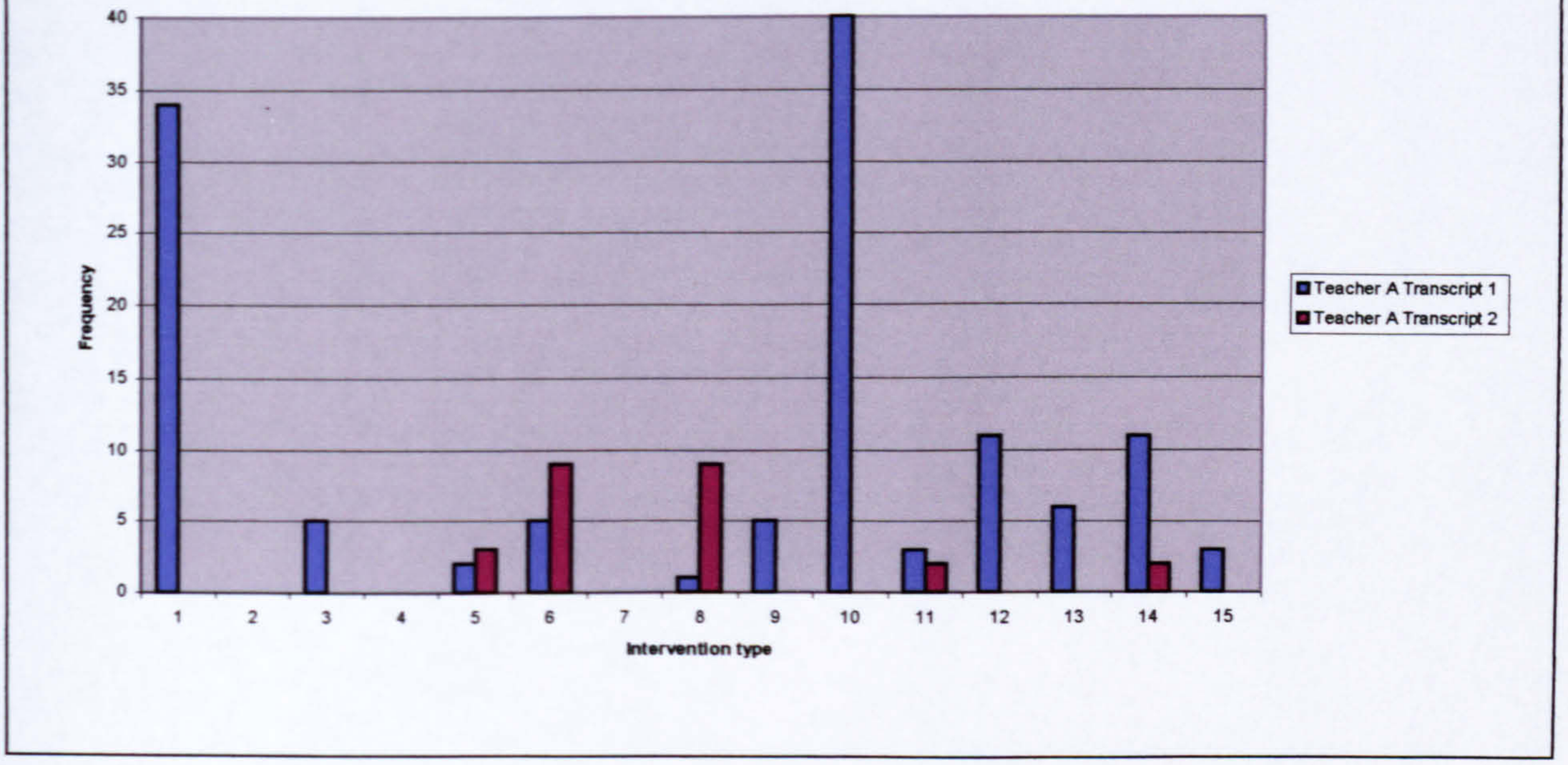


Figure 6.17 Total code-switching interventions when constructing entities Teacher A

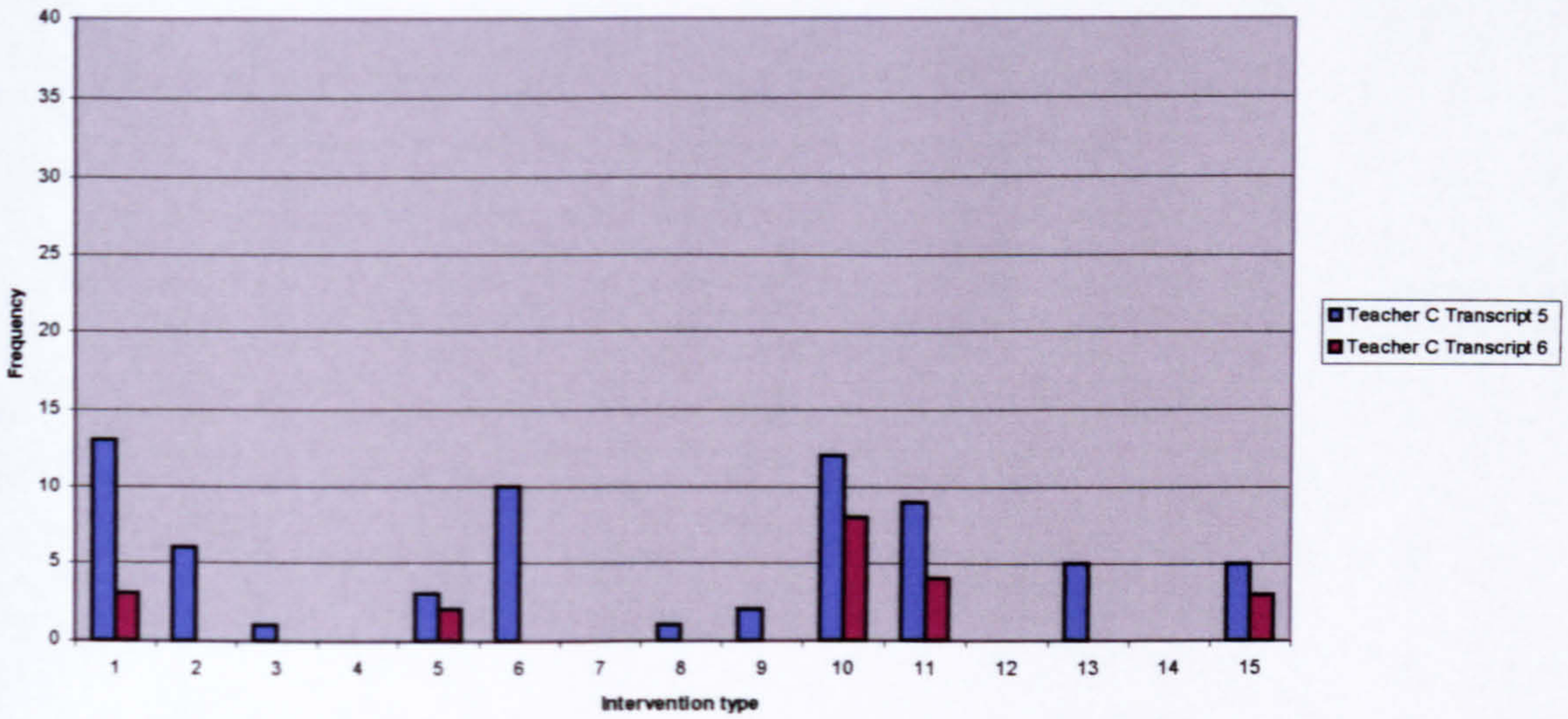



It is clear from these diagrams that a much greater use of code-switching occurs in the first lesson in comparison with the second whether the teacher is creating differences or constructing entities. Teacher A acknowledged that he code-switched to a much greater extent in his first lesson, (Seed structure) compared with his second lesson, (Functions of seed parts). Although not identical, these were quite similar lessons in that both focussed on naming the important parts of a seed. A substantial proportion of the beginning of the second lesson recovered content from the first lesson with the second lesson then going on to discuss the function of each part. Teacher A explained that he had intentionally used more code-switching in the first lesson because he felt that this was an introductory lesson and that "all work was new to the pupils". Teacher A explained that the extra code-switching was necessary to help establish "the concepts and terms" in the first lesson and that once this had been done there would be less need for code-switching in subsequent lessons. Teacher A went on to say that in lesson 2 he had only used code-switching where pupil expressions had indicated that they did not fully understand the content of the lesson or for the benefit of "slow learners".

Similarly, although teacher C spent much less time creating differences than teacher A, with no evidence of code-switching within this lesson phase, when constructing entities

much more code-switching was apparent in the second lesson. The graph below again shows data to support this observation.

**Figure 6.18 Total code-switching interventions when constructing entities Teacher C**




It could be that a common strategy is to utilise code-switching to introduce new concepts and terminology in lessons that occur at the beginning of a new topic. Again, although not identical, the two lessons covered similar ground with a substantial part of the beginning of the second lesson be used to revisit concepts from the first, moving on to present future lessons using less code-switching as the conceptual and linguistic understanding of the pupils is developed.

Conversely, teacher B used fewer code-switching interventions in his first lesson in comparison with his first. However, the two lessons taught by this teacher were very unlike each other, with the first focussing on the structure of a maize seed and the second on factors affecting germination. The first lesson, concerning the structure of a maize seed, in fact built on the lessons taught by teacher A in the previous week and therefore was not an introductory lesson. The second lesson was entirely new to pupils, containing concepts and

terminology that they had not yet been taught and so can be seen as an introductory lesson. The following graphs illustrate the data for these observations.

