

Challenges of using English as a medium of science instruction in a

South African context: A view from FET Learners and Educators

by

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DECLARATION

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I, **DANIEL ZISANHI** declare that, “Challenges of using English as a medium of science instruction in a South African context: A view from FET Learners and Educators” is my work and that all the sources that I have used or quoted have been indicated and acknowledged by means of complete references.

Signed by on the day of2013
(Mr D Zisanhi)

DEDICATION

I dedicate this dissertation to

My Wife:

Winnet H Choga Zisanhi

For her continued understanding and moral support during my studies

&

My Son

Delane T Zisanhi

For understanding and encouragement that enabled me to accomplish my goals

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Praise be to God for directing me in this quest for knowledge to get the truth through Jesus Christ who is the Truth. Psalms 18vs 15: The heart of the prudent getteth knowledge; and the ear of the wise seeketh knowledge (KJV). I want to thank Him for making it possible for me to complete this study with the assistance and support of the following persons:

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ABSTRACT

This study explores the challenges faced by high school science learners when they use English language as a medium of instruction in a South African context. Questionnaires were administered and focus group interviews were conducted with both science learners and science educators. Results indicated that learners are challenged in a number of ways when English is used to teach science especially if English is not their home language. Both learners and educators prefer to be taught and teach science respectively in English though ideally learners would like to be taught in their home languages. To overcome these challenges a home language scientific register should be drawn to cater for all learners' home language, learners should also be proficient in English or language of science instruction.

Key terms

Language proficiency, Technical and non technical language, Language acquisition, Multilingualism, Code Switching, Basic interpersonal communication skills, Cognitive academic language proficiency, Learning principles.

ABBREVIATIONS

- ESL : English Second Language.
- BICS : Basic Interpersonal Communication Skills.
- CALP: Cognitive Academic Language Proficiency.
- L1 : First Language/ Home Language.
- GDE : Gauteng Department of Education.
- FET : Further education and training.
- ABET: Adult basic education and training.
- LoLt : Language of learning and teaching.

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CHAPTER ONE

INTRODUCTION AND PROBLEM ORIENTATION

1.1. BACKGROUND AND RATIONALE

1.1.1 MOTIVATION OF STUDY

This study explores the challenges posed by the use of English as an instruction for learning science for FET learners. Most countries advocate for reforms and restructuring of science curriculum in order to improve learner achievement and attitudes towards science. There is growing awareness that mother tongue education is more effective than a second language medium of instruction (Heugh, 2002:171; Rademeyer, 2005:7). English as a second language has become the dominant medium of instruction in South Africa (De Klerk, 2002:3; De Wet, 2002:119; Kgosana, 2006:17). English language is continuing to establish itself as a global lingua franca in a period of unprecedented globalisation. In the period from 1995 to 2005 educational systems have shown interest in the adoption of English as a medium of instruction (De Wet, 2002:119). Teaching through English as a second language has been successful in certain educational environments. Failure to achieve satisfactory educational outcomes when teaching through English is common in certain countries (Kgosana, 2006:17). Personal experience on how learners struggle to understand science concepts when taught in English motivated the author of this dissertation to engage in this study to understand their challenges in greater detail.

The South African government in 1995 established the Pan South African Language Board (PanSALB) by enactment of the PanSALB Act of 1995 and amended in 1999. This language constitutional entity had to protect, enforce, promote and further or enhance the development of all South African languages (Zwane M, 2013/14) in the Annual Performance Plan). PanSALB advocates for the introduction of mother tongue as a medium of instruction from elementary level of schooling. A lot of research needs to be done so as to check advantages, disadvantages and logistics to carry such a mandate. Since the topic is highly debatable and current the researcher has chosen this topic to add to the existing literature.

1.1.2 BACKGROUND

(Becker, 1993) reports that it has been found that children learn new information best when it is taught in their home language .In South Africa out of the eleven official languages only English and Afrikaans have scientific registers (Strevens, 1976).Strevens further contend that many countries including Israel, Malaysia and Tanzania have set out to hasten the development of a

scientific register in their home languages. There are a number of factors which have contributed to low achievement in science; one of the factors is the issue of learning science in another language other than the mother tongue. A study conducted by (Minicucci, 1996) indicated that well conceived and well implemented programmes for second language learners contributed to their successes in science (Minicucci, 1996).

This study seeks to investigate the effects of the use of English in the learning of science which in turn will help educators to understand educational processes, make informed professional decisions and deliver science lessons holistically. It is hoped that such decisions will have immediate and long term effects on learners, educators, parents, communities and the nations at large since more appropriate measures will be taken to help science learners. Challenges faced by science learners in the learning of science using English as medium of communication will be understood better by educational and non educational policy groups. This was possible because the study investigated challenges of using English as a medium of instruction in the learning of science. The findings of this study will help policy formulation by policy makers seeking to improve educational practices and educators who are trying to understand educational processes, concerned public, professional and private groups (McMillan and Schumacher, 2010:3).

1.1.3 AIM OF THE STUDY

The aim of the study is

- To explore the challenges posed by the use of English as an instruction for learning science to FET learners based on both educator and learner experiences and views.
- To add to the literature by building rich descriptions of complex situations, to give directions for future research and to increase understanding of how language affects learning of science.

1.1.4 RESEARCH QUESTIONS

- ❖ What are the challenges faced by science FET learners if English is used as a medium of instruction?
- ❖ What are the FET science learners' experiences and views of using English as a science instructional medium?

- ❖ What are the science educators' views on the challenges learners face when English is used as a medium of instruction in science?

1.1.5 RATIONALE

Applied research usually focuses on problems that need to be solved so as to improve practices and enhance quality of life. In order to focus on that, applied research was used to an extent of testing the general theories such that the results may be generalised to many different educational settings (McMillan and Schumacher 2010). Personal experience of the researcher has shown that scores of learners' parents' and even educators assume that science is difficult and several learners cannot grasp scientific concepts. This study makes an attempt to explore another dimension based on the challenges science learners face in using English as a medium of instruction and puts across possible solutions and recommendations.

1.2. LITERATURE REVIEW

The adoption of English as a medium of instruction may result in positive or negative educational outcomes (Marsh, 2006:30). The adoption of English as the medium of learning is responsible for widespread school wastage in various continents (Marsh, 2006:30). In some poor countries in the world, the use of a foreign language such as English as a medium of instruction in colleges and schools is directly linked to educational exclusion and failure of learners (Marsh 2006:30). In the post apartheid South African context there is an increasing tendency for non-English South Africans to opt for English as a lingua-franca in the broader community as well as in the work place and as medium of instruction for tertiary education and training (Lamont, 2003). Learners in the FET institutions are also faced with a number of problems because they do not have sufficient command of the language necessary for educational success (Lamont, 2003).

The researcher has observed that the majority of South African learners in the setting where he is doing research are English second language learners and do face a lot of challenges in the learning of science. The difficulties second language learners face include having to use symbols to represent concepts as well as mastering the language such as the unfamiliar technical language (Johnson, 1995).The language requires so much processing when learning science as learners have to process the unfamiliar language used in the learning and teaching contexts. The performance of second language learners is often mediocre due to the fact that learners often rote learn and therefore no meaningful learning takes place (Johnson ,1995).

Since the democratisation of South Africa in 1994, educational programmes such as the Adult basic Education and training programme have been instituted (French, 2002). There has been an effort to promote universal access to education and most importantly to eradicate illiteracy among adults, many of whom were deprived of educational opportunities during the apartheid era (Lamont, 2003). However, the medium of instruction used for learning is hampering these efforts by the government because a large number of learners in our country have special experiences and problems that impede the satisfactory progress towards achieving quality educational success (Department of Education 1997). Despite the many challenges in South Africa, particularly in the educational sphere, a large number of learners still face disadvantages, like a legacy of inferior education and studying in a language other than their primary language(s) (Bordia, 2003). All of these factors impact negatively on the learning of science and in particular the (Further Education and Training) learners (FET). Studying a language which is not their primary languages poses a problem for these learners and may impact negatively on their learning and academic performance as well as the ability to complete their learning successfully (French, 2002). Learners' flexibilities and learning are not developed and this affects their involvement in education activities (Mackey, 1984).

(Lemmer and Squelch, 1993) states that attrition rates among linguistically diverse schools and higher institutions worldwide show those young or old learners with a limited proficiency in the language other than their primary language are high. (Lemmer and Squelch, 1993) further explain that it is true that limited language proficiency negatively affects the standard of the learner's achievement. In the case of FET science learners this is problematic because personal experience seems to suggest that they are far less capable of handling content subject like science through a second language than through a primary language. It may not be surprising that the majority of learners who have limited proficiency in a language of learning have a greater risk of failing and then may become school drop outs (Lemmer and Squelch, 1993).

Unlike the English Second language learner, the limited English Proficiency adult learners not only have to acquire a certain standard of English but also have to use English as a medium of instruction for all academic disciplines (Cummins, 1976). The limited English language proficient learners in the multicultural classroom also experience difficulties with academic concepts and terms when taught in a language, which are new to them (Cummins, 1976) and this may impact negatively in science learning. The learners who show limited English language proficiency in the process of learning may experience social trauma and emotional problems (Cummins,

1976). Cummins further states that the development of self-esteem necessary for sound self-actualisation can suffer and this impact negatively on the learner performance in science.

Some aspects of the effective domain can either enhance or hinder language acquisition and close the doors to cognitive advancement because learners are not able to demonstrate scientific abilities in English, especially when they are taught in English as language that is not their own (Johnson, 1995). They even develop a level of anxiety and negative attitude towards the unknown language and people who speak it. It is also evident that minority learners are able to demonstrate higher order thinking such as generalizing, hypothesizing and arguing in the first language. The learners' knowledge use of language and the broader aspects of socio-cultural context all cause discontinuity between the home and the school (Johnson, 1995:66).

Language plays an important role in teaching and learning activities whether the teachers and learners are conscious or unconscious of this (Lopez, 2001:1). Lopez further affirms that language and communication are the most common components of the school curriculum (Lopez, 2000:1). This is because there is a very close relationship between language and thought. Special problems arise in multilingual communities where learners frequently join college equipped with home languages that are often different from languages of education (Marsh, 2006).

English has been introduced in South Africa as a medium of instruction partly to offset the problem of children or learners who arrive in school with different first languages (Bordia, 2003). If the use of English as a medium of instruction creates a language problem then it is necessary to find solutions which are workable in the classroom. If English as medium of instruction result in enhanced overall learning, then it is equally necessary to identify the conditions leading to success and communicate these across educational sector (Marsh, 2006:31).

1.3 DEFINITIONS OF TERMS

Challenges: The difficulties faced by students or learners specifically in the learning of science.

English: The language on the scientific register used for teaching and learning of science in majority of schools in South Africa.

Medium of instruction: The language of communication used to give or receive information, to teach and learn science.

South African context: The study is being conducted in South Africa therefore the conditions, culture, socio; economic factors are South African in nature.

Gauteng Department of Education (GDE): The Republic of South Africa has a single coordinated national department of education headed by the minister. The minister is assisted by the director general and her deputies. In addition, each of the nine provinces of the Republic of South Africa has its own department of education. Each provincial department of education is headed by a member of the executive committee. Gauteng is one of the nine provinces in the Republic of South Africa. Thus GDE refers to the Gauteng Department of Education.

Educators: These are persons who teach, educate and train other persons and this term in this study replaces *teachers*. For the purpose of this study the term educator was specifically used to refer to science educators at FET level in South Africa.

FET science learners: The term “learner” was used in this study and replaces the terms students and pupils in schools in accordance to South African Department of Education 1997 page vii. The term Further education and training science learners refer to the learners from grade 10 to 12 learning Physical Sciences (Physics and Chemistry) and or Life Sciences (Biology) in high school in South Africa.

ABET learners: Adult basic education and training; these are adult students or learners usually from age twenty (20) onwards in South Africa.

ESL/L2/ ELL: English second language learners/ English language learners. These are learners who learn science in a language other than their mother tongue language or home language.

LoLT: Language of learning and teaching abbreviation used in South Africa.

DoE: Abbreviation previously used for department of education in South Africa. / **DBE:** Current abbreviation for department of basic education in South Africa.

1.4 CHAPTER DIVISIONS OF THE STUDY

1. 4.1 CHAPTER ONE (INTRODUCTION AND PROBLEM ORIENTATION)

Chapter one covered an introduction to the study, the problem statement, the aim of the study, a description of foreshadowed problems, a discussion of the potential significance of the study and an explanation of concepts.

1. 4.2 CHAPTER TWO (LITERATURE REVIEW)

This chapter looked at a comprehensive survey of prior researches done by other researchers. This literature review helped in understanding the problem its context and its major components. The chapter helped to prevent unnecessary duplication by identifying what has already been done in language and science learning.

1.4.3 CHAPTER THREE (RESEARCH DESIGN AND METHODOLOGY)

This chapter gave a description of the research design the site or social network selected, the research role, population, purposeful sampling strategies, data collection strategies, research instruments, data collection procedures and design limitations.

1.4.4 CHAPTER FOUR (DATA PRESENTATION, ANALYSIS AND INTERPRETATION)

The data gathered formed the empirical evidence of the research. The data was then presented and analysed such that interpretations were made. This chapter also included a discussion of data attempts which enabled to answer the sub problems and the major problem. The data was presented in a manner that answered the pre stated problems.

1.4.5 CHAPTER FIVE (CONCLUSIONS LIMITATIONS AND RECOMMENDATIONS)

This chapter summarised the research problem, methodology, limitations, results of study and major findings. Conclusions were drawn and then recommendations were made.

1.5 CONCLUSION

In this chapter the research problem has been identified and it covered an introduction to the study, the problem statement, the aim of the study, a description of foreshadowed problems, a discussion of the potential significance of the study and an explanation of concepts.

The next chapter examined the comprehensive survey of prior research, that is, research that has been done by other researchers .This literature review helped in understanding the problem, its context and its major components. The chapter also helped to prevent unnecessary duplication by identifying what has already been done in terms of learner challenges in language and science learning.

CHAPTER TWO

LITERATURE REVIEW

2.1. INTRODUCTION

Research relating to challenges experienced by learners in learning science using English language have been conducted by some researchers, especially in Asia and America and is small in number for Africa. In South African schools, there are scores of learners who are taught science in the medium of English which is not their home language, and who are limited in their English proficiency (Landsberg, 2005). The South African Constitution, Act 108 of 1997 guarantees learners the right to receive education in the language of their choice or mother tongue whilst having access to a global language such as English (Department of Education, 1997). The DoE/DBE education policy further states that the parents are allowed to choose the language in which they would want their children to be taught.

A good number of researches suggests that learners entering school are able to learn best through their mother-tongue, and that a second language (such as English) is more easily acquired if the learner already has a firm grasp of his/her home language. (Selepeng and Johnstone, 2001) assert that learners struggling to learn science in a second language lose at least 20 percent of their capacity to reason and understand in the process. The adoption of English as a medium of instruction may result in positive or negative educational outcomes (Marsh, 2006:30). Adoption of English as the medium of learning is responsible for widespread school wastage in various continents (Marsh, 2006:30). In some poor countries in the world, the use of a foreign language such as English as a medium of instructions in colleges and schools is directly linked to educational exclusion and failure (Marsh, 2006:30).

In the post apartheid South African context there is an increasing tendency for non-English South Africans to opt for English as a lingua-franca. In the broader community, work place and tertiary institutions of education and training English is used as a medium of instruction. Numerous learners are faced with a number of problems because they do not have sufficient command of the language necessary for educational success (Lamont, 2003).The challenges learners face are based on barriers in language and communication in which learners are often

forced to communicate and learn in a language which they do not usually use at home and are therefore not competent to learn effectively (South African Department of Education 2005:11).

2.2 OVERVIEW

In this literature review focus was mainly on language proficiency, technical and non technical language of science, language acquisition, language input and output, BICS and CALPS, Bilingualism/multilingualism, word order linguistics difficulties, logical connectives, code switching, language change and many other challenges faced by second language learners as presented by different researchers. The literature and the researcher's personal experience seem to suggest that majority of South African learners are English second language learners and they face a number of challenges in the learning of science using English language. The difficulties second language learners face includes having to use symbols to represent concepts as well as mastering the language such as the unfamiliar technical language (Johnson, 1995). The language requires so much processing when learning science as learners have to process the unfamiliar language used as the medium of instruction. The performance of second language learners is often mediocre due to the fact that learners often engage in rote learning and therefore no meaningful learning takes place (Johnson, 1995).

2.3. THEORETICAL PERSPECTIVES OF CHALLENGES FACED BY SCIENCE LEARNERS USING ENGLISH AS MEDIUM OF INSTRUCTION

2.3.1 Challenges posed by limited language proficiency.

(Krashen and Lee 2004:10-14) proposed that academic proficiency consists of two central components; knowledge of academic language and knowledge of specialised subject matter. Knowledge of academic language is knowledge of the special language used in school and the professions. At school it is the language of story problems in math, social studies and science texts. Outside of school it is the language of business, finance, science, and politics. Knowledge of specialized subject matter consists of knowledge of math, science, history, etc. Academic language proficiency involves the language associated with the content areas whereas academic content knowledge reflects the declarative (what) and procedural knowledge (how) associated with the content (Krashen and Lee, 2004).

(Lemmer and Squelch, 1993) states that attrition rates among linguistically diverse schools and higher institutions population worldwide shows that learners young or old with a limited proficiency in the language other than their primary language are high. This suggests that limited language proficiency drastically affects the standard of the learner's achievement. In the case of FET learners this is particularly worrisome as they are far less capable of handling content subject like science through a second language than through a primary language. It is therefore not surprising that the overall majority of learners who have limited proficiency on a language of learning run a greater risk of under achievement and then they decide to drop out of school.

Unlike the English second language learner, the limited English proficiency adult learners not only has to acquire a certain standard of English but also has to use English as a medium of learning for all academic discipline (Cummins, 1976). The limited English proficiency also affects adult learners in the multicultural classroom .Learner also experience difficulty with academic concepts and terms when taught in a language which is new to them (Cummins, 1976) and this impacts negatively in science learning. The English limited proficiency of learners who are in the process of learning in a new language may experience social trauma and emotional problems (Cummins, 1976). The development of self-esteem necessary for sound self-actualisation can suffer and this impacts negatively on the learners' performance in science. Over the ten year teaching experience of the researcher it has emerged that majority of the learners who have limited academic language proficiency have challenges expressing scientific concepts both orally and in writing.

2.3.2 Challenges posed by technical and non-technical language of science.

Non-technical vocabulary refers to terms that have one or many meanings in everyday language but which have a precise and sometimes different meaning in a scientific context (Cassels and Johnstone, 1985). Examples of non-technical terms include appropriate, component, consistent, estimate, negative and valid. These terms are amongst the 95 most difficult for secondary school learners and their meaning in a scientific context is rarely well understood Cassels and (Johnstone, 1985). (Gardner ,1972) argued that technical words include such things as physical concepts like mass, force, names of chemical elements, minerals, plants, organs, processes, the new and different meanings everyday words acquire when used as science words would result in learners not understanding certain concepts fully. Non-technical words used in science are the classroom medium of instruction and some words according to (Gardner, 1972) include random,

predict, theoretical and neglected. These words or terms remain key words in a scientific statement and helps learners to understand given that they know the technical terms used in the statements.

(Cassels and Johnstone, 1985) studies indicated that technical language of science posed a problem of familiarity however learners were seen to be able to cope reasonably well with this. A more acute problem lied in the use in science of normal, familiar language in a highly specific, often-changed and unfamiliar way. Discussion of the language involved is essential if a shared meaning is to be established. The learning of science requires learners to master not only the use of symbols to represent concepts, but also the language in particular the technical and non-technical vocabulary (Cassels and Johnstone, 1985). Studies done by (Cassels and Johnstone, 1985) mainly concentrated on the challenges posed by the use of technical and non technical vocabulary in the learning of science. These studies did not look at all the other challenges science learners face when learning science using the medium of English, thus more studies need to be done especially in a contextual point for South African situation.

According to Dr Paul Gardner's findings (1971, 1972) the following three words; disintegrate, random and spontaneous were the most difficult to learners in the researches he conducted in Papua New Guinea Secondary Schools. In the above researches he administered multiple choice tests to detect levels of difficulty of the non technical words presented to science learners.

A research done by (Maznah and Zurida, 2006:73-83) in Malaysia established that the majority of learners find the learning of science not an easy task. These difficulties arose not only from the use of symbols to represent concepts, but also the language that must be mastered in particular the technical and non-technical vocabulary. Learners who learn science not in their first language face the problem of understanding both the scientific terminologies (technical terms) and regular explanation of the knowledge itself. Non-technical vocabulary refers to terms that have one or many meanings in everyday language but which have a precise and sometimes different meaning in a scientific context .According to (Maznah and Zurida, 2006) their studies indicated that technical language of science posed a problem of familiarity, but learners were seen to be able to cope reasonably well with this. Where a more acute problem lay, was in the use in science of normal, familiar language in a highly specific, often-changed and unfamiliar way.

Results from (Maznah and Zurida, 2006) study showed that among the three streams; arts, science and engineering, the science class showed the highest comprehension level with a mean score of 25.9 followed by the engineering class with a mean of 24.4 and the arts class with 20.2. Perhaps, the contributing factor to this difference was the introduction of English for Science and Technology (EST) which was made compulsory to all science and engineering learners but not to the learners in the arts class. Level of comprehension of the non-technical terms commonly used in science teaching and learning can be improved when English is taught contextually.

The researcher experience reveal that language used in the classroom to communicate to learners reflects nature of science, the language appeals to evidence, expresses validity and reliability of the evidence, appeals to nature of science and appeals to logical reasoning. In order to achieve this technical and non technical terms are used by educators and consequently in the classroom for teaching and learning and this seem to challenge high school learners.

2.3.3 Challenges posed by foundations of language acquisition

The foundation of language acquisition comprises phonology, morphology, syntax and semantics (Miller and Gillis, 2000). Phonology forms the first level of language where any alphabetic language consist of symbols that represent the sounds of the language .According to (Miller and Gillis, 2000) phonology is the essential foundation upon which language is built and if teachers are uninformed about the various levels of language they will not be in a position to understand how these parts fit together to form a whole. Morphology is the second level of language that gives clues to meaning of words and an indication as to where these words fit into in a sentence. The third level of language is the syntax which involves word order that leads into sentence structure. Semantics is the fourth language level which put words together in order so that they form a sentence which has meaning thus comprehension becomes evident (Miller and Gillis, 2000).

Learners face some challenges using English language due to phonological and linguistic demands of the two different languages of which these difficulties would not be there if the learners have been exposed to the first language only (Rost, 2001). English second language learners find it difficult to listen to English because the phonological system ,phonotactic rules(sound sequences to make syllables)as well as tone melodies such as high ,low, rising and

falling tones may differ from the first language and this influences their speaking and reading (Rost, 2001). Where ESL learners read well in their first language they are able to generalize their reading abilities across languages. Rost further says that where phonics instruction takes place there is often a mismatch between the ESL learner's phonological system of English and pronunciation on which phonic practice is based. When the learner uses the three-cue system, namely graphophonic, syntactic and semantic, ESL learners are inclined to skip non essential words and guess at words by using context. The content of the text may not be in their frame of reference culturally and they find it difficult to comprehend. They find it difficult to break up words into syllables and mispronounce words due to these reading errors and their comprehension becomes poor (Rost, 2001).

According to (Harrison and Krol, 2007) much has been learned on the acquisition of reading skills in ESL children, leading to improved screening and identification methods for those children who may be at risk of L2 reading difficulties. There is much less knowledge about the acquisition of reading skills in ESL adults, however, including what markers are most predictive of L2 reading acquisition and risk of reading difficulty. Their study aimed to examine this relatively unexplored area by making connections between what is known about ESL children's L2 reading development with what is also known about the cognitive and linguistic aspects of reading difficulties and disabilities in adults. They were interested in assessing the word-level reading and phonological processing skills of adults learning English as a second language to see whether the findings on the cross-linguistic transfer of phonological processing could be replicated with adults. Their study was interested in whether English phonological processing measures could be given to ESL adults to screen for potential difficulties with English reading as has been found with ESL children.

(Harrison and Krol, 2007) found that the same phonological processing measures (i.e. pseudo-word repetition, phoneme deletion and phoneme detection) that predict word recognition in monolingual children and adults also predict word recognition performance in ESL Chinese speaking adults. The adults in their sample who were identified as having difficulties in learning to read in English were by no means considered learning disabled, their difficulties in acquiring English reading were associated at a basic cognitive and linguistic level with unconsolidated phonological processing skills in their second language.

2.3.4 Basic interpersonal communication skills (B.I.C.S) and Cognitive academic

Language proficiency (C.A.L.P).

(Cummins, 1996:64) defines Basic Interpersonal Communication Skills (BICS) as the Language necessary for day to day living such as conversations with friends and peers in informal interactions. Cognitive Academic Language proficiency CALP is further defined as the language necessary to understand and discuss content in texts of which there are fewer non verbal cues and the language is more complex. Academic language is composed of many skills, including oral and written vocabulary knowledge; understanding complex sentence structures and syntax; and understanding the structure of argument, academic discourse, and expository texts. Another definition for BICS is conversation social English language that is unedited and contains incomplete sentences (Brown, 2007:33).

(Cummins, 1992) conducted several studies concerning the effect of foreign language. Emphasis was placed on two levels of language proficiency: the Basic Interpersonal Communicative Skills(BICS) and the Cognitive Academic Language proficiency (CALP) .BICS represents the language of natural informal conversation and CALP represent the language proficiency for reading text. CALP requires both higher levels of language and cognitive processes in order to develop the language proficiency needed for success and achievement in academic subjects like science. (Cummins, 1981a) explains that foreign language learners may become proficient in the grammar, vocabulary and sentence structure of the English language. The learners may however lack the necessary cognitive academic language proficiency to learn the subject matter in science content, participating in dialogue and debate as well as providing written texts. Challenges are mainly faced in CALP mostly lie in science teaching and learning because it is cognitively demanding language which relates to abstract concepts and has specialised vocabulary and uses more complex language structures. (Cummins, 1996:75) studies of second language learners indicated that children develop BICS social language in two years but it takes 5-7 years for a child to work on the same level as native speakers in CALP.

Some challenges faced by learners are due to the choices taken by learners ,educators and schools in terms of language of learning and teaching .(De Wet, 2002) says that there are a number of factors which influence learners on choice of language. Indications are that it is

important for children to learn to think and function in their home language up to CALP level and then the child may transfer to the new language the system of meaning they already possess in their own home language. This will help learners to be more successful in acquiring second language literacy if they have already mastered strategies for negotiating meaning in print in their home language. Learning and changing over to a second language is a traumatic experience and this may significantly delay sometimes permanently learners' academic development (De Wet, 2002). Majority of learners in South Africa are still using or prefer using English and not their home language because of lack of suitable textbooks and suitable material for specialised language needs.

(Maznah and Zurida, 2006:73) suggested that when teachers teach the English language usage of context in science and technology would help upgrade learners' level of understanding the non-technical vocabularies. In general these learners still had problems in understanding some non-technical terms used in everyday communication. Furthermore (Maznah and Zurida, 2006:73-83) suggested that there is a need for learners to build up their vocabulary and to be familiar with the use of the words in several contexts. Learners should be taught how to gauge the meanings of words on the context of use. Use of English should be extended outside of the classroom or science laboratories so that learners have more chances of practicing communication in English in order for them to be familiar with the language and increase their vocabularies. The extended use of English could increase the BICS (Basic Interpersonal Communication Skills) which will in turn help learners in achieving the CALP (Cognitive Academic Language Proficiency) needed to understand science. When science is taught to these learners in English later on (at matriculation or college level), special considerations have to be made to the level of vocabulary used to aid them in understanding science and the science concept itself must be taught in context with the learners' experience or previous knowledge.

