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**ASPECTS OF LANGUAGE IN A STANDARD FIVE
SCIENCE CLASS**

by

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SYNOPSIS

This investigation focuses on the Science class and language activities experiences of the students in a Std 5 Science class in one of the schools in Soweto, Lekang Higher Primary School. When this investigation was carried out, the school operated under the Department of Education en Training (DET). The research design is exploratory and descriptive as it aims to explore, describe and also to explain the issue of language in Science teaching and learning, specifically focusing on English as a second language and medium of instruction.

The rationale for this case study is that respondents' personal (emic) views, obtained from a "bottom-up" research mode could contribute to the understanding of at least some linguistic issues. There are concepts and procedures during teaching and learning that need specific linguistic mediation and special skills are assumed to be required for understanding and clarity by both teachers and students. The apparent discrepancy between English language and cognition in content based subjects, especially Science, motivated the researcher to initiate the investigation. It is an assumption of this study that the linguistic component of conceptual change is lodged in mental processes that facilitate cognitive development and that the communication act is one observable part of the process, where comprehension of written and spoken text is reflected and where production of text is reflected.

The experiences, activities and perceptions of this class in Lekang School were explored and described argumentatively in the light of contemporary theories on language learning with specific reference to Science teaching. English language is discussed as medium of communication in the education process, with a strong critical eye on the fact that students alone can not develop their language of learning.

Teachers need to develop English language skills to make learning meaningful.

The inquiry took the form of a case study in which data were collected in the participants' real life situation, allowing for an in-depth and thus thick description of their behaviour and inclinations. Transcriptions of raw data were analyzed by means of coding, clustering and dendogramming after which the information was displayed and then discussed. The conclusions were drawn and implications of the study presented: the main conclusion drawn from this case study is that the development of misconceptions could arise due to linguistic inhibitions and limitations. The implication derived from this study is that in-depth and rigorous English language skills development is imperative in order to facilitate the mediation of Science concepts.

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CHAPTER ONE

THE ORIENTATION AND RESEARCH DESIGN

1.1 INTRODUCTION

This orientation chapter commences with a section in which the study is contextualized. The physical context will be described, after which the theoretical background will be sketched in order to explicate the motive for conducting the search. Subsequently the aim and rationale of the investigation will be stated, followed by the formulation of the research questions. A methodological orientation will follow, stating design, methods and techniques used, after which a conceptual analysis of framework concepts will be given. The researcher's profile will also be included.

1.2 CONTEXT OF RESEARCH

1.2.1 THE PHYSICAL CONTEXT

The research was conducted at Lekang Higher Primary School in Soweto. The school itself is in a highly deprived area of Central Western Jabavu (C.W.J.) where about 70% of the students stay with their grandparents, as their biological parents have left them, some as good riddance or to look for food. The school consists of twenty classrooms and one administration block. The school

caters for a pre-school, for students from four and a half to five years of age and from Grade 1 to Std 5. Lekang school is managed by the Parents Teacher Association, the principal and twenty-three teachers.

When this research was conducted, the Lekang School was operating under the supervision of the Department of Education and Training (DET). The students all use English, a second language as a means of learning.

1.2.2 THE THEORETICAL CONTEXT

As previously mentioned, English is the language of instruction. This inquiry was initiated to explore the issue of English language in Science teaching and learning, specifically focusing on English as a second language and a medium of instruction. The problems around issues such as language and cognition, language and culture and specifically language in Science education seem to be located in activities which are mostly communicational (Henning, 1992).

Theorists in educational linguistics and instruction of Science comment from various viewpoints. Tarvin and Al-Arishi (1993) as referred to by Henning (1992:2) refer to second language learning as a "reflective activity" which is communicative in an intrapersonal as well as an interpersonal way. Whereas Klausmeier also referred by Henning (1993:3), supports the notion that language influences conceptualization, but that it does not control it. Mestre and Royer (1988, in Henning, 1993) maintain that Science instruction happens in a

linguistically laden milieu. The linguistic processes which prepare the transportation and linking of concepts also involve conceptualization, which is again in turn regarded as a component of communicative competence in linguistic theory (Geyser, 1992).

It is an assumption of this study that the linguistic component of misconceptions in the learning of Science is lodged in mental processes and that the communication means is one observable part of the process which reflects either the presence or lack of comprehension in listening and reading and in production of language, namely in writing and speaking. It is assumed that the students in this study carry a double burden: conceptualization and the use of an undeveloped English language as means of learning. Reading, which forms the foundation of learning from standard three and above, should construct meaning from the text and this seems lacking in the culture of literacy and learning of these students.

1.3 THE RESEARCH QUESTION

The research question, emanating from the physical and the brief theoretical orientation as well as the researchers' personal experiential knowledge about the DET sub-system, more specifically its approach to teaching and learning in black South African schools, led to the formulation of a pertinent research focus. The research question is centred on these students' inability to learn, not only due to their previous educational deprivation which often leads to rote-learning and lack of Cognitive Academic Language Proficiency (CALP) (Henning, 1992), but

also due to their lack of sufficient language with which to name concepts.

The general research question emanating from the analysis of the problem is:

Which linguistic aspects feature in a Std 5 Science class?

Questions which complement the main one are:

- Which linguistic aspects (areas of language usage) are prominent in the learning progress of eight randomly selected pupils in one Std 5 class in a school in Soweto?
- Are alternative conceptions linked to levels of language proficiency?
- What are the characteristics of text reproduction in assignments, tests and examinations?
- What are the characteristics of oral communication about General Science concepts?

1.4 THE AIM AND RATIONALE OF THE STUDY

The aim of the study is to rigorously and methodically describe eight students' inclinations and experiences in their classroom situation in which English is used

as a means of teaching and learning. The object is to investigate the students over an extended period of time in an in-depth manner, in order to get their emic views and to observe their behaviour in contents in their natural setting. "Students' attitudes and apprehensions ... are of great importance within any educational context. One cannot expect successful learning in a setting where the students are uncomfortable with the means of communication" (Svartholm 1994: Personal correspondence) as quoted by Storbeck (1994:6).

It is therefore better to gain data directly from the students themselves, who are the proper experts in knowing what it is like to communicate without having sufficient access to the language of instruction.

The rationale of the study thus evolved from the theoretical and physical context of the students in a Std 5 Science class who were previously deprived.

1.5 METHODOLOGICAL ORIENTATION

This investigation takes the form of a case study, which is seen as a "holistic" study, taking in "real life events" (Yin, 1988) within natural settings. The case study is of a Std 5 Science class at Lekang Higher Primary School in which English, a second language to learners, is the medium of instruction.

The researcher is a full participant action researcher (Wagner, 1993). This format allows for a rich narrative description and exploration, much of which is through

the eyes of the subjects being observed. Within the case study various methods of data collection were used "to ensure trustworthiness" (Paul, 1994: Personal correspondence) as referred by Storbeck (1994:8).

Eight students were randomly selected for the purpose of collecting data as evidence. Lessons were conducted and video recorded. The video recordings were all transcribed after which they were processed by coding and clustering. The interviews were conducted with both teachers and students and their responses were processed by means of clustering and dendograming. Field notes were kept of the significant observations, which were later processed. The last method of data collection used was documentation where tests, classwork and paragraphs were written, then processed by coding and clustering. Finally, all the data were interwoven in order to find patterns and overall categories of significance.

1.6 THE PLAN OF STUDY

The orientation to the research is stated in chapter one, followed by the theory of the investigation in chapter two to four. Chapter two will give an overview of some contemporary theories of learning, which will be followed by readings in language and language acquisition in chapter three. Chapter four will sketch the research design followed by chapter five, the processing and interpretation of data. Findings, interpretations and implications of the research will feature in chapter six.

1.7 A PROFILE OF THE RESEARCHER

In this section the formal scientific discourse will be replaced by a more subjective discourse, as the researcher presents her own emic view on contemporary black South African students. Her interest in the research field, along with her educational paradigm and views will be presented by means of a personal narrative in the first person.

"My love and interest in the black South African education system has been a part of me ever since I entered the tertiary education, when I realized that I still need a lot of catching-up as compared to my white counter partners. I always looked back at myself as a student when I struggled with the construction of meaningful analysis of a given text. This was a sort of a challenge on my side, to go and empower my students to overcome my problem when they reach their tertiary education. This made me realize that in order to be a successful teacher, I would have to be skilled in guiding the students to seek meaning in any activity they perform, and this started my exciting exploration into the world of effective teaching and learning with my students. As my initial aim was to gain access into an understanding of skills of making teaching and learning meaningful, I started by making a comparative study of Bantu Education and Transvaal Education Department systems to see where we black South Africans go wrong. I always believed that TED education system had a better content than the Bantu Education system. Finally, I

realized that the two are the same, except for our approaches to teaching. I then became more interested into finding the cause of the handicap in black South African education system. Where previously I was happy when the students could reproduce what they have learned, I realized that it was done without meaning. It appeared that reading notes or reading books was not regarded as meaning making, so students were not gaining sufficiently from this educational approach. My case study was an eye-opener, as I realized that apart from the approach alone, language of instruction, more specially when it is a second language to learners, plays a prominent role in the teaching and learning of General Science. I would like to emphasize the important fact that for learning to be a success, the language of instruction should be well developed in order to gain students access into the content of their communication. Black students, mostly, enter tertiary education or leave schools with unsatisfactory literacy levels which makes them unprepared to venture meaningfully into the demanding world. As educators who place the needs of the students first, we should be strong enough to admit if we have made mistakes in the past, and be willing to change our educational paradigms for the benefit of black South African students, we are educating."

It is imperative that English language should be developed as a tool for learning.

1.8 SUMMARY

This study investigates what the researcher identified as a need for investigation in the black South African Education system, emphasizing the problem in the physical and theoretical context. The aim of the investigation is to rigorously and methodically explore a Std 5 Science class' experiences in using second language English as means of communication and learning. The use of an undeveloped language of instruction, limits effective teaching and learning. In conclusion the researcher's presuppositions and educational paradigm are stated briefly in order to reduce researcher's bias, by stating the bias openly.

CHAPTER TWO**THE ROLE OF THE FOUR LANGUAGE SKILLS IN THE SCIENCE CLASSROOM****2.1 INTRODUCTION**

This chapter consists of a literature review of types and qualities of classroom interaction with regard to the use of language in teaching and learning. The researcher will be looking at aspects which seem to hinder second language learners in acquiring language competency in communicative situations. The main concern is with the communicative consequences of transmitting or precluding knowledge and how teachers and students talk into existence their relationship and meaning which dominates their work together. Furthermore the use of educational artefacts and textbooks with strong linguistic components as well as turn-takings conventions and classroom discussions, workshops and other techniques and devices which are "linguistically loaded" (Mestre, 1988) are included in the conceptual framework.

2.2 LANGUAGE AND LEARNING

The role of language to learning is unquestionably vital. Classroom interaction is mostly verbal - students talk to the teacher and to others, they listen, observe experiments and express their experiences through language, to gain information from textbooks they need to read and to make notes, writing, also as a way of

how they think, is very important. Mohan (1986:18) as referred by Chamot (1987:45) says: "Helping students use language to learn, requires a look beyond the language domain to all subjects areas and to look beyond the language learning to education in general."

They maintain that language as a medium of instruction in learning naturally leads to a cross-curriculum perspective. He sees a contrast between certain language skills between learning to read and reading to learn, between learning to write and writing to learn. He feels there should be an awareness between language learning and using language to learn. He believes that a broad perspective which integrates language and content learning is vital.

Chasmain (1976:279) maintains that: communication in any of the four language skills is an active - not a passive - process in which the native speaker's language system is activated. Students need language to communicate their discoveries in content areas - especially General Science. General Science also has its own language and a specific discourse. Students' content learning and the kind of language skills they have, may be inadequate or inadequate for sufficient learning. Sutton (1992:45) argues that the way students learn is partly based on the linkage between a new way of seeing any topic and a new way of "talking" about it. He distinguishes between two ways of using language in learning. The interpretive way and labelling. He believes the interpretive way is exploratory and tentative while labelling is declarative and definite. He regards labelling alone as a mistaken way of using language in learning. He believes it is

more of a hindrance than a help to learners to simply label and not to interpret, explore and form propositions.

The four basic language skills need to be activated integratively to provide a greater degree of language mastery which students can use in a communication context in learning situations. These are listening, talking, reading and writing. The purpose of developing these skills is to assist students with practice in using language as a tool for learning subject matter in general effectively, and for use in social interaction outside the classroom. Gardner (1991:68) points out that "without language, learning by naming, classifying, enacting scripts and pretence, is unlikely to take place".

In the learning of science advanced proficiencies in all four areas is vital.

2.3 READING SCIENCE TEXT

The general aim of reading instruction in science learning is to make meaning from science text in an interactive way. Thornis (1970:83) believes that skill development in reading depends upon the teacher who understands fully which students have mastered which skills upon which to build and which materials best provide learning skills. A literate person knows "when a text is ambiguous, when a lexicon is unfamiliar or when the conceptual framework for the text is unknown", he is in fact saying that reading content text is a metacognitive learning activity. Learning science through English as a medium of instruction

and as a second language, general science can be accessed successfully only if sufficient language exists. Students can not express and access concepts. For example, students may know English words such as "steam", but when they read science text, it is referred to as "water vapour".

In her research on language and content learning, MacDonald (1990:44) distinguishes between the three stages a student takes in reading-to-learn. Firstly a student associates shapes with sounds, secondly they use reading to confirm what they already know and thirdly they use reading as a tool for gaining knowledge. She believes that, if students cannot use reading as a tool for discovering new information, it has a negative effect on the rest of their education. It is imperative that reading skills should be developed. Reading can be approached from different angles as long as the approach leads to an establishment of an ability to the effective way of an independent critical mind in getting information. Schutte (1992:4) distinguishes between four different kinds of reading skills. Scanning, skimming, comprehensive and thoughtful reading. He says scanning is a rapid type of reading done to obtain a specific fact. Skimming is a rapid type of reading done to obtain the general idea of a piece of text. Comprehensive reading is a systematic, fairly slow type of reading done to arrive at a thorough, detailed understanding of a piece of text. Thoughtful reading is a slow, intensive interaction with text, in which the reader is required to manage and manipulate information in order to arrive at a complex insight or solutions. He believes thoughtful reading brings success to a science

reader.

Most content areas that all students from standard three access in order to gain information is based on printed text. If reading is limited to word recognition it is unlikely that learning will take place. The NEPI report (1992:7) with regard to Black South African curriculum in language learning, says memory retention is overemphasized while critical thinking, reasoning, reflection and other conceptual skills are largely neglected in the teaching of reading across the curriculum.

2.4 WRITING SCIENCE TEXT

The science curriculum presupposes students' ability to formulate their thoughts in written text. Students use writing to make notes, to answer questions, to write essays and assignments, to label diagrams and to summarise. Writing is a process of immense perceptual linguistic and cognitive complexity in which creativity is involved. Writing involves a more formal mode of expression than speaking and it can assist the student in the development of thinking skills.

MacDonald (1991:49) says, learning to write, like learning to read, is a major challenge, even in the language best known. She believes that in learning to write, emphasis should be on how structures of words, sentences and paragraphs are put together to make meaning. Schutte (1992:5) argues that "it is vital to learn the principles governing the formation of words, which forms a

sentence, how they are used and a few strategies for dealing with them". He believes that when writing a sentence one needs to know its main constituents, and how they function. Writing coherent scientific discourse, therefore presupposes understanding of scientific concepts. Words can be changed to facilitate this. Peter Gordon as referred by Gardner (1991:60) says complex words can be built out of simple words in an orderly three-level procedure. Rule level one says: words can change in pronunciation and give a change in meaning, like, in red and reddish. Rule level two, words that permit an addition of a suffix like suffix -ness and reddish -ness. Rule level three, words which are applied after level one and two rules. They have the rules for regular pluralization as in reddishness; louse > lice; goose > geese. This can help students establish the origin of certain difficult words in science.

Writing science successfully means that sufficient lexis, syntax and discourse is known to the student in order to be able to construct text.

2.5 ORAL COMMUNICATION AND SCIENCE LEARNING

Students in the classroom communicate through reading, writing, listening and speaking. Rupp (1988:317) distinguishes between two communication styles for both written and spoken code the Basic Interpersonal Communicative Skills (BICS) and the Cognitive Academic Language Proficiency (CALP). CALP occurs in a decontextualized setting where students have the incentive to participate. Participation by students is an important means of developing their language

skills in communication. They learn to understand the importance to listen and to say their contribution. McGroarty (1989:58) emphasizes that the students' input in the classroom interaction should be encouraged. He believes that if students are grouped and each member given a task, he will refine his listening and talking skills through a natural talk based on a particular topic at a particular time. He says: they improve their level of engagement with the curriculum.

McGroarty (1989) explains this in his five models of communication between and amongst students:

- It is the peer tutoring communication which emphasizes mutual assistance in the mastering of predetermined content.

- The jigsaw communication whereby students are divided into teams with each member having a responsibility.

- The co-operative projects in which groups produce a final collective project.

- The co-operative individualized method where each individuals' progress contributes to a team grade.

- The co-operative interaction which allows students to work as individuals.

The aim of these models, he believes, is to minimize provision of assistance by the teacher, and give students ample chance to take part.

Students learn more meaningful when they see, touch, feel, lift and at the same time, talk. Both Cummins (1988) and Rupp (1988) support the theory of "discovery activities". It involves students in hands-on-discovery activities in which interaction is vital. Students want to know, they are curious about what is happening around them, they come to learning with preconceived ideas about what the world looks like. To have a better understanding of the world, they don't have to work like robots, they need to express their experiences. The meaning of communication includes not only the content but also the feelings associated with that content. They believe the body language of students can inform the teacher whether the content of communication is accepted, rejected or meaningless. They emphasize the point that information about body language should be interpreted according to the students' cultural context rather than the teacher's. For meaningful cooperative learning to take place in a social-constructivist mode, learners have to be able to speak to one another.

2.5.1 LISTENING SKILLS

However, in order to be able to speak, students need to be able to listen as well. Listening and speaking are the basic language skills in human communication.

During classroom interaction, students and teachers listen and talk to one another. If one does not listen, one remains passive in class and learning is unlikely to occur because learning is not a passive phenomenon. MacDonald (1991:51) states that "listening is the very first communication skill which the child develops, even before it can begin to talk. A new born baby responds to sounds. It smiles or cries to any one around it".

A primary school student responds to listening by talking. Talking at that stage is developed by sufficient peer group interaction. Listening seems to form the foundation for talking. Chasmain (1976:289) forwards the notion that getting students to listen are cognitively and affectively problematic. Students need to feel the possibility of them comprehending what they hear, they need to know why they are involved in the activity at hand at that time and how it will help them. Coakley (1987:626) believes that in order that listening should be meaningful, definite goals and decisions should be considered and choices made as to which skills should be used. This has implications for content teaching across the curriculum.