**Figure 6.19 Total code-switching interventions when creating differences Teacher B**

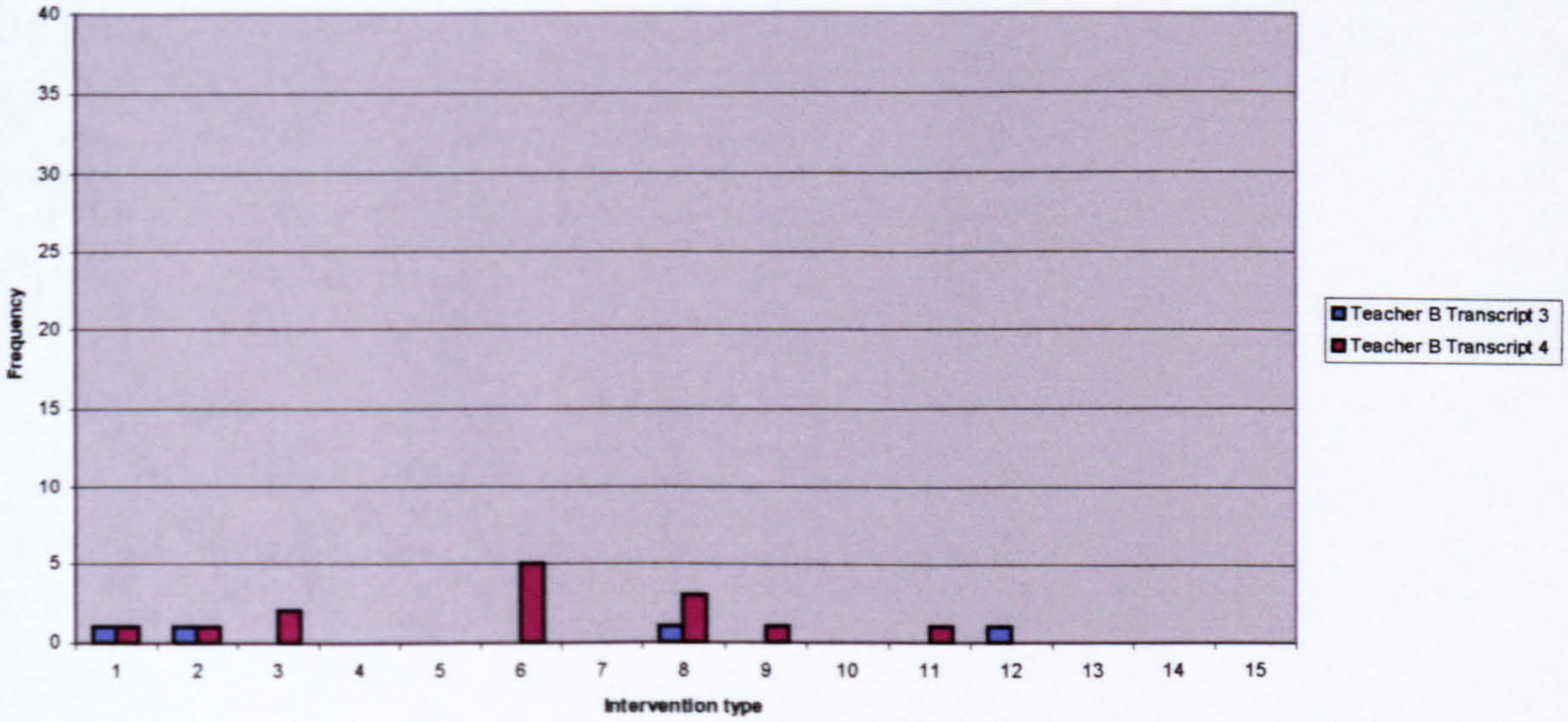
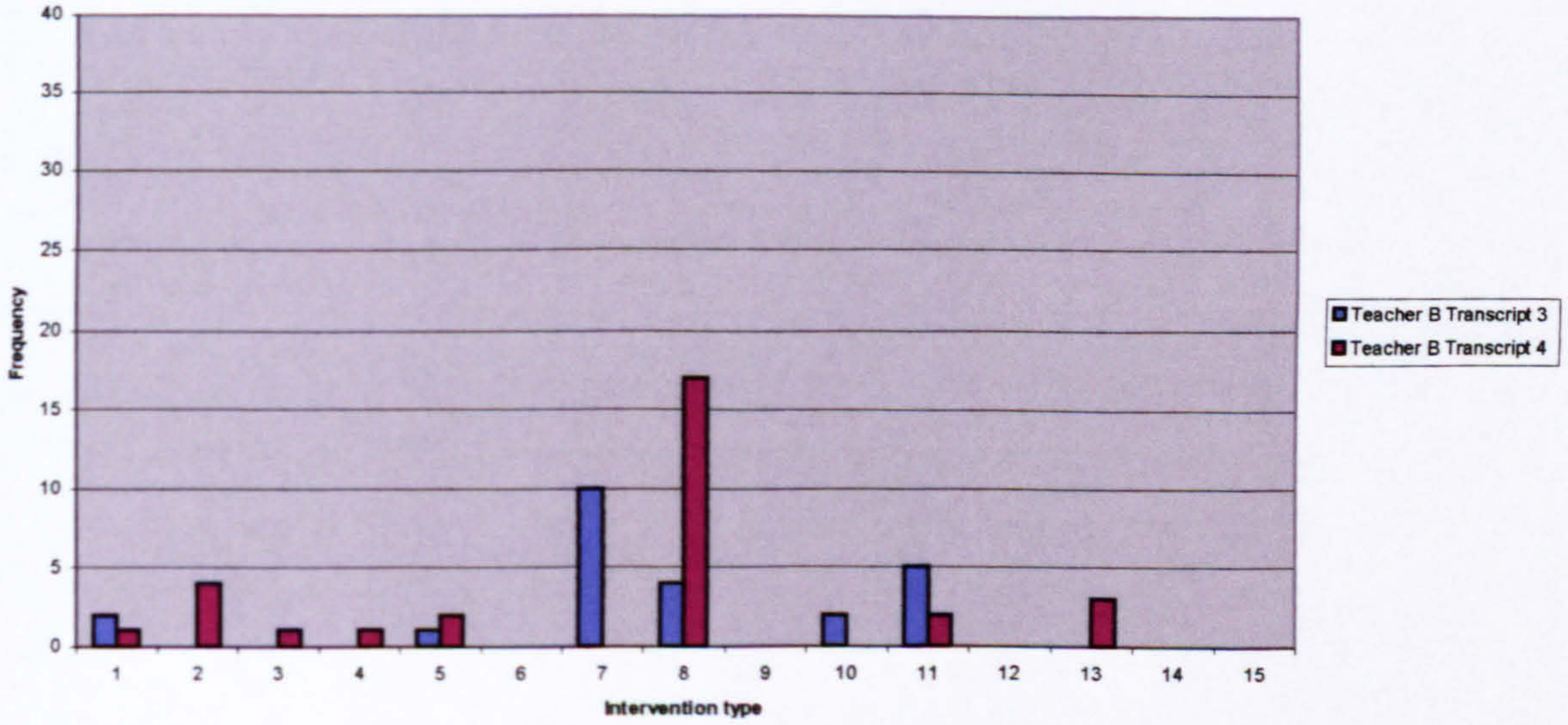