2.3.5 Challenges faced by English language learners (ELLs) or Second language learners (L2).

English Language Learners (ELLs) are defined as students/learners whose first language is not English and who are in the process of learning English (Haynes, 2009). Development of academic language is fundamental to academic success in all content areas according to (Haynes, 2009) however achieving proficiency in academic language is the primary difficulty for ELLs at all ages and grades and can remain a challenge even after ELLs achieve proficiency on state language proficiency tests. Good conversational English skills may be accompanied by limited academic language skills.

According to (Lapp et al, 2001) learners learning English second language usually begin literacy instruction in their first language .Academic and linguistic skills which have been acquired in the first language can easily be transferred to the second language and fluency in the first language shortcuts the normal developmental process in the second language. Forcing learners to learn English too early can result in their not speaking, reading or writing their first or second language well. Learners who experience prolonged exposure to their first language strengthen the foundation from which the second language is acquired.

English language learners face many obstacles when reading literature in English. Most literature is culture bound and learners are expected to have prior knowledge of literary genres such as fairy tales, myths, legends, and tall tales. If the teacher has not activated prior knowledge or built background information knowing the vocabulary will not solve the problem. ELLs may be able to read the words but it doesn't mean they will understand the text. They are not aware of information that the author left unsaid, the information that "everyone knows" (Haynes, 2009).

An abundance of idioms and figurative language in English texts, density of unfamiliar vocabulary, use of homonyms and synonyms, grammar usage especially the "exceptions to the rules", word order, sentence structure and syntax. Difficult text, structure with a topic sentence, supporting details and conclusion, unfamiliarity with the connotative and denotative meanings of words. ELLs may not have practice in expressing an opinion about text ,use of regional U.S. dialects ,fear of participation and interaction with mainstream learners ,story themes and endings can be inexplicable .Literary terms for story development are not understood ,unfamiliarity with

drawing conclusions, analyzing characters and predicting outcomes ,imagery and symbolism in text become difficult to ELLs(Haynes, 2009).

The vocabulary of science presents a huge difficulty to the learners. There are a special set of terms for the learners to learn. Even simple words that the learner may know could have another meaning in science. Material is covered very fast and directions are often multistep and difficult. There are too many concepts explained on each page of a science text. Cooperative learning may not fit in with learners experiences in learning. Visuals may be confusing and difficult to understand. Sentence structure is complex and the passive voice is used in textbooks. What was taught in class does not always match the assessment. ELLs are not used to science labs or equipment Learners lack background in scientific method and there is no standard form of delivery of information. According to (Haynes, 2009) formation of numbers varies from culture to culture, use of decimal point and comma varies from culture to culture, Learners have no experience with American measurement system, and it is an abstract to them. Mathematics is not spirally taught in many cultures. So learners may not know a lot about geometry, for example. Many learners have never seen or worked with manipulatives. They may not take a lesson using manipulative seriously. Learners learn mathematics by rote memory. Mathematics curricula in their countries may be primarily calculation. Word problems may not be introduced until much later. Estimating, rounding, and geometry are not often taught as early in other cultures. Mathematical terms do not always translate well. Mental mathematics may be the norm. Learners may not show work in addition, subtraction, multiplication and division or they may show work in a different way (Haynes, 2009). Haynes clearly shows a number of challenges learners face in using English language in learning content subjects including science .There is therefore a need to conduct researches to confirm what Haynes findings and to see if it also applies to a South African context (Haynes, 2009).

2.3.6 Bilingualism/ Multilingualism challenges.

The effects of bilingual education on academic subjects and its implications have been investigated by a number of researchers. (Collier, 1989:522) conducted researches in bilingual education programs and academic achievement. The studies showed that in bilingual programmes learners made dramatic gains compared to the success of learners schooled in single language only. The study further showed that after 4-5 years of instruction, bilingual

program learners achieved dramatically whereas the English only group dropped significantly below their grade level.

In South Africa some research has been done on some of the challenges learners face through learning science using English as a medium of instruction. A research was done by (Probyn, 2005) "Learning Science through two languages in South Africa". (Probyn, 2005) cited that recent research has stressed the need to base teacher development on teachers' definitions and perceptions of the problems of practice: 'Any serious attempt to improve the quality and effectiveness of teaching and learning in schools must start from an understanding of what people in classrooms do at present' (Cooper and McIntyre, 1996:1). The purpose of (Probyn, 2005) research was to understand the perceptions, practices and problems of teachers teaching science through the medium of English as an additional language. The research was conducted in township schools around Grahamstown in the Eastern Cape province of South Africa. Xhosa was the home language of the great majority of teachers and learners in these schools and for all of the learners and teachers who participated in the research. According to (Probyn, 2005) the interviews conducted with teachers and classroom observations showed that the language of learning and teaching frequently creates a barrier to learning when it is not the home language of learners. This was the case for the majority of African learners in South Africa. In addition teachers confirmed that they had received no training in how to teach through the medium of English as an additional language. Teachers demonstrated a wide range of practices with regard to their own language input in terms of the amount of language they used and the relative balance of English and Xhosa, the kinds of questions they asked and the language support strategies they practiced. These varying practices elicited different patterns of responses from learners (Probyn, 2005).

2.3.7 Challenges posed by linguistic problems.

Linguistic challenges are a result of one's lack of knowledge of grammar, rules of syntax, as well as meanings of words used in different contexts according to (Selepeng and Johnstone, 2001:20). Poor knowledge of these rules puts second-language learners at a disadvantage, being less able to see meaning in texts, when compared with first language counterparts who have been exposed to inherent and informal methods of learning their language at an early stage (Selepeng and Johnstone, 2001). Studies by (Cassels and Johnstone, 1985) reveal that learning academic courses through the medium of English pose problems for learners whose

mother tongue is not English. The explanations given for these problems are linguistic and psychological. Studies exploring the underlying psychological problems indicate that second language learners are frustrated by failure to see meaning in texts and start to have a tendency toward rote-learning. Therefore not much is stored in memory since what is learned by rote is easily forgotten.

According to (Ihejieta, 1995:562) there are factors other than academic standing on the learners' side which could explain the performance trend. These factors are; Learners' dislike for mathematics that may stem from psychological incidences such as fear, endurance, perseverance and associated factors. The mathematics curriculum may have not much relevance to real life situation. Mathematics teachers were not interested in the subject and did not help their learners by way of catering for individual differences. (Vygotsky, 1978) proposed that the role of language in the development of understanding can be explained in two ways: First, language accommodates a medium for learning thus learning can take place in a social context and social interaction is the essence of learning. Second language is a tool which helps the child to construct a way of thinking. Vygotsky theory explains that learners' understanding is formed and social experience is internalized through two-stage transformation: social level (inter psychological) and individual level (intra psychological). Vygotsky says that concepts cannot be acquired in conscious form without language and a child can not have a conscious understanding of concepts before they are explained in a related context using language (Vygotsky, 1978).

2.3.8 Challenges posed by learning principles.

The principles of learning are condensed theoretical statements summarising a number of learning research. These principles are usually designed to help educators analyse the quality of instruction and opportunities of learning that they offer to learners (The American Association for the Advancement of Science, 1989). It further outlines several principles of learning relevant to scientific literacy. The first one is based on learner's prior knowledge and how it influences learning. English second language learners come to science with previously existing worldviews and knowledge that may or may not correspond with the new concepts they will learn in their English schools. This prior knowledge will affect for better or worse how new information is integrated with older concepts, as well as attitudes towards science in general. A challenge for learners learning English as a second language is that they may be required to abandon

previously acquired knowledge. This is a complex process and may happen only superficially even after formal science teaching (Fathman, Quinn and Kessler, 1992).

The second principle is based on the theory that learning moves from the concrete to the abstract. Second language learners need to build a foundation upon which abstract concepts can grow and this can be done through science investigations which provide such a foundation by actively involving learners in the processes of science from observing and measuring concrete objects to classifying, hypothesizing and interpreting results (Rupp, 1992).

Thirdly, learning requires practice in new situations. This means going beyond the textbook and using the classroom to its full advantage with its possibilities for interactions, demonstrations, and hands-on activities. Some topics may lend themselves to immersive experiences outside the classroom such as on field trips. The fourth principle according to (The American Association for the Advancement of Science, 1989) is feedback for effective learning. English second language learners require feedback in a multitude of areas including pronunciation and communication, accuracy of knowledge, accuracy of skills and thought process. Understanding and effective communication expectations to the learners should be checked by educators then learner's challenges will be erased. Lastly, learning is not necessarily an outcome of teaching. Learning style for example, may greatly affect whether or not a learner absorbs the lesson being taught or if they would do better with a different mode of teaching. English second language learners in particular, bring with them unique learning styles that must be addressed to overcome the challenges the learners face (Reid, 1987).

2.3.9 Difficulties faced after language switching or language change.

Language switching is the language substitution of one language by another usually takes place when learners are taught in one language e.g. Afrikaans and then completely change the language to be taught in another language like English language. A study conducted by (Aziz, 2003) in Malaysia reported that learners have encountered language as well as contents problems in schools during implementation of English language in learning science and mathematics. In learning mathematics, learners frequently encounter mathematics problems involving calculations, understanding of concepts, principles and mathematical relationship with other subjects. Studies to assess engineering learners' perceptions in learning mathematics at University of Technology in Malaysia and some schools in Johor were carried out. The results

showed that mathematics subject was one of the interesting and important subjects to learn but it was difficult one to learn (Aziz, 1992:21). The reasons why mathematics subject were difficult to learn is that the concepts in mathematics are abstract and difficult to understand, and also the learners had alternative meaning of certain mathematical words before any mathematics teaching takes place.

Science and mathematical knowledge and skills can only be delivered through language therefore learners understanding in mathematics and science is affected by using English as medium of instruction. Language plays an important role in communication, thinking and is a tool for exchanging ideas and concepts between individuals (Aziz, 2003:60). To overcome these problems (Aziz, 2003:64) suggested that learners' needs guidance from teachers and emphasis should be given more on building up learners' proficiency in English before they can learn science and mathematics effectively. (Aziz, 2003:63) study established the following:

The learners considered English as an important subject to learn and it was useful for everyday communications and as a tool for learning science and mathematics. The learners felt that learning science and mathematics in English were difficult .However to learn science was more difficult compared to learn mathematics in English. A significant correlation between English results and other subjects' monthly test results such as English, Mathematics and Science. Science subject has been found to be more affected by the implementing of teaching science and mathematics in English. Malay language previously has been used as a medium of instruction for learning science and mathematics in schools. However with the changes of a medium of instruction to English the study revealed that some learners had problems in learning science and mathematics.

This research leaves room for further research since it looked at a situation where the learners where learning previously in another language Malay and switched on to using English .The research mainly focused on challenges especially faced by mathematics learners and a few emphasis on science learners. In such a case the challenges faced by these learners may be different from the challenges faced by science learners who have been using English language from primary school.

2.3.10 Challenges posed by language input and output.

(Krashen, 1994:45) asserts that input is a primary factor affecting language acquisition, where the input is what the learner receives. He points out that the length of input like reading large

amounts of free voluntary reading have significant positive effect on learners' vocabulary grammar and reading. Input is also the mechanism by which people learn languages according to the universal grammar model. Output on the other hand is what the learner produces after learning. Output appears to play an important role in providing learners with feedback and make them concentrate on the form of what they are saying and help them to automatize their language knowledge.

It appeared from the measures of language input by the teachers that, the language production by learners and the cognitive challenge of the lessons had the greatest opportunities for both cognitive and language development when being extended cognitively with contextual and linguistic supports as suggested by (Cummins, 2000). This seemed to corroborate research by (Wong-Fillmore, 1985) that compared classes that worked well for language learning with those that did not in a 5 year longitudinal study in 40 classrooms. (Wong-Fillmore, 1985:20) found that contrary to the popular belief that more 'open' (learner- centered) classrooms are best for language learning in fact the most successful classes for language learning were those that made the greatest use of teacher-directed activities. Classes that were open in their structure were in fact least successful for language learning as learners did not get enough English input and English language practice.

As was noted in the findings where learners had opportunities for extended group discussion there was indeed engagement by all the learners in the class but the language used in groups was largely their mother tongue so this did not directly facilitate the acquisition of English. (Probyn, 1995) stated that further research into group discussions seemed necessary in order to establish what kind of learning was happening.

2.3.11 Difficulties posed by logical connectives

Logical connectives also called logical operators are symbols or words used to connect two or more sentences of either formal or natural language in a grammatically valid way, such that the sense of the compound sentence produced depends only on the original sentences (Gamut, 1991:54). The most common logical connectives are binary connectives or dyadic connectives which join two sentences which can be thought of as the function's operands. Also commonly, quantifiers are the two main types of logical constants used in formal systems such as propositional logic and predicate logic.(Gardner, 1977:9-24) conducted a research on logical connectives and did a project to identify the more commonly used logical connectives in science

and to measure junior secondary learners' difficulties in comprehending the connectives. The results indicated that the connectives that were difficult were the ones common in science texts and in science teacher classroom talk i.e. the oral language. The first group consisted of several connectives which indicated inference like, *consequently and therefore*. The second group involved connectives with generalizations with words like *commonly, frequently and often* among others. The third was based on terms signaling similarities, comparisons and contrasts. The other logical connectives which were difficult included additives (*again, also, further*) opposition terms like *i.e., in these examples, namely, that is and viz.* (Gardner, 1977) study used an English first language sample and the most difficult connectives were three; conversely, if and moreover. This study implies that the language spoken by teachers in the classroom could be a challenge to the learners irrespective of their mother language. Second language learners acquire talking and communicating abilities differently to first language learners. When they enter school their linguistic behavior and communicative styles are not appreciated and not understood and thus learners experience discontinuity between the home and the school. The learners knowledge use of language and the broader aspects of the socio- cultural context all cause discontinuity between the home and the school (Johnson, 1995).

2.3.12 Challenges posed by code switching.

Code switching is often used in ESL classroom situations and involves going from one language to another in mid-speech when both speakers know the same languages (Cook, 1991:63). (Gemperz's, 1982) defined code switching as the juxtaposition within the same speech. The definition continues to say that code switching is the exchange of passages of speech belonging to two different grammatical systems of subsystems. (Myers-Scotton, 2006) defines code switching as the use of two languages varieties in the same conversation. In South African classes learners are sometimes taught bilingually and the learners' home language is used to facilitate the learning of Sciences and English at the same time. This poses some challenges as a good number of teachers are not fluent in the learners' first language as well as in English.

The multicultural composition of classes in South Africa especially in urban areas makes it an enormous challenge. (Rollnick and Rutherford, 1996:91-103) studies showed that the use of learners' first language worked as a powerful means of getting learners to explore ideas. They also discovered that without code switching some learners may develop alternative conceptions that could remain unexposed. Learners' written work may conceal misconceptions that are more

likely to be revealed in group discussions in the learners' first language. Interaction between learners is important to explore ideas and concepts in a comfortable environment, which implies talking in their first language. Teaching and learning in the first language provides the support needed with concept development while learners develop their proficiency in English; the medium of instruction. It does however become crucial that learners practise any newly acquired terminology and be able to talk about concepts in English. This is where the dilemma of code switching arises.

(Probyn, 2001:251) discovered that the language of the classroom is very often not English but a mixture of English and mother tongue where teachers deliver chunks of content in English, textbook style, and for discussion and further explanation, switch to mother tongue. Learners are often passive in the classroom and seldom engage in meaningful discussions in English. However, because the classroom is in many cases the only place where learners get exposure to English and their teachers are under pressure to use English as much as possible.

2.4 Conclusion

In this review in most research conducted, usually the language used is foreign to most learners and even the teachers. Most of the researchers concentrated on the need to make learners and teachers more proficient. This proficiency was assumed would make learners to achieve and meanings would come through. Studies conducted by (Gardner, 1977) showed that even learners whose mother tongue is English experiences difficulties in dealing with the specialist terminology used in science .From the different researches conducted by the other researchers it is clear that there is still room to research more on the challenges that high school science learners face especially through learning via the medium of English. This information gathered helped to explore further on challenges faced by FET science learners in a South African context.

The next chapter will give a description of the research design, the site or social network selected the research role, population and purposeful sampling strategies, data collection strategies, research instruments, data collection procedures and design limitations.

CHAPTER THREE

RESEARCH DESIGN AND METHODOLOGY

3.1. INTRODUCTION

In the previous chapter the challenges FET science learners face when learning science using English language were explored through literature study. This chapter will give a description of the research design, the site or social network selected the research role, population and purposeful sampling strategies, data collection strategies, research instruments, data collection procedures and design limitations.

From the challenges identified in literature study the variables were allocated based on four aspects which are contextual, language, and school and intrinsic. Contextual questions were based on challenges posed by environment, status, language and culture of the community. Language factors questions were based on statements on language structure, proficiency, BICS and CALPS, logical connectives, linguistics, language input and output, technical and non technical language. The statements and questions in this section ascertain the challenges faced by science learners and possible reasons for these challenges. School factors statements were chosen to examine the role of monolingual/bilingual educators, code switching, qualifications of educators, learners' language change/switching. Intrinsic factors, statements were used for positive or negative so as to ascertain possible psychological challenges to the acquisition of English language.

3.2 RESEARCH DESIGN AND METHODS

The research data collected during the research was both quantitative and qualitative. These types of data are suitable because qualitative methods provide research opportunities which extend the type of information which can be collected. These methods allow researchers to understand how subjects of research perceive their situation and their role within this context. Furthermore, it implies an interpretive or subjective approach with the focus being on how the respondents experience and understand the particular situation.

A mixed methodology which encompassed qualitative and quantitative investigation was undertaken to determine the challenges learners face when learning science using English as a medium of instruction and to explore the FET Science learner's experiences when English is used as an instructional medium. According to (Merriam, 1998:5), qualitative research is "*... an umbrella concept covering several forms of inquiry that help us understand and explain the meaning of social phenomena with as little disruption of the natural setting as possible*". A qualitative approach makes it possible to study "*things in their natural settings, attempting to make sense of or interpret phenomena in terms of the meanings people bring to them*" (Denzin and Lincoln, 2005:3). These types of data are suitable because qualitative methods provide research opportunities which extend the type of information which can be collected. These methods allow researchers to understand how subjects of research perceive their situation and their role within this context. Furthermore, it implies an interpretive or subjective approach with the focus being on how the respondents experience and understand the particular situation.

The following research methodology, interpretive paradigm was used because the interpretive research is fundamentally concerned with meaning and it seeks to understand social member's definitions and understanding of situations. More specifically this research focuses on the understanding of FET learners' experiences when learning in a language which is not their mother tongue. The fundamental assumption of interpretivists is that most knowledge is filtered through social construction. Qualitative research begins with assumptions a world view the possible use of a theoretical lens and the study of research problems inquiring into the meaning of individuals or groups ascribe to a social or human problem (Creswell, 2007).

The investigation undertaken for this dissertation focused on the following questions:

- What are the challenges faced by science FET learners if English is used as a medium of instruction?
- What are the FET science learners' experiences of using English as an instructional medium?
- What are the views of science educators on the challenges faced by learners when English is used as a medium of instruction in science?

3.3. SAMPLING

Sampling in this study is by way of non-probability (Babbie, 2007). Therefore, participants are selected by purposively sampling. The reason sampling take place like this is because this sampling strategy is entirely based on the judgement of the researcher who has to make sure that the sample is composed of all elements the study requires of the participants which include such aspects as the most suitable characteristics and representativeness, or typical attributes of the learners (Berg, 2004).

(Malhotra and Birks, 2004:358) outline certain procedures that researchers can follow when drawing a sample from a population. The steps are; defining the target population, identifying the sampling frame, selecting the sampling technique, determining the sample size and selecting the sample elements.

3.3.1 Defining the population

A population or a target population is the set of all elements. It is the large group to which a researcher wants to generalize the sample results. (Johnson and Christensen, 2004:199). (Best and Kahn, 2006:13) define a population as any group of individuals that has one or more characteristics in common and that are of interest to the researcher. (Bush et al, 2002:328) views a population as an identified group of elements that are of interest to the researcher and pertinent to infer something about the population. For this study the population was purposefully

selected from Johannesburg south district which is one of the fifteen school districts within the province. In this study the names of the school and the respondents are anonymous. The elements chosen for the study comprised of science educators and science (physical science and or life science) learners. The study was also restricted to a public school that is within the Gauteng Department of Education.

3.3.2 Identifying the sample frame

A sampling frame is a list of all the elements in a population (Johnson and Christensen, 2004:199). A sample frame is a complete list on which each unit of analysis is listed only once. Unless such a sampling frame is borne in mind it is in fact impossible to judge the representativeness of the obtained sample properly (Welman and Kruger, 2000:49). The sample should be representative of the sampling frame which ideally is the same as the population but often differs due to practical problems relating to the availability of information. For the purpose of this study the sample frame consists of science educators and learners who teach and learn respectively FET physical science and Life science at a purposefully chosen secondary school in the Johannesburg South District in the Gauteng Province of South Africa.

(Patton, 1990:169) states that "*the logic and power of purposeful sampling lies in selecting information-rich cases for study in depth. Information rich cases are those from which one can learn a great deal about issues of central importance to the purpose of the research*". Consequently, in an attempt to find out what challenges Science learners face focus group interviews were held with purposefully selected FET Sciences learners.

This study made use of purposive sampling. With purposive sampling, researchers rely on their experience and ingenuity to deliberately obtain units of analysis in such a manner that the sample they obtain may be regarded as being representative of the relevant population (Welman and Kruger, 2000:63). The sample chosen by the researcher is representative of the population because it included a multilingual educators and learners who teach and learn respectively on a school which uses English as the language of teaching and learning and furthermore the learners learn English as a home language. The participants all learn in Gauteng Johannesburg South in co-educational public school where the researcher purposefully chose and invited individuals to participate in the research. In some instances Science educators were asked to assist in identifying participants who were then approached by the researcher.

3.3.3 Selecting the sampling technique.

A major decision on the choice of a sampling technique is whether to use a non-probability or probability sampling. Non-probability sampling relies on the judgement of the researcher, while probability sampling relies on chance (Malhotra and Birks, 2004:360). Non-probability sampling techniques include convenience, volunteer, purposeful and snowball sampling (Best and Kahn, 2006:18). This study made use of purposive sampling. With purposive sampling, researchers rely on their experience and ingenuity to deliberately obtain units of analysis in such a manner that the sample they obtain may be regarded as being representative of the relevant population (Welman and Kruger, 2000:63). The sample chosen by the researcher is representative of the population because a public school which have learner populations of diverse language backgrounds that represent the wide South African spectrum of learners. The educators and learners in the school met the criteria which helped to complete this research. The basis of this sampling technique is that sample units should meet certain criteria which are appropriate to the successful completion of the investigation (Webb, 2002:57). In this research a purposeful sample of five educators and twenty percent of FET science learners was selected for this study. The criteria for the sample were FET science educators and learners at a public secondary school located in the Johannesburg South District of the Gauteng Department of Education.

3.3.4 Determining the sample size.

(Lewis, 2000) suggests that focus groups should consist of between six and twelve participants. The decision about the size of the group should be guided by two considerations. It should not be as large as to be unwieldy or to preclude adequate participation by most members nor should it be so small that it fails to provide substantially greater coverage than that of an interview with one individual, (Merton, Fiske and Kendall, 1990). The number of participants should depend on their experience and degree of expertise in the particular area of the research. Smaller groups of between four and six participants are preferable when the participants have a great deal to share about the topic or have experience in the topic under discussion (Kreuger, 1988). In this investigation the learner focus group size was limited to six participants per interview session per grade; grade 10 11 and 12. The sample chosen for questionnaires was substantially large so as to analyse more learners challenges and experiences, 20% per grade was chosen. Open ended

questions were given to educators to elicit for more challenges the learners face based on the educators experiences.

Since the sample size formulas cannot be appropriately used for non-probability samples, the determination of the necessary sample size is usually a subjective, intuitive judgement made by the researcher based on past studies (Zikmund, 2000:519). (Webb, 2002:59) is of the view that sample size primarily depends on the degree of accuracy that is needed, *i.e.* the sample must be representative of the population with respect to the characteristics/variables of interest. The accuracy depends upon two characteristics of the population namely: The degree of variability in the population: populations which have high degrees of heterogeneity require larger sample sizes than those populations which are more homogeneous. The presence of population subgroups: the sample must be large enough to allow for valid analysis of any subgroups that may be present in the population.(Churchill, 2001:521) asserts that one of the methods used by researchers is to determine the sample size used by similar studies in the past; historical evidence approach.

3.3.5 Selecting the sampling elements

A sampling element is the unit of analysis or case in a population. It can be a person, a group, an organization, or a written document that is being measured (Neuman, 2006:224). Execution of the sampling process requires a detailed specification of how the sample design decisions with respect to the population, sampling unit, sampling frame, sampling technique and sample size are to be implemented. The researcher identified all the relevant science learners and educators from a public school in Johannesburg south as sampling elements in order to ensure that the correct persons were contacted.

3.4. DATA COLLECTION

The data was collected by means of depth focus group interviews, document analysis and participant observation as well as use of questionnaires. The depth interviews give the respondent the opportunity for personal explanation and detailed responses. In addition, the individual focus allows the interviewer to draw out the information in more detail while the respondent is talking and thinking about the subject (Terre Blanche and Durrheim, 1999).

Participant observation is based on the assumption that understanding of the context. The method is based on the assumption that understanding of the inner perspectives of subjects can be achieved only by actively participating in the subject's world and gaining insight by means of observation. This makes it potentially the most powerful tool for developing an understanding of the experience and meaning attached to behaviours and social norms (Silverman, 2004).

3.4.1 Focus group interviews

Focus groups are structured small group interviews and according to (Taylor-Powell, 2002) they are "focused" in two ways. First, the persons being interviewed are similar in some way and second, the purpose of the interview is to gather information about a particular topic guided by a set of focused questions. Participants hear and interact with each other and so give different information than if they are interviewed individually. The purpose of focus group interviews is to develop a broad and deep understanding rather than a quantitative summary. The emphasis is on insight, responses and opinions. Multiple groups are recommended since each discussion is highly influenced by the participants and consequently four sessions, with different participants were held.

These interviews span two years, with two interviews in 2012 and two in 2013. Six learners per grade were interviewed at different times and days of the period of the interviews. Seven educators were also interviewed separately in focus group interviews on a number of occasions. The participants were considered due to different languages spoken and their mother language and learning science at FET i.e. grade 10, 11 and 12. On commencement of the interviews all participants were thanked for their involvement. They were assured that their input was appreciated and that no reference would be made to them as individuals. They were encouraged to speak their minds and not be put off by differing opinions. The interviews were start off with a probing question: How do you feel about learning Sciences in English if one is a non-English speaking learner? Once it appears that a saturation point has been reached and the question had been covered adequately, participants were asked how they would prefer to be taught Science concepts. The contributions were also recorded and the details are given in chapter four and annexure C.

3.4.2 Questionnaires

A questionnaire is a self report data collection instrument that each research participant completes as part of a research study (Johnson and Christensen, 2004). The questionnaire is a versatile tool for researchers which are designed to elicit information about thoughts, feelings, values, perceptions, reactions, beliefs and attitudes. Researchers attempt to measure many different kinds of characteristics using questionnaires. The researcher constructs a set of relevant questions and presents it to the subject to answer. The content and organization of the questionnaire corresponded to the research objectives. Questionnaires may include multiple questions and statements.

The questionnaire in Appendix A was chosen for this study to ensure a standardized data collection procedure that allow the data obtained to be internally consistent and be analysed in a uniform and coherent manner (Boyce, 2002). A number of items of a questionnaire were developed for this study to measure learners' challenges faced in learning science. Two questionnaires were developed of which one was developed to be filled by the educators and the other one to be filled by the learners. The educators' questionnaire consists of three different sections: A, B and C which are described below;

- A- Biographical information of the educators
- B- Biographical information of their learners.
- C- Educator views on learner challenges.

The learners' questionnaire consists of two different sections: A and B which are described as follows;

- A- Biographical information of the participants
- B- Learners' views about the challenges they face

The questionnaire comprised both structured (closed) and unstructured (open ended) questions. Respondents were requested to give their honest views in a 4— Likert scale. The scale was comprised as follows; **strongly Agree, Agree, Disagree, and Strongly Disagree**.