The act of listening is linked to understanding of the content. A listening student is not expected to reproduce information but to link information to existing knowledge schematic. Lundsteen (1976) as referred by Strother (1987:625) (in Storbeck, 1994:49) maintains that "listening is the process by which spoken language is converted to meaning in the mind". Hearing presupposes understanding, understanding presupposes analysis and later acceptance or

rejection of the message. Listening does not refer to hearing as physiological phenomenon. One can hear the train pass by or a child crying or anything that makes a sound. This does not mean learning is occurring, but it makes one aware of a particular situation. Coakley (1987:626) distinguishes between five listening skills, namely the appreciative, the discriminative, the comprehensive, the therapeutic and the critical listening skills. Coakley (1987) believes that it is not fruitful to use therapeutic listening skills in ordinary classroom communication because it only serves as a sounding board. It makes the listener aware of the presence of the sound maker. He believes that listening skills should encourage sensitivity to arguments. Chasmain (1976:285) argues that students should practise listening in communicative contexts so that they can tune their "language ears" to the rhythm and sounds of the language, especially a second language as medium of instruction.

Listening develops students' phonological awareness and recognition of different concepts in oral format. Some words sound the same, but are not written the same way nor have the same meaning, for example, "hit" and "heat". "Hit the nail with a hammer and feel the hammer." "Heat the nail on a spirit lamp and weigh it." If the "language ears" are not developed, students will experience problems to get the message in the above two statements. MacDonald (1991:51) says: students' oral skills are generally poorly developed. She believes that very little opportunity in the classroom situation is given to students to practice the basic interpersonal communicative language skills.

2.5.2 TALKING SKILLS

Talking to one another in small groups helps students to explore ideas. Through talking, problems and abilities in learning can be identified. The listener can realize how much the speaker understands the content, how close or apart the speaker is to the listener and others and how much the speaker loves what he is discussing. Talking is both evaluating and informative. Chasmain (1976:356) makes the point that speaking is influenced by affective, social and cognitive factors. The above can be identified only if talking skills in language have been well developed. The development of language skills depends entirely on how they are tackled and with what objectives in mind were they developed. Therefore talking as interaction in science learning needs to be viewed as a specific educational objective with a language base.

The NEPI report (1992:7) emphasizes the fact that if memorization is emphasized and interactive language skills are neglected, learning is unlikely to take place optimally, especially with regard to Black South African curriculum.

Talking does not necessarily mean opening a mouth and producing a sound. A speaker needs to make sense of what he is saying. Sutton (1992:49) distinguishes between two kinds of talking in teaching and learning science: the interpretive way and the labelling of concepts. Interpretive talking, he believes, is a way of finding words and seeing them as giving certain meaning. With labelling he believes talking is the use of words, sentences and definitions used

to match the actions. He believes that interpretive talking changes one's outlook towards what one is doing or saying. He emphasizes the fact that the interpretive way of using language is exploratory and tentative while the labelling way of using languages declarative and definite. General Science language seems to confine certain concepts to certain processes, results or actions. There seems to be no "freedom of speech". For example, the concept "displacement" should be described by the word "displacement" and not by "taking the place of". In General Science terminology a student who talks of "water vapour" sounds more correct than the one who says "steam". A frog "hibernates" is more preferred to the one who says a frog "hides" during winter. Underdeveloped language skills in General Science with its strict discourse parameters renders a problem to students who are expected to explore ideas meaningfully in communicative contexts. Often misunderstandings between the recipient and the sender of a message occur because the medium of communication was not mutually clear.

2.5.3 READING SKILLS AND ORAL COMMUNICATION

Reading becomes meaningful only if the reader interacts meaningfully with the text. The following worksheet will try to discuss this. This worksheet is based on an extract from the book of L. Haarman; P. Leech and J. Murray (1988:VII) Reading Skills for the Social Sciences. The key objective in using this extract is to show the enquiry approach which seems viable in the development of reading skills whereby the teacher can help students into experiencing the processes of reading, especially in general science. Reading seems to be meaningful only

when it becomes a process of interaction between a reader and the text. Haarman, Leech and Murray (1988:VII) all believe that reading can be seen as the processing of information. In Reading Skills for the Social Sciences, economics extract from a text book has been used, against which general science topic in this worksheet will be used. The following headings have been discussed:

1. Approaching the text

- Pre-reading questions
- Skimming and scanning for context
- Pre-reading vocabulary

2. Intensive reading

- Previewing text organization/content
- Explanations/Examples of key words.

3. Language work

- Vocabulary work
- Re-utilization of key vocabulary

4. Vocabulary work and word building.

Students' reading ability differs according to individuals. Husen and Postlethwaite (1985:4203) describes this as readability and reading levels which they define as a prediction that a certain percentage of readers with reading

skills of certain standard will be able to read and comprehend the text. Learning to read seems to demand a step by step approach in order that it should be used as a tool for discovering new information. It seems reading can be approached differently as long as the approach leads to the development of skills that will help students to interact meaningfully with the text. Haarman, Leech and Murray (1988:VII) (in Storbeck, 1994:58) all distinguish between four principal "styles" of reading process, which forms the structure of this worksheet which will now be discussed. These reading "styles" are mentioned in the introduction. It seems the readers' success as a learner depends on his ability to organize and process the information in the text. Haarman, Leech and Murray (1988:VII) all believe that with regard the textbook, the better the predictions, the faster the processing of text since the mind is prepared for the information.

It seems therefore that reading as described by Haarman, et al. (1988) depends on three important aspects, namely the reader with his knowledge of the world and language ability, the reading techniques which consists of motivation, purpose of reading, expectations and strategies and lastly the text with its vocabulary, sentence structures, deeper and literal meanings.

In this worksheet students will be helped to realize that reading is not an act of giving sounds to certain letter shapes but a process that allows them an opportunity to interact with the text in a meaningful way, where facts and principles will be learned.

Approaching the text : Skimming and scanning

Skimming is a rapid type of reading done to obtain the general idea of a text (Schutte, 1992) while Haarman, Leech and Murray (1988:VII) all in support of this say, skimming involves moving eyes rapidly over the text focusing on certain key words or phrases to get a general idea of what the text is about.

Scanning differs from skimming in that it is done to obtain a specific fact or piece of information. Like for instance, using a dictionary, checking on an index or a telephone directory. The success of the scanner depends on his speed and visualization of the piece (Haarman et al., 1988). A scanner can check the numerical order of headings to be able to organize his content in the correct way.

WORKSHEET 1 : MATTER AND MEASUREMENT

WHAT IS MATTER?

Matter is the name given to all the substances in the universe. It includes everything living or non-living. Matter takes up space on earth and in space. The space matter occupies and the amount matter consists of can be measured.

Matter has two important measurable properties, namely that:

- it occupies space or takes up space
- it has mass.

Matter can be defined as anything that occupies space and has mass.

When people measure things, they are measuring the properties of matter, namely its amount and the space it occupies in the universe. Matter can occupy the space in different ways. It can occupy the space between two points which is called length, it can occupy the space within a container which is called volume and the space on the total surface of an object which is called area. The amount of matter a substance consists of can also be measured and it is called mass.

In the past, people used their body parts as instruments of measurement and there was no accuracy whatsoever because people's heights are not the same. Their purpose of measuring things was to be able to compare, store, construct, direct and to sell things. In measuring things, accuracy should be maintained. So accurate measuring instruments which are calibrated in SI units are necessary. These will be tabulated in the following diagram:

Quantity	Measuring Instrument	SI Unit	Symbol
Length	Metre stick	Metre	m
Area	Metre stick	Square metre	m ²
Volume	Measuring cylinder	Cubic metre	m ³
Mass	Mass metre	Kilogram	kg

WORKSHEET 1 : SKIMMING AND SCANNING FOR CONTENT

1. Definition of matter.
2. Some examples of matter that will help the students to conceptualize the lesson.
3. Indications of the properties of matter.
4. Presentation and definition of other terms.
5. Historical references to measurement.

Students are asked to move their eyes rapidly over the text and try to find what matter is, what underlined words mean and read the bold writings and try to find out what they have to tell and lastly to look at pictures and try to figure out what is happening there. Complete the following diagram.

EXERCISE 1

Definitions	Anything that serves as eg.	underlined words
Matter is,,
.....,
Length is,
.....,
Volume is,
.....	

These questions motivate students to read with a purpose in mind. They look at the text with an inquiring mind which will encourage them to go on reading.

focusing their attention on certain aspects. The questions sort of structures the content and organize it in a way that it seems viable to assimilate.

WORKSHEET 2 : PRE-READING VOCABULARY WORK

The following list of words appear in the text. Scan the text and find the context in which they are used. The words are written under column one, under column two write the word class in which they are used and under column three define or explain them. The word "matter" will serve as an example.

EXERCISE 2

Word	Word Class	Explanation or definition
Eg. matter	Noun	Anything that occupies space and has mass.
universe
space
body parts
accurate
non-living
measurable
properties
volume
length
SI unit
measuring
instrument
overflow

When students are asked to complete the above task, it will help to see these words as saying something to them. Students are inclined to reading without checking the message in what they are reading. These questions will help them to enter imaginatively into a particular thought system for themselves although the concepts might be new to them. Sutton (1992:38) says that facts cannot be observed as facts, except in virtue of the conceptions which the observer himself supplies. Students will be made aware of the fact that they must learn something which they do not know. They might be able to spot the answers but completing this task will help them with a better conceptualization because they should make this extract theirs. When looking at the diagrams, they will see things as they are but that will form the foundation for better understanding. For example: Overflowing water > displacement; washing in the bath < immersion.

EXTENSIVE READING

WORKSHEET 3 : PREVIEWING TEXT ORGANIZATION/CONTENT

Haarman, Leach and Murray (1988:VII) all believe that extensive reading describes the strategies used when longer texts are read. The general science paragraphs given in this worksheet have bold headings **Matter and measurement** and there is a subheading **What is matter** and a number of underlined words, with definitions given and underlined. This strategy of underlining important facts and words will help the students by highlighting facts and rules, more so that the language used is second language to learners.

1. What is matter?
2. Introduction and definition.
3. Measurable properties of matter.
4. The spaces matter can occupy.
5. Measuring instruments and SI units for measurements.

EXERCISE 3

Read the paragraphs on matter and measurement and give the appropriate sentences that best explain the following headings:

Matter and measurement

1. Introduction:.....
.....
2. Definition of matter:.....
.....
3. Measurable properties of matter:
.....

4. Quantity	Measuring Instruments	SI Units	Symbol
.....	Metre stick	m
Area	
Volume
.....
			kg

The students will be assisted to understand not only the words but the function of these words in context. They will realize that the writer did not just write. He introduced his text, defined it and has shown some relationships between certain concepts. Students can later be able to make their own notes from the text.

LANGUAGE WORK

WORKSHEET 5 : VOCABULARY WORK A

Haarman et al. (1988:VII) say that meaningful reading is encoded in the understanding of words. The following will help students to form or have certain ideas about facts and rules they have learned in this text. Column A has a list of concepts or phrases. Complete column B by giving words which mean more or less the same with words in column A. Refer to the text.

A List	B
1. Anything that exists
2. To be made up of something
3. Put away for later use
4. Way of finding size
5. Mass; length; area
6. Things that can be measured
7. The whole of reality

This exercise will help the students with vocabulary and understanding of the text. It will limit the students inclination to memorizing without understanding.

VOCABULARY WORK B

Choose from the list of words given and complete the following paragraph:

SI unit; take-up space; measuring instrument; measurable properties; universe; length; non-living; volume; measured; area; mass; volume.

Matter is anything that occupies space and has mass. Occupies space means Matter can be found anywhere in the
 It can be a living or asubstance. The space which matter occupies can be Matter has two
 properties. Matter can occupy space in different ways. It can occupy the space on the surface of objects, which is called It can also occupy the space within containers which is called The amount

of matter in an object can also be measured and it is called
 In order to measure accurately a
,calibrated in appropriate
 is needed.

The students are asked to complete this text using the given list of words to try and limit memorization and develop conceptualization. Students are been lead into realizing that anything they do can be measured or anything that happens can be measured.

VOCABULARY WORK C

Read the following paragraph and give one word which best describes the underlined words:

Thabo, a twelve year old boy, travels daily from Park Station to his school, on foot. He goes around a 154 m² park before reaching the school gate. He carries $\frac{1}{2}$ litre and 250g biscuits for his lunch during summer time. During winter when it is 0° celsius he carries a flask full of hot soup for his lunch with slices of bread. He will grow to be a highly educated healthy man in future.

A	B
A twelve year old boy From Park Station to his school 154 m ² park ½ litre 250g biscuits 0° Celsius

2.6 MISUNDERSTANDINGS

There seems to be a number of concepts in General Science which are conducive to misunderstanding if formulated non-explicitly. Some of these misunderstandings could arise due to linguistic inhibitions and limitations. During classroom experiments language is vital. There are concepts and procedures that need some explanation or mediation and special skills are required for understanding and clarity. Driver, Guesne and Tiberghien (1985:195) all agree upon a number of features of students' conceptions in General Science that bring about misunderstandings:

- **The perceptually dominated thinking:** where students base their reasoning on observable features.
- **The limited focus:** where students focus on change rather than a steady-state situation.

- **The linear causal reasoning: where students tends to follow a linear causal sequence.**
- **The undifferentiated concepts: where students tend to slip from one meaning to another, unaware of it.**
- **The context dependency: where students often call upon different ideas to interpret other situations.**

2.7 SUMMARY

All of the above classroom learning activities are language dependent. It therefore seems viable to state as a premise of this study the interrelatedness of language and science learning in a Sowetan classroom. The formation of alternative conceptions, with different semantic categorisation is possibly linked to the fact that the sign (the language) is not appropriated (or is misappropriated) and therefore the signified (the concepts and procedures) is also misappropriated.

CHAPTER THREE**LANGUAGE AND SCIENCE LEARNING AND INSTRUCTION****3.1 INTRODUCTION**

The aim in this chapter is to elaborate on the context in which the following concepts have been used, namely, language in science learning, conceptualization, teaching and learning. The aim is furthermore to discuss how language can limit or assist in the teaching and learning process that takes place through communication in the classroom situation, and the role of semantic categorization where the level of understanding among students may differ.

3.2 LANGUAGE IN SCIENCE LEARNING

The World Book Dictionary (Vol 24:1992) explains that language originated from a Latin word 'lingua', which means tongue. The book defines language as a human speech, spoken or written which seems to mean to develop a language. Language should empower students through its skills to talk with confidence, to write thoughts and ideas meaningfully as well as to listen and to speak. Focusing on the four basic skills in language study, could improve proficiency and understanding of spoken and written language in a context such as a science classroom. These

aspects were highlighted in the previous chapter. The focus will now shift to language as partner in conceptualization.

Language is a means of communication and a roleplayer in conceptualization in the learning of science concepts. Dibently and Mike (1992:9) argue that "it allows the discussion between the teacher and the student to begin, and it provides an 'entrée' to the particular views we have on learning and school science". Cassels and Johnstone (1980) maintain that the problem of language lies not so much in the technical language of science, but in the vocabulary and usage of normal English in a science context. Language of instruction, which in this study is English, needs to be well grounded and developed in instructional design, otherwise students will be prone to confusion and possible development of misconceptions during their learning process. Language as classroom mediation medium needs to be problematized as mediation means. The development of English language skills, in the context of science education, is often not deemed important by many teachers (Carol, 1991). Language should inform and play a major role in mediation of learning, which points at having both the cognitive skills and language skills developed concurrently and also mutually supportive. When this is not the case, students could experience a continuous struggle of using language to assist conceptualization. It is imperative that serious consideration should be given to the role of language as mediating and conceptualising factor in academic learning especially. Communication thus becomes mediation which leads to appropriation

or learning (Crandall, 1991).

Edelsky (1985:9) maintains that language proficiency required for academic tasks is rooted in and becomes an "elaborated extension of abilities to plan, argue, persuade and justify". If one's language of learning is not proficient enough in a subject domain, one will be inhibited in learning due to lack of mediational support. This is the case with language in science learning in this study. English seems to have been developed as a subject domain with focus on grammar and literature but not on general proficiency. Students' means of communication has been their first language (Sotho), since English has been introduced as late as in standard three. So first language mediation for conceptual development is assumed to be dominant. Students understand Sotho more readily and easily than English in learning. Carol (1992) in Henning (1993:6) puts forward the notion that language problems are exacerbated by the fact that the students' first languages are structurally not always compatible with the morphological, lexical and syntactical structures of English as language of science and technology. Hence students seem inclined to the formulation of linguistic structures which could reflect misconceptions and memorization. Henning (1993:7) refers to the ease of reproducing the text of information mechanically, without semantic support. In this case students often exhibit low-level reading skills which would be linked to the absence of schemata in the domain as well as to limited knowledge of language with which to recognize linguistically labelled concepts. This does not mean that indigenous African

languages cannot communicate science and technology, but that the syntactic, lexical and morphological formats differ.

Gonzalez (1974:565) says all languages are complete in their respect of appropriateness, times, place and circumstances. English too can be appropriate as language of instruction provided the circumstances surrounding its usage are conducive to understanding. The fact that in this study it is a second language to learners of science it is argued that it should be introduced earlier, for instance as early as in standard one. Linguistic schemata have to develop concurrent with conceptual schemata as the two are mutually supportive. If science concepts develop along with language schemata in for example Sotho, then the English need to develop alongside both in order for labelling of concepts to take place in English which is the language of instruction and mediation

In support of the above, Carol (1991:69) emphasizes the fact that, language is a key to knowledge, information and communication. She believes that language can open or can close the way to educational opportunities. Henning (1993:9) argues that language enrichment in subject domains should serve as one of the channels of educational liberation where students can "learn the language of learning" and in which they can develop a culture of learning. Language seems to be an important priority through which content subjects, like for instance general science, should be learned. It needs to be well grounded and developed in the instructional design,

otherwise misconceptions and memorization could be the result as "first language concepts" will be interfering with "second language concepts". Language unfolds the secrets within concepts. If language is not well understood, concepts remain "silent", they remain words without any message. Language in general science learning is a means of conceptualization, a means of reaching the unknown.

3.3 CONCEPTUALIZATION

Conceptualization is generally assumed to be the main aim of teaching and learning. Students' learning ought to be facilitated in such a way that they personally construct knowledge. They should cognitively become aware of what is happening around them and then construct mental models. Conceptualization seems to differentiate between "seeing" and "becoming aware of" something. Wyne (1987:53) argues that conceptualization means that students are developing concepts about the things around them and that they do this on an individual basis. A growth of understanding of these things develops, not just seeing them but becoming aware of them. In this process language manifests and assists in relating experience and first-hand knowledge. Once more language fulfils a mediating role and this clearly assists in the forming of concepts.

In trying to relate language with conceptualization, Husen and Postlethwaite (1985:2479) argue that a concept is a mental representation of some experience

which is part of a wider schema. In this view, conceptualization will be a process in the mind about these experiences and this process is facilitated by language or by what Vygotsky refers to as the "inner voice" (Carol, 1991). Gardiner (1981:148) believes that conceptualization is a process of students' cognitive abilities to think in terms of mental images even if an object is absent. Language then seems to be the vehicle of these mental images for sharing, expressing ideas and communicating about them. Language also then represents the real object or phenomenon by means of semantic categorisation.