**Figure 6.20 Total code-switching interventions when constructing entities Teacher B**

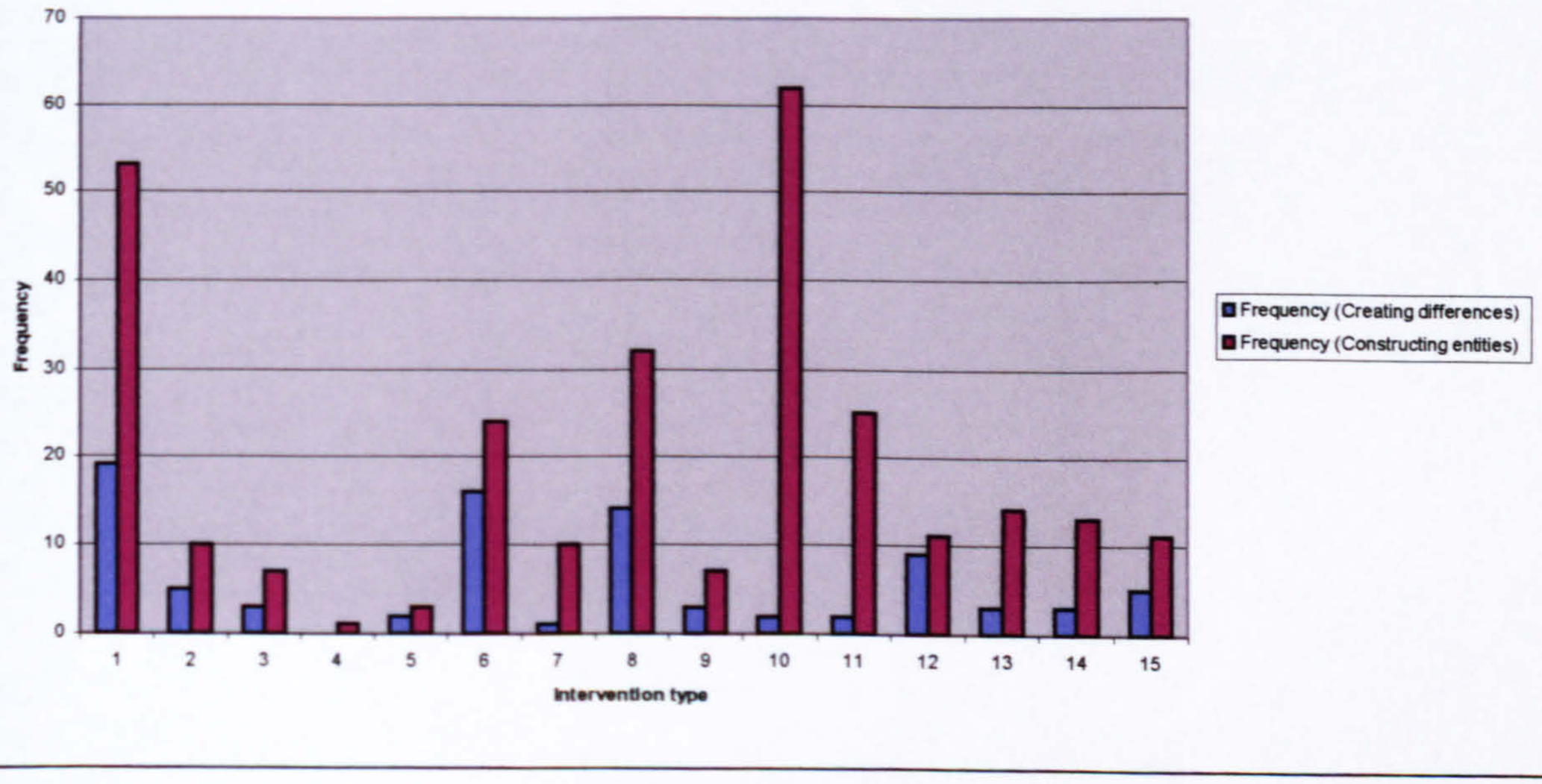


It is clear that teacher B used more code-switching interventions in his second lesson in comparison to his first.

## 6.9 Within lesson comparisons

It is possible to draw more generalisable conclusions when comparing the use of code-switching interventions within lessons because data from all observed teachers across all six lessons can be combined to give a larger database. The following graph illustrates this combined data.

**Figure 6.21 Cumulative frequencies for code-switching interventions in transcripts 1-6**




One comparison that can be made is between how teachers use code-switching when creating differences and how they use it when constructing entities. The following observations are based on the graph presented above. This graph shows the cumulative frequencies for all code-switching interventions from all six transcripts during phases of the lesson which focussed on creating differences and constructing entities.

When considering the graphical information it should be remembered that much more time was spent on constructing entities than on creating differences in all of the

lessons. The combined total of utterances when creating differences compared to constructing entities for the six transcripts is:

| Creating differences | Constructing entities |
|---|---|
| 531 | 1178 |

giving a ratio of 1 : 2.2.

In general then, just over twice as many utterances were used to construct entities as were used to create differences. There should be some caution applied to this interpretation of the balance between utterances concerned with creating differences and constructing entities as there was variation in the ways that individual teachers behaved. Teacher C, for instance, used very few utterances to create differences in comparison to those used to construct entities and no code-switching was recorded in this time.

In order to produce some provisional conclusions concerning the balance of code-switching used in the two phases of the lesson it has been assumed that, if particular code-switching interventions are used as frequently in creating differences as in constructing entities then there will be around twice as many occurrences when constructing entities compared with when creating differences. Therefore, it is only where the use of a particular type of code-switching intervention falls obviously outside of this balance that suggestions of an active preference in use are being presented.

## 6.10 Analysis of the use of interventions types

### 6.10.1 Eliciting interventions

All three intervention types (Interventions types 1,2 & 3), are used in a balanced way when creating differences or constructing entities. There is, however, a much more frequent use of closed questioning compared with open questioning. A large proportion of closed questions are used to check pupil understanding of the lesson content as it unfolds. Pupils are, for instance, frequently asked "Sawa sawa?" (Is that OK?) or "Ndio hvyo?"" (Is that so?), after some piece of information has been conveyed by the teacher. This strategy does not allow the teacher to be sure that pupils do understand the lesson content even if they respond "ndio", (Yes).

Far less frequently pupils are asked closed questions which are intended to elicit some restricted scientific knowledge, e.g., with reference to the testa of the seed "In kazi ama haina?" (Is there a function or not?) or, with reference to whether or not pupils recognise a maize seed "Inatwaje?" (What is it called?). A subset of this type of closed question is the type 3 intervention, thought completion prompt. Here teachers use an incomplete statement, strategic pause and intonation to encourage pupils to complete the statement (teacher thought). As the teacher is expecting a particular piece of information to complete the thought correctly this must be interpreted as a kind of closed question just delivered in a different format. As can be seen from the graph, these closed question interventions make up by far the majority of all questioning code-switching interventions. Unfortunately, the effect of this is that pupil oral input to the lesson is very restricted. Predominantly pupil input is a one-word response which is that required by the question. It was very rare for a pupil to offer more than a one word response and spontaneous input by pupils was almost non-existent.

Open questions, which have the potential to elicit more comprehensive responses from pupils concerning their understanding of scientific concepts, were used very infrequently. Although there were examples of well-used open questioning, often pupils could not or would not respond. It was not possible to ascertain whether or not this was to do with lack of understanding of scientific concepts or that the general authoritative nature of lessons discouraged pupils from forwarding their own viewpoint.

In order to better engage pupils in the discourse and be able to more thoroughly examine their existing understandings an adjustment in the balance between open and closed questions would be beneficial. More open questioning could be used, particularly when creating differences, to encourage pupils to be forthright about their existing understandings. Valuable discussion between teacher and pupil and between pupils could be initiated in this way.

Where closed question are used it would be better if they were designed to elicit definite scientific information from pupils rather than asking them only if they understand. The danger of the latter approach is that pupils say that they do understand when they don't or that the responses of pupils who say that they do not understand are not noticed amongst many pupils who say that they do.

### 6.10.2 Responding interventions.

Because there is no capacity within the kinds of closed questioning strategies just described, for pupils to be able to display the depth, or lack of depth, of their knowledge and understanding and because the restrictive nature of these questions leads to restricted responses, there were relatively few examples of teacher responses to pupils. Type 4 interventions, where teachers confirm or reject pupil responses without repeating them, only occurred when constructing entities, but the significance of this is limited because the total number of incidences was so low (1 incidence). Type 5 interventions, where teachers repeat pupil responses, occurred relatively more frequently, with two occurrences when creating differences and thirteen occurrences when constructing entities.

Given such low numbers of type 4 interventions it is impossible to make any meaningful comment on the balance of use between creating differences and constructing entities for these interventions. The higher incidence of type 5 interventions is less significant when it is considered that they occur across six lessons. What can be said is that the low numbers are a reflection of the limited oral contribution of pupils to lessons. Pupils, for the most part, are passive recipients of information who rarely offer their own thoughts or questions. These kinds of interventions are excellent ways of marking and reinforcing key ideas. They also help to build pupil confidence as they get positive or sensitive negative feedback on their contributions. Along with a shift in balance toward asking more open questions should come a well-thought-out feedback system to pupils which encourages their participation in discourse.

### 6.10.3 Interventions which make links

Examples of teachers code-switching to make links were more frequent than responding interventions. This was particularly true for intervention type 6, where teachers code-switch to make links to a familiar context outside of the lesson. There appears to be some imbalance in the way that this type of intervention was used with it occurring relatively more frequently when creating differences than when constructing entities. When creating differences teachers frequently contextualised questions, placing them in perspectives that pupils were familiar with from outside of the lesson. This is an excellent

strategy, which helped pupils understand and participate in the lessons. The fact that such interventions were used relatively more frequently when creating differences did not mean that they were underused when constructing entities. There were many examples of external linking of this type used to help describe protagonists and their capabilities.

There appears also to be an imbalance in the way that internal linking interventions were made. Intervention type 7, where teachers make internal links within the discourse, e.g., indicating that they are ready to move on by saying "Sasa" (Now) was used much more frequently when constructing entities. This was partly because teachers used extended episodes of direct lecturing when constructing entities (they are infrequently used when creating differences) and discourse links would be found within episodes of lecturing. Discourse links were also used between successive episodes of lecturing as a way of helping pupils to understand how the structure of the explanation enabled entities to be constructed and meaning made. This is an excellent strategy which helps pupils to understand how the scientific story fits together. This enables meaning making and helps to maintain the narrative as some of these interventions also made links from one lesson to another.

### 6.10.4 Interventions which convey information

Interventions aimed at conveying vital information were the most frequently used intervention types of all. Intervention type 8, cognate provision or definitions of unknown terms, appear to be utilised in a balanced way whilst creating differences and constructing entities. This came as no surprise, as teachers were as likely to use scientific terms unfamiliar to pupils when assessing pupil knowledge prior to the teaching of the topic as they were when constructing entities. For instance, in the lesson 'Factors affecting the germination of seeds' teacher B introduced the term 'germination' and used code-switching to define it right at the beginning of the creating differences phase of the lesson, within the first 15 utterances of the lesson. In many cases this approach is inevitable because the new terminology is the focus of the lesson and knowing whether or not there is a knowledge gap to be bridged is critical to establishing how the lesson must proceed.

Cognate provision and definition code-switching is seen as vital to the establishment of a compound multilingual understanding of concepts. This intervention

should be employed as frequently as possible in all lesson phases. Key scientific words should be presented or defined at the beginning of the lesson, first in Kiswahili (and or Kigiryama) and then in to English. This way pupils can have a compound multilingual understanding for these vital terms established at the beginning of the lesson which will help them to understand their meaning and use when broader concepts involving them are discussed within the lesson. Moving from mother-tongue to English helps pupils to transfer the concept from a stronger language to the weaker using concept mediation (Kroll, 1993, p.70). That is to say that having established understanding of the concept using L1, the concept can be associated with the relevant lexical term in L2. If pupils have these terms presented in English first they are being asked to do two things, i.e, negotiate the language barrier and then understand the concept. As Kroll identifies, L2 words will initially be mapped to L1 to gain access to concepts.