(Boyce, 2002) defines piloting as the process of testing a questionnaire before a survey commences to make sure that any errors are identified and then corrected and it provides a final pre-survey assurance that the questionnaire contains no errors and to affirm that the

questionnaire captures the information sought by the researcher. Pilot-testing was undertaken with 15 respondents which comprised of 13 learners and 2 educators from the purposefully chosen school and were drawn randomly from the pool of science learners. The pre-testing was undertaken by selecting the questions with two academics who are engaged in research in the field of education. The researcher requested the respondents to share their thoughts about the questions, their answers and any shortcomings in the questionnaire. The respondents chosen were drawn from the same population but were not part of the selected 112 so as to avoid duplication of sample elements. The participating learners included fifty four (54) boys and fifty eight (58) girls .From the participating learners twelve (12) were English first language speakers and five (5) home languages was Afrikaans. Fifty eight (58) participants were in grade 10 thirty two in grade 11 and twenty two (22) in grade 12.

3.4.3 Documents Observations

More data was collected by means of observations, checking the learner's documents books, registers to gather as much information about them. Artifacts of present day groups and educational institutions may take three forms; personal documents, official documents and objects (McMillan and Schumacher, 2010:361). A personal document is any first person narrative that describes an individual actions, experiences and beliefs. Personal documents include diaries, personal letters and anecdotal records. Anecdotal records include logs, journal, and notes on lesson plans or parent's development record of a child. Official documents include memos, minutes of meetings, working papers, drafts of proposals and they describe functions and values and how various people define the organization (McMillan and Schumacher, 2010:361)

In this research personal documents in the form of note books, written tests and activities were used to analyze English language barriers faced in answering science questions. Official documents in the form of class registers were also used to obtain learner statistics and to help in purposeful selection of learners in the population.

3.4.4 Validity

(McMillan and Schumacher, 2010:173) define validity as the degree to which scientific explanations of phenomena match the realities of the world or a judgement of the appropriateness of a measure for specific inferences or decisions that result from the scores

generated. Validity refers to the truth of propositions that are generated by research. Validity is the degree to which a test measures what it is supposed to measure. Several techniques are used to assess the validity of a measuring instrument; criterion-related validity, construct validity, convergent validity and discriminant validity. Validity can be enhanced by comparing results between interviewers by getting a number of people to analyse the same sections of the same material or relating the results to the theory on which the research was based. On a more sophisticated level the results using triangulation method and compares the results using any number of different methods to see if they complement each other (Silverman, 2001). To improve validity the triangulation approaches was incorporated. Data triangulation makes use of different sources e.g. data from informants and observations. Methodology triangulation involves use of different methods e.g. questionnaire, interview, documents and observation (Denscombe, 1998:85). In this study validity was enhanced by the use of questionnaires, focus group interviews and document observations.

3.4.4.1 Content validity

To ensure that the questionnaire satisfies content validity, a mixed methodology research process was followed. The following steps were undertaken to ensure content validity of the research instrument:

Various sources of evidence were consulted from literature in order to develop an appropriate measuring instrument. Content validity was also established by pre-testing the questionnaire among academics and educators. In addition a pilot test of the questionnaire was run among twenty respondents. Changes were made to the questionnaire in terms of question format, phrasing and content.

3.4.4.2 Construct validity

The construct validity of a questionnaire refers to the extent it measures the theoretical dimensions. If there is evidence of construct validity the questionnaire then measures what it supposed to measure. Evidence of reliability confirms the construct validity of the measuring instrument (Bosch, Boshoff and Louw, 2003).

3.4.5 Reliability

(McMillan and Schumacher, 2010:179) define reliability as the consistency of measurement, the extent to which the results are similar over different forms of the same instrument or occasions of

data collecting. Internal consistency reliability refers to how consistently the items on a test measure a single construct or concept (Johnson and Christensen, 2004). Two commonly used approaches to measuring internal consistency are split-half reliability and coefficient alpha. Split-half reliability refers to a measure of the consistency of the scores obtained from two equivalent halves of the same test. Coefficient alpha refers to a formula that provides an estimate of the reliability of a homogenous test or an estimate of the reliability of each dimension in a multidimensional test, (Johnson and Christensen, 2004: 137-138).

3.4.6 Data analysis

The data are analysed depending on the nature of the design. In triangulation design the quantitative and qualitative data are analysed concurrently in an integrated fashion. In this case there is data mixing in which quantitative and qualitative results are combined. According to (McMillan and Schumacher, 2010:25) in some cases data sets are merged by transforming data of one type into the other for example, qualitative data can be represented numerically based on frequency of occurrence which can then be used in quantitative analysis. Statistical trends can be completed by qualitative data. The data was analysed using mixed methodology interview data was analysed by means of content analysis which means that the data was explored in detail for common themes and these were then established into units of meaning or codes. From early on in the data collection process analysis should begin so that the key areas can draw out to inform the data collection process. Analysis was done during collection as well as after all the data has been gathered. After coding there was need for further data so the process was interactive and recursive, going back and forth between different stages of analysis (McMillan and Schumacher, 2010).

Section A and B of the questionnaire were analysed quantitatively. Section C content analysis was used. Analysis of every question was done using the percentages per section of the total. Graphical presentations were done and statistical analysis and comments followed from the data gathered.

3.5. ENTERING THE FIELD

Researcher used GDE research policy 2012(ANNEXURE E) to gain permission to conduct research in Gauteng department of education schools. Application form to conduct research was

filled, sent and approved. Letters were also written to Johannesburg south district director, the school principal, educators, learners and parents.

3.5.1 Area of study

The study was conducted at a school that fall under the jurisdiction of Gauteng Department of Education which has fifteen districts. Johannesburg South is one of the districts and includes parts of the South of Johannesburg like Lenasia, Lenasia South, Ennerdale and Orange Farm. This research was limited to a high school which was purposefully selected where the F.E.T Science learners have a variety of home languages including English as home language. The school also use English home language as Language of teaching and learning which made the study site ideal for the research purpose and sufficient for the dissertation.

3.5.2 Ethical considerations

Since the research is both quantitative and qualitative there was anticipation of personal intrusive thus ethical considerations were prioritised. Policies regarding informed consent, deception, confidentiality, anonymity, privacy and caring will be adopted. The research design not only involved selecting informants but also adhered to research ethics (McMillan and Schumacher, 2010:338). All ethical measures were taken into consideration which includes informed consent, freedom to withdraw, confidentiality and anonymity, privacy and empowerment and finally caring and fairness.

3.5.3 Informed consent

Consent was sought from all participants, principal, educators' learners and parents. They were informed of the purpose of the study, the demands and risks of the study and were given all information that influenced their willingness to participate .To gain permission participants signed protocol for informed consent .Informants selected interview times and places so as to establish trusting relationships and handle the dialogue. The time required for participation was none interfering and was in the natural setting as possible (McMillan and Schumacher, 2010).

3.5.4 Confidentiality and anonymity

Participants were assured that their identities, their responses will not be mentioned or revealed in this research study. Pseudonyms were used to report findings. Data collected was analysed on an aggregate basis without delineating the school or respondent. The settings and

participants was disguised so as to appear similar to several possible places and give code names of people and places if anonymity is requested .There was dual responsibility to protect the individual's confidences from other persons in the setting and to protect the informants from the general reading public. In this survey research there was dissociation of names from responses during the coding and recording process (Creswell, 2009:99).

3.5.5 Privacy and empowerment

The research participants were informed that they were free to withdraw from the research study at any time without penalty. There was negotiation with participants so that they understand the power that they have in the research process. This power and the mutual problem solving those results from it may be an exchange for the privacy lost by participating in the study (Lincoln, 1990).

3.5.6 Caring and fairness

Open discussion and negotiations were carried out to promote fairness to the participants and to the research inquiry .A sense of caring and fairness was been part of the researcher's thinking actions and personal morality in the research (McMillan and Schumacher, 2010).

3.6 CONCLUSION

This chapter gave a description of the research design the site or social network selected the research role, population and purposeful sampling strategies, data collection strategies, research instruments, data collection procedures, reliability and validity, data analysis and the adherence of the various ethical issues were explored.

In the next chapter the gathered data formed the empirical evidence of the research. The data was presented and analysed such that interpretations were made. The next chapter also has a discussion of data attempts which answer the sub problems and the major problem.

CHAPTER FOUR

DATA PRESENTATION, ANALYSIS AND INTERPRETATION

4.1 INTRODUCTION

The preceding chapters provided an introduction and background a theoretical perspective and methodology for the study. In this chapter the data gathered formed the empirical evidence of the research which is then presented and analysed so that interpretations can be made. This chapter will have a discussion and interpretation of data in attempt to answer the sub problems and the major problem. The data has been presented in a way that answers the pre stated problems. Statistical data necessary for this research study was collected and presented in a tabular or graphical format for easy reading and understanding. The simplicity of the presentation in this form is guided by the assumption, that the findings and recommendations presented here are useful to school educators, principals, policy makers within the department of education and other stakeholders requiring simple and useful information on challenges faced by science learners.

4.1.1 Steps in data organisation.

This research is a mixed methodology and the following steps were followed according to (McMillan and Schumacher, 2010) collection and organizing of the data, transcribing the data into segments, data coding, describing the data categorising and finally developing patterns. Large amounts of data were collected and were organised so as to facilitate coding. The data was organised using research questions and fore shadowed problems, interview guide themes concepts and categories used by other researchers, personal experience and the data itself.

The data was analysed from the moment it was being collected in interviews, questionnaires and document analysis. Interviews were conducted and data gathered systematically by coding the main themes and challenges mentioned by the learners and educators. The data gathered was transcribed in a book as the learners and educators presented their views on the challenges faced by the learners when learning science using English as a medium of science instruction. Transcription is the process of taking notes and other information and converting them into format that will facilitate analysis (McMillan and Schumacher, 2010). Interview notes were

collected as summaries and were expanded just after the interviews and later used to prepare data for visual review.

4.1.2 Data coding.

Predetermined categories were mainly used in the interview guide and tended to be general and fairly broad. These categories provided a starting point and were provisionally applied and refined. In order to gather more challenges apart from those mentioned in literature review data coding was done through identification of pieces of data that stand alone referred to as segments by (McMillan and Schumacher, 2010). These segments were then analysed to come up with codes which provided meaning to the segments.

During the interviews educators responded in English as they all professed to be competent and proficient in the language. Learners were given options to respond in the language they were comfortable with but all of them responded using English language. The categories and codes are given in detail in section B of this chapter starting from section 4.4.

4.2 THE PILOT STUDY

A pilot survey was conducted prior to the actual survey to ensure that the questionnaire contained no errors and to affirm that the questionnaire captured the information sought by the researcher. In the preliminary pilot survey fifteen questionnaires were administered. The questionnaire consisted of four sections. Pilot-testing was undertaken with 15 respondents which comprised of 13 learners and 2 educators from the school which was drawn randomly from the pool of science learners. The pre-testing was undertaken by selecting the questions with two academics that are engaged in research in the field of education, as well as input from the supervisor. The researcher requested the respondents to share their thoughts about the questions, their answers and any shortcomings in the questionnaire. Some of the questions were beyond the vocabulary of the learners thus simple English had to be used on some questions.

A pilot interview was also done with educators who pointed out challenges faced by science learners and their responses were factored into the questionnaire as well and were also used to design more questions for focus group interviews.

4.3 THE MAIN SURVEY

The learners who participated in this study came from a high school in Johannesburg South District 11. A total number of 112 learners constituting 20% of all the science learners participated in the study, comprising 58 females and 54 males. The data concerning the home languages and language(s) of which the learners had been taught in their primary schooling illustrated that 83 learners had been taught in English language, 29 in English and a vernacular, 9 learners indicated both Afrikaans and English were used at primary. Seven science educators were interviewed one female and six males. All of the participants were given questionnaires and the response rate was 100% as standby learners were also selected just in case some do not return the questionnaires. Six learners from each grade 10, 11 and 12 were selected for the focus group interviews and were conducted separately during different scheduled times. Educators were also interviewed separate from the learner at the convenient times of the educators.

SECTION A

4.3.1 BIOGRAPHICAL DETAILS OF EDUCATORS

4.3.1.1 Gender of the respondents.

The learners and educators who responded in this study were purposefully chosen but their gender was at random.

Figure 4.1 Gender of respondents (Educators N=7 and learners N=112)

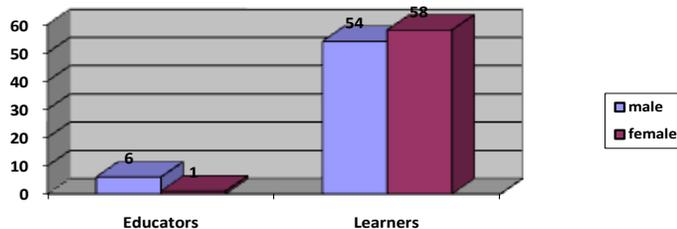


Figure 4.1 sets out the gender of the learners and educators. Among the learners there were 58 females and 54 males in the sample. Among the educators there were six males and one female and the total number of educators and learners involved were 119.

4.3.1.2 Educator involvement in the teaching of science.

Table 4.1 Educator involvement in science teaching (N=7)

Involvement in science teaching	Number of Educators
1-5 years	0
6-10 years	2
11-20 years	3
21-30 years	1
31 years or more	1
Total	7

All the science educators have experience of more than five years teaching science. Two of the educators interviewed had between 6 to 10 and three educators indicated they had 11 to 20 years teaching experience in science and only one educator had more than 31 years teaching science experience. The teaching experience of these educators made them ideal for gathering information on the challenges learners face in learning science using English language as a medium of instruction.

4.3.1.3 The educator qualifications.

The questionnaire also asked the educators to truthfully fill in their qualifications and assurance was made that their anonymity will be prioritised and these will only be used for the purposes of study only.

Figure 4.2 Qualifications of the Educators (N=7).

EDUCATOR QUALIFICATIONS

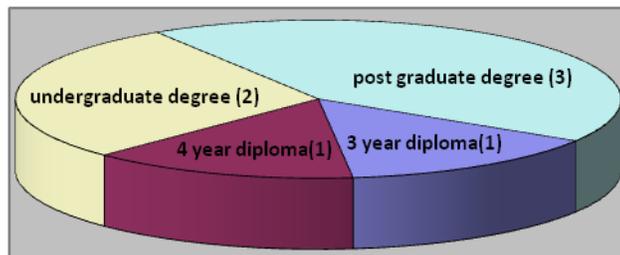


Figure 4.2 indicates that 1 educator of science had 3 year diploma 1 had 4 year diploma, 2 had undergraduate degrees and 3 had post graduate degrees. The responses show that all the educators interviewed are all qualified science teachers and these are the ideal respondents for the purposes of this study. Request was made to exclude gender in this analysis since the females in this research were only 2.

4.3.1.4 Educator home languages.

Since this research is about language and how it affects science learning educators were asked their home languages to gain an insight on their experiences in learning and teaching science. The results are recorded in figure 4.3.

Figure 4.3 Shows Home languages of the seven educators

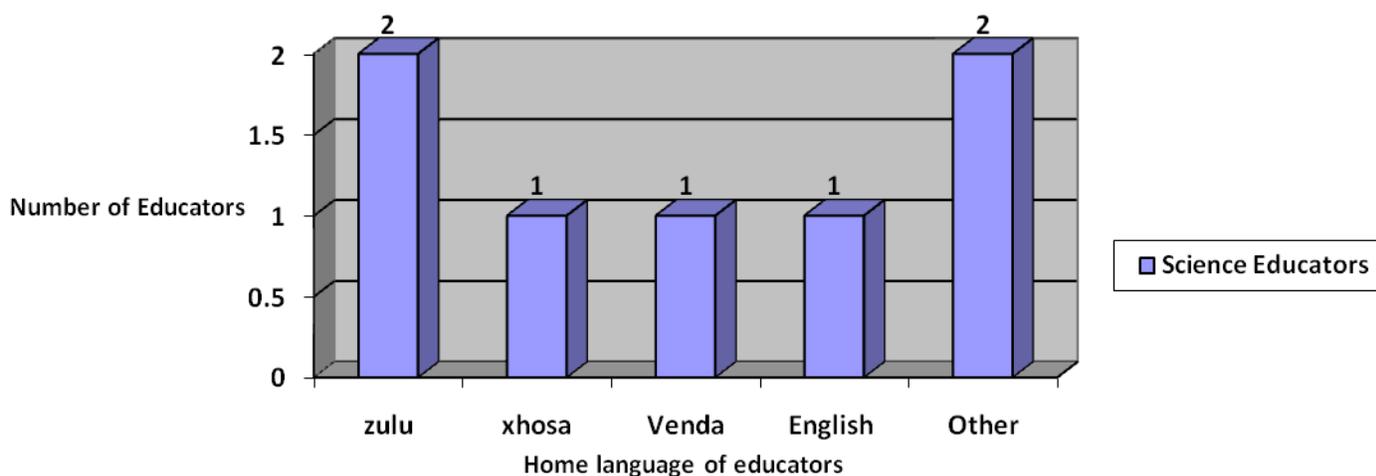


Fig 4.3 clearly shows the mother tongue of the educators, where two educators home language is Zulu, one is Xhosa speaking, one is Venda, one is English speaking and two educators speak other African languages. The richness in the educator language diversity made it easier to explore the challenges faced by science learners.

4.3.1.5 Educator qualifications to teach FET Science.

All educators indicated that they are well qualified to teach Science at FET level. From the options given on the questionnaire none of the educators indicated that they are unqualified or under qualified to teach FET level; which comprise of grade 10, 11 and 12.

4.3.1.6 Training with regards to bilingual /multilingual teaching.

Table 4.2 Educator responses regarding their training in bilingual and multilingual teaching

	Excellent training	Adequate training	Inadequate training	No training
Number of Educators	0	0	2	5

The responses of the educators showed that 2 have inadequate training in bilingual training and 5 indicated that they received no training at all regarding bilingual or multilingual teaching.

4.3.1.7 Need for in service training to teach science using English.

From the options given on the questionnaire none of the seven educators indicated that it is absolutely necessary or necessary to undergo in service training. All educators indicated it was unnecessary because they all trained teaching science using English language. The educators showed confidence in their English language competence.

4.3.1.8 Lesson presentation and code switching by the seven educators.

Fig 4.4 Pie chart showing lesson language presentation (N=7)

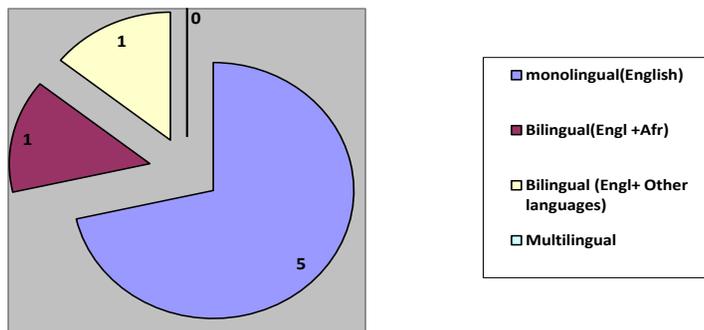


Fig 4.4 shows that 5 of the educators indicated that they use Monolingual English language to teach science concepts and 1 indicated use of bilingual English and other language to explain concepts and use it sometimes. Another 1 uses Bilingual English and Afrikaans and none of the educators use multilingual lesson presentation. Only 2 of the educators sometimes use code switching. The follow up question indicated that of the educators that use code switching all of them uses it sometimes and not in every lesson.

4.3.1.9 The proficiency of educators in English language.

Table 4.3 Educator proficiency in English language

	Totally proficient	Largely proficient	Slightly proficient	Not at all
Number of educators	4	2	1	0

The table above shows that 4 of the 7 educators indicated that they are totally proficient in English language, 2 are largely proficient and one indicated is slightly proficient in the English language.

4.3.1.10 Proficiency of educators in language structures, phonetics, morphology, syntax and semantics.

Fig 4.5 Educator English language structure proficiency (N=7)

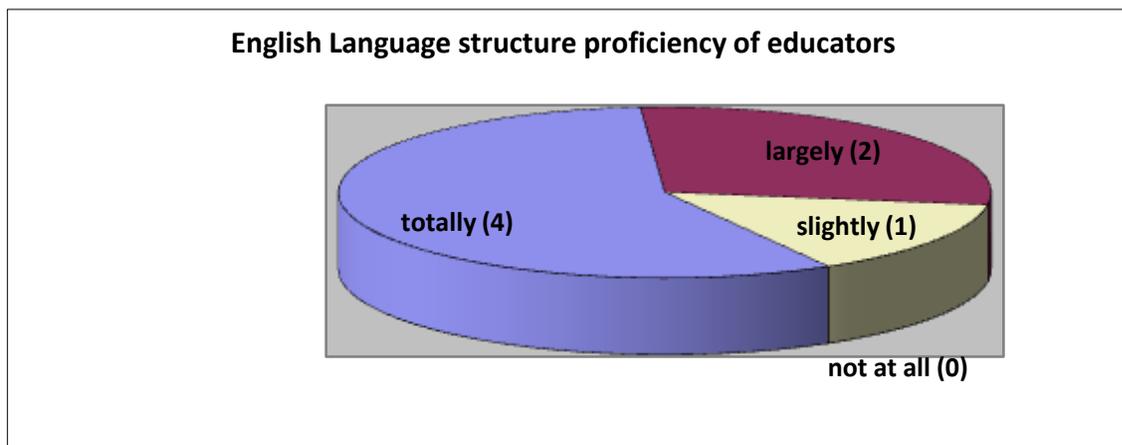


Figure 4.5 above shows that the educators who are totally proficient in language structures are 4, those who are largely proficient are 2 and only 1 indicated is slightly proficient in the English language structures. The proficiency of the educators made them the best respondents to answer certain questions based on English language structures that were presented in the questionnaires as well as in the interviews.

4.3.2 BIOGRAPHICAL DETAILS OF THE LEARNERS.

4.3.2.1 Learners participating in the study.

The learners who were purposefully selected as science learners and then 20% randomly selected are shown in the graph indicating their grades and gender.

Figure 4.6 Number of the learners participating in the research per grade by gender. (N=112)

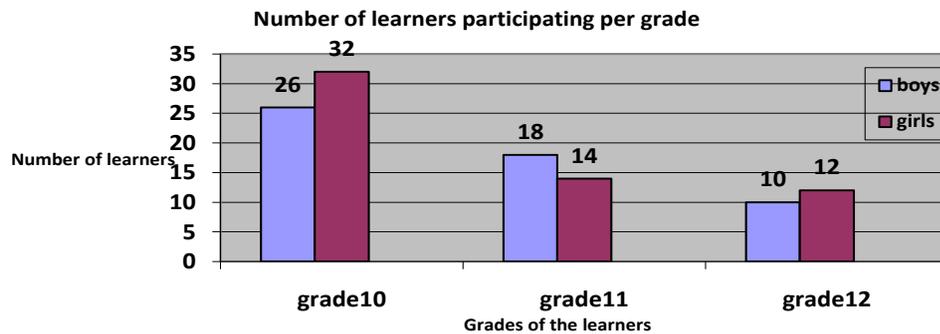


Figure 4.6 above shows that grade 10 learners who participated in this study were 58 of which 26 were boys and 32 were girls. Among the grade 11 learners they were a total of 32 where 18 were boys and 14 were girls. Participating grade 12 learners were twenty two (22) and comprised of 10 boys and 12 girls.

4.3.2.2 The age of the participating learners.

The ages of the learners who are participating were also taken into consideration in this study and the ages are given in detail in figure 4.7.

Figure 4.7. Age of participating learners (N=112)

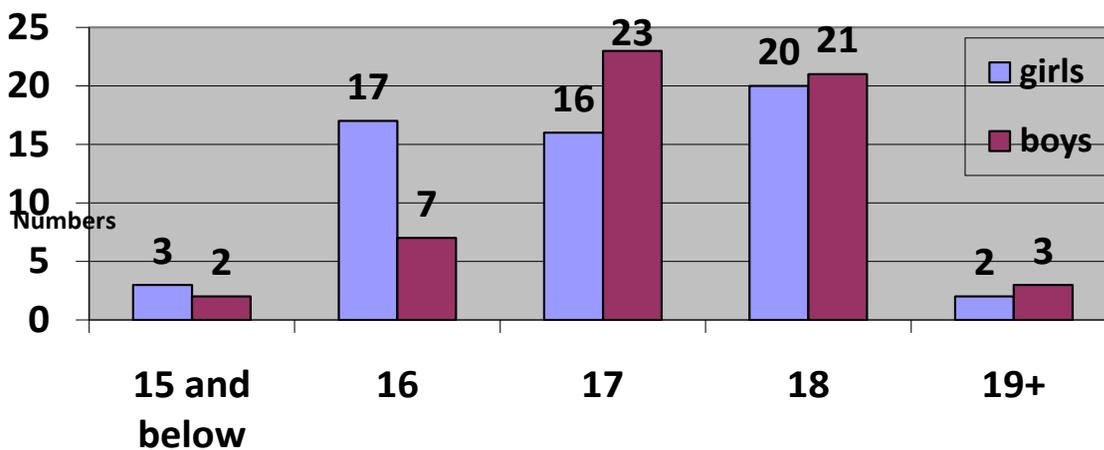


Figure 4.7 shows that the learners who participated in this study only 5 (3 girls and 2 boys) were either fifteen years or below. Seventeen (17) girls and seven boys (7) boys were sixteen years old (16 girls plus 23 boys =39 learners) were 17 years old. The learners who were eighteen years old were 20 girls and 21 boys and finally those who were nineteen years and above were only five 2 girls and 3 boys.

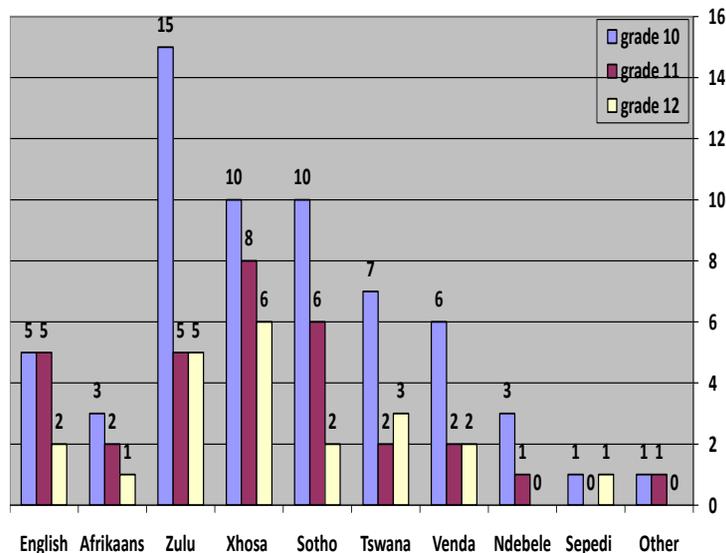
4.3.2.3. Language the learners were taught at primary.

The responses indicated that 99 out of 112 (88%) of all the learners used English language at primary school ,11% indicated they used Afrikaans and 1% indicated used Zulu at primary school. More analysis was done to those questionnaires where learners switched language from Afrikaans to English language. All learners were exposed to both English and Afrikaans at primary school.

4.3.2.4 Home languages of the learners.

Learners were asked their home language and their responses also helped in the purposeful selection of learners who would participate in the focus group interviews in the different grades covering all languages spoken in South Africa. The data gathered included the learner home language, the grade and gender and this information is presented in figure 4.8.