When this process takes place in learning through a first language, learning of concepts seems viable, but if English as undeveloped as it seems in the instance of this study, is the language of instruction, I assume that students will not be in a position to cope with language while conceptualizing but that their conceptualization process will be in a continuous destructive challenge by concepts represented in a different way in the first language they may not be compatible with those encountered via these second language, because the language which was generated to encapsulate the concepts followed a different semantic route.

Conceptualization and language seem so intertwined that trying to separate them will be like trying to separate blood from the circulatory system. Introduction of second language as a means of instruction should not be a hindrance to conceptualization but a help to developing communication and learning skills. In

order to achieve a success in this regard, better timing in introducing a second language as medium of instruction is highly appreciated. Brinton (1992:15) argues that both language and concept development are enhanced by using activities which deal with real world ideas and problems. Activities at the earliest time in schooling can be appreciated. If language of instruction can be introduced as early as standard one, conceptualization can be enhanced in higher standards because it will have a good foundation. The concurrent semantic routing will have been stabilised sufficiently and an integrative approach, whereby all the different language functions will have been developed. Listening, speaking, reading and writing will develop at an earlier phase and will not be introduced suddenly and dramatically in standard three.

The syllabus as a systematic selection of knowledge of human experiences or as a source of reality, assumes that the productive or expressive skills of talking and writing as well as the receptive skills of listening and reading can not be acquired in isolation, but need to be developed in an integrated process including the learner's own experience and their experience and needs beyond school (Geyser, 1992). Learning or conceptualization, unlike memorization, goes beyond school text and incorporates early childhood experiences, inclusive of natural world experiences and language mediatory experiences.

Conceptualization could be viewed as a level of the students' cognitive abilities to think in terms of mental images even if the image is not clearly and succinctly represented. Language playing a major role in aiding learning, presupposes that the gap between concepts and language skills should be bridged as early as possible. The first priority will be to develop language skills which will facilitate learning. The reproductive skills and receptive skills are the means of revealing the message in the concepts. They take learning far beyond the school situation. They allow the meaningful implementation of what has been learned, if they had been well grounded. This once more illustrates the need for early introduction of the ultimate language of classroom mediation.

3.4 LANGUAGE AND LEARNING IN THE TEACHING SITUATION

Language is generally viewed as a main means of mediation of learning. During classroom interaction, students express what they have learned mostly through language. Language influences what they/the students have in mind, namely, the ideas and experiences encapsulated in their concepts. If their language is not well developed, they might express an idea which is incompatible with the way in which it is expressed. This is where misconceptions mostly become observable. Sutton (1992:3) argues that language through words, do not only inform but also persuade (Edelsky, 1985:19).

In general science, the problem in using language to express ideas and experiences seem to be the fact that students are expected to conceptualize through a "foreign" language, namely English, and this language has been taught as a subject, focusing on grammar and not on the basic language skills which will facilitate communication in an instructional situation (Cassels and Johnstone, 1980). This situation seems to exacerbate learning. New learning can benefit from existing knowledge schemata and this process is referred to as transfer. Existing knowledge structures have been accommodated linguistically by means of the first language. Transfer to the second language poses a problem because transfer cannot necessarily be accommodated by translation. It seems learning new concepts in a second language could cause disturbance in conceptual development because linguistic building blocks are absent. Transfer can either be positive or negative depending on the learning experiences. If transfer is inhibited by linguistic obstacles, it clearly could be unsuccessful or negative - thereby creating conditions which are conducive to misconceptualization.

It seems that transfer or assimilation and accommodation of new knowledge is negative, because when teaching and learning from standard three onwards takes place through English as language of instruction, learning seems unlikely to occur with equal success. The accommodation facilities in the memory are also the first language and the new knowledge arrives in incompatible language structures. It simply does not fit. Students seem to fail to take learning as their own responsibility

because they feel insecure and remain dependent on the teacher as source of linguistic security and inevitably they also rely on rote learning as security device. They seem to depend entirely on their teacher and not on their own pro-active ability. It is an assumption of this study that teacher dependence is due, amongst other things, to a need for the teacher's language. Students cling to her cognitively because she understands and expresses while they feel cognitively "caged". Although they may have some pre-linguistic understanding, they have no means of mediating or transferring their knowledge and understanding (Brinton, 1992; Crandall, 1991). Both sentences and words escape them and they inevitable revert to a behaviouristic learning style and to rote learning because clear comprehensible English is not at their disposal.

Sutton (1992:21) describes "words as aspects of language drawn from nature, to arrest the hearer by their vivid and strange structure, leaving the mind in sufficient doubt in order to tease it into active thought". If students depend on what the teacher says, without constructing their own individual linguistic structures in English, it could mean that they are themselves not aware of what is happening in the learning opportunities created for them. Repeating concepts in a rote manner without cognitive involvement cannot be regarded as active constructive learning. Sutton (1992:50), in his interpretive view of learning, believes that a student should learn in a way that he explores what he learns, and through language, this process is facilitated and mediated. He believes that learning should shape the students'

thinking and that language plays a vital part in the process. The view of Vygotsky (Wertsch, 1993; McCrone, 1993; Vygotsky, 1986) is that humans learn language because contact with language is the catalyst for the development of the "inner voice" of human thought. Therefore, if students have not developed an "inner voice" in the language through which science concepts are mediated, they tend to rote learn, because they are not linguistically in control of their learning. Without sufficient linguistic support, students' learning becomes less meaningful (Sutton, 1992:17).

Sutton (1992) aligns himself with a situation in which language steers thought, to allow students to explore concepts with the help of language. Some authors also distinguish between different ways of learning through language. Among the different styles of learning through language, they emphasize "insight learning" whereby an activity at hand challenges the students to strive at performing reasonably well and gaining a sense of growth and knowledge which is expressed in personal language, even if the language is not "scientific". This seems viable only if students have a good control over the vocabulary and discourse they are expected to use. Using words or language without a clear understanding seems unlikely to be regarded as meaningful learning. Words therefore play an important role of triggering the cognitive activity of the student.

Language in the science class can therefore not be viewed as a neutral carrier of concepts which communicates a message exactly as it is formulated. The language of learning and instruction is a roleplayer in the very formation and changing of concepts. In the case of English in black schools, the matter becomes very complex.

3.5 SEMANTIC CATEGORIZATION AND PRAGMATIC CATEGORIZATION

The categories in which meaning is placed, are one of the basic characteristics of language (Botha, 1995). The generic categories are however not universally applicable. The word "plant", for example, has certain universal characteristic as a noun or a verb. However, the meaning changes as the context changes. The meaning can become metaphoric as well, as it is illustrated in the following examples: "She planted seeds of hope in the hearts of her students." Meaning of words is therefore based on the context in which they occur. One word can be used in different ways or can have different meanings depending on the context in which they are used. If this point is not well considered in instructional situations, learning will become less meaningful. For example, the word "light" can have a plethora of meanings. One can say "a floating cork is light" or "I light a candle in my room."

Driver, Guesne and Tiberghien (1992:193) all agree that students should see the world in a way that shows that they realize the different entities which may belong together, in both their processes and their relationships. Language of instruction in this regard plays a vital role. Students see reality, but what they say and write about it, contrasts with their experiences, due to the lack caused by insufficient language.

Figure 3.5.2 (p.50) reveals student's problem in seeing and not becoming aware of relationships in processes where volume of irregular objects is shown through displacement. Although the process of comprehending may not be entirely dependent on language, the social interaction and the mediation surrounding and supporting the process are related to clear and apt use of language.

The teachers' instructions:

1. Tie-up a stone and a cork with a cotton thread.
2. Immerse both of them in a measuring cylinder with the water-level at 50cm^3 .
3. What happens? Explain why?

The students realize that when the cork and stone enter the water, the water-level rises from 50cm^3 , but only the experts who can express their understanding in personal language will be cognitively aware of the fact that there is a relationship between the water that rises and the stone and cork that go into the water, and

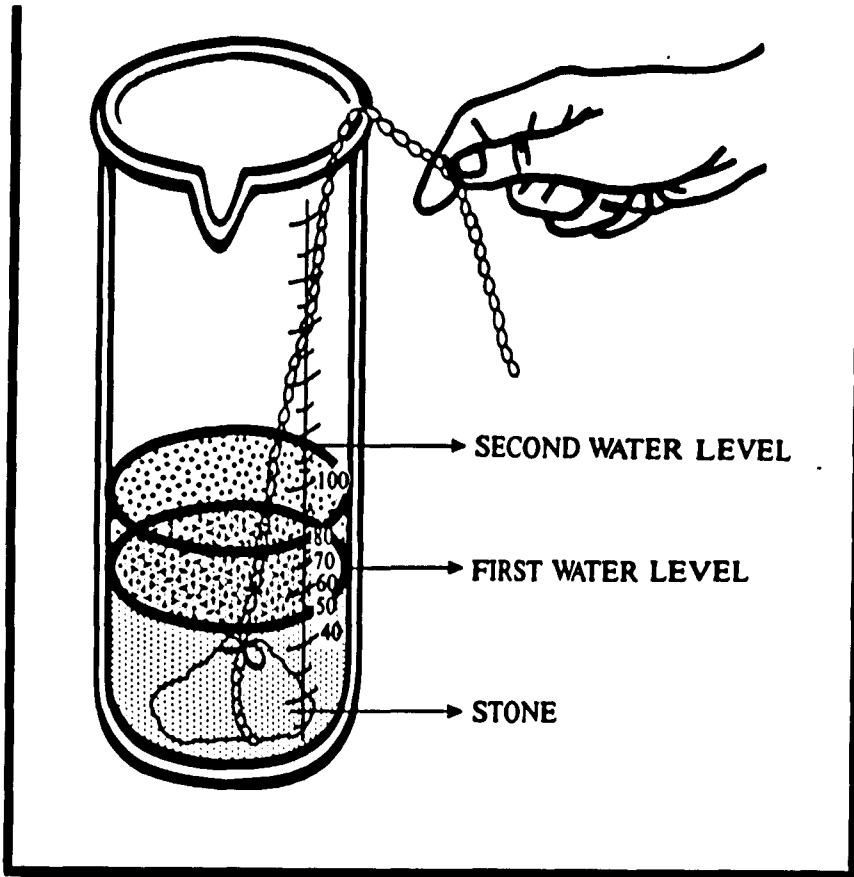


FIGURE 3.5.2: VOLUME THROUGH DISPLACEMENT

they will be able to give linguistic embodiment to this. Students who had rote-learned definitions and concepts will end-up at "we see the water-level rising" because they may understand some aspects of displacement, but the language to express this embryonic understanding is absent. The experts will account for the rising water, as looking for other space as their space is taken-up by the stone and cork. They will be able to converse about the issue of space and give adequate linguistic embodiment to it. This will show that they did not memorize the facts that no two objects can occupy the same space at the same time, but understood it. Meaningful learning give the students an ability to realize the different entities

which may belong together in their processes and relationship (Driver; Guesne & Tiberghien, 1992). Meaningful learning is also dependent on adequate mediation which again presupposes adequate language. The semantic categories into which science concepts are placed are therefore expressed in language. If language which labels or describes these categories are absent, learners could revert to pragmatic categorization, which means that they will add the "meaning" to which they associate most closely from their immediate physical or linguistic context. Pragmatic categorization can lead to non-expert concepts and even to misconceptions.

3.6 MISCONCEPTIONS IN SCIENCE LEARNING

"Misconception" is a term that seems to mean a "mistaken idea" of something. However, Gardner (1991: 151) emphasizes the fact that the use of the term entails a risk, because it may imply that the views of novices are completely inadequate and those of experts are superior. In this chapter the term "misconception" will be used in the context of language misuse as a result of lack of language proficiency and the overemphasis of pragmatic categorization. Driver, Guesne and Tiberghien (1992:101) argue that language which is meaningful to teachers may, because of students' views of the world, have a quite different (even conflicting) meaning for students. So, because of the issue of language and the variety of categorizing possibilities, it seems teachers can reinforce the very views we see as causing problems to teaching and learning processes. The view that language is difficult and

complex, for example, needs a thorough consideration. One word can have different meanings depending on the context in which it is used. Teachers should state it categorically which meaning they are talking about it in order to bridge the gap between the language used and what the students see. Teachers ought to be sensitive to the pragmatics of language in science teaching.

Sutton (1992:12) argues that the relationship between words and one's thought is that words give the best clues one has to the thoughts on which knowledge is built. It seems therefore, that if words are meaningless to the students, misconceptions might be the result. Encountering unknown words indeed is conducive to a variety of personal pragmatic interpretations by students. Take for instance an example where the teacher and the students carry out an experiment to find a volume of irregular objects through water displacement. The "new" words here are "displacement" and "volume". The students see water rising as the stone is immersed in the water. The students often can not see the relationship between the rising water and the stone. The students are inclined to holding on the belief that the water is rising but they seem to fail to account for this event by acknowledging causality. In this case the volume of the "displaced water" as the volume of the stone is something very far from the students' cognitive linguistic functioning. Language only is a factor which could assist in clarifying these concepts. The students, through language, could be assisted to realize that water is rising because the stone "took its place", and the amount of "displaced" water is the "volume" of the stone. If language was used in repeating what the teacher

is saying and not used as a means of communicating ideas for the purpose of realization of relationships, then these concepts could have an alternative meaning to the student. Hence confusion or memorization that "I see water rising" without any conceptualization of what is actually happening. Linguistic analysis of the concepts "displacement" and "volume" could assist in understanding the science concepts, because the deep structures of language, where thought and the counterpart language are generated, is the area where cognitive functioning takes place.

3.7 CONCLUSION

In this chapter an elaboration on the context in which language in science, conceptualization, teaching and learning the possible linguistic origins of misconceptions, have been argued. Furthermore, the role of the semantic categorization has been clarified. The main aim of discussing or elaborating on these concepts was to explore the concepts which form the main issues of this study. Their interrelatedness has been highlighted. Their interrelatedness emphasizes communication as a means of becoming aware of one's surrounding and the fact that language goes further than communication - it is a roleplayer in concept formation and change and it needs to feature prominently and metacognitively in a teacher's design of instruction.

CHAPTER FOUR

THE RESEARCH DESIGN

4.1 INTRODUCTION

This chapter aims at briefly setting out a theoretical framework for the procedures and investigation processes of this field study. The concepts "qualitative" and "design" will be explained briefly. The main tenets of qualitative research will be stated and a brief discussion focusing on the epistemology of the investigation, and the context will be conducted after which the design of this investigation will be set out, focusing on iconic and verbal data as the main data processing procedures. This will lead to the discussion of data consolidation and interpretation.

4.2 QUALITATIVE RESEARCH AND DESIGN

The concept "qualitative" is dynamic. It is an umbrella term for various philosophical orientations to interpretive research (Glesne & Peshkin, 1992:9). According to Kirt & Miller (1986; quoted in Krefting, 1991:214) as referred by Storbeck (1994:71), "qualitative research is a particular tradition in social science that fundamentally depends on watching people in their own territory and interacting with them in their own language, on their own terms", and has as its aim "to give an honest account with little or no interpretation of ... those

spoken words or of the observations made by the researcher" (Strauss & Corbin, 1990:21).

"Design" is the logic that links the data to be collected to the initial question of the study (Yin, 1989:27). It is an issue that involves a critical manner of the whole sequence from the selection of research problem to the collection of data, analysis and the interpretation thereof (Mouly, 1978:68). It is a plan for assembling, organizing and integrating information, and its results in a specific end product (Merriam, 1988:6) which is in essence not derived from statistical data. The data are usually iconic or verbal, distinguishing the research as another paradigm. The qualitative research paradigm is the basis for the methodology of conducting this study as it agrees with the tenets which differentiates its character from that of a quantitative research paradigm.

- * It focuses on emic perspective.
- * The epistemology is based on constructivistic principles.
- * Its activities through participants take place in natural setting.
- * It is idiographic in nature [the phenomena is looked at in-depth].
- * The researcher is an instrument which plays a subjective role.

A theoretical description of qualitative research will now follow, organising the content under certain headings.

4.2.1 EMIC PERSPECTIVE

The concept "emic" can relate to respondents' own impressions about reality. The researcher wants to see reality "through her subjects' eyes" (Bryman, 1994:78). She therefore allows their views to be prominent. By so doing the possibility of her imposing her predetermined ideas and values on the observation is diminished, and emic data is discovered and developed. This type of theory can be regarded as "bottom-up" theory in which a new theory can be established from hidden variables (Henning, 1992).

4.2.2 EPISTEMOLOGY OF QUALITATIVE DATA

Epistemology is the theory of knowledge. Knowledge constructed qualitatively through collected data during the research practice is of a specific kind. This type of knowledge can have two faces, the surface and the deep structures whereby the latter serves to give a deeper understanding of what is happening in the research setting, which again can lead to establishing an illuminative view from an in-depth inquiry.

4.2.3 CONTEXT

Well-collected qualitative data are of a certain value when it includes a study of behaviour in the subjects' "own territory" (Strauss & Corbin, 1990). This does not allow unnatural external interference, which allows for the observation of

spontaneous, thus natural behaviour.

Wilson (1989:18) as referred to by Glesne & Peshkin (1992:179) maintains that qualitative inquiry is like going into a landscape which one loved for a lifetime but which still holds secrets. One cannot be sure of what she will find in the research but invariably gets caught up in the search. The influence of the natural setting with its subjective character will give a possibility for understanding latent, underlying issues (Miles & Huberman, 1984:10). The fact is that data collected in its natural setting provides "thick descriptions" that are clear about the phenomenon (Watson, 1991; Erickson, 1991) in Henning (1993).

4.2.4 IDIOGRAPHIC IN NATURE

Strauss & Corbin (1990:24) maintain that the qualitative researcher mostly does not formulate hypothesis, but rather allows "theories" to be generated from the ground [grounded theory] inductively and that this occurs in an ideographic way. This means that an in-depth inquiry takes place with the aim of finding authenticity and not generalisability.

4.3 RESEARCH DESIGN

4.3.1 THE RESEARCH DESIGN

How one should structure her design is quite crucial as the aim and design of the

inquiry need to be compatible, and it is therefore necessary that the design is selected only once a field of study has been identified in order to ensure the most effective design for the study. This study is a case study which accommodates a variety of methods of data collection.

4.3.2 THE CASE STUDY

As the format of this study will be the case study, which is known as a format that "concentrates on the way particular groups of people confront specific problems, taking a holistic view of the situation", the focus will be on a classroom situation. The study will focus on observational methods as a sub-category of descriptive research methodology to observe what is occurring in a real-life situation (Hayman, 1968:58) and arrive at a comprehensive understanding of the group under study.

Le Ray, who is considered the founder of sociological fieldwork and of the case study in France, implemented this in his study, where the in-depth study of the family case (the specific case) provided an understanding of the society in which it existed (Hamel & Dufour, 1991). Thus by definition, a case study is the in-depth study of a specific case, a holistic description (Hamel & Dufour, 1991; Elliot, 1990) and therefore a "thick description" (Merriam, 1988:28) which is ideographic.

Yin (1984:103) maintains that a case study researcher should have a

methodological versatility and should follow certain format procedures to assure quality control during research process. In this case study multiple sources of evidence are used to allow the researcher access to addressing a broader range of linguistic aspects which could be assisting in the development of misconceptions in this science class.