Similarly, intervention type 9, rhetorical questions, showed a balance between use in creating differences and constructing entities. These interventions are a way for teachers to convey information. The teacher is not quizzing the pupil and expects no response from the pupil. The question is asked in order to set up the answer. It is the information carried in the answer which is important and the teacher supplies this. It is simply another way of presenting information and as such offers variety in lesson delivery.

There appears to be a significant difference between the balance of use of both direct lecturing intervention types whilst creating differences and constructing entities. Teachers used direct lecturing as the major strategy for conveying important information when constructing entities. On most occasions this lecturing would be delivered in Kiswahili only (there were few examples of direct lecturing in Kigiryama). In some lessons direct lecturing in Kiswahili would begin as soon as the process of creating differences was complete.

There was a distinct change in atmosphere in the lessons away from limited dialogue when creating differences towards authoritative delivery of information whilst using lecturing to construct entities. This manifested itself as a detectable change in the tone of the teacher's voice, becoming more assertive and emphatic when lecturing began. The speed with which information was conveyed increased too. Whereas a teacher might spend 15 minutes finding out about seeds pupils could name whilst creating differences, the

teacher would deliver several facts about the structure of a seed or the function of a particular part in a matter of seconds whilst lecturing. Pupils are expected to be the passive recipients of information during lecturing. The type of information that is conveyed becomes more formal and much more like that evident in the textbooks.

Type 11 direct lecturing, where the teacher repeats information that has been a part of a lecturing intervention in English immediately afterwards in Kiswahili, was also a strategy used predominantly whilst constructing entities. It was a surprise that this was not the dominant strategy given that, along with cognate provision and definition, this is a major way of developing a compound multilingual understanding of concepts and that pupils will, ultimately be examined in English. It seemed that teachers assumed that there would be automatic transfer of understanding between languages, i.e, if they used lecturing in Kiswahili to explain a concept this would lead to understanding and the ability to express that understanding in English without the need for further intervention. Seddon and Waweru (1987, p.244-248) have shown that this kind of transfer is possible between English, Kiswahili and Kikuyu in science lessons but their investigation involved lessons incorporating a large amount of practical investigation, which would have offered a strong route for conceptual mediation. They acknowledge that different teaching approaches e.g., lecturing, might produce different results. Kroll (1993, p. 70), as previously mentioned, recognises that translation from L1 to L2 would be likely to require concept mediation, particularly for pupils with low L2 proficiency. The recommendation here is, then, that where direct lecturing is used, it should first occur in L1 in order to establish the concepts in the familiar language. Concept mediation should then be used to transfer that understanding to L1 by lecturing in a combination of L2 and L1 in such a way that the concepts and associated language are linked in a way that pupils can access.

Type 10 and 11 lecturing interventions did occur whilst teachers were creating differences. This usually happened where, whilst exploring pupil knowledge of a broader concept, teachers realised that pupils did not understand concepts or terms which were a part of the wider conceptual picture. In these circumstances they would use direct lecturing to explain the sub-concept in order to overcome this barrier and proceed with creating differences. These could be seen as examples of entity construction within the creating differences lesson phase. If given this interpretation then all lecturing interventions are

associated with the construction of entities. This is a logical conclusion because lecturing is concerned only with conveying information. The information conveyed is about protagonists, their abilities and relationships to each other.

### 6.10.5 Interventions which manage pupils

Type 12 interventions, which control how pupils engage in discourse, appear to be used in an imbalanced way. There are relatively more interventions of this type when creating differences than when constructing entities. This could reflect the exploratory/dialogic nature of the creating differences phase and the authoritative nature of the constructing entities phase. When creating differences there is a greater expectation that pupils will engage in open dialogue and put forward their views even if questions are often quite restrictive. It could be that more pupils are responding and therefore there is a greater need for the teacher to manage their input using interventions such as "Wanyoshe mkono", (Raise your hands), "Huko nyuma", (from the back), "Wewe", (You) whilst pointing at a pupil or "Mwingine?", (Anybody else?) requesting further pupil responses. During the constructing of entities the more authoritative nature of discourse may discourage some pupils from engaging for fear of offering an answer that is not the expected answer. Hence, the teacher has less discourse management to do.

All of these interventions are seen as being very helpful. Where they were used frequently, they seemed to put pupils at their ease and help lessons proceed in a more fluid fashion. Recommendations for future use would include their greater incorporation into the constructing entities phase alongside the use of questioning strategies which help pupils to engage with this phase of the lesson by querying and considering more deeply the conceptual information that is being made available on the interpsychological plain. Discourse directives which encourage pupils to make oral contributions of a more extended fashion would be invaluable when creating differences and, particularly, when constructing entities.

There is also an imbalance in the use of activity directives. Interventions which manage pupil behaviour in respect of what they must do to engage in the lesson at that point, e.g., "Angalia hapa", (Look here) etc, are used relatively more frequently when constructing entities. This is not a surprise as episodes which make connections between

concepts and the real world e.g., practical activities, the production of diagrams, use of models etc, occur more frequently when entities are being constructed. The structure of any lesson, how and when teaching and learning activities are being presented will determine how and when these kinds of interventions are used. Again, these are extremely valuable interventions which help pupils understand exactly what is expected of them in order to engage in the next part of the lesson. Other than encouraging their continued use there is no recommendation to be made here in respect of when they should be used.

There is an imbalance in the use of speech directives towards a relatively greater use when constructing entities. Intervention type 14 which tells pupils to practise saying important words or parts of words are vital for pupils to gain understanding of the phonological representations of words. However, in support of the recommendations concerning the use of cognates and definitions and the presentation of key scientific words at the beginnings of lessons so that pupils understand them in the course of a lesson, would go a recommendation that speech directives are used to encourage pupils to learn the phonological representations of words. Pupils will then be more able to utilise the correct terminology during discourse in any other part of the lesson.

# CHAPTER 7

# CONCLUSIONS AND IMPLICATIONS

## 7.1 Introduction

This chapter firstly provides a summary of the major findings which arise from this study. This is followed by a discussion of the educational implications of the research findings for the use of code-switching in primary science classrooms and how these relate to issues that arise for the education system of Kenya. Finally, suggestions for improvements to the research methods are followed by some issues for further research that have emerged from the study.

## 7.2 Main findings

This study set out to investigate how code-switching is used in science lessons in one Kenyan primary school to help support meaning making for scientific concepts. In order to do this three research questions were investigated. Reviewing the findings for each in order:

**Research question 1**

How can the code-switching interventions used in science lessons in standards 4 and 5 at Mida Primary School be characterised?

A range of code-switching interventions from existing literature (Baker, 1996, Cleghorn, 1992 and Merritt *et al* 1992), which had been, or could reasonably be expected to be, utilised in science lessons in Kenyan primary schools was first assembled. This range was used to inform observations of actual code-switching practice in six standard 4 and 5 science lessons at the target school. A characterisation of the range of code-switching interventions was then produced using data emerging from the lesson observations. A typology of interventions was then constructed, consisting of 14 different interventions arranged into five groups as shown in figure 7.1 below.

**Figure 7.1 A typology of code-switching interventions**

**Primary functions** and types **of teacher code-switching intervention.**

| **Eliciting** | **Responding** | **Making links** | **Conveying information** | **Managing** |
|---|---|---|---|---|
| 1) Closed questions | 4) Confirmation or rejection of pupil response | 6) Contextual (external) | 8) Cognate provision/definition | 12) Discourse directives (Controlling talk) |
| 2) Open questions | | | 9) Rhetorical questions | |
| 3) Thought completion prompts | 5) Repetition of pupil response | 7) Discourse (internal) | 10) Direct lecturing (Kiswahili or or Kigiryama only) | 13) Activity directive (Controlling activity) |
| | | | 11) Direct lecturing (Repetition of of English lecturing in Kiswahili or or Kigiryama). | 14) Speech directive (Controlling language development) |