Figure4.8 Home language of learner respondents (N=112)



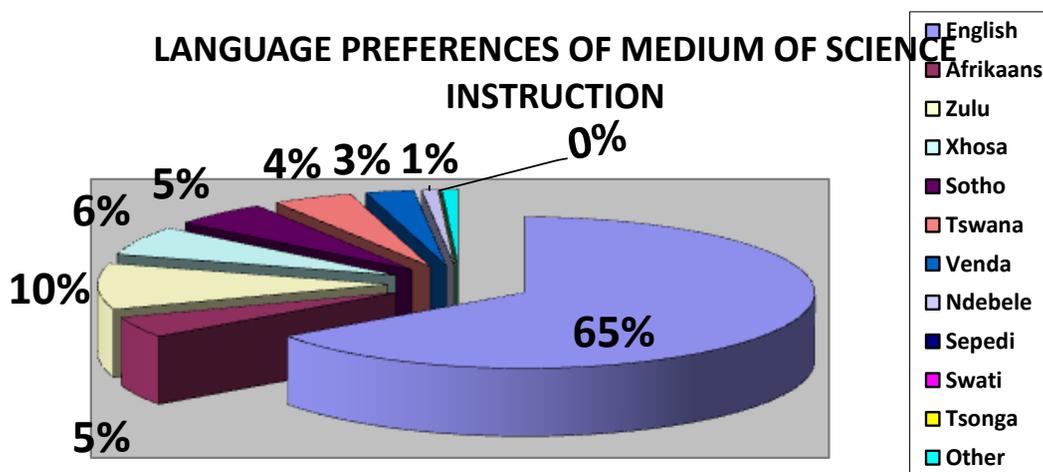
The bar graph 4.8 above shows that there were 12 English home language learners five from grade 10, five from grade 11 and two from grade 12. Six learners home language is Afrikaans of

which three are in grade 10 two in grade 11 and one in grade 12. Twenty five learners are Zulu home language speakers. Twenty four are Xhosa, eighteen Sotho, twelve Tswana, ten Venda, four Ndebele, one Sepedi and two other home language speakers among the learners who participated in the research. The richness in language diversity made the research to be in a position to identify many of the challenges learners face across the spectrum of languages.

4.3.2.5 Language preference by learners.

The learners were asked the language they prefer to be taught science and in as a medium of instruction.

Figure 4.9 Learner preferring to be taught science in different languages (N=112)

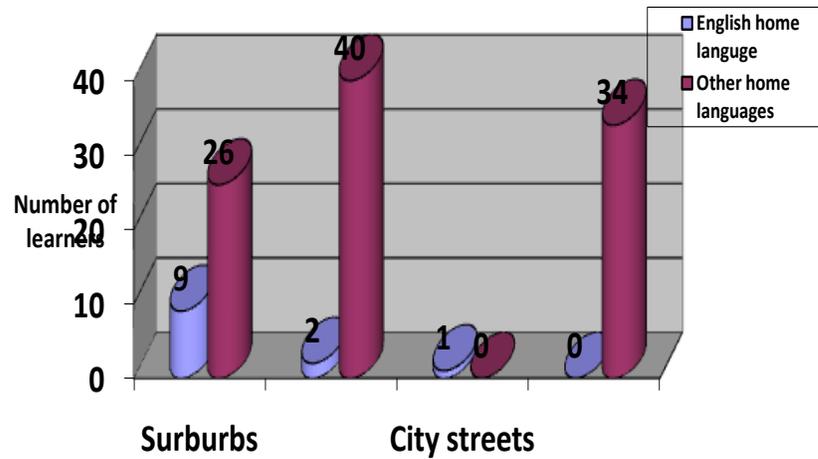


73 of the 112 learners (66%) of the learners preferred to be taught science using English language 4% preferred Afrikaans to be used, 10% preferred Zulu, 6% Xhosa, 5% Sotho, 4% Tswana, 1% Ndebele and 1% other. This clearly shows that majority of the learners want science to be taught using English language.

4.3.2.6. Type of residential areas for learners.

The graph below shows the residential areas the respondent learners come from. The graph shows the learners whose home language is English and those learners whose home language is not English.

Figure 4.10: Showing residential areas of learners (N=112)



The above graph shows that those learners whose home language is English 9 stay in the suburbs 2 in the townships and one in the city streets and none stay in the informal settlements. The learners who speak other home languages 26 live in the suburbs 40 live in the townships and 34 live in the informal settlements.

SECTION B

4.4 CHALLENGES OF USING ENGLISH IN LEARNING SCIENCE:

LEARNER AND EDUCATOR RESPONSES

The following analysis indicates the responses from the learners and the educators and these responses were mainly from the questionnaires as well as the focus group interviews. The responses of the learners and educators were put in the tables and bar graphs and comments follow thereafter on the findings. The educator and learner responses revealed the challenges learners face in learning science using English as a medium of instruction.

The learner and educator responses are grouped according to the challenges identified in the literature review. The questionnaire tried to assess some of the experiences and challenges faced by learners as revealed in the literature. Room was also left to identify some of the

challenges and experiences the learners face besides those mentioned in the literature review. Due to the wide spectrum of challenges faced by learners as identified in literature, it was not possible to study all of them. For the purposes of this study the following seven challenges were analysed.

1. Challenges posed by limited academic language proficiency.
2. Challenges posed by technical and non technical language of science.
3. Challenges with regards to foundations of language acquisition.
4. Challenges and experiences with basic interpersonal communication skills (BICS) and cognitive language proficiency (CALP).
5. Challenges posed by learning principles.
6. Challenges posed by bilingualism/multilingualism and code switching.
7. Difficulties faced after language switching or language change.

4.4.1 CHALLENGES POSED BY LIMITED ACADEMIC LANGUAGE PROFICIENCY.

The challenges learners face based on limited academic language proficiency as identified during preliminary investigations include the following: learners do not benefit much when learning science in English ,learners have limited academic language proficiency, learners lack understanding of English academic language, learners fail and under achieve due to use of a language which is not their home language or mother tongue, English home language helps to understand scientific terms, comprehension becomes easy when English is the learner's home language.

A number of questions were asked to learners and the educators in the questionnaire and in the focus group interviews regarding challenges faced due to limited academic language proficiency.

4.4.1.1 English language benefits in science learning.

In order to understand this challenge and their experiences the learners were asked if they benefit more if taught in English or their home language based on their past or current experiences.

Table 4.4 Responses of the learners (N=112) and educators (N=7) on how learning science using English is beneficial to the learners.

Learning science in English is beneficial to learners	Educators	Learners	Total Number of responses (educators learners)	Response percentages
Strongly disagree	0	7	7	5.9%
Disagree	0	20	20	16.8%
Agree	2	63	65	54.6%
Strongly agree	5	22	27	22.7%
Total	7	112	119	100%
Missing	0	0	0	0%

From the table above all the seven educators and 78 learners which indicate (54.6 +22.7=77.3%) agreed that English is beneficial to the learning of science. None of the educators and only 22.7% of the learners' responses indicated that learning in English language was not beneficial to them. The results from table 4.4 clearly show that majority of the learners and all the educators interviewed believe that English language benefit learners if they are learning science.

The focus group interviews revealed that those learners who believed that English language is beneficial further said that;

NB: For all interviews learners per group (grade 10, 11 and 12 were assigned numbers 1-6 and educators assigned letters A to G. Detailed responses from both the learners and educators are recorded in the transcripts in ANNEXURE C.

- Learner 1(10): *"We always speak English in class and we understand it very well."*
- Learner 2(10): *"I enjoy speaking English with my friends and I understand more when we discuss science"*

- Learner 3(10): *“The scientific world mainly communicates in English and majority of textbooks are in English and other languages especially African languages do not have scientific textbooks and this will limit the full learning of science”*.
- Learner 5(10): *“This is an English world and without learning in English it will be something else.”*

One learner in the focus group interview indicated that they did not benefit much the time they have been taught in other languages as one learner commented

- Learner 5(11) *“From our experience at primary we did not benefit much when we were taught science in other languages”*.

The rest of the grade 11 learners however said that they benefit when taught in English.

- Learner 1(11) *“We always benefit when taught in English I think only in a few cases that’s when we don’t benefit.”*
- Learner 3(11): *“We benefit a lot in English than if we learn in any other language.”*
- Learner 3(12): *“I cannot imagine being taught life science in Zulu some things will not make sense at all.”*

One learner who have a background in Afrikaans strongly dis-agreed to this question and she learner said;

- Learner 6(12),” *Those learners who learn using Afrikaans and their home language is Afrikaans actually pass science very well.”*

The learner cited examples of the schools whose language of teaching and learning is Afrikaans and their pass rates in science subjects is always high.

In the focus group interviews educators agreed that a large percentage of learners are not competent in English. One of the educators said;

- Educator A” *If learners are not competent in English language it does not necessarily means they will be competent in their home language and furthermore may not benefit if they learn science in their home language. What they need is to become proficient in their*

home language or English language first and then they will understand science language”.

The rest of the educators responses are shown below;

- Educator B: *“English language as I see, it is rich in vocabulary and there are so many words that English use which, in our African language there are no words for such.”*
- Educator D: *“I totally agree (with educator B) African languages are limited in most cases scientific definitions cannot be translated to speed and velocity we use the same word in my language.”*
- Educator E: *“If it be that the learners should learn science using another language they should have started learning it from primary school for easier transition. If learners start using maybe Zulu now it will not benefit them at all. I have the opinion that English is the language that will definitely benefit learners.”*
- Educator G: *“English is a universal language and we prepare learners into that world where they interact in English, even if they may not benefit much now but in the long run they will benefit.”*

The statement erred by the learners and educators seemed to corroborate what literature says especially (Haynes, 2009). To a greater degree as indicated by the interviews and questionnaire both educators and learners have a sense that English language benefits them in the learning of science.

4.4.1.2 Limitations in academic language understanding.

A second question which helps to explore challenges faced by learners due to limitations in academic language proficiency was, *“Do learners have limited academic language understanding?”* This question was selected based on literature search and from preliminary interviews conducted with educators. Educators pointed out that the learners cannot comprehend and understand scientific concepts due to limited academic language understanding. For further understanding of this challenge the questionnaire was given to learners and educators and the results are recorded in table 4.5 below showing learner (N=112) and educator (N=7) responses if learners have limited academic language understanding.

Table 4.5. Academic language understanding

Learners have limited academic language understanding	Educators	Learners	Number of learners and educators	Learners and educators percentages
Strongly disagree	0	27	27	22.7 %
Disagree	2	30	32	26.9 %
Agree	2	32	34	28.6 %
Strongly agree	3	23	26	21.8 %
Total	7	112	119	100 %
Missing	0	0	0	0 %

Table 4.5 clearly shows that (32+23=55) of the 112 learners have the view that, majority of the learners have difficulties in learning science because they have limited academic language understanding. (27+30=57) learners and 2 educators disagree and believe that they have adequate academic language to understand science concepts. The numbers of learners who agree and those who disagree in this case are almost the same. From these responses 5 out of the 7 educators indicated that majority of the learners have limited academic language proficiency. The differences in the responses of educators and learners may be attributed to the fact that educators have wide experience on judging academic language understanding compared to the learners.

Some of the responses from the focus group interviews are shown below: Learners were assigned numbers 1 to 6 and grade is given in brackets (10), (11) or (12)

- Learner 1(10): *“We do not have adequate academic language.”*
- Learner 3(10) *“We always struggle to understand what is written in science books.”*
- Learner 5(11): *“Most learners struggle to understand simple English what about the academic language.”*

- Learner 2(12): *“The language that we have is the one we use in general talking not in academic language.”*
- Learner 4(12): *“As learners we struggle with simple language in our English lesson then when it comes to academic language in science we suffer a lot.”*

It seems nearly every one of the learners in the interviews showed that learners have limited academic language proficiency. These views from the learners also corroborated the views of the Educators; some of the responses of the educators are shown below. Educators were assigned letters A to G.

- Educator B: *“Definitely learners have limited academic language understanding, this is revealed by learner responses in general talk in the class. At times you ask one question and the learners answer something else that we fail to understand as teachers.”*
- Educator D: *“That is very true even if it’s written work that is asked in science there is no coherence in some of the things the learners write, if we closely look at it we see that its more on not understanding the academic language of science. I think if some of the questions are further simplified they can easily answer the questions.”*
- Educator E: *“Those learners who have a rich English vocabulary at times lack the academic language understanding.”*
- Educator F: *“The learners do not have adequate academic language competence this is very evident in their written work, some are very fluent when talking but the written work is something else.”*

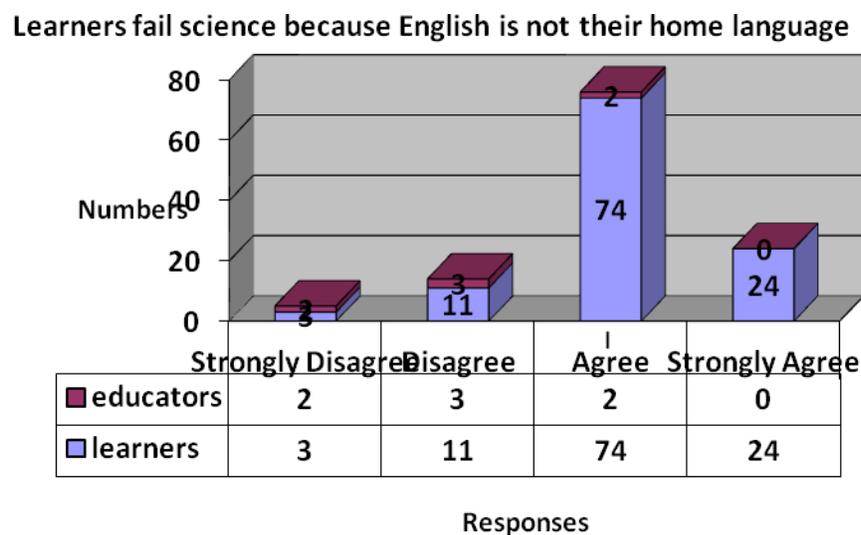
The above results from both the learners and educators seem to suggest that learners lack academic language understanding. The questionnaire from the learner responses however did not show a clear indicator whether they lack academic language understanding because their responses were almost equal between those who agreed and those who disagreed. Educators’ responses in the questionnaire showed clearly that the learners are challenged in academic language understanding.

4.4.1.3 English language and failure in science.

A third question to explore on challenges in lack of academic proficiency was asked and it said that “Do learners fail science because English is not their home language”. This question was chosen because in most cases there is an assumption that learners are competent in their home or mother tongue language and not highly competent in a second or third language .The question was asked in the questionnaire so as to see if these corroborate the interview and literature.

Figure 4.11 Responses on the statement” learners under achieve or fail because their home language is not English”.

Educators (N=7) Learners (N=112)



Graph 4.11 responses reveal that (11+3=14) learners and 5 educators disagreed to the statement that, “learners’ under achieve or fail because their home language is not English”. The rest of the learners (74+24=98) and only 2 educators agreed that learners fail if their home language is not English. From these results it seems educator views differ from those of learners mainly because the educators have more experience on the type of learners they teach.

Responses from the interviews are given below (see Appendix C).

- Learner 2(10): “Some of the English words used are difficult, we only understand the when we revise the test with the teacher.”

- Learner 4(10): *“We always fail science because of English.”*
- Learner 5(10): *“When we are asked some science questions in my language I answer very fast but when asked in English I have to think.”*

The learners during interviews also revealed that not being exposed to English language in all spheres of life have a negative impact on understanding science. One learner commented

- Learner 2(11): *“We are highly challenged in science because we are taught in a language that we don’t speak at home or with our friends and we have to understand the language first before we start to understand science itself”.*

Learners whose home language is not English were the ones who believed that being taught in a second language contribute to their failure. Focus group interviews with learners showed that the learners whose home languages are African languages share the sentiments that failing is partly blamed to the use of English only in teaching and learning of science (Appendix C).

One of the learner interviewee, an English home language speaker disagreed to sentiments of the other learners and said

- Learner 3(12): *“ Even if your home language is English you can fail science, I think there are no added advantages .The underlying principle is understanding the scientific principles and applying them furthermore mathematical understanding is crucial in science learning”.*
- Learner 5(12): *“I agree with (learner 3), I also have a friend who is English speaking but his marks are always lower than mine.”*

Educators said that,

- Educator E:” *Even if learners home language is English they may fail science because it is not a linguistic subject but requires scientific approach and furthermore science has its own language just like mathematics”.*
- Educator F : *“Failure of learners cannot be attributed to the language used to teach them that’s why even the best English speakers fail, its only due to lack of understanding of scientific concepts.”*

The results above indicate that from the interviews majority of learners believe that English a second or third language contributes to their failure. These views were especially backed up by nearly all grade 10 and 11 learners during the interviews. Grade 12 learners and educators however showed a different perspective that it's not always true that learner fail because they use a language which is not their home language.

4.4.1.4 English home language and comprehension of scientific terms.

Question 4 was asked so as to gather the learners experiences on the comprehension of the scientific terms as well as their views on how English home language affect learner comprehension in science .

Responses on the question “The learners whose home language is English comprehend scientific terms very well” are shown in table 4.6 below.

Table 4.6 English home language and comprehension, Educators (N=7) Learners (N=112)

The learners whose home language is English comprehend scientific terms very well	Educators	Learners	Total Number of responses	Response percentages
Strongly disagree	0	3	3	2.6%
Disagree	0	4	4	3.4%
Agree	2	6	8	6.8%
Strongly agree	5	97	102	87.2%
Total	7	110	117	98.3%
Missing	0	2	2	1.7%

The above table 4.6 clearly shows that 5 educators and 97 learners strongly agree and 2 educators and 6 learners agree that those learners whose home language is English language comprehend scientific terms very well .There were no educators who disagreed and there were

only 7 learners who disagreed to this statement. Two learners did not fill this part of the questionnaire. From the learners responded those whose home language is not English strongly agreed to the statement in the questionnaire? The reason why 103 of the learners agreed to this statement is likely to be that they have observed their English home language peer learners articulating themselves very well. All educators agreed maybe because of their experience teaching learners of different home languages and this was supported by the interviews conducted.

This question was further asked in the focus group interviews and the learners also expressed the following views presented below:

- Learner 2(10): *“If you are good in English comprehension becomes easy also.”*
- Learner 3(10): *“It is totally true the more you understand English language then it becomes easy to comprehend science.”*
- Learner 1(11): *“Learners who are good in English if you see their marks also have high marks in science.”*
- Learner 6(11): *“We have been taught comprehension in English lesson and this greatly benefited most of us in all other learning areas including science.”*
- Learner 4 (12): *“There is direct proportionality between English language comprehension and science comprehension.”*
- Learner 5(12): *“I strongly agree there is a strong relationship.”*
- Learner 6(12): *“Only those English home language speakers who are good in the written language may be good in comprehension of science.”*

The majority of the educators also showed that they believe that English home language learners who have good comprehension skills have a greater chance of understanding and comprehending science. Some of the responses are shown below;

- Educator B: *“if learners understood English terms very well and not necessarily being their home language they will end up comprehending scientific terms better.”*

- Educator C: *“Most learners who are English home language speakers have exposed more to the language hence their comprehension is better in comparison to those who have other home languages. The comprehension of science however does not translate to passing science”*

The results in table 4.6 shows that both educators and learners concur and according to one educator;

- Educator G:” *For the years that I have been teaching almost $\frac{3}{4}$ of the high achievers have a good English background or their home language is English”.*

Both learners and educators have the view that learners who are English home language speakers can easily comprehend science. From the interviews it appeared that those learners who can comprehend English language regardless of their home language are also in a position to comprehend science.

This section 4.5.1 has revealed that limited academic language proficiency is a challenge to learners and it contributes to limited understanding of science concepts. The empirical evidence in this section corroborated literature and it can be concluded that FET science learners face some challenges with academic language proficiency.

4.4.2 CHALLENGES POSED BY TECHNICAL AND NON TECHNICAL LANGUAGE OF SCIENCE.

Codes

Preliminary investigations revealed that the challenges based on technical and non technical language of science emanate from the following, not understanding scientific technical language (USL), difficulties with non technical terms (NTT), challenges with technical science academic language (TAL), the use of cognitively demanding science academic language (ALD) and unfamiliarity with technical non technical academic language (UTT).

A number of questions were developed from both literature search and from the initial interviews with educators and learners. The results from the questionnaire are given in the table 4.7 below. The first item was, Learners face difficulties understanding non- technical language of science,

the second item was: learners lack understanding of academic language, the third one was: science academic language is cognitively demanding and learners don't understand it. The final question was: learners face difficulties in understanding Science academic language. Both educators and learners were supposed to respond to one of the choices on the Lirkert scale. Science has a lot of technical language and also non technical terms wherein a good number of learners find difficulties in understanding and applying this language. In an effort to find out the learners' challenges and experiences with technical and non technical language questions were drafted for the questionnaire and the results are shown in the tables and graphs below.

The table below shows five of the items which show the challenges posed by technical and non technical terms used in science teaching and learning.

Table 4.7. Technical and non technical language responses, Learners (N=112) Educators (N=7)

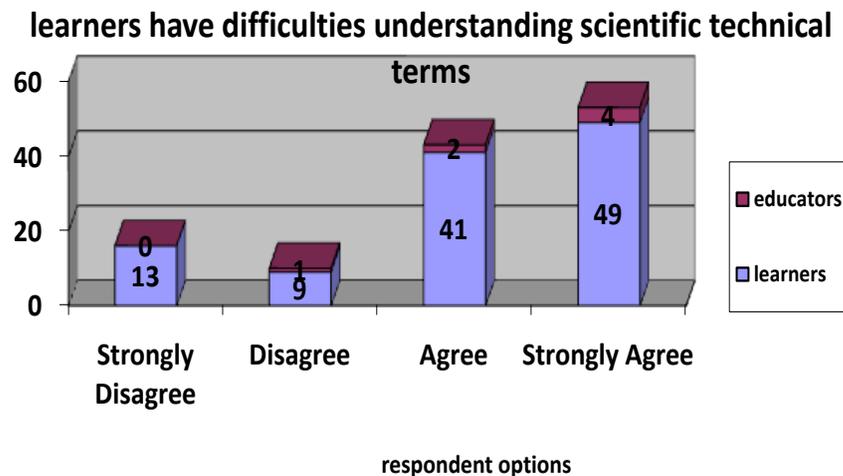
Item description	Strongly Disagree		Dis Agree		Agree		Strongly Agree		Total	
	learner	educator	learners	Educators	learners	educators	learners	educators	learners	educators
1 Learners face difficulties understanding scientific technical terms.	13	0	9	1	41	2	49	4	112	7
2.Learners face difficulties understanding non-technical language of science	4	0	14	1	54	2	40	4	112	7
3. Learners lack understanding of academic language.	11	1	7	1	47	2	47	3	112	7
4. Science academic language is cognitively demanding and learners don't understand it.	4	0	7	1	33	2	68	4	112	7
5.Learners face difficulties in understanding "unfamiliar" Science academic language	9	0	25	1	63	4	15	2	112	7

4.4.2.1. Difficulties in understanding scientific technical terms.

The first question asked in order to gather the challenges faced by learners due to technical and non technical language of science was, “do learners have difficulties understanding scientific technical terms”?

Graph 4.12 below shows numbers of learner (N=112) and Educator (N=7) responses per option to the statement that, Learners have difficulties understanding scientific technical terms.

Figure 4.12 Understanding of scientific technical terms responses.



The above bar graph indicates that majority of the learners 41+49=90 learners and 6 out of the 7 educators agreed that learners face difficulties in understanding scientific technical terms. Only one educator and 13+9=22 learners did not agree to the statement. The results seem to suggest that majority of the learners face difficulties understanding scientific technical terms.

The focus group interviews clearly showed that scientific technical language highly challenges learners and some responses included the following; (see Annexure C).

- Educator C: “These terms are not used in their daily situations and are taught in a second language to most science learners’ .This results in learners being overwhelmed by new words, terms and language that is so unfamiliar to them.”

- Educator F: *“Scientific technical terms are not used in everyday situations in the life of learners. These terms come as new language to them in addition to the non technical terms they don’t understand”*.
- Educator G *“Technical language include concepts like mass, force, weight and learners are challenged in using these because in different African languages mass and weight can be used interchangeably which is scientifically incorrect. Power work and energy are usually confused by learners due to the fact that the ways they use them in everyday language differ from the scientific definitions”*.

Learners revealed that they see most of these terms for the first time at high school as indicated by the learners. Some responses are as shown below;

- Learner 1(10) *“We see most of these terms first time at high school”*,
- Learner 2(10) *“I want to agree with (learner 1) for a fact that these technical and non technical language and terms we only meet them now in high school but at primary we never met them ,they are so unfamiliar to us. This will result in us failing also because actually we are meeting new things for the first time”*.
- Learner 5(10): *“The terms are difficult to remember.....”*
- Learner 6(10): *“Most tests when asked scientific one word items we have to cram them to pass.”*
- Learner 1 (11): *“Some scientific terms are easy to remember and understand but majority are difficult.”*
- Learner 3(11): *“New language is difficult to grasp.”*
- Learner 4(11): *“We have to read over and over to understand them.”*
- Learner 6(11): *“Scientific term we were introduced in grade 8 we still remember them but those from grade 10 and now(grade 11) we don’t remember that much”*

Both educator and learner contributions in the interviews seemed to corroborate the questionnaire findings. There is an agreement between learners views and educator views that

scientific technical terms are difficult to the majority of the learners thus they are highly challenged in this regard.

4.4.2.2 Difficulties in understanding non- technical language of science.

From the table 4.7 above item 2 (54+40=94) of the learners agreed that learners face difficulties with the non technical language ,and (4+14=18) learners have the view that they have no difficulties dealing with non technical terms used in science learning. The majority, six of the educators seem to agree with 94 of the learners as 6 out of 7 educators agreed that learners face difficulties understanding non –technical language of science.

During focus interviews both learners and educators seem to agree that learners' face challenges regarding the non technical terms .Some of the responses are shown below (see Annexure C).

- Learner 3(10): *“Both the technical and non technical terms are difficult to me.”*
- Learner 4(10): *“language in science has too many terms which are confusing.”*
- Learner 1(11): *“As long as we do not have wide English vocabulary non technical terms will always be difficult.”*
- Learner 5(12): *“English has many words that we don’t understand and when used in a science class as non technical terms we further get very confused.”*

Responses from educators are shown below;

- Educator A: *“Learners are not challenged in non technical language rather they simply don’t read or take time with their books; those who read regardless of their home language will definitely not be challenged.”*
- Educator B: *“non technical language helps learners to understand the concepts in science, most learners lack this language and it becomes very difficult for them to conceptualise science facts.”*
- Educator C: *“this language is closely related to technical terms if a learner does not know one it is difficult to understand the other”*

- Educator D: *“Difficulties are inevitable if English language is not a home language to the learner.”*
- Educator E: *“Technical and non technical terms are very difficult to distinguish to non English speakers.”*
- Educator F: *“Learners should practice more in both language definitions and scientific definitions in order to increase their terminology base otherwise they are highly challenged in non technical terms.”*
- Educator G: *“Challenges are faced in both technical and non technical language equally.”*

From the interviews and the questionnaire above only one educator indicated that learners are not challenged with non technical terms. All the other educators B, C, D, E, F and G all indicated that learners face challenges with non technical terms. The comments and the results from the above table 4.7 all corroborate literature for example according to (Cassels and Johnstone, 1985) ,non technical terms are amongst the 95 most difficult for secondary school learners and their meaning in a scientific context is rarely well understood.

4.4.2.3 Academic language understanding.

Item 3 in table 4.7 above shows that 5 out of 7 of the educators and (47+47=94) of the learners agreed that learners lack academic language. On the contrary only (11+7=18) learners and 2 educators did not agree to the statement. There is a strong relationship between learner responses and educator responses due to the fact that a large amount of learners use simple language instead of the academic scientific language.

Some of the responses which emerged from the interviews conducted with the learners are shown below:

- Learner 3(10): *“We face difficulties in English itself what about academic language...?”*
- Learner 2(11): *“Normal English we understand better but that used in life science and physical science is hard”.*
- Learner 3 (11): *“We may hear in class some of the language but some we don’t and we always ask what some words mean every time”*

- Learner 1(12): *“Simple language should be used for us to understand”.*
- Learner 5 (12): *“Academic language is difficult compared to English language we use on a daily basis.”*

The above results show that those learners’ who lack understanding in academic language are highly challenged in the context of this study. Five of the educators and 94 learners have the view that the learners are highly challenged and this is corroborated by both literature and questionnaire responses.