4.4 THE PROCEDURES FOR DATA COLLECTION

The unique strength of the case study is the fact that it has the "ability to deal with a full variety of evidence - documents, artifacts, interviews and observations" (Yin, 1984 quoted in Merriam, 1988:8). To maximise the advantages of these methods, however, three principles of data collection are proposed, which when adhered to, the data collected, will "reflect a concern for construct validity and for reliability, thereby becoming worthy of further analysis" (Yin, 1980:103). These principles will be briefly discussed in order to provide a background against which the relevant data collection methods will be discussed. The principles are: case study data base; and maintaining a chain of evidence.

Multiple sources of evidence act as a process of triangulation of findings, and conclusions of a case study are far more authentic if they are grounded on various sources of information (Yin, 1989:95-97).

The case study data base acts as an essential principle leading to construct validity and reliability. Yin (1989:99) maintains that a case study should build

up a retrievable data base in order for other researcher to scrutinise the evidence directly. Yin (1989:98-108) states that the reliability is increased by a data base which should include documents, notes, video recordings and transcripts.

Maintaining a chain of evidence allows an observer to follow the evidence gathered from beginning to end (Yin, 1989:102) and to do so in a replicable, chronological manner.

Each of the available data collection methods [documents, field notes, video recordings, interviews] will now be considered, with reference to the collection and analysis of data in this case study.

4.4.1 DOCUMENTS

Data obtained from documents include any written materials (Merriam, 1988). This written material provides easily accessible ready-made data (Yin, 1989) which were mostly constructed in-situ.

The kind of documents collected in this case study were class exercises, tests and written paragraphs. As writing is a way of expressing thinking, a narrative discourse was formulated from these documents, that acted as a summary as well as a progress chart of the information discovered in this way.

4.4.2 VIDEO RECORDINGS OF LESSONS

(Kidder, 1981b:264, in Merriam, 1988:88) states that observation as a qualitative data collection method is a research tool when it, serves a formulated research purpose, is planned deliberately, is recorded systematically, and lastly when it is subjected to checks and controls on validity and reliability.

The researcher in this case study took the role of "participant observer" (Wagner, 1993), which has been defined as "those individuals who conduct research activities from within non-researcher roles that they occupy as fully as other non-researchers in the particular group, setting, or organization they are investigating" (Wagner, 1993). To be more specific, in this study the researcher is a full "participant observer" who is a teacher and researcher at the same time.

The lessons were observed and analysed holistically. The setting, the behaviour of the participants, the activities and the interaction, as well as certain subtle factors were noted. The researcher in this study is a full "participant observer" and is therefore in the field study all the time observing the participants as they unfold in their natural setting while the whole activity was video recorded. The advantage of full participant observation is that the researcher gets first hand knowledge through experience, making it possible to see and record behaviour as it is happening and allowing her a glimpse of phenomena that a subject might not have revealed in other methods of data collection (Yin, 1989; Merriam, 1988).

It is thus clear that a participant researcher "routinely gets access to data that is unavailable to non-participants" (Adler & Adler, 1987 as quoted in Wagner, 1993:11) while one of the greatest criticisms of participant researcher investigation from researchers in other paradigms is that the method is too subjective and therefore has little credibility among other researchers. Silverman (1993:46) as referred by Storbeck (1994:85), in answer to "potential bias", writes, "no hypotheses are ever 'theory-free', we only come to look at things in certain ways because we have adopted, either tacitly or explicitly, certain ways of seeing".

4.4.3 INTERVIEW

As one of the aims of the qualitative inquiry is to "see through the eyes" of the subjects, through "close involvement", and to be engaged in a more "fluid and flexible" research (Bryman, 1994:78) where the researcher is an observer open to unexpected findings, interviews with both students and teachers were conducted. Unobservable feelings, thoughts and intentions are explored and this gives access to the insight and comprehension of the person being interviewed (Silverman, 1993:94, Merriam, 1988). Merriam (1988) regards this social interaction as a conversation, "a person-to-person encounter", with the purpose of gathering descriptions of the life-world of the interviewee with respect of interpretation of the meaning of the described phenomena (Kale, 1983:174).

Kale, (1983:174) maintains that the qualitative interview is theme centred and not person centred and thus focuses on the life-world of the interviewee as he experiences it. Therefore the qualitative research interviews seek to give meaning to the theme through describing and understanding what has been said by the interviewee.

The interview data of this study were collected via what Denzin (1978, cited in Le Compte & Preissle, 1993:169) refers to as a "non-scheduled standardized interview". Questions which were asked focused on what the interviewee know about their world, and how they feel about what they experience and how they behave towards this.

Both teachers who taught the same class and students were candidates of the interviews. The language of instruction is English and the interviews were conducted through the medium of English. The responses were captured in the audio recorder as evidence of raw data and later each of the students' responses were transcribed for processing and analysis. With regard the teachers' responses, they were recorded as raw data in a note book as evidence for later analysis.

The interview preparations takes on the design of a conversation in which most students feel quite comfortable and relaxed. The candidates are usually open to the questions being asked and thus give the interviewer access to their perspective on a phenomenon, although in this case English language limited the

participants' ability to express their views.

4.5 PROCEDURES FOR DATA ANALYSIS AND PROCESSING

Miles and Huberman (1994) cite several systems through which data can be organized, systematized and analyzed (Peshkin, 1992 and Miles & Huberman, 1984). They see this stage as a way of arranging data collected in order to systematise it into more accessible units of interpretation. Although this process is essential, it has been described by Bryman and Burgess (1994:216) as a problem, as qualitative data is often "voluminous, unstructured and unwieldy". It is therefore imperative to cluster data into smaller units systematically.

Miles and Huberman (1994) describe this process as "consisting of three concurrent flows of activity: data reduction, data display and the drawing and verification of conclusions. It has been suggested that collection and analysis be simultaneous, which will lead to data that are both "parsimonious and illuminating" (Merriam, 1988:124).

The process of data analysis employed in this study will now be clarified, in terms of the three phases identified by Miles and Huberman (1994): data reduction, data display, conclusion drawing/verification with reference to the different stages conducted from the mined data as cited by Glesne and Peshkin (1992) to the final stage of data analysis.

Figure 4.1 can be considered as a retrieval and systematic means which gives the researcher access to identifying and organizing pieces of data that belong together that form a certain pattern which leads to the clearer understanding of the phenomena (Glesne & Peshkin, 1992:130).

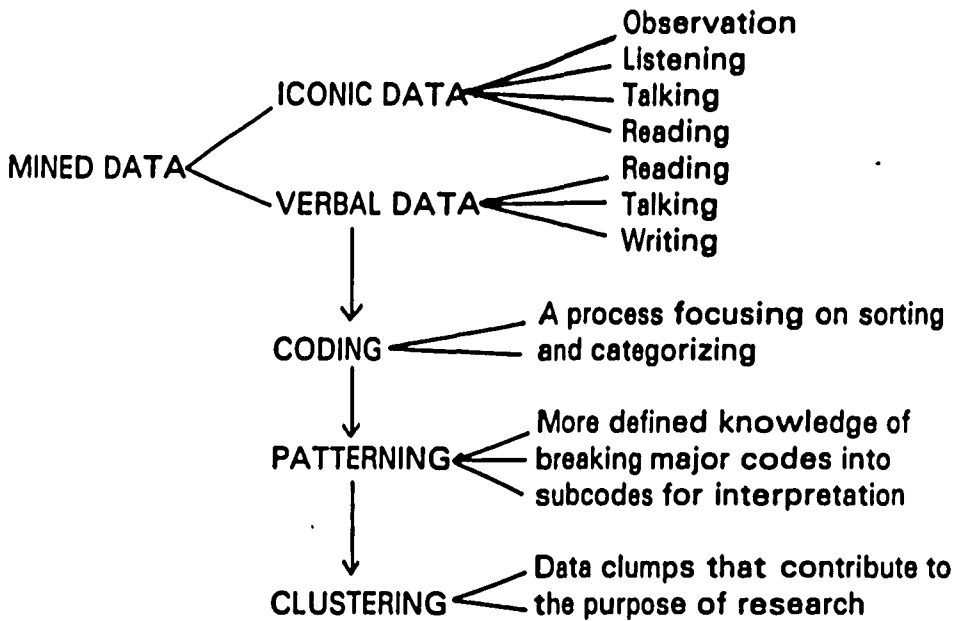


FIGURE 4.1: IDENTIFYING AND ORGANIZING OF DATA

4.5.1 DATA REDUCTION

Peshkin (1992) refers to this stage as having the mined data, which can be iconic and verbal, and which are to be simplified, whereas Miles and Huberman (1994:10) maintain that this process refers to "focusing, simplifying, abstracting and transforming the data that appear in written-up field notes or transcripts".

In this study, this data condensation process (Tesch, 1990, in Miles & Huberman, 1994), was achieved by coding, a process of focusing on sorting and

categorizing and clustering data clamps that contribute to the end product of the investigation. The technique used was that of the dendogram.

4.5.2 DATA DISPLAY

Miles and Huberman (1994:11) regard this stage as a design used in research to "assemble organized information into an immediately accessible, compact form so that the analyst can see what is happening and allow a quick assimilation of large amounts of information (Cleveland, 1985 in Miles & Huberman, 1994:92). Peshkin (1992:130) refers to data display as clustering whereas Miles and Huberman (1994:11) regard the process as a means of sorting out events, participants, processes, setting and sites into categories. This process helps the researcher to move from the more concrete data-information to more abstract conclusions. Miles and Huberman (1994:101) maintain that the chosen display needs to interact with the analytic text, in order to fully explicate the information carried over, by clarifying each other through identifying patterns, suggesting comparisons, discovering relationships and proposing explanations which can lead to optimal understanding of data.

4.5.3 DATA INTERPRETATION

Consolidation in qualitative research invariably leads to interpretation. Deductions are made regarding the research findings and finally the theoretical framework is implemented to explain these findings (Merriam, 1988).

Goetz and Le Compte (1984:167, in Merriam, 1988:141) define theorising as "the cognitive process of discovering or manipulating abstract categories and the relationships among these categories". Thus one can say the theory leads to analysing the implications of the findings and the significance for future research in the field.

The following figure 4.2 gives a summary of Huberman (1994) the process of consolidation and interpretation into what they refer to as "tactics for generating meaning".

Noting patterns, themes Seeing plausibility and clustering	To help the analyst to see "what goes with what"
Counting	A familiar way to see "what's there and how often it occur"
Noting relationship between variables	A pervasive tactic that sharpens understanding. Differentiation is needed too, as a partitioning variable
Building a logical chain of evidence and making conceptual coherence	A systematically assembled coherent understanding of data

FIGURE 4.2: CONSOLIDATION AND INTERPRETATION (Huberman, 1994)

4.6 CONCLUSION DRAWING AND VERIFICATION

With regard to credibility in research, reference is usually made to validity and reliability (Yin, 1988; McMillan, 1992; Merriam, 1988). Miles and Huberman (1994:277-280) set these criteria as standards for establishing the quality of conclusions. Conclusions need to be drawn systematically from empirical, systemised data, interpreted against the background of the theoretical framework.

4.6.1 VALIDITY AND RELIABILITY

Merriam (1988) distinguishes between two types of validity, the internal validity and the external validity. She states that internal validity refers to how the research findings coincide with reality and external validity refers to the generalisability of the research findings. She maintains that it is essential that the study be established as internally valid before questioning the external validity (Yin, 1988; McMillan, 1992 & Merriam, 1988).

Reliability and external validity are somewhat unlikely in qualitative research, therefore the following techniques have been suggested as ways to ensure dependable results: triangulation, which comes about by the use of multiple methods of data collection and analysis; having an "audit trial" of your research, including detailed descriptions of processes of research; and stating the researcher's position, explaining the assumptions and theory behind the study

(Merriam, 1988). Miles and Huberman (1994:11) maintain that the meaning emerging from the data, have to be tested for their plausibility, sturdiness, conformability in order to be valid.

4.7 CONCLUSION

In this chapter trustworthy qualitative research has been discussed. The research paradigm of the investigator influences the research procedures holistically and it is therefore essential that the researcher leaves a detailed trail of evidence. This chapter also provided an overview of the research methodology used in this investigation. The next chapter will focus on how the methods were implemented to collect and process the data.

CHAPTER FIVE**THE COLLECTION PROCESSING AND CONSOLIDATION OF THE RAW DATA****5.1 INTRODUCTION**

In this chapter, I will discuss how data were collected, analyzed and finally consolidated. The methods used for collecting data were the following: A video recording of classroom observation, an interview with both students and teachers, written class work and experiments and lastly field notes of longitudinal observation.

A video recording with the focus on observation, plays a major role in this research. The lesson recorded on the video is based on how students read and comprehend the text at hand. Written work consists of a written paragraph, tests done on monthly basis, and daily classwork limited to written exercises to complement lessons and experiments.

These data were collected in order to place the researcher in a position to assess systematically and rigorously how students cope with English as a medium of instruction in the teaching of General Science in a standard five classroom.

The video recorded data were transcribed and processed by means of coding and clustering techniques. The findings will be displayed graphically and discussed

briefly. The research question which I had formulated in chapter one has been my guiding technique during the data collection process. The research question reads as follows:

Which linguistic aspects feature prominently in the conceptual change in the teaching of general science in standard five?

The above formulation subsumes the sub-question articulated on p.4:

The chapter will end with a consolidation of the data across four sources which are, in effect, the triangulation categories. I will display and clarify relationships between the methods as a tactic to determine a strong chain of evidence of dominance amongst categories. Structures of meaning which indicate linguistic aspects which dominate in learning science will be presented.

5.2 THE COLLECTION OF CLASSROOM OBSERVATION DATA BY MEANS OF VIDEO RECORDINGS

Lessons based on reading and discussion, focusing on "a study of a variety of plants", were conducted and video recorded for observation purposes. A day before the recording, the students were informed that a recording machine and its operator will be present in class. They were told that in the long run the recording will be to their advantage because it was part of the teacher's research of the work in class. They were advised to relax and ignore the operator. The video cassette was filed as evidence of raw data for later analysis.

5.2.1 THE PROCESSING OF DATA FROM THE VIDEO RECORDING

The processing of data was done individually with the three individual video recorded lessons. The themes of the lessons were as follow:

Lesson one: The study of a variety of plants.

Lesson two: Magnetism.

Lesson three: Discussion initiated by means of questions from students.

Each recording of the lessons was subdivided into different episodes for analysis purposes. I viewed the film afterwards several times for processing. The lessons were episodically processed as follows:

1. **Holistic phase one:** It provides a global impression on the whole lesson.
2. **Holistic phase two:** It shows events as they occur.
3. **Frequential content analysis:** It indicates how often a structure of meaning features.
4. **Consolidation of data:** It provides final clustering of the processed data and prepares it for interpretation.

5.2.1.1 LESSON ONE: "A STUDY OF A VARIETY OF PLANTS"**A. Holistic phase one:**

This phase yields the global impression on the lesson recorded. Holistically, the following aspects arise from examining the recording.

- * The students seemed very relaxed.
- * The students talk in choral form.
- * Teacher guidance seems dominant.
- * The students seem to respond freely when their responses are initiated by the teacher.
- * The students lack vocabulary and resort to gestures in order to explain what they want to say.
- * In most instances, students seem to lack interaction with the text at hand.
- * Some students share textbooks.
- * The teacher uses chalkboard, pictures and concrete learning aids.

B. Holistic phase two:

The events are listed as they occur from the video. I transcribed events and used coding system for processing. The following codes were used:

CODED SYMBOL	MEANING OF THE CODE
SWP	Students' wrong pronunciation
TG	Teacher guidance
IA	Individual response
WCP	Whole class participation
SDSE	Students demonstration as lack of English language
MC	Misconception
TGA	Teacher guidance through teaching aids
NJ	No interaction
ST	Student(s)
T	Teacher
GP	Grammar problem

The following extract from the video data will serve as example of selected raw data from eight samples in lesson one, showing how coding and clustering was done with transcribed raw data.

C. I. Lesson one, episode one: Reading and comprehension

T: Reads the heading "a study of a variety of plants".

ST: A study of a "vayarati" of plants.

T: She reads the heading again while emphasising the word "variety".

ST: A study of a "vayarati" of plants (repeating the same mistake).

T: What does variety mean?

St.7: "vayarati" mean a seed of plant.

T: She explains "variety" as different things. We vary our meals.

II. Lesson one, episode two: Flowering plants

T: She reads the topic aloud.

ST: They read in chorus.

St.1: A plant that have a root, stem and leaves.

St.3: A plant that flowers.

T: What does a flowering plant consists of?

St.7: A bean.

III. Lesson one, episode three: More class activity

T: She brings pot plants to each group. She indicates the structure of the plant to students.

ST: They read the heading in chorus.

T: She hands out bean seeds to explain cotyledon. She asks students to peel the bean.

ST: They peel the bean and identify a cotyledon.

T: She asks questions to help the students to conceptualize.

ST: They respond correctly in a group.

IV. Lesson one, episode four: Consolidation of "Germinate"

T: She asks which word are the students not familiar with?

St.4: Is "germinate".

T: She explains the word - enjoy, happy, develop.

ST: They repeat what the teacher say in chorus.

V. Lesson one, episode five: More challenging activities

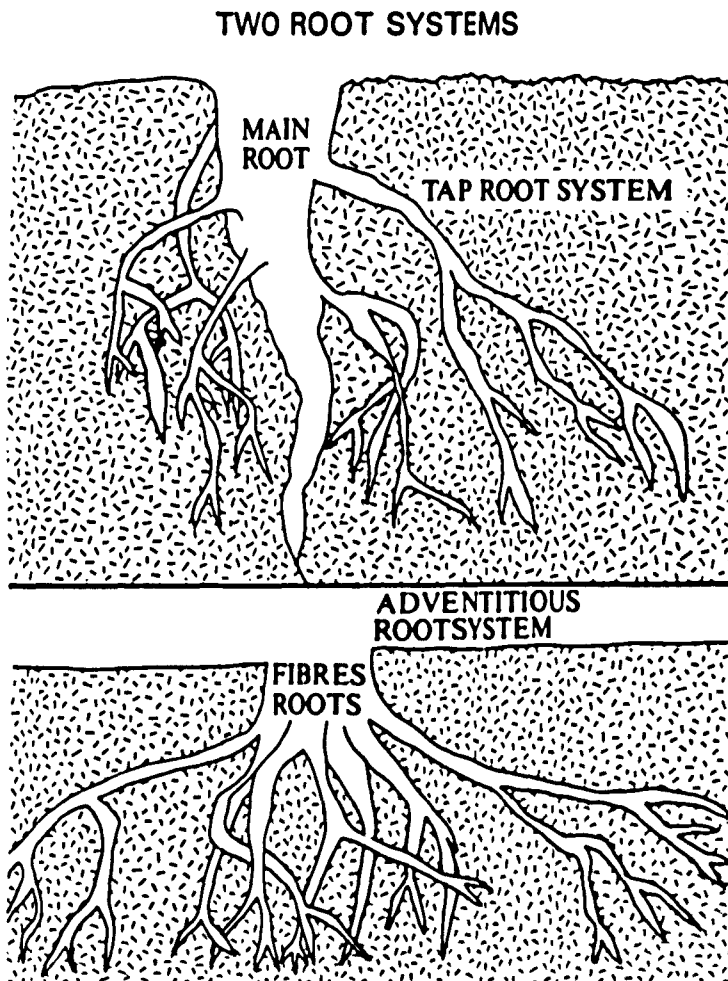
T: She draws two types of root systems on the chalkboard.