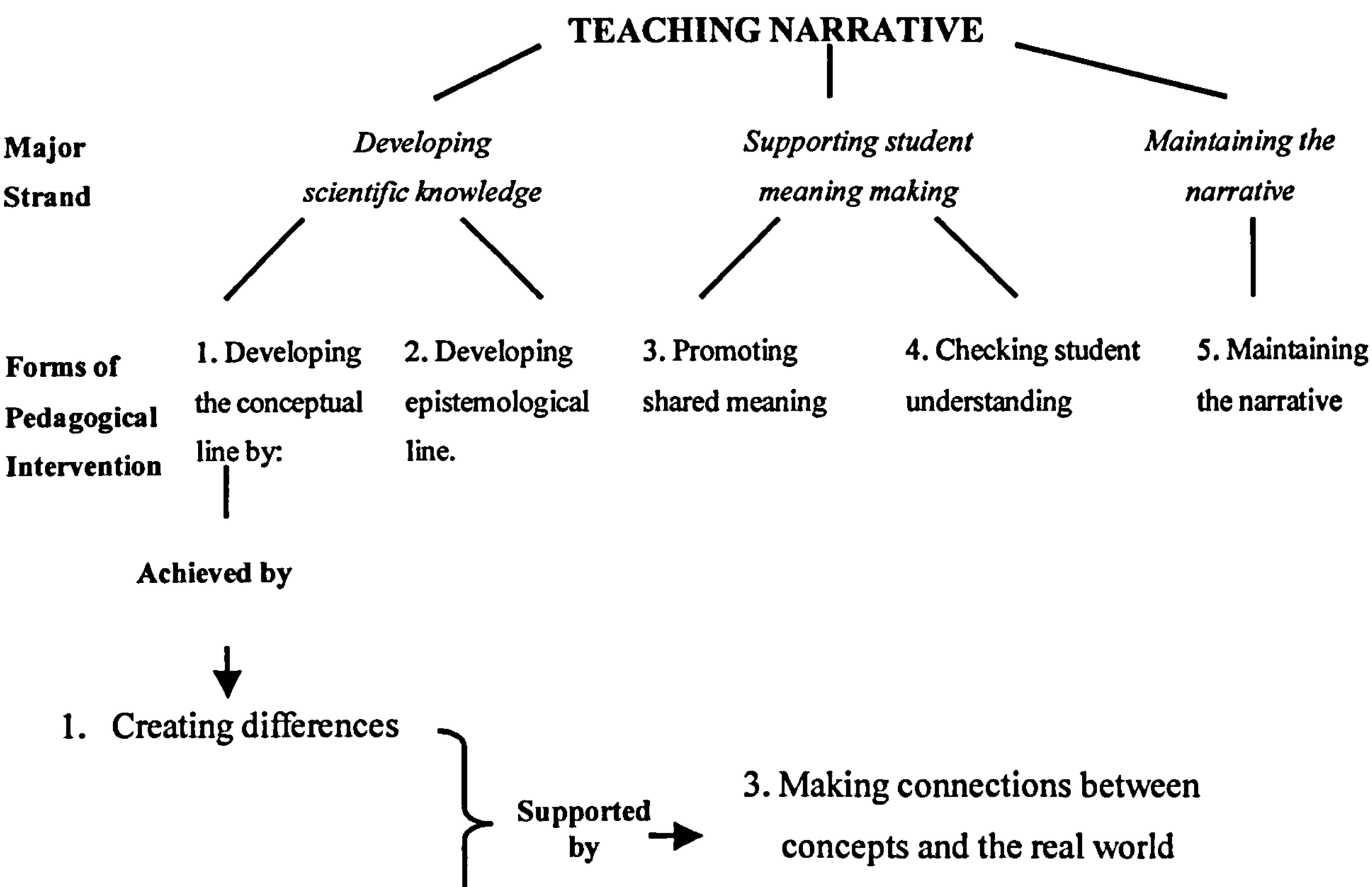
The five 'primary' groups are based on the function of interventions placed in each i.e., *eliciting, responding, making links, conveying information* and *managing pupil engagement in lessons*. The study added a number of new code-switching strategies to those identified in the existing literature including previously unrecorded questioning strategies and linking strategies which help place the scientific discussion in contexts familiar to the pupils.

**Research question 2.**

How are code-switching interventions used to support the meaning-making process in science lessons in standards 4 and 5?

A further level of characterisation utilises a framework for the analysis of key aspects of meaning-making in the science classroom to describe how each code-switching intervention from the typology contributes toward the development of understanding of scientific concepts. This framework is shown in figure 7.2 below. It has been constructed by combining structures and ideas presented by Scott, 1998 and Ogborn *et al*, 1996. This work of Scott and Ogborn *et al* is concerned with elucidating how teachers explain scientific concepts in the classroom. The link between this framework and code-switching interventions has been fully explored in Chapter 6.

**Figure 7.2 A framework for the analysis of key aspects of meaning-making in the science classroom**




(Developed through the combination and modification of frameworks from Scott, 1998, p. 56 and Ogborn *et al*, 1996, p. 11-16)

**Research question 3.**

What are the contextual factors that might influence the use of code-switching by individual teachers?

The following findings have emerged from a combination of data sources including teacher self-assessments, teacher training questionnaires and discussions with education professionals. These findings have been grouped into three categories based upon areas of context which impact upon practice in the classroom.

**Contextual factors which influence the use of code-switching by teachers.**

**Policy and practice.**

1. Code-switching in primary schools is a practice accepted as necessary by the government, schools inspectorate, the target school's teachers and management.

**Training and INSET.**

1. All of the three teachers observed had received English as a second language teaching and learning strategies training as a part of their initial teacher training.
2. Of the three teachers observed, only teacher B had received English as a second language teaching and learning strategies training as a part of INSET. This had occurred four years previously.
3. All of the three teachers observed had received Kiswahili as a second language teaching and learning strategies training as a part of their initial teacher training.
4. Of the three teachers observed, only teacher B had received Kiswahili as a second language teaching and learning strategies training as a part of INSET. This had occurred three years previously.

**Language proficiency.**

1. The three teachers observed, assessed themselves as having similarly high language proficiencies in English, Kiswahili and Kigiryama (Teacher A assessed his reading and writing proficiency in Kigiryama as moderate.)
2. Teachers articulated a strategy for the direction of translation between languages. This was to move from the known, i.e., L1 to the language that was unknown, i.e., L2.

In the past, a strict adherence to the language of instruction policy has tended to discourage the use of code-switching by teachers in primary schools (Abagi and Cleghorn, 1990). This data shows that there is a recognition of the need for the use of mother tongue in, for instance, science lessons. However, due to the fact that the Kenyan Certificate of Primary Education (KCPE) is written and examines in English and the importance of English in higher education and commerce, teachers still view the development of English language skills as a vital part of their teaching responsibilities. As schools are graded on the

performance of their pupils in the KCPE there is significant pressure within the system towards the use of English, at the expense of other languages, within the science classroom. This pressure often operates to the extent that isolated scientific facts are taught in English, by rote, so that pupils can place them verbatim within their KCPE scripts. Teachers understand that this approach does not enable the meaning-making process and that one of the most effective tools in this respect is code-switching.

Added to this pressure towards the use of English, there is evidence that the availability of teacher training, in respect of the use of code-switching, is variable and does not follow any policy or plan. Also, although, the three teachers observed here rate themselves highly in respect of their proficiencies in English, Kiswahili and mother tongue, there are teachers within the target school and other schools (Abagi and Cleghorn, 1990), who do not. It is likely that this is situation is replicated in schools all over the country and does not make for a situation where the effective use of code-switching as an essential element in the meaning-making process is always possible.

## 7.3 The implications of these findings for practice

The importance of good practice in language-use when teaching in any language environment cannot be over-emphasised. The role of language as a carrier of meaning at the single word level and when words are combined to produce more complex meaning, demands that teachers utilise effective, language-based strategies for guiding pupils towards understanding of these meanings. Pupils need to be encouraged to utilise language to express and thereby gain greater understanding of scientific concepts. When pupils do this they reformulate their thoughts through the medium of language and gain a deeper understanding of how concepts interrelate. The sharing of experiences that illustrate scientific concepts in action, and the making sense of those experiences, will be accomplished through the skilled use of language aimed at drawing pupils into a dialogue in respect of the critical concepts revealed by the experience. Focusing pupil attention on the critical aspects of learning experiences and tasks will also demand specific language-based approaches. It is within this background of skilled language utilisation that code-switching will operate. The effective use of code-switching will complement effective language strategies that are already being used by teachers in the classroom.

Abagi and Cleghorn conclude their study by stating that:

> English, Kiswahili and mother tongue may present obstacles to teachers in providing students with more effective instruction. Educational planners and policy makers need to take a long-term view of the role that Kenya's languages and cultures are to play in the country and to articulate that with curriculum content and with teacher training. The issue is much more complex than simply advocating the use of one language or another for instruction. The manner in which language is used during instruction is one of the most important aspects of the educational process.
>
> (Abagi and Cleghorn 1990, p. 70)

Abagi and Cleghorn and this study have identified that teachers and the education establishment recognise the importance of code-switching for helping pupils to better understand the science they are taught, have a tacit understanding of some of the ways in which it can best be utilised, but that the present organisation of certain aspects of the education system conspire to frustrate its effective use. If the best use of code-switching is to be made by teachers to enable the meaning-making process in primary science classrooms, some way of overcoming these obstacles must be found. This will involve developing educational policy that promotes a **planned** use of code-switching by teachers.

When making recommendations for improved practice in respect of language use in science teaching, it would be sensible to begin by outlining how we might expect the 'planned' use of code-switching for meaning-making in science lessons to look. This might then be compared to actual practice observed at the case-study school and then relevant suggestions can be made for modifications that would enable the meaning-making process.

### 7.3.1 General code-switching practices planned to support meaning-making in science lessons

Given that the government already accepts the need for code-switching in rural primary schools we might expect that education policy and practice would adopt the principle that, in general, when teaching science to pupils in lower primary school, the direction of

translation should be from L1 to L2. This is in recognition of Kroll's (1993, p.70) assertion that, for pupils with limited proficiency in L2 (English in this case), "Conceptual mappings are stronger from L1 than from L2" and that "translation from L1 to L2 is therefore more likely to require concept mediation". The underlying philosophy here is that concepts should first be established in L1, utilising the substantially larger L1 lexicon (Kroll, 1993, p.70) and conceptual memory resource. These concepts can then be transferred by translation and linking across into L2 (English) using the conceptual understanding established via the L1 to help make meaning for important scientific vocabulary in L2. This approach allows for the use of concept mediation in helping to make meaning for important L2 words and for broader concepts represented by relationships between groups of L2 words.

### 7.3.2 Specific code-switching practices planned to support meaning-making in science lessons

This study has identified three main parts to the meaning-making process, creating differences, constructing entities and making connections between concepts and the real world. Each will now be considered in turn to clarify critical code-switching strategies that would be expected to support meaning-making in each stage.