4.4.2.4 Cognitively demanding Science academic language.

“Science academic language is cognitively demanding and learners do not understand it”, were sentiments shared by (33+68=101) out of 112 learners and also 6 out of 7 educators in table 4.7 item 4. In overall this gave a percentage of 90% of which 72 of the responses strongly agreed. Only 10% of all learners, educator responses (12) did not share the same sentiments given in the statement.

The results suggest that majority of learners face challenges in understanding academic language because it is cognitively demanding. The results corroborate the interview findings and some of the responses are given below; see (Annexure C).

- Educator A: *“There is a lot required in science academic language higher order thinking is required and we need to apply that.”*
- Educator G: *“Most learners obtain low marks in science because the language used in science is more challenging and provokes a lot of thinking compared to other learning areas.”*
- Learner 3(12): *“Questions that need application are so difficult we need those questions which we have seen in class.”*
- Learner 4 (11): *“At times when we read the textbooks we do not understand a thing unless our teachers explain in simple language.”*
- Learner 5(10): *“Academic language is for the clever for others it is difficult.”*

Results from both the above table 4.7 and the interviews all suggest that learners are challenged with the academic language because it is cognitively demanding. Educators mentioned words like “higher order thinking, provokes thinking” which is an indicator of difficulties faced.

4.4.2.5 Difficulties in understanding “unfamiliar” Science academic language.

From table 4.7 item 5 it shows that (9+25=34) out of 112 learners and only one educator refuted the statement that learners face difficulties in understanding “unfamiliar” science academic language. (63+15 =78) learners and 6 educators agreed to the statement of which 16 of these responses strongly agreed.

The focus group interviews revealed that both learners and educators view that science academic language is unfamiliar to a good number of learners and they do not understand it. The responses of the learners and educators are shown below:

- Educator C: “*Science academic language is taken as difficult by learners and they close their minds from understanding it.*”
- Educator D: “*Most of my science learners when they meet unfamiliar science language they seem to quit and leave the question only to say we knew the answer when I revise re explaining the terms.*”
- Educator E: “*Those learners whose home language is not English are highly challenged more than those who are English home language speakers.*”
- Learner 1(10): “*There are a lot of difficult things that are not familiar.*”
- Learner 2(10): “*It is true I agree with (learner 1).*”
- Learner4 (11): “*As I said earlier on some of the academic language is totally new and we meet these for the first time at high school.*”
- Learner 6(11): “*We do not understand these unfamiliar terms unless the teachers explain them.*”

These results are consistent with researchers like (Maznah and Zurida, 2006) whose studies indicated that technical language of science posed a problem of familiarity and more acute

problems were found in the use of science normal familiar language in a highly specific often-changed and unfamiliar way.

This sub section 4.5.2 empirical evidence seem to point to the conclusion that the FET Science learners in question are challenged in both technical and non technical term use in the learning of science.

4.4.3 CHALLENGES FACED BASED ON FOUNDATIONS OF LANGUAGE ACQUISITION.

Codes:

Poor language acquisition (LA), Use of symbols in science differ from what the learners acquired (LS), Confusion generated by new scientific language (NSL), Frustrations with terminology (T), scientific jargon (SJ), Difficulties with pronunciations (P), Challenges with understanding meaning of words (MW), Problems understanding syntax (word order) and semantics (meaning of sentences (USS), comprehension and understanding meanings of scientific terms. Frustrations brought by failing to get meanings in English texts which are unfamiliar (ME).

Foundations of language acquisition according to (Miller and Gillis, 2000) comprises of phonology, morphology syntax and semantics, phonology which forms the first level of language where any alphabetic language consists of symbols that represent the sounds of the language. This question was chosen so as to understand the challenges learners face with the first level of language acquisition. The statements formulated from the literature studies are shown in table 4.8. Item 4 in the table is based on morphology which is the second level of language that gives clues to meaning of words and an indication as to where these words fit into in a sentence. The fifth item in table 4.9 was developed from (Miller and Gills, 2000) levels three and four of language acquisition. The third level of language is the syntax which involves word order that leads into sentence structure. Semantics is the fourth language level which puts words together in order so that they form a sentence which has meaning thus comprehension becomes evident. The challenges and experiences were analysed from the specific challenges were gathered using the questionnaire and focus group interviews.

The table below shows the responses of the learners (N=112) and educators (N=7) on the challenges posed by foundations of language acquisition.

Table 4.8 Foundations of language acquisition responses.

Item description	Strongly Disagree		Dis Agree		Agree		Strongly Agree		Total	
	learners	educators	learners	Educators	learners	educators	learners	educators	learners	educators
1. Learners show poor English language acquisition.	7	0	10	0	62	4	33	3	112	7
2.Learners get confused by the use of symbols in science	12	0	10	1	70	2	20	4	112	7
3. Scientific jargon/terms frustrates learners when learning science	9	1	37	1	53	2	13	3	112	7
4. Learners find it difficult to listen and understand English due to its pronunciation which differ with their home languages	17	0	7	3	60	2	28	2	112	7
5. Learners are proficient and understand meaning of words.	20	4	75	2	7	1	10	0	112	7
6. Learners are proficient in syntax (word order) and semantics (meanings of sentences).	5	0	54	5	39	1	14	1	112	7
7.Knowing the meaning of scientific terms help learners to comprehend and answer questions correctly	5	0	7	1	53	4	47	2	112	7
8. Unfamiliar academic terms in science contribute to learners becoming overwhelmed by unknown words.	17	1	12	1	30	2	53	3	112	7
9.Learners are frustrated by failure to see meaning in English texts and resort to rote learning or cramming	1	0	23	3	13	1	75	3	112	7

4.4.3.1 Poor English language acquisition.

For an in-depth understanding on challenges faced due to language foundations a question was phrased in the questionnaire and further asked in the focus group interviews. Table 4.8 items one shows that all the seven (7) educators agreed that learners show evidence of poor language acquisition. The learners on the other hand had mixed opinions indicated by (7+10=17) who disagreed to the statement. The majority of the learners (62+33=95) out of the 112 learners all agreed or strongly agreed to the statement. These results seem to suggest that 95 of the 112 learners' background were negatively influenced by poor English language acquisition.

Responses of the learners during interviews suggested that most learners are challenged because of poor language acquisition. Some responses are shown below:

- Learner 2(10): *"Our foundations in English were poor; we only started speaking English in grade 3."*
- Learner 4(10): *"Most of my teachers were not good in English".*
- Learner 3(11): *"Teacher even up to grade seven (7) liked to speak and teach in Zulu".*
- Learner 6(11): *"I acquired all my English skills from home and school all my primary teachers used English at times Afrikaans."*
- Learner 5(12): *"At home we speak Xhosa with my friends Zulu; I only speak English at school even at primary".*
- Learner 6(12): *"I never understood English grammar or comprehension at primary".*

Educators also reported that majority of learners showed that their language acquisition skills suffered at some stage at primary schooling.

- Educator D: *"Most scientific statements of learners lack coherence an indicator that their language acquisition skills in English were poor."*
- Educator E: *"If learners' foundations in English are poor they always switch to their home language when speaking and this is evident with majority of my learners."*
- Educator G: *"Sentence structures of most learners especially those who are not English speakers show a lot of errors which point to poor English language acquisition."*

The responses in the table 4.8 and the interview responses seem to corroborate each other and the reasons are mainly based on primary school learning which they believed “was void of the skills required”.

4.4.3.2 Use of symbols in science.

The second question asked in the questionnaire under the challenges faced with foundations of language acquisition was to investigate if learners are confused by the use of symbols in science .Science as revealed from literature review has several symbols that are used and most of them are there to simplify the content, however some learners end up being confused with those symbols.

Graph 4.13 below shows responses of both learners (N=112) and educators (N=7) on the question, “if the use of symbols in science confuses learners.”

Figure 4.13 Use of symbols in science.

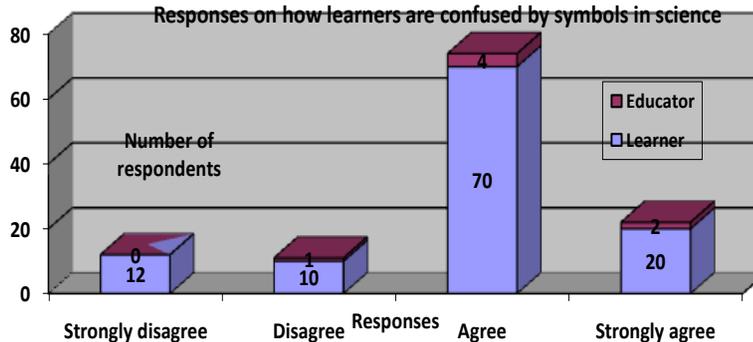


Figure4.13 shows that 90 learners agree to the statement that symbols used in science are confusing to learners and this number includes 70 agreeing and 20 strongly agreeing to the statement. Only (12+10=23) learners did not agree to the statement that learners get confused by symbols used in science. Majority of the educators 6 out of 7 agreed to the statement and only one educator disagreed. The results suggest that learners have experienced confusion with the symbols used in science. The above graph 4.13 shows majority of both educators and learners emphasising that symbols in science result in confusion.

The focus group interviews also showed the same trend as shown by some of the interview responses below;

- Learner 2(10):*“I think that the symbols used in science make life easier for us because it simplifies complex things. If we look at the periodic table they use symbols for the elements some which are difficult to remember but symbols help a lot.”*
- Learner 3(10) :*“It is true that symbols used in science make things better and if we look at the formulas’ that we use in physics all are symbols which help us to calculate. I however do not agree totally with--- (learner 2) because some of the symbols are difficult to understand like the sigma ohms and many other symbols which confuse learners.*
- Learner 1(11):*“There are too many symbols and scientific terms that we are continuously given especially life science and physical science, it becomes so difficult to remember most of them.”*
- Learner 4(12):*“Personally I think that symbols make science difficult as most of the symbols are used in mathematical operations, this makes physical science to be more difficult as it becomes more similar to mathematics.”*

The rest of the responses from the other learners in the focus group interviews indicated that symbols make science difficult. These studies suggest that learners are highly challenged due to the presence of symbols in science.

Educators reasoning was that symbols actually make science easier but the learners however face confusion. Some educator comments are shown below;

- Educator A: *“Those learners who are mathematically inclined show no confusion because maths is full of symbols”*
- Educator B: *“Nucleic acids for DNA and RNA even test crosses in genetics are simplified using symbols but I have seen that most learners fail these topic and this clearly indicates that symbols confuse them.”*
- Educator F. *“Learners are challenged by symbols to a greater extent though they should help them understand better. Consider periodic table of elements, they do better in writing word equations but fail symbols equations.”*

These results in section 4.5.3.2 from both the questionnaire responses and interviews clearly show that both learners and educators have the view that learners face challenges with the use of symbols in science.

4.4.3.3 Scientific jargon/terms in learning science.

The second question used in this explored on symbols and special terms used in language of science. These scientific terms emanate from the symbols used in science for example, the relationship between ohms (symbols) and resistance (terms). The question formulated asked on frustrations faced by educators in lesson preparation and teaching and learner frustrations which clearly showed that they were challenged in that regards.

Shows responses of learners (N=112) if scientific jargon/terms frustrates them when learning science and Educators (N=7) if scientific jargon/terms frustrate them when teaching science.

Table 4.9 Scientific jargon/terms in science.

Scientific jargon/terms frustrates me when teaching/learning science	Educator Numbers	Learner Numbers	Total Responses	Response percentages
Strongly disagree	4	9	13	11
Disagree	2	37	39	33
Agree	1	53	54	45
Strongly agree	0	13	13	11
Total	7	112	119	100
Missing	0	0	0	0

Table 4.9 shows that majority of the educators 6 out of 7 and only (39+13=52) learners are not frustrated by scientific jargon when they are teaching and learning respectively. On the other

hand majority (54+13=67) of the learners are frustrated by scientific jargon used in some texts and science literature. The responses of educators differ from those of the learners, this might be because educators have studied and learnt most of the terms in their teaching careers whereas learners are meeting most of these terms for the first time in their lives.

- Learner 1(10): *“Big words in science are frightening to me.”*
- Learner 5(10): *“It’s difficult to understand those scientific big words.”*
- Learner 3(11): *“Surely I am frustrated by big words ,suppose you are reading a paragraph and you meet one big word and another before you even understand the statement, that’s bad.”*
- Learner 6(11): *“There are some words that require interpretation sir, if you are not explained by the teacher you get nothing.”*
- Learner 2(12): *“Frustration always comes for example when in an exam and there suddenly appear a big word like phenomenon I get confused.”*
- Learner 3(12): *“ Science teachers especially in physics use very big new words when teaching and we have to ask now and then what the words mean, I agree it frustrates us.”*

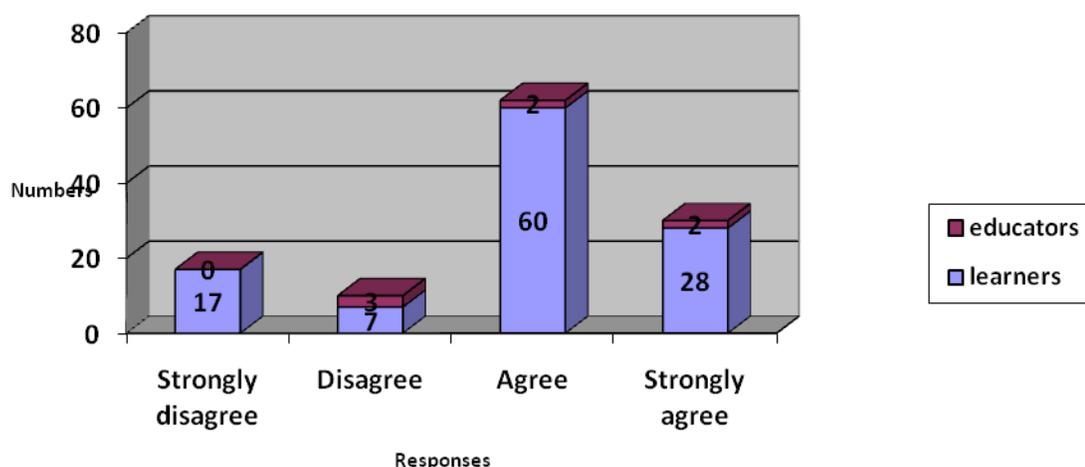
The above results somehow show that learners face some challenges when it comes to the scientific terms which are referred in this study as ‘*jargon*’ or ‘*big words*’.

4.4.3.4 Listening and understanding English and home languages.

The fourth statement asked in the questionnaire was generated from the literature review and the codes from the interviews. According to (Rost, 2001) phonotactic rules(sound sequences to make syllables)as well as tone melodies such as high ,low, rising and falling tones may differ from the first language and this influences their speaking and reading.

Graph 4.14 below shows responses by educators (N=7) and learners (N=112) to the question, “Learners find it difficult to listen and understand English due to its pronunciation which differ with their home languages”.

Figure 4.14 Understanding English and pronunciation.



The table shows that majority (60+28=88) of the learners and also 4 educators agreed that learners face difficulties to listen and understand English due to its pronunciation which differ from how their home languages are pronounced. (17+7=24) of the learners and 3 educators constituting 33% of all responses disagreed to this statement. Analysis shows that most learners who disagreed were English speaking learners. Since 77% of all educator and learner responses agreed with the statement and it is clear that learners are challenged in this regard.

These results seem to corroborate literature for example (Harrison and Krol, 2007) who concluded that difficulties in acquiring English reading skills were associated at a basic cognitive and linguistic level with unconsolidated phonological processing skills in their second language. (Rost, 2000) concur with the findings indicated by the statement that learners find it difficult to break up words into syllables and mispronounce words resulting in reading errors, and their comprehension becomes poor.

Responses from the interviews however did not agree with those from the questionnaires given in the table interviews.

- Learner 1(10): *“Pronunciations by our teachers does not differ from what we know we totally understand them.”*
- Learner 2(10): *“I don’t think that my home language and English differ in pronunciation the way things are said in English I understand them totally.”*
- Learner 4(11): *“We speak English all the time and I don’t think my teachers’ pronunciation in English affect our listening abilities, me for one I understand them very well.”*

- Learner 4(12) : *My home language is English and one of my teacher has an African accent and pronunciation in English perfectly fine ,I don't think this results in any challenge at all."*

Educators also agreed with the learners in that their English language pronunciation does not affect the learning of science.

- Educator A: *"Pronunciation does not cause any challenges to learners."*
- Educator B: *"There are no major words that when pronounced different will affect learner understanding in science."*

The results from the interviews show that learners are not challenged regarding to pronunciation which is also the view from the researcher's own experienced. The differences may be because the question was more personal in the interviews where as in the questionnaire learners might have generalised on what they think other learners face.

4.4.3.5 Proficiency and understanding meaning of words.

From table 4.8 items 5 show that (75+20=95) of the learners and 6 out of 7 educators indicated that majority of the learners are not proficient in understanding meaning of words. Since the majority of educators and learners indicated that learners are not proficient this suggests that learners are challenged in understanding meanings of words.

Further questions answered in the focus group interviews corroborated with the questionnaire responses and some extracts are shown below;

- Educator A: *"Most of the learners are not proficient and they do not understand most meanings."*
- Educator B: *"We have to teach and re-teach for learners to understand meanings of words at time using many illustrations."*
- Learner 5(10): *"Some of the meanings are difficult to understand if we read on our own".*
- Learner 1(11): *"When our teachers explain the words we understand them better".*
- Learner 3(12): *"We don't always understand fully some of the meanings of words in science".*

- Learner 4(12): *“Those words we meet only in Life Science are difficult for us to understand”*
- Learner 5(12): *“When teachers repeat certain word and explain them we understand better.”*
- Learner 6(12): *“Some words which we meet in English language or Life orientation and used again in Life Science we understand them better but those new words found in Life science are difficult.”*

The response from the interviews shows that most learners have problems when it comes to understanding meanings of words.

4.4.3.6 Proficiency in Syntax (word order) and semantics (meanings of sentences).

Table 4.8 item 6 shows that (39+14=53) learners and 2 educators agree that learners are proficient in syntax (word order) and semantics (meanings of sentences) and the majority of the educators 5 out of 7 and learners (54+5=59) out of 112 learners have the view that learners are not proficient with regards to syntax and semantics.

Focus group interviews responses by educators and learners are given below:

- Educator B: *“Majority of my learners are not proficient in word order and semantics, this is clear in most paragraphs written in their books.”*
- Educator F: *“Meanings of words are difficult to the learners the reason is definitely syntax and semantics.”*
- Educator G: *“If learners do not understand Basic English we cannot expect them to understand English language structures and how to apply them.”*
- Learner 1(10): *“I don’t think I am proficient in those things”*
- Learner 3(10): *“I understand word order but the meanings of certain sentences I don’t understand them.”*
- Learner 1(11): *“We are not proficient at all.”*
- Learner 2(11): *“I think some of these things we learn them in English language so we may be proficient in them.”*
- Learner 5(11): *“I don’t think we are proficient we may know some of the word order and semantics.”*

- Learner6 (11): *“English language grammar we are taught that majority of us we are partly competent.”*

The large percentage clearly indicates that learners face difficulties in the levels of language acquisition thus their syntax and semantics negatively affected. The responses from both the interviews and questionnaires corroborate each other a good indicator that these FET science learners are challenged when it comes to syntax and semantics.

4.4.3.7 Knowing the meaning of scientific terms help learners to comprehend and answer questions correctly.

Item 7 in table 4.8 shows those 6 educators and (53+47=100) learners agreed that knowing the meaning of scientific terms help learners to comprehend and answer questions correctly and only (5+7=12) learners and 1 educator refuted this statement. These results from the questionnaire were consistent with the responses of the learners and educators in the interviews and are shown below.

- Educator B: *“The moment learners master their scientific terms I have observed that they start improving even in their comprehension.”*
- Educator F: *“Those learners who usually pass section A one word items will also have high marks in section B which requires a lot of comprehension.”*
- Educator G: *“From my experience there is direct relationship between scientific terms knowing and good grades.”*
- Learner 4(11): *“I totally agree that if you know scientific terms learning becomes easier.”*
- Learner 5(11) *“Some of the questions we cannot answer if there are too many scientific words we do not know.”*
- Learner 6(11): *“I have also observed that the more terms I don’t, know the more I fail questions”.*

The responses from the questionnaires and the focus group interviews corroborate each other where majority of the learners and educators have the view that when learners understand meanings of scientific terms they will easily comprehend scientific terms.

4.4.3.8 Unfamiliar academic terms in science contribute to learners becoming overwhelmed by unknown words.

Item 8 in table 4.8 shows that 2 educators disagreed and 5 agreed to the statement that, “*Unfamiliar academic terms in science contribute to learners becoming overwhelmed by unknown words*”. Total (30+53=83) learners out of 112 learners agreed to the statement. The remaining (12+17=29) learners did not share the same view.

Some of the responses from the learners in the focus group interviews are shown below

- Learner 3 (10): “*I think that there are so many words which are unfamiliar to us and they confuse us*”.
- Learner 5 (10): “*That is true we are always overwhelmed.*”
- Learner 2(11): “*Unknown words are too many in science and some you do not even see them from the English dictionary.*”
- Learner 6(11): “*Those terms we meet in science maybe for the first time definitely overwhelm us especially if there are many terms like that.*”
- Learner 1 (12): “*It is not always that we become overwhelmed this mainly occurs if we have too many terms at a time.*”
- Learner 4 (12): “*I also think the same with (learner 1) we are only overwhelmed if they are too many.*”

The results from the questionnaire and group interviews in this case seem to support each other that learners are challenged and overwhelmed with academic terms.

4.4.3.9 Learners are frustrated by failure to see meaning in English texts and they resort to rote learning or cramming.

The last item nine (9) in table 4.8 under challenges emanating from foundations of language acquisition shows that (13+25=38) learners making up 32% of the total learners disagreed to the statement that learners are frustrated by failure to see meaning in English texts and they resort to rote learning or cramming. 82 out of 119 making up 68% of the responses given agreed to the statement mentioned above.

The results from the questionnaire corroborate results from the interviews (Annexure C)

- Learner 1(10): “*As learners if we do not see meanings in science paragraphs we cram a lot.*”

- Learner 3(11): *“It is true cramming is food for us if we want to pass science.”*
- Learner 5(11): *“There are so many difficult things in physical science, if you do not cram some we will not pass.”*
- Learner 2(12): *“When I started learning science in grade 8 the more I wanted to understand the more I failed so I resorted to rote learning and it worked to pass but soon after exam I forgot.”*
- Learner 3(12): *“I strongly agree the more we do not make sense of certain science paragraphs the more we cram to pass it.”*
- Educator A: *“This is a common problem learners tend to rote learn too much that is why they easily forget fast what they learn.”*
- Educator B: *“That’s absolutely true English is difficult to most learners who do not speak it always so most statements in science are not understood therefore they resort to rote learning”.*

Responses from the questionnaire and interviews reveal that majority of learners have experienced or still practice rote learning especially when they cannot see meanings in science English texts.

Conclusion for this section 4.5.3 is reflected by the three learners who commented in the focus group interviews and their responses are given below;

- Learner 4(11): *“I strongly believe that if the foundations of English language itself are poor then it will be transferred to all other learning areas including science. Foundations of English will help in us understanding the language better such that we can understand the English used in science”.*
- Learner 2(12): *“ I think that if we do not have proper grounding in any language we will not be able to learn science properly regardless of the language used to teach and learn science .What I think is that even if we are taught in Afrikaans we should have strong foundations in that language so that we pass. I therefore conclude that English language foundations if not strong will contribute to difficulties to learning science in English”.*
- Learner 3(10): *“Poor foundations in English language will result in us not being well versed with most meanings of English words and the different science statements or sentences. I agree it is definitely a challenge to us and affect negatively science learning.”*

The results from this section 4.5.3 have revealed that FET science learners were faced with poor language acquisition which makes the learning of science in English challenging to them.

4.4.4 CHALLENGES WITH BASIC INTERPERSONAL COMMUNICATION SKILLS (BICS) AND COGNITIVE ACADEMIC LANGUAGE PROFICIENCY (CALP).

Codes

Lack of basic communication skills in English (CSE); interpersonal communication in home languages(ICH); comprehending scientific statements(CSS), proper communication in academic language(PC); cognitively demanding science language(CDSL)

The challenges learners face due to BICS and CALP were identified and appropriate questions asked so as to analyse and gather learner experiences from their point of view and the educators' point of view. The interviews and literature search revealed that learners are challenged in Communication skills and cognitive academic language and the codes are listed above and were gathered and analysed below.

Table 4.10 (B.I.C.S) AND (C.A.L.P.S) Challenge responses.

Item description	Strongly Disagree		Disagree	Disagree	Agree	Agree	Strongly Agree		Total	
	learners	educators	learners	Educators	learners	educators	learners	educators	learners	educators
1 Learners lack basic communication skills in English	4	0	10	1	54	2	44	4	112	7
2.Learners interpersonal communication is mainly in their home languages	11	1	7	1	47	2	47	3	112	7
3. Learners lack proper communication skills in academic language.	17	0	7	3	60	2	28	2	112	7
4. Learners cannot comprehend scientific statements or follow scientific instructions.	7	1	20	2	81	3	4	1	112	7

5. Science academic language is cognitively demanding and learners don't understand it.	3	2	8	2	11	2	90	1	112	7
6. Unfamiliar academic terms in science contribute to learners becoming overwhelmed by unknown words.	13	0	31	1	41	3	27	3	112	7

4.4.4.1 English interpersonal communication skills.

The above table 4.10 item one (1) show that fifty four (54) learners agreed and twenty nine (29) of the learners strongly agreed that learners lack interpersonal communication skills. On the other hand only 18 of the learners disagree, of which fourteen (14) disagreed and four (4) strongly disagreed. The educators responses in the questionnaire shows that only one disagreed and six agreed to the statement that the learners lack interpersonal communication skills. The following views were obtained from the learners (Annexure C):

- Learner1 (11): *“we do not lack interpersonal communication skills it's only that we are more competent in our own home languages. Majority of us lack basic communication skills in English that's why most of our discussion and general talk outside the classroom we use Zulu, Sotho or isi Xhosa.”*
- Learner 3(11):*“we definitely lack English interpersonal communication it's so difficult to talk in English even to our friends.”*
- Learner 4(10): *“we tend to have problems in English communication”.*

These results corroborate what five educators said in the interviews see (Annexure C).

- Educator A: *“ learners lack basic interpersonal communication skills and this is shown by their constant switching of language when they are required to discuss using English language during class presentations or group discussion.”*
- Educator B: *“they do lack interpersonal communication skills only in the English language or a language which is not their mother tongue or home language”.*

- Educator C: *“From experience I have observed that those learners whose home language is English have very good interpersonal communication skills and can express themselves very well”.*

From all the interviews conducted analysis revealed that lack of basic communication skills was mentioned by a good number of learners and educators stated that learners lack basic communication skills in English. Interpersonal communication in this study is a challenge to most of the science learners according to the majority of the learners and educators.

4.4.4.2. Interpersonal communication and home language.

From table 4.10 item 3 shows those 18 learners and 2 educators disagreed to the statement that learners mainly interpersonally communicate in their home languages. 5 educators and (47+47=94) learners do share the view that learners interpersonal communication is in their home languages.

Educators and learners responses seem to suggest that in most cases learners do use their home languages for interpersonal communication. The above results from the questionnaires were corroborated by the interviews from both learners and educators and some of the responses are given below;

- Learner 1 (10): *“It is true we always communicate in our home languages even in class,”*
- Learner 4(10): *“Every time we are told to discuss in our science lessons we communicate in our home languages.”*
- Learner 3(11): *“My communication with my friends is always in Zulu.”*
- Educator B: *“I always reprimand learners when they try to explain scientific concepts in their mother tongue.”*
- Educator E: *“When we give time for learners to discuss something, as you move around majority of the groups will be discussing in their home language.”*
- Educator G: *“It is true majority of my learners communication in all spheres is in their home languages.”*

The results above would imply that learners are more comfortable in communicating in their home languages as compared to a second language. These results can be further deduced to say that learners will learn more comfortably and gain more if they learn in their home language.