T: She asks how the two root systems differ?

St.7: Tap root grow... grow... dow... down (showing direction).

St.5: A tap root has primary and secondary roots.

T: Provides two points which differentiates a dicot from a monocot plant in a tabulated form:



DICOT PLANT	MONOCOT PLANT
1. Has two cotyledons 2. Has a taproot system	Has one cotyledon Has an adventitious root system

T: Reads the points aloud from the board.

ST: Read in a group with gestures to show understanding.

5.2.2 FREQUENTIAL CONTENT ANALYSIS: LESSON ONE

See Table 5.1 on p. 78.

5.2.3 CONSOLIDATION OF DATA FROM LESSON ONE

The first category which emerged from the analysis was that the TG (teacher guidance) occurs most often. The teacher seems aware of the English language problem which the students experience and therefore attempts to intervene as the guide and support, trying to mediate.

The second category is IR (individual response) which states that although students seem not to interact with the text, they are relaxed and participating. Category three and four provide evidence of their participation. The results of their interaction are clear in category five where there is evidence of misconception.

TABLE 5.1
 LESSON ONE: PLANT STRUCTURE
 CONSOLIDATION OF CODED DATA

EXPLANATION OF CODE	CODE SYMBOL	FREQUENCY	STANDARD	EXAMPLES OF CLUSTERS IN EPISODES
Teacher guidance	TG	26	-	Asks what "variety" means. Explains clearly what "germinate" means. Rephrases questions when not understood
Individual response	IR	17	std 1 std 2	"Vayariti" means a seed of plant. "Vayarity" means a seed you can plant.
Whole class participation	WCP	14	-	Reading of headings, reading of instructions and reading of questions from the textbook. repeating the teacher.
Student demonstrate when stuck with English	SDSE	10	std 1	Taproot grows down (showing by hands).
Individual student misconception	ISM	8	std 2	Cotyledon means a thing that is a little
Student conceptualisation	SC	6	std 8	The seed of a dicot-plant has two cotyledons when that of a mono-cot plant has one cotyledon.
Student grammar problem	SGP	5	std 3	Flowering plant means - "a plant that flowering" - a plant that we flower.
Whole class misconception	WCM	4	std 5	A taproot system have primary roots at the top and adventitious roots at the bottom.
Teacher guidance through teaching aids	TGTA	4	-	Uses potplants, writing board charts, wall charts and textbooks
Students wrong pronunciations	SWP	2	-	variety - "vayarati" adventitious - adventitious
Students awareness of prob words	SAPW	1	-	Germinate.

Category six marks the grammar problem that the students experience.

Category seven illustrates the teachers' attempts to make learning meaningful.

The following sketch explains the outcome of lesson one from the video recorded raw data in a nutshell.

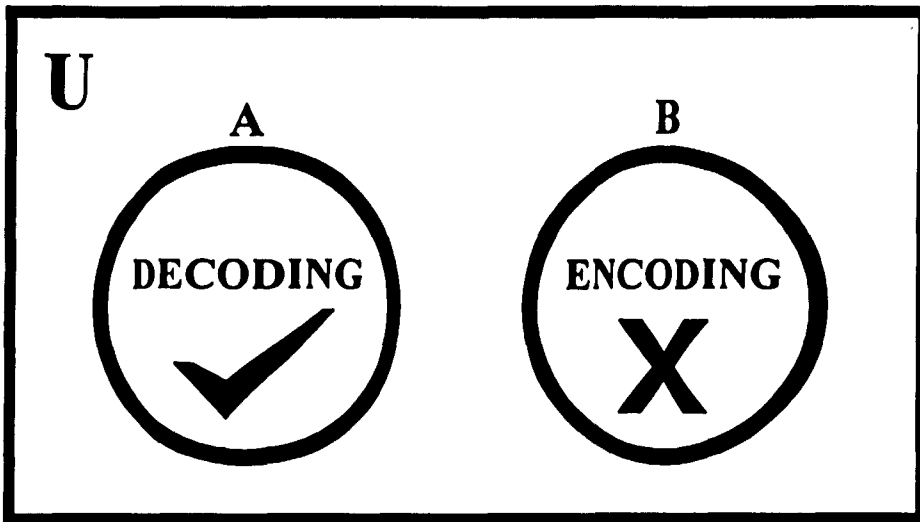


FIGURE 5.1: LEARNING THROUGH READING AND COMPREHENSION

Learning through reading should consist of decoding and encoding which forms my "universal set". I borrowed this concept from mathematical terms to highlight the lack of learning through reading. An element of reading aloud or being able to read should interact with the element of comprehending what is read to make learning through reading meaningful. According to table 5.1 there seems to be a discrepancy between decoding and encoding. Students seem to repeat or only imitate their teacher instead of seeking meaning in what they are learning. They read "mechanically" but not "semantically".

The linguistic aspects which played a role in the type (rote or real) and the quality (memorisation or understanding) of the students' learning which emanated from this analysis seem to be manifold, but lack of sufficient language is generally observable and the inability to make meaning from text is obvious. See Table 5.2: Consolidation of coded data on p. 81.

5.3 DATA COLLECTED FROM WRITTEN WORK

Three ways of collecting documented data were used:

- * A written paragraph.
- * Tests.
- * Class exercises and experiments.

Paragraphs and tests were written once a month and exercises and experiments were done once a week. Out of the whole class, eight randomly chosen specimens from each of the three sources mentioned above, were taken and filed as evidence of raw data for later processing and analysis.

5.3.1 PROCESSING OF RAW DATA FROM WRITTEN WORK

When raw data were processed, coding and frequential analysis techniques were used once more. I went through the raw data several times looking at aspects which belong together and a holistic impression was established.

TABLE 5.2
CONSOLIDATION OF CODED DATA

CODE	FREQUENCY	EXPLANATION OF CODE	TEACHER AND STUDENT EXAMPLES
TG	37	Teacher guidance	Explanations, illustrations, questions, rephrasing of questions.
IR	24	Individual response	Vayarati is a seed you can plant. Another field is football field.
WCP	22	Whole class participation	Reading is choir. Repeating after the teacher. Experimenting.
SDSE	15	Student demonstrate when stuck with English	Taproot grows down (showing with hands) iron fillings stan..and up (pointing up with fingers)
ISM	10	Individual student misconception	Cotyledon means a thing that is a little. Vayarati means a seed of plant.
SC	8	Student conceptualisation	It is not glass because iron fillings move. The seed of dicot plant has two cotyledons when that of a monocot one.
TGTA	8	Teacher guidance through teaching aids	Potplants, wall charts, writing board, iron fillings, paper, plastic.
SGP	5	Student grammar problems	Flowering plant is a plant that we flower.
SGPa	4	Small group participation	Class divided in small groups to carry instructions together.
WCM	4	Whole class misconception	Yes a taproot has primary roots at the top and secondary at bottom.
SWP	2	Student's wrong pronunciation	"Vayarati" "Adventitial root"

The following are symbols used to code raw data from written work and their explanations. The codes were assigned in a grounded manner according to the data which emerged and were not predetermined.

CODE	EXPLANATION
SP	Spelling mistakes
MC	Misconception
S	Syntax
LL	Limited language
M	Memorization
A/PM	Analogy/Pragmatic meaning
ADTM	Adverb of time

The following are examples of raw data from the eight specimens filed for analysis. It depicts how data were transcribed, coded and analyzed.

Student No 8:

WHAT I UNDERSTAND ABOUT ACIDS AND BASES.

"I now about acids and bases are called alkalids, there is different alkalids other are dangers. When you use those things you must be cafol, like acids. I don't talk by a acids of a lemmon. When you want to use acids of a car you must be caful becaes is very danger. Other you can use it."

Student No 5:**WHAT I UNDERSTAND ABOUT ACIDS AND BASES.**

"I understand that acids have a very sharp sour taste and there is some dangers acids that you not eat them because they can kill a person like caustic soda. And in basis I understand that basis have a bitter and burning taste and when you touch it is soapy and slipery."

All eight specimens were coded and together they are presented in the following Table 5.3 (see p. 84.)

5.3.2 CODED DATA FROM WRITTEN EXERCISES

The following examples serve as evidence of raw data collected and processed through coding. Three questions asked and students' responses will bear witness to it.

The following questions were asked:

1. What is length?
2. Complete the following sentence:
 - (a) A fish easily through water because it has
 - (b) All things in the universe are made up of

TABLE 5.3: DATA CODING: PARAGRAPH

CODE	EXPLANATION	FREQUENCY	EXAMPLE
SP	Spelling	50	biesle > bicycle
S	Syntax	17	When we put a lemon juse it is going to change.
MC	Misconception	16	An indicator is when we ride with car.
A/PM	Analogy/ pragmatic meaning	9	An indicator is when we ride with car.
LL	Limited language	6	I am going to pore my fingers in the solution
ADT	Adverb of time	2	Indicator is when

The following answers were obtained from the various students:

RESPONSES TO QUESTION 1:

St.2: Length is the distance between two point

St.3: Length is distance

St.6: Is distance betwin too point.

RESPONSES TO QUESTION 2 (a):

St.1: It has slimy body

St.4: It has spinde-shape

St.7: It has strimeline body.

RESPONSES TO QUESTION 2 (b):

St.5: are made ap of solids

St.6: all things are make up of matter

St.8: are make of matter.

The following table represents the main structures of meaning which emanated from the analysis of the exercise data. (See Table 5.4 on p. 86.)

5.3.3 EXAMPLES OF CODED RAW DATA FROM EXPERIMENTS

Data were collected through answering the following questions after experiments were conducted. The experiment was based on calculating the volume of

TABLE 5.4: DATA CODING: CLASSWORK

CODE	EXPLANATION	FREQUENCY	EXAMPLE
SP	Spelling	23	cantain > contain lemmon > lemon
MC	Misconception	9	A base that will <u>acid</u> in water
M	Memorisation	6	A base that will <u>acid</u> in water
LL	Limited language	2	What do bases in solution feel like - Bases in solution ... nothing
T	Tense	1	Explanation of answers - Orange it have acid it self.
LTA	Limited thinking ability	2	Yes, orange juice contain acid. Why? Because orange has acid.

irregular solids. The apparatus used were the following: Measuring cylinder, string, stone, water.

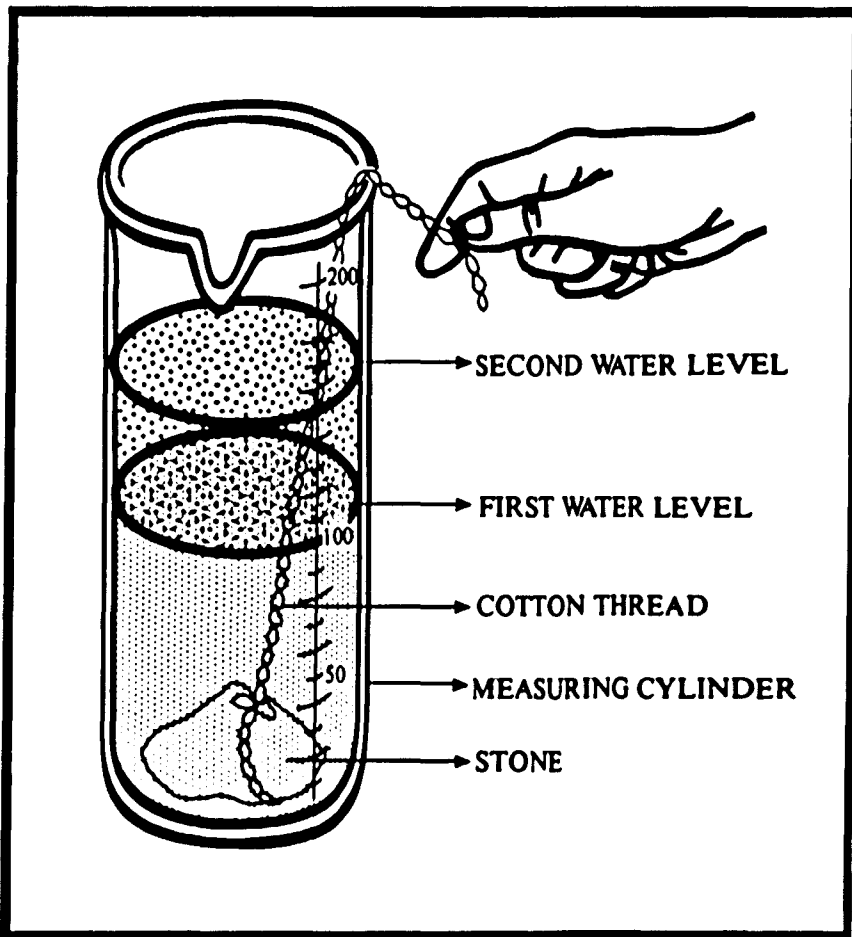


FIGURE 5.2: AN EXPERIMENT CALCULATING THE VOLUME OF IRREGULAR SOLIDS

The following instructions were given to the groups in class:

1. Tie the string around the stone.
2. Pour water into the measuring cylinder.
3. Immerse the stone in the water.
4. Observe what happens.

The teacher explained that they are finding volume through water displacement.

Questions asked were:

1. What was the first water level.
2. What happens when the stone is lowered into the water?
3. What is the water level when the stone is inside?
4. Why is the water level rising?

The following will serve as examples of raw data obtained from some of the eight student specimens selected.

RESPONSES TO QUESTION ONE:

- St.3: The water level is 102cm^3 .
- St.4: It is in 100cm^3 .
- St.5: Water level is 100cm^3 .

RESPONSES TO QUESTION TWO:

- St.1: It is the bubbles.
- St.2: The stone go down.
- St.8: The water is more.

RESPONSES TO QUESTION THREE:

- St.1: It is 150cm³.
- St.8: The water level is at 150cm³.
- St.7: The water is in 150cm³.

RESPONSES TO QUESTION FOUR:

- St.7: It is more.
- St.6: It is in 150cm³.
- St.5: The water is going up.

The students' response to question one and three indicates their ability to take a reading with their observation. They are reasonably accurate but they seem to experience lack of understanding and of expression of understanding between what they see happening and what it means. This bears witness in responses to question four especially.

5.3.4 EXAMPLES OF CODED DATA FROM TESTS

Data were collected from answering the following questions:

1. What is an abdomen?
2. What do you mean when you say "dissolve a little soap in water"?
3. What does a fish use to extract oxygen from water?

The following are raw data obtained from students' responses.

RESPONSES TO QUESTION ONE:

- St.1: The last part of an insect.
- St.3: The softest part that protect the insect.
- St.4: Part of the insect and is not in front is in back last.

RESPONSES TO QUESTION TWO:

- St.1: You mean you porr water and soap together.
- St.7: You mean you mix them.
- St.5; You make a solution and melt.

RESPONSES TO QUESTION THREE:

- St.8: Mouth and gills.
- St.3: Gills.
- St.4: Mouth.

TABLE 5.5: DATA CODING AND FREQUENTIAL ANALYSIS OF EIGHT TESTS

CODE	EXPLANATION	FREQUENCY	EXAMPLE
SP	Spelling	80	femali > family wi > we
MC	Misconception	19	Measuring instrument is instrument that measure a length.
S	Syntax	14	A displacement means that wen you wash.
LL	Limited language	5	During mateing the female layr eggs and male pour sperm on the eggs. I how they reprodus.
ADT	Adverb of time	2	A standard unit is when we measure area.

5.3.5 CONSOLIDATION OF DOCUMENTED RAW DATA COLLECTION FROM WRITTEN WORK

Table 5.6 (p.93) includes all written work as a source of raw data collection. It indicates that there is a high rate of spelling errors, misconceptions and poor syntax. The contents of table 5.6 seem to imply that there is little evidence of learning as far as written work products are concerned. This is displayed on p.85-90. The second most frequent aspect is "limited language proficiency". These results seem to lead to an answer to the question of "why students seem inclined to memorization". Analogy seems to be another problem. Students seem inclined to grasping an analogue more than the real content of lesson.

The following diagram (see Fig. 5.3, p. 94) is a summary derived from table 5.6, calculated in percentages to show a possible learning capacity as observed in creative writing.

Percentage wise at least 45% learning evidence in creative writing can be considered acceptable. In contrast the diagram on p.94 shows that only 14% learning with these students seems possible at present.

The sketch indicates that the students make 46% SP (spelling mistakes), 18% of learning outcomes are based on misconceptions, 12% of learning is by rote and 4% lack of language proficiency and limited thinking ability. The learning in this class seems largely based on memorization. This seem to indicate that

TABLE 5.6: SUMMARY OF ALL WRITTEN WORK, CODED AND FREQUENTIALLY ANALYZED

CODE	EXPLANATION	FREQUENCY	EXAMPLE CODED
SP	Spelling	153	mateing > mating; anithing > anything
MC	Misconception	44	An indicator it show direction: the standard unit is when we measure area.
S	Syntax	31	Indicator is when we ride a car when we want to turn left we indicator or right it show the left or right.
LL	Limited language	13	Porr a stone instead of immerce: a thing> instead of naming it.
M	Memorisation	12	Acids form dissolve solutions. A base that will alkaline in water is called an acidic.
A/PM	Analogy/ pragmatic meaning	9	A car is: an indicator. lemon tea is a indicator.
MT	Misuse of terms	6	Alkali solution: acids form dissolve solutions.
ADTM	Adverb of time misused	5	The standard unit in when we measure area: Displacement means that <u>when</u> you wash.