#### 7.3.2(i)Creating differences

1. Checking student understanding.

In order to assess the current level of pupil understanding, the 'common view', and for the teacher to, thereby, determine that it is significantly different from the scientific point of view, we would expect code-switching strategies which help pupils to express their existing knowledge and understanding in relation to the scientific concepts or phenomena in question. Here, the quality of pupil expression is key to teachers gaining a detailed and accurate understanding of the common view. It is vital, therefore, that pupils are encouraged to give oral descriptions of their understandings which are as detailed as possible. This would be achieved, obviously, through the use of *eliciting* interventions. *Open questioning,* is of particular importance, because it encourages pupils to respond in

depth and gives them the freedom to express their actual understandings without influence by the suggestion and restrictions that are embedded in closed questioning. The use of open questioning can also allow other pupils to listen to and consider the understanding of other responding pupils this, in turn, will stimulate and influence their own understandings and any inputs to discourse that they decide to make.

This is not to say that *Closed questions* are not of importance too. Their value in respect of helping the teacher to determine what pupils know in relation to the scientific story, however, is greatest if they are structured to elicit scientific knowledge and understanding directly. General questions like, "Sawa, sawa?", (Is this OK?) for instance, are of less value because pupils are likely to respond "ndio" or "yes" even if they do not understand. An effective use of elicitations for checking pupil understanding would, perhaps, involve the strategic use of open-questioning aimed at opening up discourse which maximises pupil oral involvement and, therefore, reveals most about their true understanding. Key closed questioning could be used within this discourse to elucidate pupil understandings through the elicitation of specific scientific information whilst helping guide the discussion in a direction that meets the needs of the lesson focus.

*Contextual linking* is very important for placing the discussion in a setting that is familiar to pupils, particularly where scientific concepts are abstract or where language or cultural issues render them difficult for pupils to understand. Framing elicitations in contexts that pupils have regular experience of will allow them to engage with the concepts and, therefore, in the discussion, much more easily.

Having encouraged pupils to be proactive in expressing their ideas through the use, particularly, of open questioning, support should be provided via the use of sensitive and positive *responding* interventions. If pupils are to continue to make extensive oral inputs to lessons they must feel that they are operating in a 'safe' environment. Pupils need to know that their contributions are valued and respected by all involved in discussions, even if incorrect, and that teachers will sensitively evaluate and respond to their input. Teacher responses should, therefore, help to create classroom conditions where all pupils feel secure enough to make uninhibited contributions. This may require the prior setting and maintaining of discussion ground-rules as well as ongoing supportive responses.

In a climate where many voices make contributions to the scientific debate *discourse management* interventions will become more important for managing the orderly progress of the discussion. There will be an increase in their use as a consequence of using the code-switching interventions described above to involve pupils more deeply in discourse.

### 7.3.2(ii) Establishing differences between the common and scientific view

'Establishing differences' here, really means **communicating** that there is a difference. Having checked pupil understanding the teacher is aware that it differs from the scientific story and they must let the pupils know this. Ogborn *et al* (1996, p.38) comment that there are two major kinds of difference. There is the difference "between what pupils do not know and what they need to know" i.e., knowledge and information that is completely new to the pupil, and the difference "between what pupils think they know and knowledge which runs counter to that" i.e., knowledge and information that is an alternative to the common view of the pupil.

The first of these categories Ogborn *et al* refer to as the "What we are going to do next" group because teacher interventions which communicate that there is entirely new ground to be covered will tend to reveal to pupils that the lesson is concerned with a foray into, thus far, unexplored territory. Teaching interventions that we would expect to hear here, then, would tend to be those that *convey information,* particularly *direct lecturing* interventions.

The second of these categories Ogborn *et al* refer to as the "What do you expect?" category because the teacher often tries to set up conflict between the common conceptual understanding of the pupil and the conceptual understanding from the scientific viewpoint. Frequently, this may be achieved by providing some practical demonstration of scientific phenomena or concepts, i.e., by making connections between concepts and the real world. The key code-switching that we would expect to hear here would be *eliciting* interventions. Particularly, these would involve *open questions* designed to get pupils to, first, express their own understanding and, second, *direct lecturing,* to try to explain that there are differences between their understanding and the scientific story, perhaps as witnessed in any demonstration.

In order to understand entirely new knowledge or to explain an alternative understanding of a concept the pupil will require, amongst other things, new language resources. There will be new key vocabulary used to describe and explain new or alternative concepts. A major part of the role of the teacher when communicating the differences between the common and scientific view is to explain to pupils the resources that they will need in order to understand the scientific story. The meanings of new scientific vocabulary will need to be discussed here so that pupils can use it to make meaning later in the lesson. The key code-switching interventions we would expect to hear here would be those for *conveying information* especially *cognate provision/definition* of new scientific vocabulary. *Direct lecturing and contextual linking* will also play an important part in this process as teachers expand upon the meanings of individual words and try to link them to understandings from pupil personal experience. Finally, as it is of vital importance that pupils can use the scientific vocabulary during discourse when entities are constructed, *speech directives* are important to encourage pupils to practise saying the new words.

### 7.3.2(iii) Generating a learning appetite

Establishing differences and generating a learning appetite often occur simultaneously. Although these can be seen as two separate aims, the first often influences the second, i.e., when pupils understand that there is new knowledge to be gained or that there is an alternative way of explaining scientific concepts, this can trigger the motivation to find out more. The act of establishing the difference can, thereby, generate a learning appetite.

Where pupils find it difficult to summon such motivation simply through knowing that there is new knowledge to be gained, supplementary strategies are essential. Some of these strategies can be seen as being essential for helping pupils understand the framework of the learning program and for broader understanding of the significance of scientific concepts and should be a part of the lesson anyway. These strategies deal with the 'why' as opposed to 'what' of the lesson content and can be looked upon as the 'big picture'. The big picture can relate to how this lesson fits in to the broader understanding of this field of study, e.g., that understanding germination helps us to understand more about plants and

plant reproduction or it may relate to the personal educational pathway of the pupils, e.g., understanding germination is a topic which frequently appears in important examinations, or will help you to be a more successful farmer. Code-switching to be expected here would be *eliciting* interventions aimed at helping pupils to consider various aspects of the big picture and *conveying* interventions, particularly *direct lecturing* interventions which help to explain the big picture.

**Table 7.1 Summary of expected code-switching interventions when creating differences**

| Meaning-making purpose | Expected code-switching interventions |
|---|---|
| Checking pupil understanding | Open and closed questioning, contextual linking, responding, discourse management. |
| Establishing differences (What we are going to do next) | Direct lecturing |
| Establishing differences (What do you expect?) | Open questioning, direct lecturing |
| Providing resources for understanding the scientific story, particularly key scientific vocabulary. | Cognate provision/definition, direct lecturing, contextual linking, speech directives. |
| Generating a learning appetite, exploring the big picture. | Open questioning, direct lecturing. |

### 7.3.2(iv) Constructing entities

Constructing entities involves the presentation of the scientific story on the interpsychological plane in such a way that it helps pupils to modify their current understanding on the intrapsychological plane. This involves more than just telling pupils the scientific story, particularly if knowledge and understanding is entirely new to the pupils. The first three subsections of entity construction, **describing protagonists, revealing protagonists capabilities and explaining how protagonists affect each other,**

could be construed as straightforward transmission of information in relation to protagonists in the story.

However, the fourth section, **talking entities into existence,** highlights the importance of how this should be done if effective modification of the common view is to take place. If pupils are to modify their current understanding to that represented by the scientific story they must be encouraged to consider, through discussion, how the scientific viewpoint compares to their current understanding and how (and why) their current view must be developed to accommodate the scientific view. The 'talking' into existence should, therefore, be a group endeavour involving the oral input of teacher and pupils in true discourse so that all pupils have the opportunity to move from their own particular understanding towards a commonly (within the group) accepted understanding of the scientific view.

Obvious code-switching interventions that we would expect to be utilised in order to describe protagonists, reveal their capabilities and their affects on each other, would be *conveying* interventions, especially *direct lecturing* and *cognate provision/definition.* It is important to remember that these three meaning-making stages do not occur discretely but, rather, are interwoven within discourse as entities are talked into existence. In order to talk entities into existence as a group enterprise we would expect that pupils would be encouraged to consider the information provided by the teacher, compare it with their own understandings and comment on how it differs from and modifies their current view. We would expect the teacher to respond to and comment upon pupil ideas.

In order to enable this group discourse during entity construction we would expect the use of *linking* interventions to allow the pupils easier access to the new information. *Contextual linking* is, again, of particular importance because it helps to place new knowledge in a context that pupils can more easily relate to. *Discourse linking* interventions help pupils to understand the structure of the explanation and how one section of entity construction relates to another within the scientific story. *Eliciting* interventions would be used to encourage pupils to explore and reveal their understandings in relation to the scientific story and *responding* interventions would be used to evaluate and comment upon pupil contributions. Finally, *discourse management* interventions will be important to coordinate pupil input.

**Table 7.2 Summary of expected code-switching interventions when constructing entities**

| Meaning-making purpose | Expected code-switching interventions |
|---|---|
| Describing protagonists | Direct lecturing, cognate provision/definition. |
| Revealing protagonist capabilities | Direct lecturing, cognate provision/definition. |
| Explaining how protagonists affect each other | Direct lecturing, cognate provision/definition. |
| Talking entities into existence | Open and closed questioning, responding, contextual linking, discourse linking, discourse management. |

### 7.3.2(v) Making connections between concepts and the real world

Making connections between concepts and the real world involves a variety of strategies which can help to support both the creation of differences and the construction of entities. Making connections involves offering pupils experiences which illustrate the concept in operation either through the use of language to describe the concept in action or by explaining the workings of some kind of visual representation of the concept. Both strategies represent a form of linking between the underlying scientific viewpoint and how it appears or operates in reality. In one case the pupils hear about the concept's manifestation in the 'real world', in the other they see the concept and hear about its manifestation in the real world. This, in essence, is the point of science education, i.e., understanding how the real world works through scientific theory.