4.4.4.3. Proper communication skills in academic language.

24 learners and 3 educators in table 4.10 refuted to the statement that, *“learners lack proper communication skills in academic language”*. (60+28=88) learners and 4 educators agreed and strongly agreed that learners lack proper communication skills in academic language. Interview responses are given below;

- Learner 2(10): *“In English I think we communicate properly and I am not very sure with academic language.”*
- Learner 1(12): *“Academic language differs from social language and I agree that we as learners lack the proper communication in academic language.”*
- Educator A: *“Our learners’ communication is always social and they don’t have time to discuss and polish academic skills at all.”*
- Educator B: *“Majority of our learners definitely lack proper communication skills in academic language, the way they respond in class even written work is evident.”*
- Educator C: *“Academic language communication skills are developed through constant interaction with others and books, some of the learners’ majority in fact are far from that.”*
- Educator F: *“Apart from being science teachers we are also English language teachers because we always now and the correct their academic language, and this is an indicator that they lack proper communication skills.”*

The above results from the questionnaire and responses from focus interviews point to the conclusion that learners lack communication skills in academic language.

4.4.4.4. Comprehension of scientific statements and following scientific instructions.

Three educators and 30 learners =33 (28%) did not agree to the fact that some of the learners cannot comprehend scientific statements and cannot follow scientific instructions. A substantial number of responses (81+5=86) which gives 73% agreed to the statement of which 4 are educators and 82 are learner responses.

Focus group interview (Annexure C) revealed the following;

- Learner 1(10): *“Instructions we can follow but my friends just want to touch and mix chemicals without understanding.”*
- Learner 1(12): *“learners can follow scientific instructions but there is a tendency of trying to divert from what is given and we want to do what we think we can do on our own.”*
- Learner 5(11): *“the reason we are not able to follow instructions is because of the language used at times it is too complicated and too many steps to follow especially practical work.”*
- Educator A: *“The calibre of learners we have they cannot comprehend scientific statements because majority of them are not English home language speakers.”*
- Educator F: *“Instructions in science are very easy but learners have a funny way of doing things they want to do the wrong things.”*
- Educator G: *“Learners are able to follow instructions from my opinion but comprehension is another thing.”*

The above results from the questionnaire show that only a few learners and educators think that learners cannot follow instructions. The interviews however revealed that learners can actually follow instructions but divert somehow. Most learners and educators agree that learners face challenges in comprehending scientific statements.

4.4.4.5. Science academic language and cognitive demands.

The fifth item in table 4.10 showed that 87% of all responses given represented by 13 agreeing and 91 strongly agreeing to the statement that *“science academic language is cognitively demanding and learners do not understand it”*. Only 5 learners and 3 educators did not agree to this statement. Both educators and learners responses corroborated each other as well as from literature and the interviews. Some of the interview responses are show below;

- Learner 4(10): *“I think its true we do not understand science language because of that (cognitively demanding).”*
- Learner 5(10): *“It requires a lot of thinking in science.”*

- Learner 1(11): *“If a lot of thinking, designing is required then we may not understand it.”*
- Learner 2(11): *“it is true science language is too academic in most cases.”*
- Learner 3(12): *“A lot of thinking skills are needed in science like designing experimenting all these are cognitively demanding.”*

Educators also had the same notion as the learners;

- Educator A: *“I seem to differ that all science language is cognitively demanding Bloom’s taxonomy tries to address that. Most learners however are not competent with the higher order thinking.”*
- Educator F: *“Simple English language is a toll order for the learners if we introduce academic language it’s even worse.”*
- Educator G: *“Science papers even our daily questions we try to balance all cognitive levels according to bloom’s taxonomy, the simple recall questions they answer easily but the cognitively challenging questions majority fail.”*

The above responses from both the interviews and questionnaires seem to suggest that learners have challenges with regards to the aspects which are cognitively demanding in science including language.

4.4.4.6. Unfamiliar academic terms in science and unknown words.

Item 6 in Table 4.10 shows that 44 learners and 1 educator disagreed to the statement that unfamiliar academic terms in science contribute to learners becoming overwhelmed by unknown words. 41 learners and 3 educators agreed and 27 learners and 3 educators strongly agreed to the statement given in Table 4.10 item 3.

Table 4.11 Understanding of science academic language responses.

Learners face difficulties in understanding Science academic language	educators	learners	Respondent numbers	Respondent percentages %
Strongly disagree	0	6	6	5.0
Disagree	0	12	12	10.1
Agree	2	23	25	21.0
Strongly agree	5	71	76	63.9
Total	7	112	119	100
Missing	0	0	0	0

Table 4.11 above shows that all the seven educators as well as (76+25=101) out of 112 learners agree that the learners face difficulties in understanding science academic language. Eighteen (12+6=18) of the 112 learners disagreed to the statement and believe that learners do not face difficulties in understanding science academic language. From the results it is clear that majority of learners and all educators totally believe that understanding science academic language is a big challenge to learners.

4.4.5. CHALLENGES WITH BILINGUALISM / MULTILINGUALISM AND CODE SWITCHING.

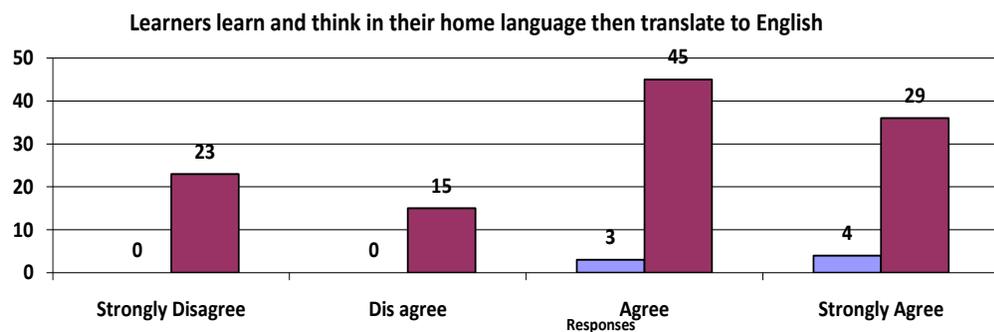
Codes

Learners learn and think in their home languages (THL); Concepts understood better if taught in more than one language (L2); benefits of second language or home language (L2B); code switching to explain scientific concepts (CS)

4.4.5.1 Learners learn and think in their home languages.

The graph 4.15 below shows responses of 112 learners and 7 educators on whether learners learn and think in their home languages and try to change or translate it to English.

Figure 4.15 Home language and thinking.



The above graph 4.16 shows that none of the seven educators disagree but all agree to the statement that learners think in their home language and the try to change or translate it to English. From the learners responses (23+15=38) disagreed to the statement. Forty five (45) learners agreed and 29 learners strongly agreed to the statement.

- Learner 3(10) *“It is true I always do that (think in a home language).”*
- Learner 4(10): *“ Most questions we think in our language that is why we answer in Zulu”*
- Learner2 (11): *“In our groups we always discuss in Zulu because we need to understand most science questions better.”*
- Learner 6(12): *“If your home language is no English it is easy to think in home language and try to interpret I do that most often.”*

The responses of the learners clearly support the questionnaire responses and comments from the educators below.

- Educator B: *“Naturally everyone thinks primarily in their home language to try to process information which is only an advantage to English home language learners.”*
- Educator C: *“I think the more you are exposed to a certain language the more you are inclined to think in that language.”*
- Educator D: *“Our learners always think in their home language then try to think of proper words to translate what they have processed in most cases failing to translate to English.”*
- Educator G: *“I have observed that a lot and I totally agree.”*

The results from both the questionnaire and interviews seem to corroborate and suggests that learners in most cases think in their home languages and then translate that information in a language they are expected to answer in, in this case English language. This in a sense may result in learners not expressing fluently the knowledge they have due to this language barrier. It can be deduced that learners if taught in their home language they may understand and put across what they have processed in their minds better.

4.4.5.2. Concepts understood better if taught in more than one language / code switching.

In order to investigate bilingualism, multilingualism and code switching educators were asked in the questionnaire if they are multilingual and if they use code switching and how often they use it. Four educators indicated they use monolingual for teaching and explaining concepts and the other three educators indicated they use bilingual or multilingual approach in their lessons.

The table below shows respondents numbers and percentages per response to the question, *“if learners understand scientific concepts better if taught in more than one language”*. This becomes a challenge to learners if they are only taught in English language and concepts not clarified or explained in their home language.

Table 4.12 Code switching responses.

Learners understand scientific concepts better if taught in more than one language.	Learners	Educators	Total numbers	Response percentages
Strongly disagree	5	1	6	5.2
Disagree	8	1	9	7.8
Agree	46	2	48	41.4
Strongly agree	50	3	53	45.7
Total	109	7	116	97.5
Missing	3	0	3	2.5

The above table shows that 5 educators and (46+50=96) learners agree that learners understand scientific concepts better if taught science in more than one language. Only 15 responses did not agree to the statement of which (8+5=13) are learners and 2 are educators. The reason why the majority of the learners 86% agreed may be because they have been exposed to such situations especially from primary.

From their responses those educators who use two languages to explain scientific concepts were asked to explain further on their experiences.

- Educator C: *“Most of my learning understands most scientific concepts when taught or explained in their home language”.*
- Educator D: *“Due to the different languages learners Speaks, I ask them to discuss in groups in their home languages .Their feedback after that reveals that they grasp the concepts better.”*

Most educators do not use code switching at the school in question because the official language of teaching and learning is English language and all the learners learn English language as a home language.

- Educator B: *“I am fluent in one language that’s English, I also speak three other languages and I am not very fluent, it will be gross injustice to try to explain in another language that I am not competent in.”*
- Educator G: *“At universities or colleges we were never taught to teach in more than one language it becomes difficult to try to code switch all the time.”*

All learners interviewed agreed that they will understand better science if it is explained in their home language. Some of their responses are shown below:

- Learner 5 (10): *“I understand if taught something in English and then explained in Zulu.”*
- Learner 6 (10): *“It is good for teachers to explain also in our home language.”*
- Learner 3(11): *“It benefits a few learners who speak that language that the teacher is switching to, so it’s better if they stick to English always.”*
- Learner 5(12): *“At primary school we were taught in both English and our home language though most teachers explained to us in Zulu. It was better because we would understand science and even ask question freely in vernacular.”*

Explanations by the learners during focus group interviews suggested that learners can understand better science concepts if they are explained further in their home languages. Challenges however would be code switching to every learner’s language which is practically impossible in a South African context where official languages are eleven. Educators will also be challenged in multilingual classes due to the fact that they have limited languages they are fluent in.

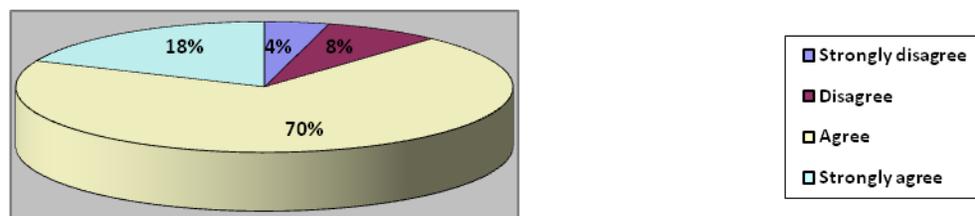
4.4.5.3. Benefits of second language or home language.

In order to investigate the challenges faced due to multilingualism a positive question to evaluate if learners would benefit if taught in their second language or their home language was formulated and the questionnaire responses are analysed below.

Graphs 4.16 Second or home language responses in learning science

Graph 4.16 (a) shows the percentage responses to the question; *“if being taught scientific concepts in a second language is not beneficial to learners.”*

Figure 4.16(a) Second language benefits.



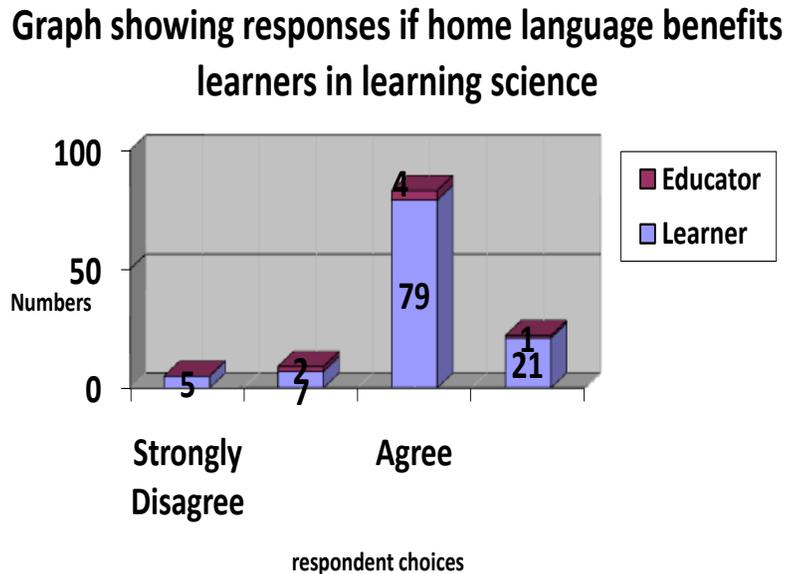
The above graph shows that (70 +18=88%) of the responses given by learners agree to the statement that being taught in a second language does not benefit the learners. Only a few learners (4+8=12%) of all the 112 learners disagreed.

Some responses to this question by learners are given below:

- Learner 1(10): *“If we are taught in a second language it becomes difficult compared to a home language.”*
- Learner 2(10):*“We are born with our languages and we understand them well, so if we are taught in our home language we will pass science easily.”*
- Learner 6(11): *“ A second language is someone else’s language and using it to learn science has many disadvantages”*
- Learner 3(12): *“I also think learning in a home language will benefit especially when we start from primary school.”*

Graph 4.16(b) below shows Learner and educator responses to the question, “if learning science in their home language is beneficial to learners”.

Fig 4.16 (b) Home language benefits.



The bar graph clearly shows that the majority of the learners (79+4+21+1=105) agreed that learning in their home language is beneficial to the learners. Only a few respondents 14 disagreed to this statement. Both graphs 4.17 a and b shows that 5 educators and 105 of the learners believe that they will benefit more if a second language or a home language is used to teach learners science. These seem to corroborate some of the interview responses as one learner put it;

- Learner 4(12):*“I think if you are a non English speaker you should not learn science using English rather learn using your home language because it is easier to understand things you are taught in your own language. As learners I think we do not benefit much when learning science in English and that is why so many of us fail science, so there should be a change to learning using our home languages”.*

The responses from the questionnaires and the interviews both corroborate each other. The results therefore suggest that learners face challenges when being taught in a second language and they understand or benefit more in science if they are taught in their home languages.

4.4.6 CHALLENGES POSED BY LEARNING PRINCIPLES.

Codes

Use of prior knowledge (PK); challenges with practical work (PW); Active feedback in communication (FC), Language accuracy by educators (LAC).

Table 4.13 Learning principles responses.

Item description	Strongly Disagree		Dis Agree		Agree		Strongly Agree		Total	
	learners	educators	learners	Educators	learners	educators	learners	educators	learners	educators
1 Learners easily use prior knowledge to understand scientific principles better	13	0	46	1	38	3	15	3	112	7
2. Science investigations or practical work helps learners to be actively involved in the learning process	43	0	7	0	15	0	47	7	112	7
3. Learners are actively given feedback in communication, and language accuracy by educators	9	0	5	0	71	1	26	6	111	7

4.4.6.1 Challenges posed by the use of prior knowledge.

Learning principles investigated here are based on The American association for the advancement of science. The first investigation focused on whether learners have challenges in using prior knowledge from their different linguistic backgrounds. The results in table 4.13 show that only one (1) educator and (13+46 =59) learners disagreed and have the notion that learners do not use prior knowledge to understand scientific principles better. On the other hand 6

educators and (38+15=53) learners agreed that learners easily use prior knowledge to understand scientific principles.

Focus group interviews seem to suggest that learners do not usually use prior knowledge in their science lessons;

- Learner 1(10): *“We easily forget what we have been taught previous years most things we are taught look as if they are new.”*
- Learner 6(10): *“Many teachers assume we know things from grade 8 and 9 we don’t remember most of them.”*
- Learner 3(11): *“Prior knowledge does not help us most things in physical science look new.”*
- Learner 4(11): *“We only remember things when teachers explain again.”*
- Learner 1(12): *“There are certain formulas we remember and use but if we are asked prior knowledge majority we do not remember.”*

Educators were asked on any challenges learners face with prior knowledge; one educator gave an example in Electricity;

- Educator F: *“In African language electricity moves and learners always explain literal movement .It is a challenge trying to explain how electron vibrations and transfer of energy or as charge carriers. In this case trying to help learners undo or abandon previously acquired knowledge is difficult, the learner pretends to understand but when a test or exam comes they still write their original prior understanding”.*
- Educator B: *“If learner prior knowledge contains some misconceptions it is a bit difficult to undo what they already know and teach the new correct scientific concepts.”*
- Educator D: *“Learners are highly challenged in that regard use of prior knowledge is difficult.”*
- Educator G: *“In most cases learners do not apply what they know they always want to be reminded, only in rare cases that’s when they use the prior knowledge they have.”*

The results from this research seem to corroborate literature for example. A challenge for learners learning English as a second language is that they may be required to abandon previously acquired knowledge. This is a complex process and may happen only superficially even after formal science teaching, (Fathman, Quinn and Kessler, 1992).

4.4.6.2. Practical investigations and learning processes.

The second principle of theory of learning is based on the fact that learning moves from concrete to abstract. Second language learners need to build a foundation upon which abstract concepts can grow and this can be done through science investigations. A question was formulated to view learner challenges and experiences and the responses are given in the graph below;

Graph 4.17 below shows responses from educators (N=7) and learners (N=112) to the statement that; “*Science investigations or practical work helps learners to be actively involved in the learning process*”.

Fig 4.17 Practical work and science learning.

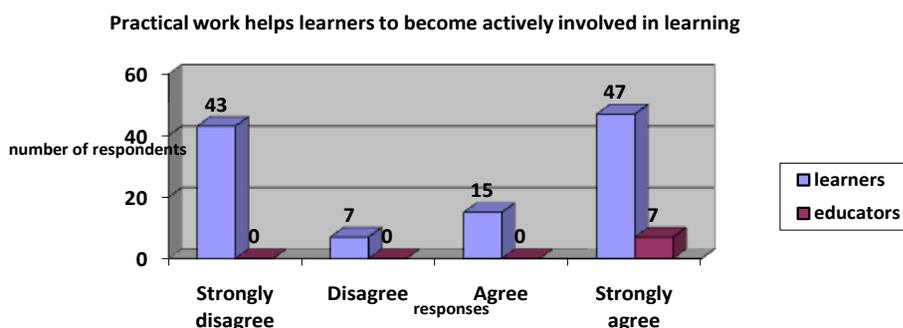


Fig 4.17 above shows that all the seven educators strongly agreed to the statement that practical work helps learners to become actively involved in learning 47 learners also strongly agreed and 15 agreed. 43 learners strongly disagreed and 7 disagreed to the statement. The learners who disagreed might have done so because they do not really benefit or do not do productive practical work.

- Educator A: “*It is true that most learners are still in the concrete stage according to Piaget’s theory and they need hands on activities in the form of practical work.*”

- Educator C: *“Those learners that experiment with new situations beyond the classroom will definitely benefit. If learners take practical work and research tasks seriously then they will pass and even enjoy learning science.”*
- Educator D: *“Experience has taught me to dwell more on practical activities as learners enjoy themselves at the same time actively learning.”*
- Educator E: *“It is true that learners benefit only if there is close supervision and they know exactly what to do. Chemistry experiments are a bit tricky as learners always want to mix what they are not supposed to mix.”*

Science can be understood more or better when learners have hands on experience through practical work; this is the conclusion that can be drawn from the questionnaire and interview responses in this sub section 4.4.6.2.

4.4.6.3. Feedback in communication and English language accuracy.

Table 4.14 is showing the responses of 7 educators and 111 learners to the statement that learners are actively given feedback in communication and language accuracy by educators

Table 4.14 Educator feedback and language accuracy responses.

Learners are actively given feedback in communication, and language accuracy by educators	Educators	Learners	Total Numbers	Respondent Percentages%
Strongly disagree	0	9	9	7.6
Disagree	0	5	5	4.2
Agree	1	71	72	71.2
Strongly agree	6	26	32	16.9
Total	7	111	118	99.2
Missing	0	1	1	0.8

The above table 4.14 shows that (9+5=14) learners and no educators disagreed that learners are actively given feedback in communication and language accuracy by educators all the seven

educators agreed to the statement of which 6 of the educators strongly agreed. Learners on the other hand corroborated what the educators said as there was a substantial number (84+20=104) learners agreeing to the statement.

Responses from the focus group interviews show that both learners and educators maintain that feedback in proper language use is given.

- Learner 1(10): *“We are given feedback always.”*
- Learner 4 (10): *“They cause us to lose our confidence because they are so quick to correct our English.”*
- Learner 5(10): *“Our books are full of red ink corrections all over.”*
- Learner3 (11): *“We are told now and then language is important for us to say across our science knowledge.”*
- Learner 6(11): *“Feedback is always there in presentations and in our books.”*
- Learner 2(12): *“I agree almost all teachers give us feedback and give us the correct wording every time.”*
- Learner 5(12) *“Science lessons also improves our English language skills because of the language corrections.”*

Learners who responded to the interview questions all supported the questionnaire responses and they also concurred with what the educators said.

- Educator A; *“It was part of our training at university to check language accuracy at times we don’t mark wrong wording or incorrect sentencing.”*
- Educator B: *“Spellings and grammar is emphasised in class activities, but in our final exams we may be lenient as we mainly check scientific correctness and not necessarily language.”*

The results in this sub section reveal that educators gave constant feedback to learners with regards to language accuracy thus they follow the third principle of learning identified in this study.

From the learning principles identified for the purposes of this study learners seem to be challenged in the use of prior knowledge, in this case they do not use it to fruitfully learn science and further more if they have misconceptions it is difficult to undo and re teach new concepts. From this study it seems that learner's benefit a lot from practical experience thus neglect of practical work may hinder learning of science. Finally under learning principles Educators follow principles of communication, feedback and language accuracy which benefit learners in science learning.

4.4.7. DIFFICULTIES FACED AFTER LANGUAGE SWITCHING OR LANGUAGE CHANGE.

Codes

Language change (LC); medium of teaching and learning switching (LS)

Table 4.15 Language change /switching responses

Item description	Strongly Disagree		Dis Agree		Agree		Strongly Agree		Total	
	learners	educators	learners	Educators	learners	educators	learners	educators	learners	educators
1 Learners are challenged with language change	3	0	5	0	62	2	42	5	112	7
2 Will learners face difficulties with switching from one language of teaching and learning to another	5	1	28	2	48	3	31	1	112	7

4.4.7.1 Challenges with language change.

Educator responses when they filled in information about the science learners they teach revealed language(s) of which the learners had been taught in their primary schooling and illustrated that 84 learners had been taught in English language,19 in English and a home language, 9 learners indicated both Afrikaans and English were used at primary. Based on these it seems there are no learners who have completely changed a language from primary to

high school. A question was however formulated to gather learner and educator views on whether learners will be challenged if they change their language of teaching and learning.

Item 1 in table 4.14 clearly shows that only 8 learners say that learners will not face challenges. The majority of the learners (62+42=104) and all 7 educators indicated that learners will face difficulties when their language is changed.

Responses from the focus group interviews are shown below:

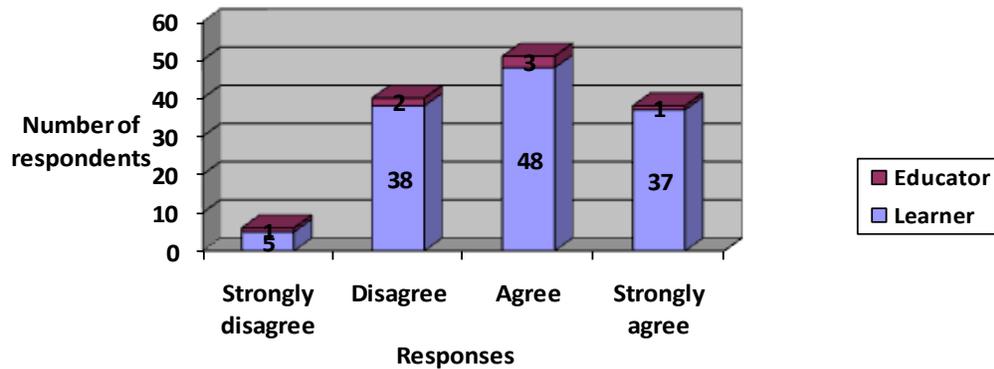
- Educator A: *“I strongly believe that language change does not affect learners especially at a young age as compared to adults. I obtained my degree in a Spanish language which we had to learn in six months, majority of us non Spanish speakers passed.”*
- Educator B: *“. The moment learners change a language they have to start learning the language first before they start to learn the subject matter and this hinders science understanding.”*
- Educator F: *“Even if young learners grasp languages faster than adults a language change will disrupt learners in learning science.”*
- Educator G: *“I have not experienced situations where learners change from English to Afrikaans, but the learners who changed from Afrikaans to English faced no major challenges because they used both languages at primary.”*

The above results from the questionnaire and the interviews seem to suggest that a change in language will negatively impact learners in science learning. These results are consistent with literature (Aziz, 2003) see (2.3.9) studies showed that learners were challenged after language change and encountered language and contents problems.

4.4.7.2. Challenges with switching from one language of teaching and learning to another

Graph 4.18 below is showing numbers of educator and learner responses to the question; “will learners face difficulties if they have switched from another language at primary school to use English at secondary as a medium of learning”.

Figure 4.18 LoLT switching responses.



From the above graph, figure 4.18 it shows that the majority (51+38=89) which gives 75% of both educators and learners agree that learners face difficulties when they have changed or switched language that is used as medium of instruction. Only 25% of the responses from (38+5=43) learners and (2+1=3) educators did not agree to the statement. Further analysis to the question asked in the interview with selected learners showed that 5 out of 7 learners used vernacular or home languages from grade 1 to grade 3. English was introduced from grade 4 onwards for academic purposes but majority of the learners continued to communicate in their home languages.

- Learner 3(10): “It is challenging and difficult to understand science concepts when the language of teaching and learning is changed.”
- Learner 5(10): “A change in language of teaching and learning will result in difficulties I think.”
- Learner 2(11): “Changing languages will confuse us.”

➤ *Learner 3(11): “There will be too many new words and terms and they will make us fail.”*

The focus group interview revealed that six learners out of eight learners whose medium of instruction at primary was another language other than English language did not face many difficulties because it was more bilingual and they mainly used code switching. It is also suggested that educators at primary schools mainly used code switching to explain scientific concepts. One of the educators refuted the statement that changing a language results in learners failing or not conceptualising science.

➤ *Educator C: “There are so many cases in which learners have switched languages completely e.g. from English to Spanish and they never faced immense challenges”.*

The majority of the learners and educators however insisted that the learners will face difficulties if they change their language.

➤ *Educator A: “The moment learners change a language I believe it will take a long time to grasp and become fluent in the language hence hinder or derail science learning.”*

➤ *Educator E: “Even if young learners grasp languages fast ,challenges in science learning will increase because they are now learning in a third language.”*

The above data and analysis seem to suggest that science learners are challenged when it comes to language change from one language to another. Both the interviews and questionnaires in this section revealed that learners will face challenges when they learn science in a new language. Though nearly every one of the learners interviewed in this sample did not change or switch languages they have the view that learning science will be hindered or slowed down due to language change.

4.5 CONCLUSION

This chapter provided a detailed discussion of all data collected via the questionnaire and focus group interviews. A detailed discussion and analysis is provided after each graph and table. In addition this chapter examined correlations and provided reliability analysis and validity analysis. The researcher is also satisfied that the questionnaire and the good response rate and the transcription of the interviews are sufficient to validate this research study and can therefore be relied upon. The final chapter five focused on conclusions that were drawn from the results as well as recommendations for future research and limitations emanating from the study.