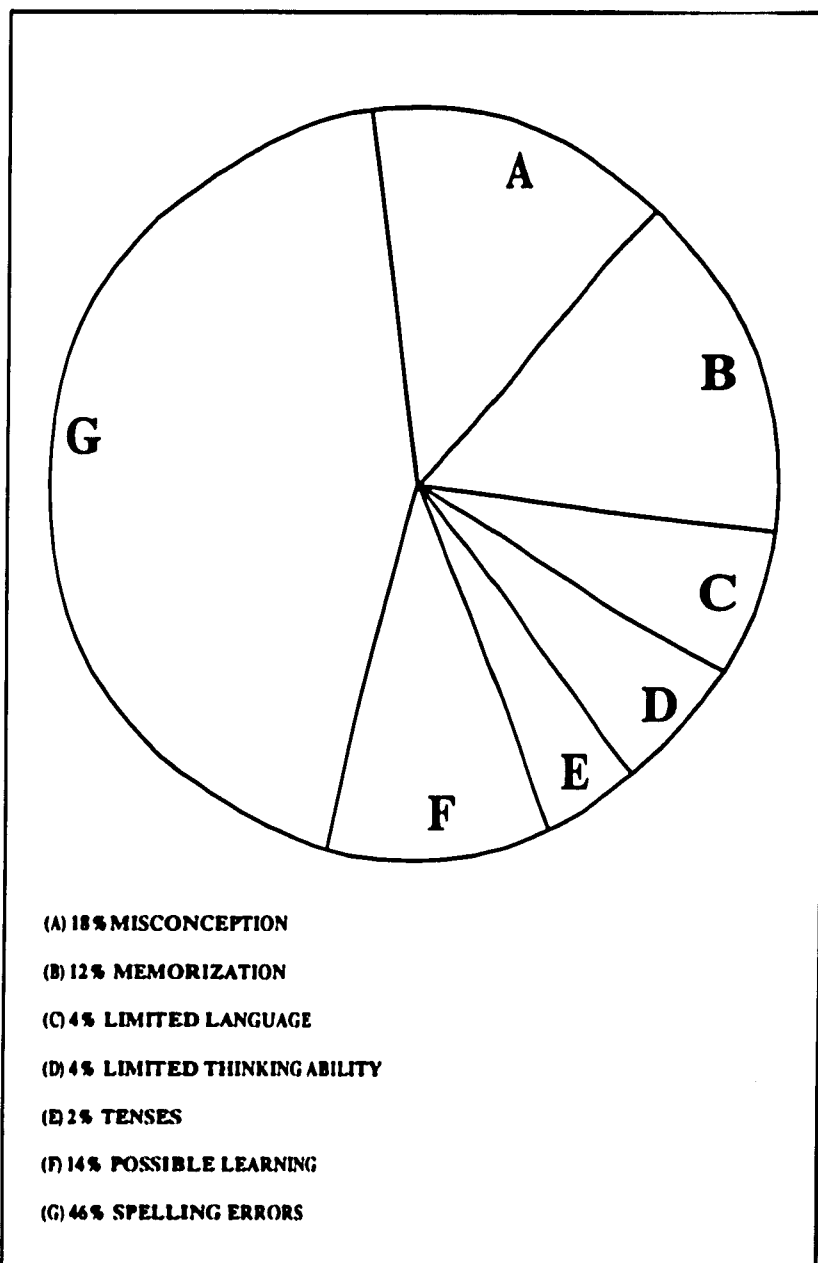


FIGURE 5.3: DIAGRAM OF PERCENTAGES OBSERVED IN CREATIVE WRITING

students are more channelled to rote learn prestructured text than to construct their own language and the concurrent concepts.

5.4 DATA COLLECTED FROM INTERVIEWS WITH STUDENTS

Interviews with students were conducted in a structured way. Students were told to feel free and were encouraged to participate. The researcher used an audio tape to record the students' responses. She later transcribed the recorded verbal text. This was then filed as evidence of raw data which were going to be processed by means of chronological clustering-cum-content analysis.

5.4.1 PROCESSING OF DATA FROM INTERVIEWS WITH STUDENTS

The researcher went through the recorded verbal text several times and important recurring themes were noted and clustered. The following questions serve as examples of those asked during the interviews.

- 1. How do you feel about learning General Science through medium of English?**
- 2. Why do you like it, if not, why do you dislike it?**
- 3. What do you think about spelling and grammar?**
- 4. How well do you think you learn?**

The following serve as a few examples of raw data obtained from students' responses in the interview.

RESPONSES TO QUESTION ONE:

St.1: I feel I like English

- Because when you want to work in Auckland Park you must speak English.

St.3: I feel good

- Because English is best and we learn it.

St.2: I feel OK and very best

- Because teachers at high school they teach General Science in English. It is going to be difficult to me.

RESPONSES TO QUESTION THREE:

St.6: We copy wrong spelling from friends.

St.5: Because the speaking, sound like we write.

St.8: Mam, why do letters sound different and are write the same? That is why I confuse spelling.

RESPONSES TO QUESTION FOUR:

St.7: When I change periods I don't understand next lesson.

St.4: I fear to ask when I am not understand.

St.3: When the teacher is shout me I fear and don't hear.

The following is the clustered examples from questions one and two on how students feel about English and why (see Table 5.7, p. 97).

TABLE 5.7: CLUSTERED EXAMPLES FROM QUESTIONS ONE AND TWO

STUDENT	BAD	GOOD	BEST	REASONS	CLUSTERING
1		•		Work	<p>The diagram shows the following clustering:</p> <ul style="list-style-type: none"> Student 1: Work → Speaking Student 2: International → Speaking Student 3: Speaking → Speaking Student 4: Speaking → Speaking Student 5: Learning → Speaking Student 6: Work → Speaking Student 7: Teaching → Speaking Student 8: Learning → Speaking Speaking (from all students) → Communication
2			•	International	
3			•	Speaking	
4		•		Speaking	
5			•	Learning	
6			•	Work	
7			•	Teaching	
8		•		Learning	

5.4.2 CONSOLIDATION OF RAW DATA FROM STUDENTS' INTERVIEWS





The following themes or categories were consolidated by means of analysis of the interviews. Holistically students seem to be positive about English as language of instruction in General Science. The students seem to realize that they need English language in order to communicate.

If English as the language of communication is not well developed, learning becomes difficult and learning becomes less meaningful. The reasons students provide for their positive attitudes towards English as their language of instruction, lead to the reduced category of communication when they are clustered as in the diagram displayed as table 5.3.

5.5 DATA COLLECTED FROM INTERVIEWS WITH TEACHERS

The interviews with teachers were not structured but were conducted in discussion format (see Table 5.8). The researcher took every possible opportunity and questioned the teachers in the research school with regard to the following questions, along with symbols to represent the various questions.

TABLE 5.8: DATA COLLECTED FROM INTERVIEWS WITH TEACHERS

SYMBOL	QUESTION
	Why do students make so many spelling and grammar mistakes?
	Why is there a development of misconceptions among students?
	Why is there a high rate of rote learning?
	Why is there a strong dependence of students on teachers?

The researcher took it upon herself to explain in detail the purpose of the interviews. The teachers were very eager to voice their opinions. The researcher recorded the teachers' responses in a notebook and filed that for later analysis.

Prior to the interviews, the researcher visited one teacher while she was conducting a lesson based on "the three phases of matter". It is this experience which encouraged the researcher to interview teachers as well.

The following is the example of the teacher's lesson and its outcome.

The science period lasted for thirty minutes only, therefore the information which emanated during this period is only impressionistic. The class teacher welcomed the researcher in her class. The teacher's emphasis during the lesson was that "water is matter and has three phases". The aim of the lesson, according to the researcher, should have been: to develop students' awareness that matter is any substance which takes up space and has mass and can be seen in three different phases, namely solid, liquid and gas. Students should realise that water, ash, oxygen, milk and several other objects all consist of matter.

The lesson seemed to channel or condition the students that "water is matter and matter should be seen in the three phases". This was evidenced in an exercise during which the students were required to choose from a given list of objects, those which can be classified as matter.

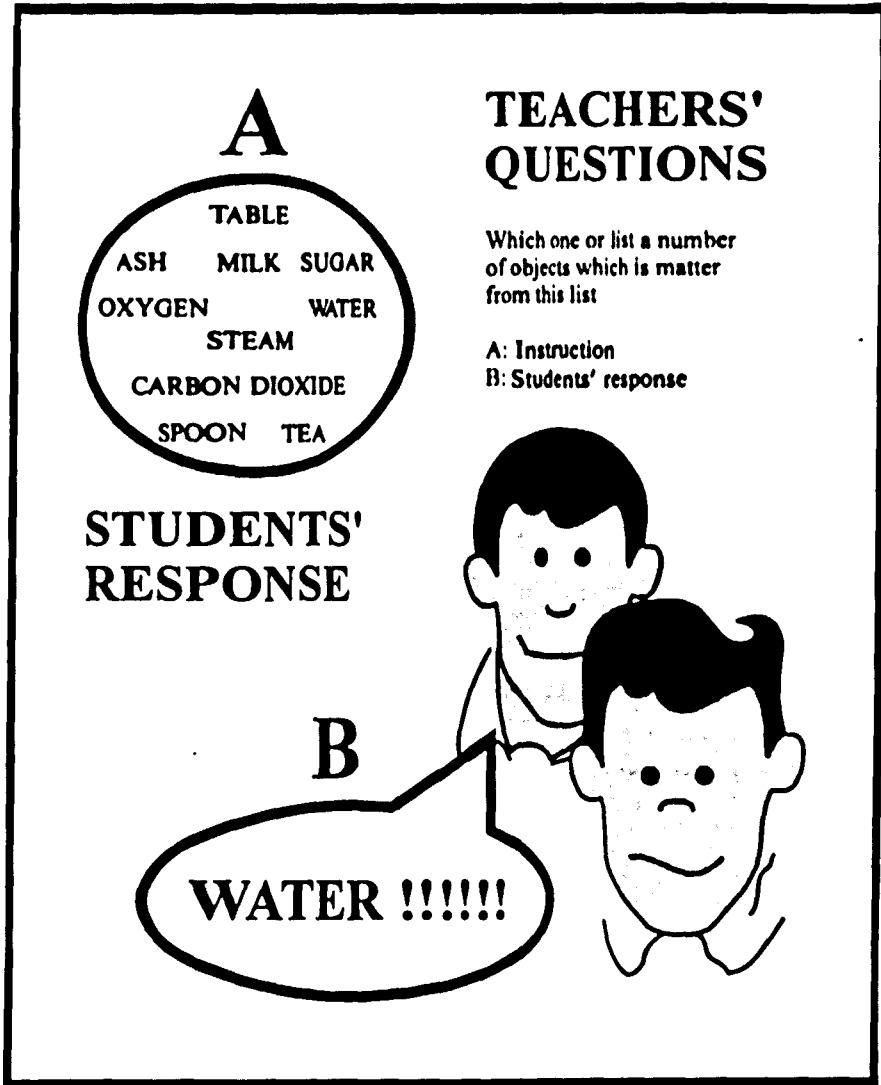


FIGURE 5.4: CLASSIFICATION OF MATTER

The teacher was surprised when she realised that the students see water alone as matter, little realising that this is exactly what she had mediated by linguistically structuring her lesson on water as matter.

The actual interviews with teachers were conducted mostly with higher primary teachers, where English is the language of instruction.

5.5.1 PROCESSING OF DATA FROM THE INTERVIEWS WITH TEACHERS





As was the case with the students, similar ideas from different respondents were clustered. The following dendogram (Table 5.9, p. 102) serves as an example of raw data from the teachers' responses. The first column indicates the symbols for each question asked, the second column the teachers' responses and the third column the researcher's clusters.

5.5.2 CONSOLIDATED DATA FROM THE INTERVIEWS WITH TEACHERS

In processing teachers' responses, certain categories were prominent. The holistic impression of question one is that the students are not keen to make learning their own responsibility. According to the teachers they seem to lack interest in their own learning.

The holistic impression of question two is that teachers do not allow communication to be reciprocal. They dominate the teaching and learning process. The holistic impression of both questions three and four indicates the shared idea that language limits the students' understanding in learning so they resort to memorisation and total dependence on their teacher and the language she uses.

TABLE 5.9: RAW DATA FROM TEACHERS' RESPONSES

SYMBOL	TEACHER RESPONSES	CLUSTERING
	<p>T1. Lack of concentration T2. Lack of wanting to know T3. Students always pre-occupied T4. Teacher not using chalk board</p>	<p>No interest Abstract learning</p>
	<p>T1. There is a lot of poverty T2. Too much talking by teacher T3. Teaching methods informs but questions need awareness T4. Lack of science knowledge from teachers</p>	<p>Poverty Method of teaching Lack of science knowledge</p>
	<p>T1. English is difficult for them T2. Lack of science facilities T3. Undeveloped thinking skills T4. Their mind always abstract</p>	<p>Learning facilities Language Abstract learning No learning interest Lack of science knowledge</p>
	<p>T1. Language is difficult T2. Language introduced late T3. Unaware that they learn T4. Teacher is dominant</p>	<p>Language problem (limited language) Ignorant Method of teaching</p>

5.5.3 CONSOLIDATION OF PROCESSED DATA FROM BOTH STUDENTS' AND TEACHERS' INTERVIEWS

The following categories came to light in both interviews. With regard to the students, eight categories came to light, but during clustering, they were reduced to one category - communication. This means in effect that English language is regarded as necessary for communication purposes by the students.

With regard to the teachers, twelve categories were initially prominent, which when clustered, were reduced to five categories: language; methods of teaching; poverty; lack of interest in learning; and lack of science knowledge from the teachers' side.

According to the teachers, language as a means of communication seems to be one aspect impeding learning. This is evident in both the teachers' and students' responses. Teacher dominance also plays a role in aspects which limits learning.

5.6 FIELD NOTES

Data collected by means of the already mentioned sources correspond with data collected in the field notes. Field notes were recorded on a regular basis over the year in which this study was conducted. The field notes are summarized briefly in expository format. On a daily basis, students seem relaxed and passive. Learning, to them, seems to be just one of the several class activities which is

imposed on them. When a lesson is conducted they seem attentive, but when they have to participate they always need the teacher to initiate their responses. They seem dependent on the teachers.

The holistic impression is that the students talk mostly because they have to. They seem to lack self-confidence and reasoning power, but only talk in the limited language at their disposal. There seems to be a serious lack of interaction with the written text they have at hand. When the meaning of a specific concept is required to be explicated they seem conceptually absent and revert to any nearby key or clue for a response. (For example: "variety" means a seed or plant.)

It seems a general phenomenon that students resort to gestures whenever they lack English expression. They try to express themselves by means of bodily gestures and also facial expressions.

Holistically, the observation is that the teacher seems to shoulder the students' responsibility to learn. She tries everything possible to help them understand. She uses the chalk board, concrete teaching aids as well as analogy, but still the students refrain from participatory classroom activities.

5.7 CONCLUSION

In this chapter I have discussed how data were collected, processed and finally

consolidated. The categories which came to light during analysis have been identified and briefly discussed. The categories will be interpreted in the following chapter during which explanation and illumination from theory will be sought.

The outcomes of the empirical section of this investigation culminates in the following main categories:

- * There is little or no interaction between reading and understanding - there seems to be a discrepancy between decoding and encoding in the students' reading.
- * Students seem to read "mechanically" but not "semantically".
- * Where analogies have been used, students seem inclined to understanding it far more than the real content of a lesson.
- * In addition to the above, there is a high rate of spelling errors, poor syntax and grammar errors.
- * The students revealed a number of misconceptions in their science knowledge.

- **Students are positive about English as the language of instruction but because of the lack of its vocabulary, they seem to feel insecure when they have to communicate both in oral and in written mode.**
- **With regard to teacher's interviews the dominant feeling is that language incompetency limits the students' understanding in learning so they resort to rote learning and a total dependence on teachers.**
- **The holistic impression of this study is that English, which is a language of instruction, seems to be one important factor which could impede learning. It seems to be treated as a subject on its own but it is not developed as a means of learning.**

The data obtained from the various sources, and which have been consolidated in this last section, will be interpreted, discussed within the context of relevant theory, and validated to the extent that is feasible in the following chapter.

CHAPTER SIX

INTERPRETATION OF THE FINDINGS

6.1 INTRODUCTION

In this chapter, the analyzed and consolidated data will be interpreted and it will be discussed in the background of the existing theoretical framework. Conclusions will be drawn from the findings and will be validated by the procedures suggested by Miles and Huberman (1994). Weaknesses of the research procedures will be highlighted and lastly the recommendations will be proposed.

According to the assumption stated at the beginning of this study, Black students at Lekang Higher Primary School in a standard five general science class are regarded as acceptably typical of Sowetan students, in a school which, at the time during which this study was conducted, operated under the supervision of the Department of Education and Training (D.E.T.). The focus of this research has been the manifestation of problems in learning through medium of English which is a second language, and which is not sufficiently developed to meet the requirements of academic learning. This complicates the learning process. Reference has been made to MacDonald (1991) and Chick (1992) who argue that the average Black pupil finds it difficult to access a culture of learning, partly because of insufficient language, and more specifically, academic

discourse. These students find it difficult to cope with learning by means of insufficient English language and at the same time this is argued to hamper conceptualisation.

6.2 THE INTERPRETATION OF DATA FROM VIDEO RECORDED LESSONS

The analyzed and consolidated data were collected through video recorded lessons. The aim of the lessons conducted was to observe how students comprehend during reading, listening and talking activities in the lessons.

Students were found to use and understand only limited English and to make use of grammatical and syntactic structures clumsily. Devine, et al (1987:91) argue that for the reader, grammar and syntax are the key to comprehending language, but the students in this research lack that ability as their English competence is incompatible with the English competence required for a meaningful reading from scientific text books. What these students know or think about remained hidden due to the insufficient knowledge of the language of instruction. The reading activity took place in a natural setting (classroom) as it is believed that, when spending more time where behaviour occurs naturally, the researcher could obtain a qualitative information as she constructs a rich understanding of the phenomenon McNiff (1988).

The following table 6.1, illustrates the methods of data collection, the focus of the researcher's interests and the findings.

TABLE 6.1: METHODS OF DATA COLLECTION

Video-recorded lessons	Behaviour Reading skills: listening reading talking thinking	Teacher guidance Individual response Whole class participation Students' demonstration Misconceptions Wrong Pronunciation
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6.2.1 TEACHER GUIDANCE

In this category, teacher guidance becomes prominent through out the lesson. This pattern or structured unit of meanings suggests that students lack language proficiency, hence their dependence on their teacher to always take an initiative to explain, illustrate some concepts, ask questions and rephrase them to assist in comprehension. This illustrates their own lack of language. When the language skills are not well developed it becomes the teacher's responsibility to give extensive explanations and discussions of new concepts to make learning possible. The teacher mediates extensively, but the students do not appropriate successfully.

The teacher's guidance should be minimised by assisting students in making learning their own responsibility, otherwise it will lead to rote learning where students say or imitate the teacher without really learning effectively. Teachers

should also concentrate on developing the students' reading, listening, thinking and talking skills to make learning a reciprocal activity. Henning (1993:7) argues that "in activities where students imitate the teacher without semantic support, they exhibit low-level reading skills which could be linked to the absence of schemata in the domain as well as to limited knowledge of language with which to recognise linguistically labelled concepts for recall".

This finding leads to the other similar finding where the students remain passive in classroom interaction. This implies that their listening skills are not developed sufficiently, but it also implies lack of language once more. Macdonald (1991:69) says that "language is a key to knowledge, information and communication opportunities". Students' passiveness indicates that the opportunities for educational communication cannot be utilised. Macdonald emphasises that language can open or close the way to educational opportunities. In this case, students' opportunity to take part and explore in gathering knowledge and information about the topic at hand is not adequately utilised due to the fact that the teacher is the figure who inevitably dominates and her language is imitated rather than appropriated and interpreted.

6.2.2 INDIVIDUAL RESPONSE

The students are relaxed and at home with their teacher. This is evidenced in their ability to make individual responses to the teacher's questions. There appears to be an irony in the student-teacher interaction. Although their learning

environment is conducive to effective learning, there seems to be a limited realisation of learning. It is therefore clear that the success of their interaction is limited to some degree by the language of their communication. It is also evident that the efforts of the teacher to create an environment conducive to learning is obstructed by lack of interaction. Corder as referred by Ellis (1990:56) argues that language teaching is necessary to ensure that learners could not only use English correctly with correct formal structuring, but also appropriately, and that they could perform in a variety of situations requiring different types of discourse. The discourse in a Science class needs to be developed alongside the knowledge.