Using language only to make connections, obviously, represents a form of linking not too dissimilar from contextual linking. Contextual linking, as it has been defined in this study, however, involves the use of a single word or a few words to direct the pupils' thinking towards contexts with which the pupil has had direct personal experience e.g., their home, the local environment or some artefact from everyday life. Whereas making connections using language involves the presentation of a kind of extended narrative which

may be beyond the personal experience of the pupil but which allows the pupil to make sense of an otherwise isolated scientific idea. It may be that, within this extended story, contextual links relating to the pupil's personal experience are used to place some aspects of it within the common understanding of the pupil. For instance, a story about seeds found buried in Egyptian tombs, germinating after many thousands of years, is an example of dormancy operating over a striking time period in the real world but not a world of immediate personal experience for most of the pupils. Contextual links might be used within this story to explain, for instance, that the Pharaoh is the equivalent of a tribal chief, but the significance of the whole tale does not rely upon the use of them. Similarly, analogy involves making difficult scientific concepts easy to understand because they are explained as being like a mechanism or arrangement that all pupils already understand. This understood organisation acts as a model for the concept in action. Using analogy a teacher might, for instance, describe the concept of a word equation for a chemical reaction as being similar to the concept of a cooking recipe for a dish. Again, there will be an extended use of explanation by the teacher in which contextual links might or might not appear.

How code-switching might be used when presenting metaphors, is more difficult to explain as metaphor within English and Scientific language depends upon semantics which have been established through many cultures over long periods. Many are now so well hidden within words that we may not recognise them as native English speakers. How metaphors translate across languages and cultures is an involved question worthy of further research.

Within the use of stories and analogies for helping to create meaning for scientific concepts, code-switching that we would expect to be utilised would be *conveying* interventions, particularly *direct lecturing* as teachers relay stories or describe analogies. Also, *cognate provision/definition* as stories and analogies reveal vocabulary which is new to pupils and *contextual linking* where such links help pupils to better access the story. *Eliciting* interventions as the teacher attempts to draw pupils in to the story, its significance and to assess their understanding. Having elicited pupil ideas there would be need for *responding* interventions and perhaps, *discourse directives* to manage pupil contributions and *discourse linking* within and outside of stories/analogies to help pupils understand the structure of the explanation.

**Table 7.3 Summary of expected code-switching interventions when making connections between concepts and the real world using language only**

| Meaning-making purpose | Expected code-switching interventions |
|---|---|
| Using narrative to illustrate concepts operating in real world | Direct lecturing, cognate provision/definition, contextual linking, Open and closed questioning, responding, discourse directives. |
| Using analogy to illustrate concepts operating in real world | Direct lecturing, cognate provision/definition, contextual linking, Open and closed questioning, responding, discourse directives. |

Where connections are made through the presentation and translation of images all of the code-switching interventions described for the language-based explanations from above apply because the teacher will present a commentary concerning what the pupils are viewing. However, in addition, there is a need to organise pupils and pupil attention so that they are engaging with the critical parts of the visual presentation at the critical times. We would therefore expect that *activity directives* would be utilised to organise pupil involvement in either the presentation and translation of practical activities or images.

**Table 7.4 Summary of expected code-switching interventions when making connections between concepts and the real world when presenting and translating images**

| Meaning-making purpose | Expected code-switching interventions |
|---|---|
| Providing a commentary for explaining practical activities. | Direct lecturing, cognate provision/definition, contextual linking, Open and closed questioning, responding, discourse directives, activity directives. |
| Providing a commentary when using images. | Direct lecturing, cognate provision/definition, contextual linking, Open and closed questioning, responding, discourse directives, activity directives. |

Making connections between concepts and the real world can be seen as the presentation of a lesson within a lesson. Perhaps, the learning episode that is used to make the connection is aimed at exploring some discrete aspect of the scientific story and perhaps it is intended to illustrate the entire story for that lesson. Whatever, it is clear that these episodes can occur at any time during lessons. Sometimes they can be used to create differences, perhaps by showing pupils a scientific phenomenon that differed from their view of how the world should work. Sometimes they can be used to construct entities when they would be used to show the scientific story or some aspect of it in action. In many ways the kinds of interventions that the teacher will use alongside the episode will depend upon the purpose. If the teacher is using it to create differences then we would expect to see more eliciting interventions as the teacher tries to explore the pupil view and how it relates to their experience of the learning activity making the connection. If the teacher is using the example to illustrate protagonists behaving as described during entity construction then we would expect to see more activity directives, as the teacher draws pupil attention to the important details, and conveying of information as the teacher explains and describes what pupils experience.

## 7.4 Comparing expected code-switching approaches to observed practice

### 7.4.19(i) Creating differences - Eliciting interventions

Although, eliciting interventions were used frequently by teachers when creating differences there is some variation between how they were used and how we might expect them to be used. Firstly, although teachers A and B used elicitation frequently, teacher C did not use them at all when creating differences. Teachers A and B used open-questioning much less frequently than might have been expected, relying on closed-questioning to probe pupil understanding. Even then, the kind of closed-questioning used was frequently not structured to elicit specific scientific information but rather to ask pupils if they had a general understanding of what the teacher had just said. Thought completion prompts, a type of closed question, were used to elicit scientific information on occasion. However, as these interventions frequently assessed what teachers had told pupils immediately before their use, they cannot be considered as effective in respect of examining pupil prior knowledge and understanding.

Pupil utterances were mostly restricted to one-word responses to closed questions many of these being "yes" or "ndio" (yes) to "sawa, sawa" (Is that OK?) when teachers were asking them if they understood what had just been said. This pattern of interaction was apparent in all phases in lessons and led to the impression that pupils did not feel that they were expected to make extended oral input. On one of the few occasions when pupils were asked an open question "Maana yake ni nini?" (What is the meaning of this?) in relation to the word 'germination', there was an extended pupil response but it was so quiet that it could not be clearly distinguished on the recording. The result of this approach was that pupil involvement in this phase of the lesson was very limited and, therefore, that teachers must have completed this phase knowing very little about what pupils actually knew already about the scientific focus of the lesson.

### 7.4.1(ii) Creating differences - Responding interventions

There are extremely few examples of teachers responding to pupil utterances during the creating differences phase. Teachers did sometimes repeat pupil utterances, usually as a way of confirming their correctness but pupils were never told, directly that their response

was correct, that the teacher was pleased that they had made it or that the teacher would like to hear more detailed information. In most cases the nature of the questioning determined that one-word responses were all that could be offered by pupils. Teacher C, as previously noted, used no elicitations and so there was no requirement for responses to pupil utterances. It must be concluded that responding interventions were not intended to encourage pupils to be fully involved in open discourse.

### 7.4.1(iii) Creating differences - Making links

Teachers A and B, who spent much more time on the creating differences phase than teacher C, used contextual linking interventions very well. In both cases this kind of linking placed the questions within contexts that pupils were familiar with. Teacher A for instance, linked his discussion concerning seeds to types that pupils knew from their experiences within and outside of school, whilst teacher B placed his discussions concerning germination within the context of pupil experience in their 'shambas' or smallholdings.

### 7.4.1(iv) Creating differences - Conveying information

Whilst teacher A and B used the full range of information conveying code-switching interventions in creating differences teacher C did not use any. Cognate provision/definition was used most often by teachers A and B. This cognate provision can be construed as a way of providing the necessary resources for understanding the scientific story as it was often used to begin explaining the meanings of scientific terms that would be used in the construction of entities. However, there did not seem to be a planned strategy for introducing key scientific vocabulary, but instead it was discussed as the words emerged during the creating differences phase. A more planned approach might have seen important scientific words introduced in an organised way with more use of direct lecturing in Kiswahili to help begin to establish meaning for these words.

### 7.4.1(v) Creating differences - Managing interventions

Discourse management directives were quite apparent during the creating differences phase because, although each pupil response was short, there were often many pupils who wanted to respond. In terms of the management of who could and should respond, i.e., that a variety of pupils were allowed to contribute, these interventions were well used. If more open-questioning was utilised and pupils were more familiar with making extended contributions it would be expected that discourse management interventions would increase.

Speech directives were used relatively infrequently during the creating differences phase. If new scientific vocabulary was introduced in a planned way this planning would incorporate opportunities for pupils to practise saying the new words so that they would be able to use them with confidence later in the lesson. Hence, it would be expected that speech directives would be used more frequently when creating differences.

### 7.4.2(i) Constructing entities - Conveying information

When describing protagonists, revealing their capabilities and explaining how they affect each other, teachers used direct lecturing as their main strategy. Sometimes they did this by repeating in Kiswahili that which they had just lectured in English and sometime lecturing occurred in Kiswahili only. It was a surprise, however, that the only lecturing strategy, other than Kiswahili only, that was observed, involved lecturing first in English and then repeating in Kiswahili, given what teachers had had to say about moving from the known to the unknown. For the reasons recorded earlier concerning general code-switching practices planned to support meaning-making, this study suggests that where lecturing is used and the teacher assesses that code-switching is necessary, the direction should be from L1 to L2.

Teachers made good use of cognate provision/definition but this was partly because teachers were explaining the meanings of scientific words which emerged during entity construction when a planned approach would have had most of the explanation of key words occurring during the creating differences phase whilst outlining the necessary learning resources to pupils. This would still leave a place for cognate provision and

definition as a reminder and to help explain words which could not be covered, perhaps for time management reasons, in the earlier lesson phase.

### 7.4.2(ii) Constructing entities - Eliciting interventions

Observations of eliciting interventions reveal an even greater reliance on closed questioning during entity construction than during creating differences. There was much less use of open-questioning. If the group is to 'talk entities into existence' eliciting interventions should, perhaps, engage pupils in discourse by encouraging them to make extended oral contributions concerning their current understandings and how these relate to the scientific story as it is being presented. We might expect pupils to question the teacher and each other as they explore the characteristics of protagonists and their relationships with each other.