CHAPTER FIVE

CONCLUSIONS, LIMITATIONS AND RECOMMENDATIONS

5.1 INTRODUCTION

The previous chapter presented the results of the empirical investigation followed by discussions. This chapter explores the conclusions of the literature study and the empirical research with regards to the challenges faced by FET science learners when English is used as a medium of science instruction. The limitations of the study are highlighted and recommendations that have educational implications are made to overcome some of the challenges FET science learners face. The limitations, recommendations and conclusions are made on the basis of the findings in the investigation and are applicable to the learners involved in the research and probably with minor adjustments to any other context.

5.2 CONCLUSIONS FROM THE STUDY

Conclusions below were reached from both the literature study and from data collected and analysed in the empirical investigation. The questions that probed this study were “What are the challenges faced by science FET learners if English is used as a medium of instruction”? And “What are the FET science learner’s experiences of using English as an instructional medium”?

This research aimed at raising awareness of the current trends in research findings and experiences regarding the challenges in learning science using English as a medium of instruction to high school learners.

5.2.1. Limited academic language proficiency

The first part of the literature review focused on challenges faced when learners have limited academic language proficiency. Limited academic language is a factor that hinders effective learning of science and this challenges high school learners. (Lemmer and Squelch, 1993) discovered that learners with limited language proficiency are far less capable of handling content subject like science through a second language than through a primary language. The

overall majority of learners who have limited proficiency on a language of learning run a greater risk of under achievement and then they decide to drop out of school.

Limited English proficiency of learners in the multicultural classroom results in them having difficulties with academic concepts and terms when taught in a language which is new to them (Cummins, 1976) and this impact negatively in science learning. The English limited proficiency of learners who are in the process of learning in a new language may experience social trauma and emotional problems (Cummins, 1976).

(Carrier, 2005) says that academic language can be confusing when first encountered by ESL learners because of terms that sound similar to conversational English, but have different meanings. The other challenge is that some learners are not able to translate the terminology used on science tests into language they are familiar with and this gap in proficiency between conversational and academic English explains the duality sometimes seen with ESL learners who may be able to converse with great success but have a difficult time interpreting written examination questions.

(Avalos et al, 2007) have investigated reading levels in ESL/ELL (English language learner) learners and discovered that the key to determining readiness appears to be the learner's reading level in the first language. This indicated the importance of first language or home language literacy assessment to guide second language instruction. (Avalos et al, 2007) concluded that if learners are struggling readers in their primary language, they are not able to grasp a second language as easily as proficient first-language readers. (Wang, 1996) concluded that the processing of information in the mother tongue enhances the transfer of concepts to the second language. The more proficient learners are in English language the higher their academic achievements furthermore (Wang, 1996) pointed out that learners who have limited language proficiency in the second language perform poorly scholastically.

This research dissertation clearly showed that if learners have limited academic proficiency they will not benefit much if taught in that language and will have difficulties understanding or comprehending English scientific concepts.

5.2.2 Technical and non technical language of science.

Technical language pose a problem of familiarity according to (Cassels and Johnstone, 1985) discovered that learners were seen to be able to cope reasonably well with this. A more acute problem lies in the use in science of normal, familiar language in a highly specific, often-changed and unfamiliar way. Thus discussion of the language involved is essential if a shared meaning is to be established. The learning of science requires learners to master not only the use of symbols to represent concepts, but also the language in particular the technical and non-technical vocabulary (Cassels and Johnstone, 1985).

Learners who learn science not in their first language face the problem of understanding both the scientific terminologies (technical terms) and regular explanation of the knowledge itself (Maznah and Zurida, 2006).Level of comprehension of the non-technical terms commonly used in science teaching and learning was improved when English was taught contextually.

This research dissertation seems to corroborate literature due to the fact that learners whose home language is not English have difficulties understanding both scientific technical terms and non technical terms. This however is to a smaller extent especially to those learners whose home language is English due to the fact that they understand better the non technical terms of science.

5.2.3. Challenges based on foundations of language acquisition

(Miller and Gillis, 2000) affirmed that foundations of language acquisition which comprise of phonology, morphology and syntax and semantics are important and will help learners understand English language better. If learners do not understand the building blocks of the language they use, then they may be highly challenged in comprehending scientific concepts. Studies by (Rost, 2001) corroborate studies by (Harrison and Krol, 2007) which assessed English second language learners and the challenges faced with linguistic transfer of phonological processing. The studies concluded that difficulties in acquiring English reading were associated at a basic cognitive and linguistic level with unconsolidated phonological processing skills in their second language. Findings in this study reveal that second language learners who lack foundations of English language acquisition like phonology, morphology, syntax and semantics are more vulnerable and may be confused by symbols used in science

and may not understand and comprehend pronunciations in English, thus impeding on science learning.

5.2.4 Basic interpersonal communication skills (BICS) and Cognitive academic language proficiency (CALP)

BICS represents the language of natural informal conversation and CALP represent the language proficiency for reading text. CALP requires both higher levels of language and cognitive processes in order to develop the language proficiency needed for success and achievement in academic subjects like science. (Cummins, 1981a; 1989 and 1992) conducted several studies on how BICS and CALP affect learning. Cummins revealed that challenges are mainly faced in CALP which is mostly used in science teaching and learning. Science uses cognitively demanding language which relates to abstract concepts and has specialised vocabulary and uses more complex language structure. (Selepeng and Johnstone, 2001) studies revealed that learner's lack of knowledge of grammar, rules of syntax, as well as meanings of words used in different contexts pose challenges. Poor knowledge of these rules puts second-language learners at a disadvantage being less able to see meaning in texts when compared with first language counterparts who have been exposed to inherent and informal methods of learning their language at an early stage. Research findings in this study shows that majority of the learners do not lack basic interpersonal communication skills in their home language but lack it in a second language and in this case English language. It is also clear from this study that Science academic language is cognitively demanding and a good number of second language learners do not understand it.

5.2.5 Challenges posed by learning principles.

Learning principles should be adhered to and if they are not followed they may result in learners not understanding scientific concepts .First principle is based on prior knowledge which affect for better or worse how new information is integrated with older concepts as well as attitudes towards science in general. A challenge for learners learning English as a second language is that they may be required to abandon previously acquired knowledge. This is a complex process and may happen only superficially even after formal science teaching (Fathman, Quinn and Kessler, 1992). This study revealed that if certain learning principles are followed learners will not be highly challenged in the learning process. Science is a " hands on" practical subject and if

learners are exposed to multiple opportunities even language barrier is broken when learning science.

5.2.6 Code switching and multilingualism.

Code switching practices by teachers are intentional and limited due to nature of the classes which are multilingual. From the research code switching seem to help learners to understand some scientific concepts. Educators however do not use code switching due to language of teaching and learning (LoLT) which prescribes to either English or Afrikaans in South Africa. This research concluded that learners understand scientific concepts better if they are taught in English and the home language of the learner. The majority of the learners will definitely benefit if science is taught in their home language only if scientific registers are developed in the different home languages just like English and Afrikaans registers in South Africa.

5.2.7 Language change or switching.

Learning and changing over to a second language is a traumatic experience and this may significantly delay, sometimes permanently, learners' academic development (De Wet, 2002). From this research it was not clear if learners are challenged by language change this was because nearly everyone of the learners have been using English language from primary and only an insignificant number switched from Afrikaans to English. Further more they hinted that they were using code switching between English and Afrikaans. However the little data gathered points to the conclusions from literature as cited by (De Wet, 2002) and also (Aziz, 2003) that learners learning can be delayed or slowed down when a language is changed or when a new language is used.

5.3 LIMITATIONS OF THE STUDY

During the course of this study some limitations were identified. Only the most significant limitations were discussed below

- The study was limited to a public school in Johannesburg South District of Gauteng Department of Education. The results therefore cannot be generalized to other regions districts or provinces.

- Underreporting by educators may have occurred as a result of the personal nature of the items questioning their English language competencies and abilities to teach multilingual classes. This might have prevented them from answering truthfully and faithfully.
- The structured nature of the questionnaire limited the possibilities of exploring a wider field of areas to investigate as unstructured and open ended question could do. Only a few learners involved in the focus group interviews provided more challenges the learners face.

It should be noted that these limitations do not nullify the conclusions emerging from this study.

5.4 RECOMMENDATIONS

In light of the findings in this study the following recommendations are deemed necessary to overcome some of the challenges faced by science learners:

5.4.1 Recommendation for educators.

- Educators can determine the reading level of learners in their first language by using English Language teachers, home language teachers in the school, or community members would all be options in determining a learner's primary-language proficiency.
- Support English Second or third language learners' science learning by use of a worksheet that employs simpler language in a sentence frame, use of pictorial materials, use of peer interpreters, and altered assessment tools such as drawings and individual interviews. These approaches are consistent with instructional strategies that research supports for English Second language learners learning.
- Use of peer interpreters can be useful since conversational English is the first acquired, (O'Loughlin and Haynes, 2008). Pairing learners of diverse linguistic abilities can be a useful strategy for English learners as they may be more comfortable asking a peer for clarification in their home language than the teacher. This peer should have greater English skills and preferably have already acquired proficiency in academic English.
- Use of pictorial materials also assists in understanding Science English language learners (O'Loughlin and Haynes, 2008).The use of pictures replaces some of the technical

terminology used by science educators. Diagrams of procedures or materials can be used along with text instructions to enable science understanding by English second language learners of varying abilities.

5.4.2 Recommendations to schools.

- Schools and governing bodies should revisit their language policies regarding the additional languages taught in schools based on their enrolment. The first additional language should be preferably the home language of the learners.
- English language structures like Basic English phonetics must be taught and revised daily and educators must pronounce phonetics clearly and correctly.
- Difficult scientific terms should be taught and used in as many tasks as possible.
- Science learners need to be exposed to a variety of reading materials and other types of resources like school library, internet access and variety of English interactions outside the classroom.

5.4.3 Recommendations to parents

- Parents should expose learners to English language at an early age and use both their home language and English language as modes of communication in their homes.
- Enrol learners to local libraries.
- To assist with homework by checking, helping and explaining English terms to the learners.

5.4.4 Recommendations for further research

- Research on psychological challenges faced by science learners.
- Research the challenges posed by language input and output in language acquisition.
- Investigate on reasons why learners and parents enrol to schools which offer English as a home language even if the learners home language is not English.
- Research on how logical connectives or logical operators and how they affect science learning.

- Research on how bilingualism or multilingualism enhances science teaching and learning.
- Research on the challenges faced by learners who learn science in their home language like English or Afrikaans home language speakers.
- Research of the challenges faced by learners in natural science at primary (GET level)

5.5 CONCLUSION

From this research dissertation it is clear how complex language issues are in high school science learning. There are a lot of challenges faced by high school science learners especially when exposure to English is via the teacher only. The researcher was interested in the difficulties or challenges faced by high school science learners when English is used as a medium of instruction in science learning in a South African context. The challenges faced by learners in the above context were investigated and discussed. Several challenges were identified from literature study but the most significant ones were investigated, discussed and analysed in detail. The research has shown that learners are highly challenged when they learn Science in a language that is foreign to them or a language they are not competent in. The research suggested that if learners have good English language acquisition and understand the language structures and are proficient in a language they are most likely to understand science concepts as well.

Conclusions were reached by the researcher, recommendations were made and the limitations of the study were highlighted. It is hoped that all stakeholders in the education fraternity will take cognisance of the findings and recommendations thereof. In South Africa and the world at large currently there is a skills shortage especially in science related fields. If some of the challenges as identified in this research are eliminated it will go a long way in alleviating the skills shortage being faced in the scientific world.

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ANNEXURE A

CHALLENGES FACED BY LEARNERS WHEN LEARNING SCIENCE USING ENGLISH AS A MEDIUM OF INSTRUCTION AT FET LEVEL

QUESTIONNAIRE FOR EDUCATORS

INSTRUCTIONS

1. Please DO NOT write your name or the school's name on the questionnaire or on response pages provided.
2. This is a confidential questionnaire and you are assured that no individual educator's name or school name will be published
3. Your assistance in completing this questionnaire to the best of your knowledge and experience is appreciated.
4. Section B require you to provide quantitative data from your records or from learner responses according to the requirements of each statement
5. For each item on the questionnaire indicate your answer on the response spaces by writing the selected number on the square provided.
6. The information asked should be as accurate as possible.

SECTION A: BIOGRAPHICAL INFORMATION

1 What is your gender

Male []

Female []

2 What is your age

20- 30years []

31- 40years []

41- 50years []

Older than 51 []

3 What is your teaching experience

Less than 5 years []

6- 10 years []

11- 20 years []

21- 30 years []

30 or more []

4 Indicate your qualification

- University postgraduate Degree []
- University undergraduate Education Degree []
- 4years Education Diploma []
- 3 years Education Diploma []
- Other Qualifications [] if other specify.....

5 Indicate your home language

- | | | | |
|-----------|-----|----------|-----|
| Zulu | [] | Setswana | [] |
| Sesotho | [] | Ndebele | [] |
| Afrikaans | [] | Venda | [] |
| Xhosa | [] | Sepedi | [] |
| English | [] | other | [] |

6 Describe your qualification regarding FET

- Unqualified (no educational qualification) []
- Under- qualified (educational qualification not for FET) []
- Qualified (for FET level) []

7 Describe your training with regards to bilingual/multilingual teaching

- Excellent []
- Adequate []
- Inadequate []
- No training []

8 How do you rate yourself for the need for in service training in the teaching of Science using English language

- Absolutely necessary []
- Necessary []
- A little necessary []

Unnecessary []

9 Do you present your lessons

Monolingual- English []

Bilingually – English/ Afrikaans []

Bilingually- English/Other language []

Multilingual- English/ Afrikaans/ Other languages []

10 How often do you use code switching to explain science concepts

Every lesson []

Sometimes []

Not at all []

11 To what extent are you proficient in English

Totally []

Largely []

Slightly []

Not at all []

12 To what extent do you understand English language structure areas like phonetics (decoding, encoding), Morphology (meaning of words), Syntax (word order) and Semantics (meanings of sentences).

Totally []

Largely []

Slightly []

Not at all []

.....

SECTION B: LEARNER INFORMATION

1 Indicate the number of F.E.T science classes that you teach(tick applicable box)

1 class []

2 classes []

3 classes []

4 classes []

5 classes or more []

2. Indicate the total number of F.E.T.science learners you teach. (Tick applicable box)

0-19 learners []

20-39 learners []

40- 59 learners []

60-79 learners []

80 or more learners []

3 From the totals you have, indicate the number of learners you teach per grade

Grades 10 indicate number []

Grade 11 []

Grade 12 []

4. Indicate how many learners from all your classes who use English as home language

(tick applicable box)

0-9 learners []

10- 19 learners []

20- 29 learners []

30- 39 learners []

40 or more learners []

5. Indicate the average age of the learners who use English as home language in your science classes(tick)

Grade 10 14 years [] 15 years [] 16 years []

17 years and older []

Grade 11 15 years [] 16 years [] 17 years []

18 years and older []

Grade 12 16 years [] 17 years [] 18 years []

19 years and older []

6. The home language of those science learners whose home language is not English.
Totals grade 10, 11,12 (Indicate the numbers in the boxes)

Zulu	[]	Setswana	[]
Sesotho	[]	Ndebele	[]
Afrikaans	[]	Venda	[]
Xhosa	[]	Sepedi	[]
SiSwati	[]	other	[]

7. Indicate the numbers of learners who prefer to be taught Science in the different languages below. Totals from grade 10, 11and 12 (Indicate the numbers in the boxes)

English	[]	Zulu	[]
Setswana	[]	Tsonga	[]
Sesotho	[]	Ndebele	[]
Afrikaans	[]	Venda	[]
Xhosa	[]	Sepedi	[]
SiSwati	[]	other	[] specify.....

8. Indicate the average age of the learners whose home language in your science classes is not English (tick)

Grade 10	14 years []	15 years []	16 years []	17 years and older []
Grade 11	15 years []	16 years []	17 years []	18 years and older []
Grade 12	16 years []	17 years []	18 years []	19 years and older []

9. Type of residential environment in which most English home language speakers reside

Suburbs [] Informal settlements []
 Townships [] City streets [] other (specify).....

10. Type of residential environment in which most learners whose home language is not English.

Suburbs [] Informal settlements []
 Townships [] City streets [] other (specify).....

SECTION C: CHALLENGES FACED BY LEARNERS

VIEWS ABOUT THE LANGUAGE CHALLENGES IN SCIENCE LEARNING

Please read each of the following statements very carefully and tick the answer which best describes your degree of agreement or disagreement.
 The following abbreviations are used: **SA** - Strongly Agree; **AG** - Agree; **DA** Disagree; **SD** - Strongly Disagree.

No.	Item description	Strongly Disagree (1)	Dis-Agree (2)	Agree (3)	Strongly Agree (4)
A	ACADEMIC LANGUAGE PROFICIENCY				
1	Learning science only in English is beneficial to the learners				
2	Learners have limited academic language understanding.				
3	Learners who underachieve usually their home language is not English				
4	English home language learners comprehend scientific terms very well				
B	TECHNICAL AND NON TECHNICAL TERMS				
5	Learners have difficulties understanding scientific technical terms				
6	Learners have difficulties understanding non- technical language of science				
7	Learners lack understanding of academic language				
8	Science academic language is cognitively demanding and learners don't understand it.				
9	Learners face difficulties in understanding "unfamiliar" Science academic language				
C	LANGUAGE ACQUISITION				
10	Learners show poor English language acquisition.				
11	Learners get confused by the use of symbols in science				
12	Scientific jargon frustrates me in preparation of daily lessons				
13	Second language learners find it difficult to listen and understand English due to its phonological/				

	pronunciation system which differ with their home languages				
14	Most learners are proficient in phonetics(decoding, encoding) and morphology(meaning of words)				
15	Most learners are proficient in syntax (word order) and semantics (meanings of sentences).				
16	Knowing the meaning of scientific terms help learners to comprehend and answer questions correctly				
17	Unfamiliar academic terms in science contribute to learners becoming overwhelmed by unknown words.				
18	Learners are frustrated by failure to see meaning in English texts and resort to rote learning or cramming				
D	B.I.C.S AND C.A.L.P				
19	Learners lack basic communication skills in English				
20	Learners interpersonal communication is mainly in their home languages				
21	. learners lack proper communication skills in academic language				
22	.Learners cannot comprehend scientific statements or follow scientific instructions.				
23	Science academic language is cognitively demanding and learners don't understand it.				
24	.Unfamiliar academic terms in science contribute to learners becoming overwhelmed by unknown words.				
E	BILINGUALISM / MULTILINGUALISM AND CODE SWITCHING				
25	Second language learners learn and think in their home languages and try to transfer it to English.				
26	Learners understand scientific concepts better if taught in more than one language				
27	Bilingual learners understand scientific concepts better than monolingual learners				
28	Explaining scientific concepts in a second language is not beneficial to learners				
29	Learning science in their home language is beneficial to learners.				
F	LEARNING PRINCIPLES				
30	Learners easily use their prior knowledge to understand scientific principles better				
31	Science investigations helps learners to be actively involved in the learning process				
32	Learners experiment with new situations beyond the classroom				
33	I actively give feedback to learners in communication, accuracy of knowledge ,skills and thought process				
G	LANGUAGE CHANGE/SWITCH				
34	Learners are challenged with language change				

3. In what language(s) have you been mostly taught in your primary schooling?

Afrikaans. []
 English. []
 Other. [] if other specify

4. What is your home language?

English [] Afrikaans [] Zulu []
 Sotho [] Tswana [] Sepedi []
 Xhosa [] Ndebele [] Swati []
 Venda [] Tsonga [] other [] specify.....

4. What language(s) do you use in communicating with your classmates, teachers, and staff at the school?

Classmates.....
 Teachers.....
 Staff.....

SECTION B:

VIEWS ABOUT THE LANGUAGE CHALLENGES IN SCIENCE LEARNING

Please read each of the following statements very carefully and tick the answer which best describes your degree of agreement or disagreement.

The following options are given: Strongly Agree; Agree; Disagree; Strongly Disagree.

No.	Item description	Strongly Disagree (1)	Dis-Agree (2)	Agree (3)	Strongly Agree (4)
A	ACADEMIC LANGUAGE PROFICIENCY				
1	Learning science only in English is beneficial to the me				
2	I have limited academic language understanding.				
3	Learners who underachieve usually their home language is not English				
4	English home language learners comprehend scientific terms very well				
B	TECHNICAL AND NON TECHNICAL TERMS				

5	I face difficulties understanding scientific technical terms				
6	I face difficulties understanding non- technical language of science				
7	I lack understanding of academic language				
8	Science academic language is cognitively demanding and I don't understand it.				
9	I face difficulties in understanding "unfamiliar" Science academic language				
C	LANGUAGE ACQUISITION				
10	I have poor English language acquisition.				
11	I get confused by the use of symbols in science				
12	Scientific jargon or terms frustrates me when learning science				
13	I find it difficult to listen and understand English due to its phonological/ pronunciation system which differ from my home languages				
14	I am proficient in phonetics(decoding, encoding) and morphology(meaning of words)				
15	I am proficient in syntax (word order) and semantics (meanings of sentences).				
16	Knowing the meaning of scientific terms help me to comprehend and answer questions correctly				
17	Unfamiliar academic terms in science contribute to my becoming overwhelmed by unknown words.				
18	I am frustrated by failure to see meaning in English texts and resort to rote learning or cramming				
D	B.I.C.S AND C.A.L.P				
19	I lack basic communication skills in English				
20	My interpersonal communication is mainly in my home language.				
21	I lack proper communication skills in academic language.				
22	I cannot comprehend scientific statements or follow scientific instructions.				
23	Science academic language is cognitively demanding and I don't understand it.				
24	Unfamiliar academic terms in science contribute to me being overwhelmed by unknown words.				
E	BILINGUALISM / MULTILINGUALISM AND CODE SWITCHING				
25	I learn and think in my home languages and try to transfer it to English.				
26	I understand scientific concepts better if I am taught in more than one language				
27	Bilingual learners understand scientific concepts better than monolingual learners				

28	Explaining scientific concepts in a second language is not beneficial to me				
29	Learning science in my home language is beneficial to me.				
F	LEARNING PRINCIPLES				
30	I easily use their prior knowledge to understand scientific principles better				
31	Science investigations helps me to be actively involved in the learning process				
32	I experiment with new situations beyond the classroom				
33	We are actively given feedback in communication, accuracy of knowledge ,skills and thought process by our teachers				
G	LANGUAGE CHANGE/SWITCH				
34	Learners are challenged with language change				
35	Will learners face difficulties with switching from one language of teaching and learning to another?				

ANNEXURE C

FOCUS GROUP INTERVIEW TRANSCRIPTS

1 CHALLENGES POSED BY LIMITED ACADEMIC LANGUAGE PROFICIENCY

1.1 What are your opinions about learning Sciences in English if one is a non-English speaking learner?

- Learner 1: *"I think if you are a non English speaker you should not learn science using English rather learn using your home language because it is easier to understand things you are taught in your own language. As learners I think we do not benefit much when learning science in English and that is why so many of us fail science, so there should be a change to learning using our home languages"*.
- Learner 2: *"We all know that English language is universal and that's the language we use especially in academic learning .Most of our learning areas use English and the exams are also asked in English so I think we should use English when we are being taught science. Learners fail because science is just hard or maybe we don't just understand the academic language and not English language"*
- Learner 3: *"I actually agree with----- (learner 2) because science has many terms in English and I can't imagine all those terms like atoms, neutrons having words in Zulu or other South African languages. I think we should continue learning science using English language as we will end up being confused if we use other home languages"*.
- Learner 4: *"I think if you are not an English speaker you will have limited English language proficiency and this will cause people not to understand the academic language and we end up failing science due to use of a language which is not our home language"*.
- Learner 5: *"If English language is your home language it helps to understand scientific terms because you use most of the word at home and in everyday speaking. Comprehension is also easy when English is your home language. I think those learners who speak English at home have more advantages than us who only speak English at school with teachers"*.

Learner 6: *"From my own opinion I think English is the best language we can use to learn science because it's used internationally and almost all learning areas use English. I don't think it will be fine to now change science and make us to learn in different home*

languages and for a fact we have 11 official languages in South Africa that would be confusing.”

- ❖ Follow up questions were then asked for voluntary responses from learners or educators

1.1.1 Do you benefit if English is used when learning science?

- Learner 1(10): *“We always speak English in class and we understand it very well and definitely we benefit a lot.”*
- Learner 2(10): *“I enjoy speaking English with my friends and I understand more when we discuss science”*
- Learner 3(10): *“The scientific world mainly communicates in English and majority of textbooks are in English and other languages especially African languages do not have scientific textbooks and this will limit the full learning of science”.*
- Learner 5(11) *“From our experience at primary we did not benefit much when we were taught science in other languages”.*
- Learner 1(11) *“We always benefit when taught in English I think only in a few cases that’s when we don’t benefit.”*
- Learner 3(12): *“I cannot imagine being taught life science in Zulu some things will not make sense at all.”*
- Learner 6(12),” *Those learners who learn using Afrikaans and their home language is Afrikaans actually pass science very well.”*

1.1.2. Is learning science in English beneficial to the learners?

- Educator A” *If learners are not competent in English language it does not necessarily means they will be competent in their home language and furthermore may not benefit if they learn science in their home language. What they need is to become proficient in their home language or English language first and then they will understand science language”.*
- Educator B: *“English language as I see in is rich in vocabulary and there are so many words that English use which in our African language there are no words for such.”*

- Educator D: *“I totally agree (with educator B) African languages are limited in most cases scientific definitions cannot be translated to speed and velocity we use the same word in my language.”*
- Educator G: *“English is a universal language and we prepare learners into that world where they interact in English, even if they may not benefit much now but in the long run they will benefit.”*

1.2 What are your views on learner’s academic language understanding?

- Educator A: *“Some of the learners especially those who are not English speakers cannot comprehend and understand scientific concepts because they have limited academic language understanding. Simple scientific facts become a tedious task because they have to understand first the language. I have learners who failed momentum question because they did not understand the word ‘recoiling’ they wanted a simple word moved back to complete the calculation on conservation of momentum. They all knew the principles behind but because they are not proficient in English they got stuck and failed the question”*
- Educator D: *“definitely majority of the learners are highly challenged in science learning, we actually observe this every time we are teaching certain aspects of the work given cannot be completed because they don’t understand certain English words and I have to explain them further if necessary in a vernacular language for them to understand.”*

1.2.1 Do you lack academic language understanding?

- Learner 1(10): *“We do not have adequate academic language.”*
- Learner 3(10) *“We always struggle to understand what is written in science books.”*
- Learner 5(11): *“Most learners struggle to understand simple English what about the academic language.”*
- Learner 2(12): *“The language that we have is the one we use in general talking not in academic language.”*
- Learner 4(12): *“As learners we struggle with simple language in our English lesson then when it comes to academic language in science we suffer a lot.”*

1.2.2 Do learners have limited academic language understanding?

- Educator B: *“Definitely learners have limited academic language understanding, this is revealed by learner responses in general talk in the class. At times you ask one question and the learner answers something else that we fail to understand as teachers.”*
- Educator D: *“That is very true even if it’s written work that is asked in science there is no coherence in some of the things the learners write, if we closely look at it we see that its more on not understanding the academic language of science. I think if some of the questions are further simplified they can easily answer the questions.”*
- Educator E: *“Those learners who have a rich English vocabulary at times lack the academic language understanding.”*
- Educator F: *“The learners do not have adequate academic language competence this is very evident in their written work, some are very fluent when talking but the written work is something else.”*

1.3 What are your views to the claim that others make that learners fail because they learn science using English Language as a medium of instruction which is not their home language.