6.2.3 WHOLE CLASS PARTICIPATION

The other category which was constructed from the analyzed and consolidated video recorded data is that students participate in choral responses. This might be regarded as minor because it is the typical practice in many D.E.T. schools. I suppose this act in most students is not a constructive response but a mere singing without understanding what "the song" is about. Learning is an individual awareness of some sort. Teachers should minimise this response and be in a position to identify individuals who need attention.

This category implies that effective learning through choral response is not observable. Students find it hard to participate individually. It has become apparent through the holistic analysis that students' limited language proficiency

creates serious communication problems. Students want to say something but they do not have the means to do so. They therefore revert to choral repetition. Cummins (1981:31) says that students are unable to master the discourse of subjects through medium of English due to lack of cognitive Academic Language Proficiency (CALP). Because of the absence of CALP they hide under the umbrella of group responses. In this way they cannot be held accountable for what they "say". Once more they do not appropriate and develop a personalised discourse for Science learning.

6.2.4 STUDENTS COMMUNICATE BY MEANS OF GESTURES

This category implies clear knowledge and understanding that there is insufficient vocabulary resulting in demonstrations. Fletcher (1993:182) argues that students' oral involvement in learning is dominated by passivity which is partly the result of limited English proficiency and the inability to express themselves in English as a second language. The students' lack of proficiency in English language is evident in their use of bodily gestures as means of expressing their ideas. Language development in content subject needs to be a priority, and it should be developed not as a subject on its own but as a means of learning which will bridge the gap between concepts labelled in English and the explanation of these concepts also by means of English.

Teachers should explain to the students and make it clear that general science is not only abstract, but part of the physical reality and they should assist

students by all means possible to become aware of it and be in a position to discuss it in scientific discourse. This can be achieved if English as a means of communication can be introduced as early as in standard one. This will empower students at an early age level to become competent in their language of instruction. In support of this Douglas (1989:103) states that teaching the language of instruction at an early age provides a bridge between a more simple use of language (naming, personal social demand etc.) and something much more complex. He further explains this as an act which will allow students to move through a developmental period that makes possible the growth of both vocabulary and syntactical and grammatical abilities in intelligible speech.

6.2.5 MISCONCEPTIONS

As mentioned before, Macdonald (1991:69) states it categorically that language is the key to knowledge, information and communication. If language is not developed as inherent to both communication and cognition, sufficient development of concepts could be obstructed. This category of findings implies that the use of English language as medium of learning has the potential of letting misconception arise. Students' English acquired at this stage is not sufficient to optimise learning. Sutton (1992:11) argues that students try out some framework of understanding through words. Difficult science vocabulary is used and students are inclined to use it in their own personalised way. It may be the other factor to clarify this, that the language used in student's textbooks, from which reading is conducted, is difficult for the students and far more

advanced than their everyday English language experience. (Their social language proficiency according to Cummins, 1989).

The students understand or are more familiar with simple phrases like, "what is this?" "where are you going?" and so on, but they do not possess the English competence required for meaningful use of the textbooks which are written in formal science discourse - reading then seem meaningless. I believe that there is nothing wrong with words or language used in these textbooks except that they assume their readership to be proficient in both English and scientific language. Students need to be afforded the means of understanding the written language by a text designed for their needs.

Sutton (1992:12) argues that "words relate to thought by giving the best clues students have to thoughts on which science was built". In this research, words which students give as a response to questions asked, often have little to do with the question asked. Students arrange these words in a meaningless order. In most cases if their response is correct, it is rote learned. They copy the text or the teacher.

This pattern suggests that the use of an undeveloped English language as means of conceptualising in science could be linked to the development of alternative conceptions or misunderstandings. Henning (1993:6) argues that the development of alternative conceptions is exacerbated by the fact that the first languages of these students are structurally not always compatible with the

morphological, lexical and syntactical structures of English as language of science (MacDonald, 1992). These students' first language dominates in their learning process and the skills of transferring and translating have not been developed adequately.

The problem for the listener, or speaker or reader or writer, is that meaning lies not "out there" but within our own experience (Douglas, 1989). He argues that symbols, in this case words, provide a convenient stimulus for bringing those ideas, (own experiences) to the surface of awareness which Dewey (1938) speaks of as "reconstruction of experience". This implies that these students could be in an acceptable state of cognitive confusion. Their own experiences are dominantly experiences through their first language and when confronted with English, links are made linguistically which lead to the formation of non-scientific propositions or misconceptions. For instance, students have a problem with the word "variety" as it appeared in the discussion of different plants. They can not link it with anything they know on an abstract level of argument and linking. They can not realise that "variety" means differences in type across a number of cases or variations. When starting to classify plant structures according to their differences, it becomes more apparent that this awareness is absent. The lesson in question is based on plant structures but the focus is on developing ideas about their differences. The generic term does not "surface" because it is absent. I assume the concept is not absent and could be accessed through the vernacular.

This finding provides evidence that the students in this research are carrying a double burden, that of struggling to acquire knowledge and information through second language and the lack of the means to do so. For example, the word "variety" limits or makes learning too abstract. They fail to understand the whole lesson and the teacher or mediator can not reach them unless she translates or transfers to the vernacular. The language used sometimes is incompatible with the one they possess. Mestre (1984) as referred by Henning (1993:8) refers to learning in a school context as learning in a "linguistically laden milieu", where advanced oracy and literacy are paramount.

6.2.6 WRONG PRONUNCIATION

In this category wrong pronunciation has become prominent. Students pronounce English words as if they are pronouncing their first language words (Sotho). This implies that the first language is interfering with second language learning. Devine, et al (1990:107) argue that the second language reading is viewed as a process of transfer-in-learning, taking place in an interlingua context. I assume that this problem could lead to the development of wrong spelling and pronunciation much more because in Sotho they write and pronounce words more phonetically. Developing English as language of learning can minimise this problem as in comparisons with Sotho. Gollnick and Chinn (1990:209) argue that "the total immersion in the linguistic community may make it easier to master the finer points of language usage and the associated subtleties that allow for alternative and appropriate ways of saying things at the appropriate

time".

In summary of the discussion of the video-recorded, analyzed and consolidated data, the holistic interpretation is that there is no important sign which marks comprehension during the reading, listening, thinking and talking activity. Students struggle to cope, due to the limited language background, incompetent background knowledge of science, and fail to conceptualise in the present lesson. Douglas (1989) states it categorically that, "reading or writing", like "listening or speaking", provides an avenue for reconstructing experience, stimulating the equilibration process, and thus learning". I suppose one can not seek meaning of words listed in a text if one is not comfortable with the language used. One can read aloud but the main concern of this study is, how effective that reading is with regard to understanding and knowledge-making.

The other factor which could be considered again in reading is what Devine, et al (1987) calls "readability of materials given to students". He argues that the material given to students to read can strengthen their reading comprehension. I still maintain that language development in reading is the first priority. For instance, if you can give the most delicious meal to a person who as a result of many factors has passive digestive organs, the feeding process will be a failure. The student's English language competence should be developed to empower them to read, think, listen and talk meaningfully.

6.3 THE INTERPRETATION OF DOCUMENT DATA

6.3.1 "SPELLING ERRORS"

It is evidenced in students' writing that their spelling is inconsistent and irregular. Stubbs (1986:226) argues that written work is based on letter-sound correspondences, that is, it is basically phonemic while Macdonald (1990:100) perceives writing as means of thinking which she calls "performative writing". It is through a written script that one can assess how much the writer knows or understands or can think. She further clarifies her view that writing is relevant to thinking because it demands thinking and it is a means of thinking in a more formal and organised format.

This category suggests that the students think more about the concepts in their first language when they have to write in English. Hence an abundance of spelling errors arise concurrent with wrong pronunciation. This implies that the students' mental images are Sotho dominated. Spelling errors as strange as "everything" instead of "anything" indicates their first language domination. The students' written scripts indicate that their language of instruction is technically not advanced. Reading and writing are intertwined and the students' reading inability is also reflected in their inability to write meaningfully and fluently. The inaccuracies in spelling seem to have a debilitating impact on the ease with which they write and could be an inhibiting factor for possibly correct concepts to be expressed.

These spelling errors can not be corrected without developing language, that is, a thorough teaching of reading, listening, talking, thinking and writing. I suggest that teachers could adapt the interesting sources on writing referred by Macdonald (1990:101). The Little Red Writing Book of (Scardamalia, Bereiter and Fillian, 1979) where a collection of exercises is offered to empower students to critique each other's work and promote independent working system. The other one by Anderson, Bereiter and Smart (1985) on procedures for activating the "Inert Knowledge" in writing is also good. If students can be exposed to learning experiences like these, the gap between language and concepts can be bridged.

6.3.2 SYNTAX

This finding indicates that students lack the ability to construct meaningful sentences. It has been evident in the list of words they give as sentences. A sentence given in African first language differs greatly from that given in English. Henning (1993:6) argues that such a difference originates from the fact that the first language of the Blacks is structurally not always compatible with the morphological, lexical and the syntactical structures of English (Macdonald, 1992).

What becomes prominent in their sentence construction is that firstly they lack vocabulary and secondly which is most important is that they do not possess the

ability to arrange words to form a meaningful sentence, so in most cases they copy the sentence as they saw it somewhere or they just list words that comes up their minds. When one compares the sentences constructed in their textbooks one notices a vast difference with those that they construct. It seems as if the author did not have his audience in mind when compiling the book. This is not the case, but the fact that students have not been prepared to access the CALP-based text and they are also not able to produce this type of text. Students list words in a sentence form, without clear meaning and regard it as a sentence because it appears correct and the main nouns are present. For instance, if the student can write, "Indicator is when we ride a car when we want to turn left we indicator or right". "It show the left or right". It is clear that the life world steers the language. This implies that the level of English language for learning purposes at this stage is very poor in its written format. It again means that the mental images which the students possess are scattered, and needs language to put them together and to form the propositions that are essential to the learning of science.

A gradual introduction of second language as medium of instruction is essential to prepare students for a more advanced English standard which is required in standard three and further. As matters stand, the gap between the English subject competence ideally held by students and the competence required for meaningful use of the language as means of learning is too great for any student to bridge (Van Rooyen, 1990). Teachers should then play their role and assist the students in making learning their own. Teachers should realise the fact that

linguistic aspect in student's learning processes is the problem in order that they should have a point of departure in their teaching.

6.3.3 MEMORISATION

The other category constructed from written scripts of the students, especially the paragraphs is that, they seem inclined to rote learning. The main point that can be argued concerning this category is that, although teaching and learning activities are ostensibly taking place, students are not cognitively involved. There is little indication of language register and topic knowledge. During their communication with the teacher, they remain passive and only become active in imitating their teacher. When they have to write, their writing remains passive too. Students are aware that the teacher expects them to know, and they are aware that failure to know is followed by punishment, so they want to satisfy the teacher and escape the punishment. Unfortunately they do not have the means to do so except to imitate the teacher and memorise what she says or what the given notes say. Underlying this overarching need to reproduce, is students' inability to phrase their knowledge in clear English.

It is again evidenced in the way they answer tests. For instance if a student says, "Acids form dissolve solutions", it is clear that basic syntax and verb usage are lacking. They list knowledge items in haphazard mixes of parts of speech. Crandall (1991) and Henning (1992:5) argue that "if the cognitive academic language is not stable and coherent, there will probably be no

semantic back-up for the reproduced language", whereas Gonzalez (1992(b):1) as referred by Henning (1993:6) prefers what she calls a "triple-inter-actional model" where the components of cognition, linguistic proficiency and expert scientific discourse are seen as the prerequisite for school-based learning. Linn (1986) as referred by Macdonald (1989:3) reports that the new basics for mathematics, science and technology include communication and higher problem skills and scientific and technological literacy. All these requirements can be achieved through English language development and the development of thinking skills in tandem with the science concepts.

This category of findings implies that students act as instruments in which knowledge and information can be programmed and reproduced on demand and they do not generate or transform language to label and transport knowledge and to express knowledge personally.

6.3.4 ANALOGY/PRAGMATIC MEANING

The other category constructed from the documented analyzed and consolidated data is the students' inclination to understand an analogue used more than the lesson content directly. This may have only significant influence on the formation of misconception, but if one looks at the students' responses it becomes more apparent. For instance the student says, "A car is a indicator". The teacher used "a car" to clarify the meaning of the concept "indicator". To show them that they know what an indicator is, but, it is only that it is used in

a different context, but instead they understand an analogue better and use it as the information they have acquired in their responses.

6.3.5 ADVERBS OF TIME

The misuse of "when" indicates a socio-cultural problem where instead of explaining a concept to show understanding, the student will come up with a story starting with "when". For instance when a student explains the concept "displacement" the explanation becomes "when you wash". This reminds her of her personal experience. Here again an analogue has become more meaningful and dominant. The student states this without really understanding what the whole process means. They use adverbs without clear understanding. This is no learning at all. Brown (1983:48) quotes the distinction made by Ausubel between rote and meaningful learning which denotes that in rote learning, knowledge and experience are not there. In this example the students involved use their experience, but fail to establish a firm scientific proposition.

6.4 THE INTERPRETATION OF INTERVIEW DATA

The dominant linguistic problem in teaching and learning, namely the English language incompetence, formed the main findings in data collecting during interviews. It becomes apparent that the students are all positive about using English as a means of learning and that they are aware that lack of English also limits their understanding. The main question in the interviews was "How do

they feel about using English as their medium of instruction". The emergence of this category indicates that students are aware that they need assistance to be in a position to cope with learning and understanding. That is they need to be helped with English Competency. Van Rooyen (1990) argues that the gap between the English subject competence the students possess and the English competence required for learning purposes is too big for students to bridge. That is why it is important that teachers should develop the basic language skills if teaching should be meaningful.

The other finding is that there is lack of vocabulary for students to express themselves. This has been evidenced in their use of gestures as they run out of words. Saville-Troike (1984) argues that knowledge of vocabulary is the most important aspect of second language competence for learning academic content through that language. Words alone are, however, not sufficient for learning. The way they are used in sentences is more vital.

Again some students feel that the change of periods from one subject to the other interferes with their focus of learning. They have to change their language for different classes. This implies that conceptualisation per subject is not present. This indicates lack of subject vocabulary and Blachowitz (1987:133) argues that vocabulary plays a very prominent role in content-areas as well as language lessons, and emphasises that very little class time is devoted to its instruction. This implies that teachers have a huge amount of work ahead of them to assist students with building vocabulary. This can only be achieved

through conceptualisation as partner in vocabulary learning.

During the interviews with the teachers, it became apparent that, students do not understand the teachers when they talk to them. This findings also points at English language incompetence. Students do not have enough words to put their ideas across, and again they do not possess English competence to understand the teacher, hence there is a limited amount of learning, which might lead to the formation of misconceptions. Mediation is based on a false premise, namely that students, teacher and text share a language base.

6.5 CONCLUSIONS AND SUGGESTIONS

The findings and interpretations of the qualitatively analyzed and consolidated data seem to confirm the assumption of the sub-question of the research asked at the beginning of this inquiry, namely, "Is there a linguistic aspect prominent in the development of misconceptions?" The problems identified in the problems associated with formation of misconceptions in the standard five science class is that language is not developed to serve as the means of communication, conceptualisation and mediation.

The other linguistic aspect interfering with learning is the dominance of mother-tongue over second language. Students are struggling with English as medium of teaching and learning and this incompetence can not be resolved by students alone. They are ready to learn and they avail themselves on a daily basis at

school as evidence to that. The issue is that language of instruction is introduced late in standard three and students' own experiences are dominantly experiences through their first language and when they are expected to conceptualise through English, links are made linguistically and this leads to the possible development of misconceptions in science (Henning, 1993). This is evidence to the theoretical view of Macdonald (1991) and Chick (1992) that the average Black pupil finds it difficult to access a culture of learning, partly because of insufficient language, and more specifically, academic discourse. During the students' reading, listening, thinking, talking and writing activities, what they understand, or think, or want to express orally or in writing, remains hidden within their minds, due to insufficient English language competency.

Science teachers should develop the language of instruction to assist students with the ability to communicate and the background knowledge of science to establish a better understanding of reality.

I suggest that the Gauteng Department of Education, should introduce a new project that will focus on improving the English language competence of both teachers and students. The language skills development will serve as a priority to both existing teachers and those at colleges as the students can not resolve language problem alone. The course should include the following incentives to motivate all existing teachers to go for it. A totally different category which will mark teachers who have undergone the course and a form of an increment to that effect.

Teachers country wide are demanding increments but most unfortunately effective teaching and learning is not taking place. If the Department of Education could take this opportunity and introduce the course on language development, it would enhance the standard of education among Blacks and at the same time prepare for the economic growth of this country in the near future. The incentives mentioned above can have significant influence over educational growth amongst Black South Africans. Most of the existing teachers are just good for industries, they do not possess the know how to identify learning problems, so I do not blame them that much, but, the Education System that prepared them for the type of job they are doing. If they can not be liberated from the ideology they possess and regard as teaching skill, educational channels for improvement are doomed, because they possess no teaching career relevance, their attitude towards teaching is unfavourable.

6.6 VERIFICATION OF CONCLUSIONS

6.6.1 NOTING PATTERNS, THEMES

According to Miles and Huberman (1994:246), findings and patterns need to be subject to scepticism. They further assert that "pattern finding can be very productive when the number of cases and/or the data overload is severe" Stearns et al. (1980). They state that, when you are working with text, you often note recurring patterns, themes, or "gestalts", which pull together many separate pieces of data. Like for instance in figure 5.4, the high rate recurring

pattern of misconception and spelling errors.

The pattern realised between teaching and learning where English is the medium of instruction and second language to learners is that, effective learning is absent. The major relationship between all the variables as interpreted previously points at the undeveloped second language, English, and first language interference. The relationship found between the variables indicates a pattern of high rate of teacher involvement in teaching and a high rate of the lack of student's cognitive involvement in learning. Macdonald (1990) perceives writing as a means of thinking, but one does not get much about the students' thinking capacity or knowledge, from their written work.

6.6.2 FINDING INTERVENING VARIABLES

It is always expected that reading and comprehension should go together to make learning meaningful, but this relationship in this research is inconclusive. This is evidence in figure 5.2 where reading is evidenced only by the decoding aspect and has no encoding one. Students are mostly dependent on their teacher. It is the teachers' responsibility to understand the text and inform them. As Miles and Huberman (1994) state, an intervening variable between two variables that ought to go together can make it clear why they don't, a careful coding analysis showed that the intervening variable between all reading patterns could be the lack of English language competency, and this makes the claim that the relationship between decoding in reading and encoding

inconclusive, valid. This third variable fills out a reasonable chain linking all the patterns between reading and comprehension. The following figure shows the two variable relationship with the intervening variable.