### 7.4.2(iii) Constructing entities - Responding

Responding interventions were, again, very infrequent. In an open debate about protagonists, their capabilities and effects, whilst constructing entities, we might expect that teachers would utilise responding interventions which enable the debate.

### 7.4.2(iv) Constructing entities - Linking interventions

Contextual linking was well used in entity construction, again placing the discussions in contexts that pupils were familiar with. Much effort was made by all teachers to discuss relevant aspects of plant science as pupils would have experienced them on their shambas or in the home or when out in the local environment. This seemed to greatly enable pupil access to the scientific concepts being discussed with many pupils offering responses to closed questions.

Discourse links too, were much more apparent as teachers helped pupils understand the structure of comprehensive explanations which covered by far the largest proportion of the lesson time-wise and which ranged across a variety of learning activities.

### 7.4.2(v) Constructing entities - Managing interventions

Discourse management directives were observed but not much more frequently than when creating entities. Again, the use of these kinds of intervention are influenced by the level of input from pupils, and, as the predominant use of closed-questioning did not encourage lengthy pupil input, there was little need for management.

## 7.4.3 Making connections between concepts and the real world

There were many examples of this occurring in the transcripts analysed. Sometimes these occurred during the creation of differences and sometimes during the construction of entities. There are too many examples for all to be discussed so two only will be referred to here. They have been chosen because they are substantial and because one occurred as differences were created and one whilst entities were being constructed.

In the lesson "Germination of seeds" teacher B uses diagrams on the blackboard to describe the setting up of and results for an experiment to investigate the factors affecting the germination of seeds. He is using this to illustrate the scientific story as it has been presented during the lesson. He wants to show pupils that, firstly in theory and then in fact by performing the experiment, that seeds need water, warmth and air in order to germinate. During the lengthy production of a comprehensive set of diagrams (see page 111) the teacher uses only two activity directives (one to re-engage a pupil whose attention has wandered) and two cognate provision interventions (naming the types of seed that the teacher would like pupils to bring to the next lesson in order to perform the experiment) presented at the very end of the learning activity in preparation for the next lesson. It was clear that, although this was an activity intended to make connections between the fundamental concepts of the lesson and what happens in reality, the teacher utilised almost none of the code-switching interventions that a planned approach might incorporate to enable meaning-making.

In the lesson "Seed structure" teacher A uses the bisection of a paw-paw to show pupils what seeds look like during a long creating differences phase which examines, in depth, pupil understanding of the concept of a seed. During the learning activity pupils are invited to watch the teacher bisect the paw-paw and then to comment on the seeds that they

see inside. During the activity the teacher uses closed questioning, responding, contextual links, cognate provision, direct lecturing in Kiswahili only and activity directives to present and translate the learning experience. There is a reasonable match here between what is observed and what might be expected in a planned program. The lack of open questioning could be due to the low cognitive demand of the task, where the teacher is only really wanting to know that pupils can recognise real seeds. This lack leads to a limited need for discourse management. Activity directives are well represented as pupils are directed to view the relevant parts of the demonstration.

By systematically comparing code-switching interventions to those observed in practice it can be seen that a significant gap exists across all phases of the meaning-making process. This has implications for teacher INSET and PRESET where the consideration of training for a planned approach to code-switching in meaning-making could help to close this gap.

## 7.4 Evaluation of the methodology of the study

On reflection I feel that the methodology used in this study was appropriate, however, there are a few specific points which are worthy of note.

### 7.5.1 The observational approach

There are a number of factors which help to limit the significance of observation effects in this study. Firstly, pupils and teachers had had past experience of my presence in lessons on a number of occasions over a number of years. During this study, overt pupil reaction to my presence in the classroom, e.g., turning to look at me, smiling at me, speaking with me etc., diminished rapidly as time passed within individual lessons. It also diminished as the whole study proceeded. In addition all teachers were asked if they felt that they had modified their code-switching behaviour as a result of the presence of the researcher or as a result of their developing understanding of the focus of the study. Teachers unanimously agreed that any code-switching had been prompted by their perceptions of the needs of the pupils at the time.

Obviously, it would be naive or ill-considered to suggest that there were no effects on behaviour due to the presence of the researcher in lessons. It is possible, for instance, that teachers have responded to questions concerning such effects in ways that they feel the researcher wants to hear. It is also difficult to quantify the influence of observer effects without having a better understanding of how lessons would proceed without the presence of a researcher, which is itself something of a conundrum.

Such observer effects are an inevitable part of any such study and they undoubtedly play a part in this one. They can be reduced by, for instance, habituation, but never completely removed. One possibility might be to leave audiovisual recording equipment operating in the classroom but the researcher not be physically present. However, teachers and pupils would still be aware that observation was occurring and therefore similar effects would still exist. It is also felt that vital information would be lost using this approach, not least because it might not be possible to zoom in and focus video equipment on key aspects of the lesson in the way that was achieved during this study and that awareness of significant features of the lessons would be lost if not directly observed. In any future study, a better approach might involve spending longer in lessons at the study location, thereby better habituating students and teachers to the presence of the researcher.

### 7.5.2 Issues associated with translation, transcription and data analysis.

Undoubtedly, the biggest challenge, in this respect, lay in the translation and transcription of code-switching interventions following lesson observation. Ideally, the teachers who were observed should be involved in the translation as they are best able to describe, with precision, the meaning of code-switching interventions they had uttered themselves. It is, however, difficult for teachers to help with translation as they have other teaching commitments and are, understandably, tired following the teaching of lessons, particularly if they have been delivered late in the day. These factors also mean that there can be a delay between the lesson observation and post observation interviews, particularly if teachers are, subsequently, absent for any reason.

A modification for future study that would help to overcome some of these difficulties would be to operate with a team of researchers, where some members of the team are fluent in the relevant language(s). The burden in respect of translation and

transcription could then be shared, with transcripts being more easily prepared for use during post-observation interviews. An additional advantage would be that the team could discuss their perspectives on any new or complex code-switching interventions, enabling a more accurate description of its type and contribution to meaning making. Members of such a team would become familiar with use of the research instrument and, subsequently, be able to conduct their own research in other locations, gradually helping to build up a more detailed picture of what happens more widely.

### 7.5.3 The scale of the study

Although, the findings in this study are in broad agreement with those of other similar studies, (Abagi and Cleghorn, 1990, Cleghorn, 1992 and Merritt *et al* 1992) it is recognised that this is a study of limited scale. The findings presented here can be considered only as those from a single case in a particular location and as such are not necessarily generalisable across other similar schools. For further consideration of this aspect of the study I would refer the reader to section 3.2.2 in chapter three.

## 7.6 Areas for further research.

There are a number of potential areas for further research the first two of which, recorded below, would help to refine the code-switching typology, understanding of how interventions are used to create meaning in science lessons and the effective utilisation of the research instrument in the field. One particular consideration in pursuing these two areas of investigation would be the effect of varying levels of literacy amongst teachers on the use of code-switching. Given that the teachers observed in this project all rated their language proficiencies, for all three languages, highly, there are many questions concerning the use of code-switching by teachers who are less proficient language users.

1. Continued application of the instrument at the target school, and other similar (Kigiryama) schools in the region, to further explore code-switching practice in science lessons with the intention of determining if the practice observed in the target school is representative of general practice in the area.

2. Application of the instrument in science lessons in schools in other regions of Kenya, where the L1 is not closely related to Kiswahili, to investigate code-switching strategies which might be operated in these different circumstances.
3. Given that both English and Kiswahili are actively taught in schools and therefore literacy levels in these two languages should be fairly well established amongst pupils by standard four, can the same be said for L1 literacy skills in other regions of Kenya? Will the pupil L1 proficiency in other regions be such that it offers a viable alternative to English and Kiswahili as a tool for making meaning through the use of code-switching?
4. Investigation of code-switching practice in other parts of the world with particular reference to identifying strategies which maximise educational improvement.
5. There are enormous research implications associated with the incorporation into practice of recommendations emerging from this project. Issues associated with the feasibility and educational impact of changing approaches to educational policy, code-switching practice in the classroom, teacher training and educational resources, offer a range of investigative possibilities.

Implementing the suggestions from this study opens up another research arena where limited projects could assess the efficacy of a planned approach to code-switching in support of the meaning-making process. In a limited way this process has already begun as a Teachers International Professional Development project, conducted at the target school in April 2002, saw teachers from my own school collaborate with Kenyan teachers in implementing a number of suggestions emanating from this research in the classroom. This initiative was managed as an action research project where a number of new approaches were introduced to lessons, e.g., the planned introduction of key scientific vocabulary in Kiswahili and then English at the end of the creating differences phase and the use of more open questioning when creating differences and constructing entities. Some analysis of findings through the action research cycle has been completed with teachers agreeing that the approaches to the presentation of key vocabulary helped pupil understanding and that increased use of open questioning helped assess pupil initial understanding and enabled the meaning-making process for scientific concepts. It was also apparent that there was a

relatively high level of pupil oral participation in lessons. However, it must be stressed that these are preliminary results which would better be expressed as teacher impressions at this stage. In one way the lessons were very different in that British teachers were actively involved in the teaching of lessons. Data from this project is available for more detailed analysis in the future.

A final point would be that the observation and analysis of classroom practice that this project has allowed, coupled with the exploration of code-switching and development of theory in respect of the explanation of scientific concepts, has resonated with my own experiences within my own lessons. New ways of considering practice within science lessons in my own school, new approaches toward enabling the meaning-making process and consequent discussion and professional development amongst and between science teachers at the school, have flowed from this research and contributed effectively toward educational provision for the pupils.

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