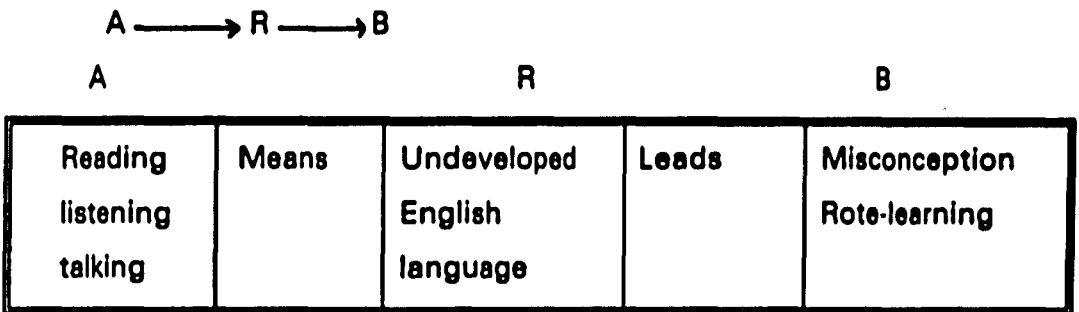


FIGURE 6.2

The figure indicates that if the English language is developed in reading, comprehension will be present, but if not misconceptions and rote-learning will be the result. This intervening variable can explain, for instance, the high rate in teacher guidance, memorization, and so on. It explains the reason why it should be that the high teacher effort of teaching leads to rote-learning and misconceptions.

6.6.3 CLUSTERING

Miles and Huberman (1994:249) perceive clustering as a tactic that can be applied at many levels to qualitative data. In this study it has been used in processing data collected through interviews with both teachers and students

in trying to understand the linguistic aspects that limit learning, by grouping and then conceptualising the teachers and students' responses, that have similar patterns. Examples of how teachers and students responded during their interview is illustrated in chapter four and these clusters took a good deal of summarising and eventually they became clear that the final pattern is that as English is not well developed, it can not be used as a tool for communication. Miles and Huberman (1994:250) argue that clustering can be seen as a process of moving to higher levels of abstraction. Data which have been used are fully representative of the universe of events which was observed during the interviews and it is supportive to the claim that English as medium of instruction in this case study, limits students' educational opportunities.

6.6.4 COUNTING

Miles and Huberman (1994:253) argue that in qualitative research numbers tend to get ignored but they believe that, "after all, the hallmark of qualitative research is that it goes beyond how much there is of something to tell us about its essential qualities". They further emphasise that resorting to counting, assists the analyst in the following: one, in seeing rapidly what they have in a large batch of data, two, in verifying a hunch or hypothesis, and three, in keeping themselves analytically honest and protected against being biased. For instance, during the processing of video recorded data, certain patterns in the students' responses were coded, counted and totalled. By doing these counts, it assisted in clearing out the responses which could indicate linguistic aspects

which limit effective learning. In counting, it turns out that 37 counts points at teacher guidance, 24 counts at individual responses and many others, they all indicate learning pressure and constrains. Miles and Huberman (1994:254) argue that, doing qualitative analysis of all data with the aid of numbers, which is dominantly used through out the processing of data in this case study, is a good way of testing for possible bias, and seeing how robust one's insights are.

6.6.5 MAKING CONTRAST

Miles and Huberman (1994:254) argue that comparison is a "time-honoured, classic way to test a conclusion", because it is drawn between sets of things. For instance, in this study when we look at the variables of video recorded lessons, written work and interviews with both teachers and students, the comparison showed that the students lack the means of communication with their educator, which means their language of instruction, learning and mediation is not developed to empower them with speech proficiency, so they lack the ability to make learning their own responsibility. They rather resort to memorisation, and again it indicates that English language is being interfered with by the students' first language. Learning is linguistically constrained.

6.6.6 BUILDING A LOGICAL CHAIN OF EVIDENCE

Miles and Huberman (1994:261) assert that the relationship that binds the chain of evidence needs to make sense and the chain must be complete. There is a

logical basis for the claim that the students' formation of alternative conceptions is exacerbated by the fact that their language of instruction is undeveloped. The patterns found from all the raw-data leaves no gap. Miles and Huberman (1994:261) prefer the classic procedure of "analytic induction", where the analyst constructs the evidential trail gradually, getting an initial sense of the main factors, like for instance, the coding system. This gives rise to gradually developed categories from raw-data, testing them against "the yield from the next wave of data collection, and modifying and refining them into a new explanatory map", for instance giving an interpretation, which then gets tested against new cases and instances. Their method is two-fold, the "enumerative induction", where a variety of instances leading to the same direction is collected, and the "eliminative induction", in which the hypothesis is tested against alternative and qualifications are checked that bounds the generality of the conclusion.

For instance, coding has been used dominantly in this study, building the evidential trail which lead to the development of various patterns. These patterns were later interpreted to give an explanatory map of the fact that, English language limits learning. This has later been tested and conclusions decided upon. In support of this, Le Compte and Goetz (1983) argue that coding is a way in which an analyst looks at the data to see which things go together and which do not. Typically as Bulmer (1979) points out that, these things emerge from an interaction of theory and data. In building up a logical chain of evidence in this study, coded and clustered responses have been interacting with the

theoretical view points and also the researcher's experiential knowledge.

6.7 LIMITATIONS AND STRENGTHS OF THE STUDY

This study, which lasted for three years, is based on the principles of both qualitative and quantitative components of data collection and processing. The researcher found this type of inquiry to be challenging and methodologically exploratory. The aim of the research was to get deeper into the inclinations in learning, of the standard five students, who use English, a second language, as means of learning and to illuminate some processes of misunderstanding and formation of misconceptions in their general science class.

The researcher got a better understanding of the problems experienced by the eight cases she studied during the process and assumes that their findings would reflect an ideographic view of a broader reality. This is at the same time a strength and a weakness of the study. Only a larger scaled investigation or a field experiment could yield findings that can be generalisable beyond the respondents. Yet only this type of study could present findings of depth, collected over time. The school year during which the data were collected was complemented by another eighteen months of analysis, reading and reflection plus discussions.

At times the researcher had to go beyond the students and visit other teachers conducting science lessons. It was not easy as some of the teachers do not feel

comfortable with this. The researcher finally resorted to an informal interview with higher Primary teachers. It was then impressionistically realised that the students' learning problem is not limited to one class. The undeveloped English language which is used as means of communication during teaching and learning in the rest of the school, and the high rate interference of the students' first language in their learning process prevail in other classes too.

The researcher feels very proud and happy to have realised these findings systematically and honestly because she used to believe that only "Bantu Education" is the problem of students' learning, but not knowing exactly, how it is a problem. One aspect has now been researched in one class.

The study has been a little costly but it was for a good course. It has been so challenging that it enabled the researcher or it motivated the researcher to practise her findings in her teaching and it really needed a lot of effort to change the students' method of rote-learning to effective learning. It takes a great deal of time to introduce just one new topic because English language is now seen as the nucleus for mediation in a science class. I believe that, from this view, good action research has been conducted.

6.8 CONCLUSION

This exploratory descriptive study has identified the linguistic aspects which feature prominently in the possible development of misunderstanding in a

standard five science class. It is explained in the findings that limited English language proficiency plays some role in the development of misconceptions.

The researcher feels great and proud of the impact that the research has had on her as a mathematics and science project committee member in her area. She runs maths and science workshops, trying to make other teachers aware of the basic language skills which need to be developed in these subjects. She is using an integrated model of teaching and learning in which listening, thinking, talking, reading and writing skills are incorporated to try and assist students in learning the language of communication as well as to conceptualise. Teachers learn to mediate meaningfully.

The issues touched upon in this study need to be investigated both more broadly and more deeply, and this study serves as a contribution to local educational research as a pointer. It also serves as an illustration of the value of participatory action research in changing practice.

BIBLIOGRAPHY

- ALTWERGER, B; EDELSKY, C & FLORES, BM 1982. Whole language. What's new? The Reading Teacher, 41 (a), September.
- BARNHART, LC & BARNHART, KR 1992. The World Dictionary. The World Book Encyclopedia, London.
- BLACHOWITZ, CLZ 1987. Vocabulary instruction: What goes on in the classroom? The Reading Teacher, November.
- BRINTON, DM; SNOW, MA & WESCHE, MB 1989. Content-based Language Instruction. New York: Newbury House.
- BROWN, G & YULE, G 1983(b). Discourse Analysis. Cambridge: University Press.
- BRUMFIT, C 1984. Communicative Methodology in Language Teaching. London: Cambridge University Press.
- BRYMAN, A & BURGESS, RC 1994. Reflections on qualitative data analysis. (In: Bryman, A & Burgess, RG (eds). Analysing Qualitative Data. London: Routledge.)
- CHAMOT, AU & O'MALLEY, JM 1987. The Cognitive Academic Language Learning Approach. A Bridge to the mainstream. TESOL Quarterly, 21(2), June.
- CHASMAIN, K 1976. Developing Second Language skills. London: Houghton Mifflin.

- COHEN, L & MANION, L 1987. Research methods in education. London: Croom Helm
- CRANDALL, J 1987. ESL through content-area instruction. New Jersey: Prentice-Hall Englewood Cliffs.
- CRESWELL, JW 1993. Research design. Qualitative and quantitative approaches. Newbury Park: Sage Publications.
- CUMMINS, J 1980. The cross-lingual dimensions of language proficiency: Implications for Bilingual Education and the optimal age issue. TESOL Quarterly, 4(2), 175-188.
- CUMMINS, J 1981. Issues in assessment and Pedagogy. Bilingualism and Special Education, 9(4).
- CUMMINS, J 1984. Multilingual matters. Bilingualism and Special Education, 11(3).
- CUMMINS, J 1988. Minority Education: From shame to struggle. Clevedon: Multilingual Matters.
- DE LANGE, JP (Chairman) 1981. Provision of education in the RSA. Report of the Main Committee of the HSRC Investigation in Education. Pretoria: HSRC.
- DE LANGE, JP (Chairman) 1982. Report of the Work Committee: Language Education. Pretoria: HSRC.
- DEVINE, J; CARRELL, LP & ESKEY, DE 1987. Research in reading in English as second language. TESOL Quarterly, 21(2), June.

- DOUGLAS, MP 1989. Learning to read, the quest for meaning. London: Teachers College.
- DRIVER, A; GUESNE, E & TIBERGHEN, A (Eds) 1985. Children's ideas in science. Buckingham, USA: British Library University Press.
- EDELSKY, C & DRAPER, K 1985. Reading/Reading; Writing/Writing, Text/Text. (In: Reading and Writing, Theory and Research, edited by Petrosly. Norwood, NJ: Ablex.)
- EDELSKY, C 1986. Writing in a bilingual program. Havia Una Va. Norwood, NJ: Ablex.
- EDMUNDS, MC 1988. Four overseas models of Second Language Teaching, Implications for English as second language in South African primary schools. Stellenbosch: University of Stellenbosch (unpublished master's dissertation).
- EDWARDS, PD & FURLONG, VJ 1978. The language of teaching. London: Heinemann Educational Books Ltd.
- EDWARDS, AD & WESTGATE, DPG 1978. Investigating classroom talk. London: Falmer Press.
- EDWARDS, JA 1979. Language and disadvantage. London: Edward Arnold Ltd.
- EISNER, E & PESHKIN, A 1991. Qualitative inquiry. The ongoing debate. Newbury Park: Sage Publishers.
- ELLIS, R 1990. Instructed Second Language Acquisition. Oxford: Basil Blackwell.

- ENCYCLOPEDIA BRITANNICA 1992. Worldwide usage of the English language (3R-5501). Chicago, USA.
- GARDNER, H 1991. The unschooled mind: How children think and how schools should teach. London: Fontana Press.
- GEYSER, HC 1992. A pragmatic perspective on curriculum design for first language. Paper presented at the annual conference of the South African Association for Language Teachers, Pietermaritzburg, 13-15 July.
- GONZÁLEZ, V 1992(a). A model of cognitive, cultural and linguistic variables affecting bilingual Spanish/English childrens' development of concepts and language. National Association for Bilingual Educational Journal (in press).
- GONZÁLEZ, V 1992(b). Bilingual Spanish/English childrens' development of concepts and language. Paper presented at the annual meeting of the American Educational Research Association, San Francisco, 20-24 April.
- GRAY, WS 1969. The teaching of reading and writing. Switzerland: UNESCO.
- HALPERN, DF (Ed) 1992. Enhancing thinking skills in the sciences and mathematics. New Jersey: Hillsdale, Lawrence Erlbaum Associates.
- HARTSHORNE, KB 1987. Language policy in African education in South Africa, 1910-1985, with particular reference to the issue of medium of instruction. (In: Young, D (Ed), Bridging the Gap. Cape Town: Maskew Miller Longman.)
- HARTSHORNE, KB 1966. The teaching of English as a second language in South Africa. Johannesburg: Publication No 1 of the English Academy of Southern Africa.

- HAYMAN, JR & JOHN, L 1968. Research in Education. Ohio: Columbus.
- HENNING, E 1992. The standard six English classroom at an urban multicultural school: An ethnographic enquiry. Paper presented at the annual meeting of the American Educational Research Association. San Francisco, 20-24 April.
- HENNING, E 1993: An ethnography study of a Std Six classroom at an urban school. South African Journal of Education, 13(3).
- HITCHCORK, G & HUGHES, D 1989. Research and the teacher. London: Arnold Limited.
- HUDSON, T 1991. A content comprehension approach to reading English for science and technology. TESOL Quarterly, 25(2), 77-104.
- HSRC, 1981. See De Lange (Chairman).
- HSRC, 1985. See De Lange (Chairman).
- HUSEN, T & POSTLETHWAITE, TN 1985(a). The International Encyclopedia of Education Research and Studies. Vol. 1. Oxford Pergamon Press.
- HUSEN, T & POSTLETHWAITE, TN 1985(b). The International Encyclopedia of Education Research and Studies. Vol. 2. Oxford Pergamon Press.
- HUSEN, T & POSTLETHWAITE, TN 1985(c). The International Encyclopedia of Education Research and Studies. Vol. 3. Oxford Pergamon Press.
- HUSEN, T & POSTLETHWAITE, TN 1985(d). The International Encyclopedia of Education Research and Studies. Vol. 8. Oxford Pergamon Press.

- HUSEN, T & POSTLETHWAITE, TN 1985(e). The International Encyclopedia of Education Research and Studies. Supplementary Volume. Oxford Pergamon Press.
- KALE, S 1983. The qualitative research interviews: a phenomenological and hermeneutical mode of understanding. Journal of Phenomenological Psychology, 14:171-196.
- KESSLER, C; QUINN & HAYS 1985. "ESL and Science Learning." (In: ESL Through Content-area Instruction, Crandall, J (Ed) 1987. Newbury Park: Englewood Cliffs: Prentice Hall.
- LESCHINSKY, CCJ 1983. Aims and methods in second language instruction. Pretoria: HSRC.
- LESCHINSKY, CCJ 1984. Aims and methods in second language instruction. Pretoria: HSRC.
- LINCOLN, Y & GUBA, N 1985. Qualitative Research. Newbury Park: Sage Publishers.
- MACDONALD, C 1990. Reasoning skills and the curriculum. Johannesburg: British Council Library.
- MACDONALD, CA & BURROUGHS, E 1991. Eager to talk and learn and think. Bilingual primary education in SA. Johannesburg: Maskew Miller Longman.
- McNIFF, J 1989. Action Research: Principles and Practice. London: MacMillan Education.

- McGROARTY, M 1989. The Benefits of co-operative learning arrangements in second language instruction. National Association for Bilingual Education Journal, 13:127-143.
- MERCER, N 1988. Language and literacy from an educational perspective, Volume II in schools. Philadelphia: Open University Press.
- MESTRE, JP 1984. On the relationship between the language of natural discourse and the language of logic; The interpretation of semantically complex sentences. Paper presented at the Harvard Conference on Thinking, Boston, 19-23 August.
- MILES, MB & HUBERMAN, AM 1994. Qualitative data analysis. A source book of new ideas, 4th edition. London, Beverley Hills: Sage Publishers.
- MOHAN, BA 1979. Relating language teaching and content teaching. TESOL Quarterly, 13(2).
- NATIONAL EDUCATION POLICY INVESTIGATION (NEPI), 1992. Early childhood educare. Cape Town: Oxford University Press/NECC.
- NATIONAL EDUCATION POLICY INVESTIGATION (NEPI), 1992. Curriculum. Cape Town: Oxford University Press/NECC.
- NATIONAL EDUCATION POLICY INVESTIGATION (NEPI), 1992. Language. Cape Town: Oxford University Press/NECC.
- NEWMAN, RE 1982. Reading, writing and selfesteem. New Jersey: Prentice Hall Inc: Englewood Cliffs.

- ORR, MH & SCHUTTE, CJH 1992. The language of science. Durban: Butterworth.
- PESHKIN, A & GLESNE, C 1992. Becoming a qualitative researcher. Johannesburg: Maskew Miller Longman.
- RICHARD, A 1988. Multicultural classroom. San Bernardino: California State University.
- ROTH, WM & ROYCHOUDHURY, A 1992. The social construction of scientific concepts or the concept map as conscription device and tool for social thinking in high school science. Science Education, 76(5), 531-557.
- RUPP, JH 1988. Multicultural classroom: Discovery science and language development. San Francisco, USA: California State University.
- SAVILLE-TROIKE, M 1984. The ethnography of communication: An introduction. Oxford: Basil Blackwell.
- SAVILLE-TROIKE, M 1991. Classroom enquiry. (In: Henning, E 1991: The standard six English class at an urban multicultural school: An ethnographic enquiry.)
- SCHUTTE, CJH & ORR, MH 1992. The language of Science. Durban: Butterworth.
- STORBECK, C 1994. Case study of bilingual education in a school for the deaf. Johannesburg: Rand Afrikaans University (M.Ed. dissertation).
- STRAUSS, A & CORBIN, J 1990. Basics of qualitative research. Grounded theory procedures and techniques. Newbury Park: Sage Publishers.
- STUBBS, M 1986. Educational Linguistics. New York: Basil Blackwell Limited.

- SUTTON, C 1992. Words, science and learning. Philadelphia: Open University Press.
- THORNIS, EW 1970. Teaching reading to non-English speakers. New York: MacMillan Publishing Co. Inc.
- VAN ROOYEN, H 1990. The disparity between English as a subject and English as the medium of instruction. Pretoria: HSRC.
- VYGOTSKY, LS 1978. Mind in society: The development of higher psychological processes. Cambridge: Harvard University Press.
- WAGNER, J 1993. Educational research as full participant: Challenges and opportunities for generating new knowledge. Qualitative Studies In Education, 6(1), 3-18.
- WILLIAMS, S & GRAY, S 1969. The teaching of reading and writing. Switzerland: UNESCO.
- YIN, RK 1984. Case study research. London: Sage Publishers.
- YIN, RK 1988. Case study research, design and methods in applied social research methods, 2nd edition, Vol. 5. London: Sage Publishers.
- YOUNG, D 1978. English in education. (In: Lanham & Prinsloo, KP (Eds): Language and communication studies in South Africa. Cape Town: Oxford University Press.