- Learner 1: *“We are highly challenged in science because we are taught in a language that we don’t speak at home or with our friends and we have to understand the language first before we start to understand science itself. I think that is the truth at times they put complicated or difficult English words that we don’t understand. Even in class when our science teachers teach us we always ask them to explain some of the English words they use”.*
- Learner 2: *“Even if learner’s home language is English they may fail science because it is not a linguistic subject but requires scientific approach and furthermore science has its own language just like mathematics. If it was the case we would expect all the English home language speakers to be passing science with flying colours. When you look at the white school where all learners are English speakers they don’t always have 100% pass rates in science. Failing science I think is associated with laziness in most than to use of English, there are so many blacks who pass science who are not English speaking”.*
- Learner 3: *“I totally agree with (learner 2) it is true what she is saying even if your home language is English you can fail science, I think there are no added advantages .The underlying principle is understanding the scientific principles and applying them furthermore mathematical understanding is crucial in science learning Those learners who are doing physical science and mathematics are better off than those who are doing maths literacy and physical science here”.*

1.3.1 Do you fail because you learn science using English Language which is not your home language?

- Learner 2(10): *“Some of the English words used are difficult, we only understand the when we revise the test with the teacher I think that’s the reason we fail.”*
- Learner 4(10): *“That is true sir we always fail science because of English.”*
- Learner 5(10): *“When we are asked some science questions in my language I answer very fast but when asked in English I have to think.”*
- Learner 2(11): *“We are highly challenged in science because we are taught in a language that we don’t speak at home or with our friends and we have to understand the language first before we start to understand science itself”.*
- Learner 3(12): *“ Even if your home language is English you can fail science, I think there are no added advantages .The underlying principle is understanding the scientific principles and applying them furthermore mathematical understanding is crucial in science learning”.*
- Learner 5(12): *“I agree with (learner 3) I also have a friend who is English speaking but his marks are always lower than mine.”*

1.3.2 Do you think learners fail science because English is not their home language?

- Educator E :” *Even if learners home language is English they may fail science because it is not a linguistic subject but requires scientific approach and furthermore science has its own language just like mathematics”*
- Educator F : *“Failure of learners cannot be attributed to the language used to teach them that’s why even the best English speakers fail, its only due to lack of understanding of scientific concepts”.*

1.4. Do you agree or disagree that the learners whose home language is English comprehend scientific terms very well?

- Learner 2(10): *“If you are good in English comprehension becomes easy also and this is true for English home language learners.”*

- *Learner 3(10): "I agree it is totally true the more you understand English language then it becomes easy to comprehend science."*
- *Learner 1(11): "Learners who are good in English if you see their marks also have high marks in science."*
- *Learner 6(11): "We have been taught comprehension in English lesson and this greatly benefited most of us in all other learning areas including science."*
- *Learner 4 (12): "There is direct proportionality between English language comprehension and science comprehension."*
- *Learner 5(12): "I strongly agree there is a strong relationship."*
- *Learner 6(12): "Only those English home language speakers who are good in the written language may be good in comprehension of science."*

1.5 Is it true that learners whose home language is English comprehend scientific terms very well

- *Educator B: "if learners understood English terms very well and not necessarily being their home language they will end up comprehending scientific terms better."*
- *Educator C: "Most learners who are English home language speakers have exposed more to the language hence their comprehension is better in comparison to those who have other home languages. The comprehension of science however does not translate to passing science"*
- *Educator G "For the years that I have been teaching almost $\frac{3}{4}$ of the high achievers have a good English background or their home language is English".*

2 CHALLENGES LEARNERS FACE REGARDING TECHNICAL AND NON TECHNICAL LANGUAGE

2.1. What are the challenges learners face regarding to technical and non technical language used in science.

- *Learner 1: "I think that if we are exposed to technical and non technical terms at an early age it will not be a challenge now. The problem is that most of the technical language is*

coming to be presented to us now, most of these terms we never heard them at primary school. This is one of the reasons why science becomes difficult to most of us.”

- *Learner 2: “We do have a lot of challenges regarding technical terms ,the first thing is that they are not directly linked to English some of them like in life science we hear them for the first time and the teacher told us they originate from Latin or other languages. Other terms are combinations of languages it becomes so confusing to us”*
- *Learner 3: “I think it is difficult to understand science language because it contains these technical and non technical terms which we must think about and find their definitions before we even use them or apply them to science. Some of these terms are too demanding academically and we may not use them properly.”*
- *Learner 4: “It is true as you said that non technical language may have different meaning to the everyday common meaning. When I started learning physical science I did not understand the word magnitude I had to ask several times what is magnitude that the question wants us to calculate, when Mr (X) told me that it is the size or value I then understood what it meant but the way we use it in English is different .”*
- *Learner 5: “Technical and non technical language according to me is that it is understood by English people because all of them are in English. I have never seen any of the terms in our language I think that the technical and non technical language is difficult to non English speakers and easy for the people who speak English at their homes.”*
- *Learner 6: “I want to agree with (learner 1) for a fact that these technical and non technical language and terms we only meet them now in high school but at primary we never met them ,they are so unfamiliar to us. This will result in us failing also because actually we are meeting new things for the first time.”*
- *Educator C: “These terms are not used in their daily situations and are taught in a second language to most science learner’s .This results in learners being overwhelmed by new words, terms and language that is so unfamiliar to them.”*
- *Educator F “Scientific technical terms are not used in everyday situations in the life of learners. These terms come as new language to them in addition to the non technical terms they don’t understand” .*

- Educator G *“Technical language include concepts like mass, force, weight and learners are challenged in using these because in different African languages mass and weight can be used interchangeably which is scientifically incorrect. Power work and energy are usually confused by learners due to the fact that the ways they use them in everyday language differ from the scientific definitions”.*

2.2 What are your challenges with technical terms?

- Learner 1(10) *“We see most of these terms first time at high school”,*
- Learner 2(10) *“I want to agree with (learner 1) for a fact that these technical and non technical language and terms we only meet them now in high school but at primary we never met them ,they are so unfamiliar to us. This will result in us failing also because actually we are meeting new things for the first time”.*
- Learner 5(10) *“The terms are difficult to remember.....”*
- Learner 6(10) *“Most tests when asked scientific one word items we have to cram them to pass.”*
- Learner 1 (11) *“Some scientific terms are easy to remember and understand but majority are difficult.”*
- Learner 3(11) *“New language is difficult to grasp.”*
- Learner 4(11) *“We have read over and over to understand them.”*
- Learner 6(11) *“Scientific term we were introduced in grade 8 we still remember them but those from grade 10 and now(grade 11) we don’t remember that much”*

2.3 Do you face difficulties understanding non- technical language of science?

- Learner 3(10): *“Both the technical and non technical terms are difficult to me.”*
- Learner 4(10): *“language in science has too many terms which are confusing.”*
- Learner 1(11): *“As long as we do not have wide English vocabulary non technical terms will always be difficult.”*

- *Learner 5(12): “English has many words that we don’t understand and when used in a science class as non technical terms we further get very confused.”*

2.4 Are learners challenged with non technical terms?

- *Educator A: “Learners are not challenged in non technical language rather they simply don’t read or take time with their books; those who read regardless of their home language will definitely not be challenged.”*
- *Educator B: “non technical language helps learners to understand the concepts in science, most learners lack this language and it becomes very difficult for them to conceptualise science facts.”*
- *Educator C: “this language is closely related to technical terms if a learner does not know one it is difficult to understand the other”*
- *Educator D: “Difficulties are inevitable if English language is not a home language to the learner.”*
- *Educator E: “Technical and non technical terms are very difficult to distinguish to non English speakers”*
- *Educator F: “Learners should practice more in both language definitions and scientific definitions in order to increase their terminology base otherwise they are highly challenged in non technical terms.”*
- *Educator G: “Challenges are faced in both technical and non technical language equally.”*

2.5 Do you lack understanding of academic language?

- *Learner 3(10): “We face difficulties in English itself what about academic language...?”*
- *Learner 2(11): “Normal English we understand better but that used in life science and physical science is hard”.*
- *Learner 3 (11): “We may hear in class some of the language but some we don’t and we always ask what some words mean every time”*

- Learner 1(12): *“Simple language should be used for us to understand”.*
- Learner 5 (12): *“Academic language is difficult compared to English language we use on a daily basis.”*

2.6 Are learners challenged with cognitively demanding Science academic language?

- Educator A: *“There is a lot required in science academic language higher order thinking is required and we need to apply that.”*
- Educator G: *“Most learners obtain low marks in science because the language used in science is more challenging and provokes a lot of thinking compared to other learning areas”.*
- Learner 3(12): *“Questions that need application are so difficult we need those questions which we have seen in class.”*
- Learner 4 (11): *“At times when we read the textbooks we do not understand a thing unless our teachers explain in simple language.”*
- Learner 5(10): *“Academic language is for the clever, for others it is difficult.”*

3. CHALLENGES WITH LANGUAGE ACQUISITION

3.1 Do English language foundations contribute to challenges in science learning?

- Learner 1: *“I strongly believe that if the foundations of English language itself are poor then it will be transferred to all other learning areas including science. Foundations of English will help in us understanding the language better such that when we can understand the English used in science”.*
- Learner 2: *“I think that if we do not have proper grounding in any language we will not be able to learn science properly regardless of the language used to teach and learn science .What I think is that even if we are taught in Afrikaans we should have strong foundations in that language so that we pass. I therefore conclude that English language foundations if not strong will contribute to difficulties to learning science in English”.*
- Learner 3: *“Poor foundations in English language will result in us not being well versed with most meanings of English words and the different science statements or sentences. I agree it is definitely a challenge to us and affect negatively science learning”*

3.2 Tell me about your English language acquisition.

- Learner 2(10) : *“Our foundation in English were poor we only started speaking English in grade 3”*
- Learner 4(10): *“Most of my teachers were not good in English”*
- Learner 3(11): *“Teacher even up to grade seven(7) liked to speak and teach in Zulu”*
- Learner 6(11): *“I acquired all my English skills from home and school all my primary teachers used English at times Afrikaans.*
- Learner 5(12): *“At home we speak Xhosa with my friends Zulu; I only speak English at school even at primary”.*
- Learner 6(12): *“I never understood English grammar or comprehension at primary”.*

3.3 .Do you think learners acquired good English skills?

- Educator D: *“Most scientific statements of learners lack coherence an indicator that their language acquisition in English was poor.”*
- Educator E: *“If learner’s foundations in English are poor they always switch to their home language when speak in and this is evident with majority of my learners.”*
- Educator G: *“Sentence structures of most learners especially those who are not English speakers show a lot of errors which point to poor English language acquisition.*

3.4 Does the use of symbols in science confuse you?

- Learner 2(10):*“I think that the symbols used in science make life easier for us because it simplifies complex things. If we look at the periodic table they use symbols for the elements some which are difficult to remember but symbols help a lot.”*
- Learner 3(10) :*“It is true that symbols used in science make things better and if we look at the formulas’ that we use in physics all are symbols which help us to calculate. I however do not agree totally with--- (learner 2) because some of the symbols are difficult to understand like the sigma ohms and many other symbols which confuse learners.*
- Learner 1(11):*“There are too many symbols and scientific terms that we are continuously given especially life science and physical science, it becomes so difficult to remember most of them.”*

- Learner 4(12): *“Personally I think that symbols make science difficult as most of the symbols are used in mathematical operations, this makes physical science to be more difficult as it becomes more similar to mathematics.”*

3.5 Does the use of symbols confuse learners?

- Educator A: *“Those learners who are mathematically inclined show no confusion because maths is full of symbols”*
- Educator B: *“Nucleic acids for DNA and RNA even test crosses in genetics are simplified using symbols but I have seen that most learners fail these topic and this clearly indicates that symbols confuse them.”*
- Educator F. *“Learners are challenged by symbols to a greater extent though they should help them understand better. Consider periodic table of elements, they do better in writing word equations but fail symbols equations.”*

3.6 Do scientific jargon/terms frustrate you when learning science?

- Learner 1(10): *“Big words in science are frightening to me.”*
- Learner 5(10): *“It’s difficult to understand those scientific big words.”*
- Learner 3(11) : *“ Surely I am frustrated by big words ,suppose you are reading a paragraph and you meet one big word and another before you even understand the statement, that’s bad.”*
- Learner 6(11): *“There are some words that require interpretation sir, if you are not explained by the teacher you get nothing.”*
- Learner 2(12): *“Frustration always comes for example when in an exam and there suddenly appear a big word like phenomenon I get confused.”*
- Learner 3(12): *“ Science teachers especially in physics use very big new words when teaching and we have to ask now and then what the words mean, I agree it frustrates us.”*

3.7 Do you find it difficult to listen and understand English due to its pronunciation which differs with your home languages?

- Learner 1(10): *“Pronunciations by our teachers does not differ from what we know we totally understand them.”*

- Learner 2(10): *“I don’t think that my home language and English differ in pronunciation the way things are said in English I understand them totally.”*
- Learner 4(11): *“We speak English all the time and I don’t think my teacher’s pronunciation in English affect our listening abilities, me for one I understand them very well.”*
- Learner 4(12) : *My home language is English and one of my teacher has an African accent and pronunciation in English perfectly fine ,I don’t think this results in any challenge at all.”*

3.8 Are you proficient in understanding meaning of words?

- Learner 5(10): *“Some of the meanings are difficult to understand if we read on our own”*
- Learner 1(11): *“When our teachers explain the words we understand them better”*
- Learner 3(12): *“We don’t always understand fully some of the meanings of words in science”*
- Learner 4(12): *“Those words we meet only in Life Science are difficult for us to understand”*
- Learner 5(12): *“When teachers repeat certain word and explain them we understand better.”*
- Learner 6(12): *“Some words which we meet in English language or Life orientation and used again in Life Science we understand them better but those new words found in Life science are difficult.”*

3.9What are your views on the use of symbols in science?

- Learner 1:*“There are too many symbols and scientific terms that we are continuously given especially life science and physical science, it becomes so difficult to remember most of them.”*
- Learner 2:*“I think that the symbols used in science make life easier for us because it simplifies complex things. If we look at the periodic table they use symbols for the elements some which are difficult to remember but symbols help a lot.”*
- Learner 3:*“It is true that symbols used in science make things better and if we look at the formulas’ that we use in physics all are symbols which help us to calculate. I however do not agree totally with--- (learner 2) because some of the symbols are difficult to understand like the sigma ohms and many other symbols which confuse learners”*

- Learner 4: *“Personally I think that symbols make science difficult as most of the symbols are used in mathematical operations, this makes physical science to be more difficult as it becomes more similar to mathematics.”*

3.10 Do learners have adequate interpersonal communication skills?

- Learner 1: *“We do not lack interpersonal communication skills it’s only that we are more competent in our own home languages. Majority of us lack basic communication skills in English that’s why most of our discussion and general talk outside the classroom we use Zulu, Sotho or isiXhosa.”*
- Educator 1: *“Learners lack basic interpersonal communication skills and this is shown by their constant switching of language when they are required to discuss using English language during class presentations or group discussion.”*
- Educator 2: *“They do lack interpersonal communication skills only in the English language or a language which is not their mother tongue or home language”.*
- Educator 3: *“From experience I have observed that those learners whose home language is English have very good interpersonal communication skills and can express themselves very well”.*

3.11. Can you comment on how learners follow scientific instructions?

- Learner 1: *“Learners can follow scientific instructions but there is a tendency of trying to divert from what is given and we want to do what we think we can do on our own. The reason we are not able to follow instructions is because of the language used at times it is too complicated and too many steps to follow especially practical work.”*

3.12 Do learners benefit when code switching is used?

- Educator B: *“Most of my learners understand scientific concepts when taught or explained in their home language. Due to the different languages learners speak I ask them to discuss in groups in their home languages their feedback after that reveals that they grasp the concepts better.”*
- Educator E: *“At universities or colleges we were never taught to teach in more than one language, it will become a big problem to now switch languages in our classes. Some of the educators only speak one language and majority of us we are not competent in all the 11 official languages. In one class you may face learners who have all 11 official languages how will we balance that?”*
- Learner 1: *“At primary school we were taught in both English and our home language though most teachers explained to us in Zulu. It was better because we would understand science and even ask question freely in vernacular or our own home languages.”*

3.13 Are there any challenges learners face based on prior knowledge?

- Educator1: *"In African language electricity moves and learners always explain literal movement. It is a challenge trying to explain how electron vibrations and transfer of energy or as charge carriers, In this case trying to help learners undo or abandon previously acquired knowledge is difficult, the learner pretend to understand but when a test or exam comes they still write their original prior understanding"*
- Educator 2: *"Almost all learners come to class with some misconceptions, some are due to ignorance and lacking knowledge .From my experience those misconceptions on prior knowledge learnt in home languages predominate those due to lack of knowledge. What they know from street talk is totally different from scientific facts"*
- Educator 3: *"Those learners that experiment with new situations beyond the classroom will definitely benefit. If learners take practicals and research tasks seriously then they will pass and even enjoy learning science."*

3.14 Are you proficient in syntax (word order) and semantics (meanings of sentences)?

- Educator B: *"Majority of my learners are not proficient in word order and semantics, this is clear in most paragraphs written in their books."*
- Educator F: *"Meanings of words are difficult to the learners the reason is definitely syntax and semantics."*
- Educator G: *"If learners do not understand Basic English we cannot expect them to understand English language structures and how to apply them."*
- Learner 1(10): *"I don't think I am proficient in those things"*
- Learner 3(10): *"I understand word order but the meanings of certain sentences I don't understand them."*
- Learner 1(11): *"We are not proficient at all."*
- Learner 2(11): *"I think some of these things we learn them in English language so we may be proficient in them."*
- Learner 5(11): *"I don't think we are proficient we may know some of the word order and semantics."*
- Learner6 (11): *"English language grammar we are taught that majority of us we are partly competent."*

3.15 Knowing the meaning of scientific terms does it help you to comprehend and answer questions correctly?

- Educator B: *“The moment learners master their scientific terms I have observed that they start improving even in their comprehension.”*
- Educator F: *“Those learners who usually pass section A one word items will also have high marks in section B which requires a lot of comprehension.”*
- Educator G: *“From my experience there is direct relationship between scientific terms knowing and good grades.”*
- Learner 4(11): *“I totally agree that if you know scientific terms learning becomes easier.”*
- Learner 5(11) *“Some of the questions we cannot answer if there are too many scientific words we do not know.”*
- Learner 6(11): *“I have also observed that the more terms I don’t know the more I fail questions.”*

3.16 Unfamiliar academic terms in science do they contribute to you becoming overwhelmed by unknown words?

- Learner 3 (10): *“I think that there are so many words which are unfamiliar to us and they confuse us”*
- Learner 5 (10): *“That is true we are always overwhelmed.”*
- Learner 2(11): *“Unknown words are too many in science and some you do not even see them from the English dictionary.”*
- Learner 6(11): *“Those terms we meet in science maybe for the first time definitely overwhelm us especially if there are many terms like that.”*
- Learner 1 (12): *“It is not always that we become overwhelmed this mainly occurs if we have too many terms at a time.”*
- Learner 4 (12): *“I also think the same with (learner 1) we are only overwhelmed if they are too many.”*

3.17 Are you frustrated by failure to see meaning in English texts and they resort to rote?

- Learner 4(11): *“I strongly believe that if the foundations of English language itself are poor then it will be transferred to all other learning areas including science. Foundations of English will help in us understanding the language better such that when we can understand the English used in science”.*

- Learner 2(12):“ *I think that if we do not have proper grounding in any language we will not be able to learn science properly regardless of the language used to teach and learn science .What I think is that even if we are taught in Afrikaans we should have strong foundations in that language so that we pass. I therefore conclude that English language foundations if not strong will contribute to difficulties to learning science in English*”.
- Learner 3(10):“*Poor foundations in English language will result in us not being well versed with most meanings of English words and the different science statements or sentences. I agree it is definitely a challenge to us and affect negatively science learning*”

4 CHALLENGES WITH BASIC INTERPERSONAL COMMUNICATION SKILLS (BICS) AND COGNITIVE ACADEMIC LANGUAGE PROFICIENCY (CALP).

4. 1. Do you lack interpersonal communication skills?

- Learner 1(11) “*we do not lack interpersonal communication skills it’s only that we are more competent in our own home languages. Majority of us lack basic communication skills in English that’s why most of our discussion and general talk outside the classroom we use Zulu, Sotho or isiXhosa.*”
- Learner 3(11):“*we definitely lack English interpersonal communication it’s so difficult to talk in English even to our friends.*”
- Learner 4(10)“*we tend to have problems in English communication*”

4.2. Do learners lack basic interpersonal communication skills?

- Educator A “*learners lack basic interpersonal communication skills and this is shown by their constant switching of language when they are required to discuss using English language during class presentations or group discussion.*”
- Educator B “*they do lack interpersonal communication skills only in the English language or a language which is not their mother tongue or home language*”.
- Educator C “*From experience I have observed that those learners whose home language is English have very good interpersonal communication skills and can express themselves very well*”.

4.3. Is your interpersonal communication mainly in your home languages?

Learner 1 (10): “*It is true we always communicate in our home languages even in class,*”

- *Learner 4(10): “Every time we are told to discuss in our science lessons we communicate in our home languages.”*
- *Learner 3(11): “My communication with my friends is always in Zulu.”*

4.4. Do learners lack proper communication skills in academic language?

- *Learner 2(10): “In English I think we communicate properly and I am not very sure with academic language.”*
- *Learner 1(12): “Academic language differs from social language and I agree that we as learners lack the proper communication in academic language.”*
- *Educator A: “Our learners’ communication is always social and they don’t have time to discuss and polish academic skills at all.”*
- *Educator B: “Majority of our learners definitely lack proper communication skills in academic language, the way they respond in class even written work is evident.”*
- *Educator C: “Academic language communication skills are developed through constant interaction with others and books, some of the learners’ majority in fact are far from that.”*
- *Educator F: “Apart from being science teachers we are also English language teachers because we always now and the correct their academic language, and this is an indicator that they lack proper communication skills.”*

4.5 Are you able to comprehend scientific statements and follow scientific instructions?

- *Times it is too complicated and too many steps to follow especially practical work.”*
- *Educator A: “The calibre of learners we have they cannot comprehend scientific statements because majority of them are not English home language speakers.”*
- *Educator F: “Instructions in science are very easy but learners have a funny way of doing things they want to do the wrong things.”*
- *Educator G: “Learners Learner 1(10): “Instructions we can follow but my friends just want to touch and mix chemicals without understanding.”*

- Learner 1(12): *“learners can follow scientific instructions but there is a tendency of trying to divert from what is given and we want to do what we think we can do on our own.”*
- Learner 5(11): *“the reason we are not able to follow instructions is because of the language used at are able to follow instructions from my opinion but comprehension is another thing.”*

4.6. Is science academic language cognitively demanding such that you do not understand it?

- *Times it is too complicated and too many steps to follow especially practical work.”*
- Educator A: *“The calibre of learners we have they cannot comprehend scientific statements because majority of them are not English home language speakers.”*
- Educator F: *“Instructions in science are very easy but learners have a funny way of doing things they want to do the wrong things.”*
- Educator G: *“Learners Learner 1(10): “Instructions we can follow but my friends just want to touch and mix chemicals without understanding.”*
- Learner 1(12): *“learners can follow scientific instructions but there is a tendency of trying to divert from what is given and we want to do what we think we can do on our own.”*
- Learner 5(11): *“the reason we are not able to follow instructions is because of the language used at are able to follow instructions from my opinion but comprehension is another thing.”*
- Learner 2(11): *“it is true science language is too academic in most cases.”*
- Learner 3(12): *“A lot of thinking skills are needed in science like designing experimenting all these are cognitively demanding.”*
- Educator A: *“I seem to differ that all science language is cognitively demanding Bloom’s taxonomy tries to address that. Most learners however are not competent with the higher order thinking.”*
- Educator F: *“Simple English language is a toll order for the learners if we introduce academic language it’s even worse.”*

- Educator G: *“Science papers even our daily questions we try to balance all cognitive levels according to bloom’s taxonomy, the simple recall questions they answer easily but the cognitively challenging questions majority fail.”*

5. CHALLENGES WITH BILINGUALISM / MULTILINGUALISM AND CODE SWITCHING

5.1 Do you learn and think in your home languages?

- Learner 3(10) *“It is true I always do that (think in a home language).”*
- Learner 4(10): *“ Most questions we think in our language that is why we answer in Zulu”*
- Learner2 (11): *“In our groups we always discuss in Zulu because we need to understand most science questions better.”*
- Learner 6(12): *“If your home language is no English it is easy to think in home language and try to interpret I do that most often.”*
- Educator B: *“Naturally everyone thinks primarily in their home language to try to process information which is only an advantage to English home language learners.”*
- Educator C: *“I think the more you are exposed to a certain language the more you are inclined to think in that language.”*
- Educator D: *“Our learners always think in their home language then try to think of proper words to translate what they have processed in most cases failing to translate to English.”*
- Educator G: *“I have observed that a lot and I totally agree.”*

5.2. Do you understand science concepts better if you are taught in more than one language (code switching)?

- Educator C:*“Most of my learning understand most scientific concepts when taught or explained in their home language,”*
- Educator D:*“Due to the different languages learners Speaks, I ask them to discuss in groups in their home languages .Their feedback after that reveals that they grasp the concepts better.”*

- Educator B: *“I am fluent in one language that’s English, I also speak three other languages and I am not very fluent, it will be gross injustice to try to explain in another language that I am not competent in.”*
- Educator G: *“At universities or colleges we were never taught to teach in more than one language it becomes difficult to try to code switch all the time.”*
- Learner 5 (10): *“I understand if taught something in English and then explained in Zulu.”*
- Learner6 (10): *“It is good for teachers to explain also in our home language.”*
- Learner 3(11): *“It benefits a few learners who speak that language that the teacher is switching to, so it’s better if they stick to English always.”*
- Learner 5(12):*“At primary school we were taught in both English and our home language though most teachers explained to us in Zulu. It was better because we would understand science and even ask question freely in vernacular.”*

5.3. Do you benefit if either a second language or a home language is used to teach you?

- Learner 1(10): *“If we are taught in a second language it becomes difficult compared to a home language.”*
- Learner 2(10):*“We are born with our languages and we understand them well, so if we are taught in our home language we will pass science easily.”*
- Learner 6(11): *“ A second language is someone else’s language and using it to learn science has many disadvantages”*
- Learner 4(12),*“I think if you are a non English speaker you should not learn science using English rather learn using your home language because it is easier to understand things you are taught in your own language. As learners I think we do not benefit much when learning science in English and that is why so many of us fail science, so there should be a change to learning using our home languages”.*

6 CHALLENGES WITH LEARNING PRINCIPLES

6.1. Are learners challenged with use of prior knowledge?

- Educator F: *“In African language electricity moves and learners always explain literal movement .It is a challenge trying to explain how electron vibrations and transfer of energy or as charge carriers. In this case trying to help learners undo or abandon previously acquired knowledge is difficult ,the learner pretend to understand but when a test or exam comes they still write their original prior understanding”*

6.2. Do practical investigations help learners in the science learning processes?

- Educator A: *“It is true that most learners are still in the concrete stage according to Piaget’s theory and they need hands on activities in the form of practical work.”*
- Educator C: *“Those learners that experiment with new situations beyond the classroom will definitely benefit. If learners take practical work and research tasks seriously then they will pass and even enjoy learning science.”*
- Educator D: *“Experience has taught me to dwell more on practical activities as learners enjoy themselves at the same time actively learning.”*
- Educator E: *“It is true that learners benefit only if there is close supervision and they know exactly what to do. Chemistry experiments are a bit tricky as learners always want to mix what they are not supposed to mix.”*

6.3. Are you always giving feedback in communication and English language accuracy?

- Educator A; *“It was part of our training at university to check language accuracy at times we don’t mark wrong wording or incorrect sentencing.”*
- Educator B: *“Spellings and grammar is emphasised in class activities, but in our final exams we may be lenient as we mainly check scientific correctness and not necessarily language.”*

7 DIFFICULTIES FACED AFTER LANGUAGE SWITCHING OR LANGUAGE CHANGE

7.1 Are learners challenged with language change?

- Educator A: *“I strongly believe that language change does not affect learners especially at a young age as compared to adults. I obtained my degree in a Spanish language which we had to learn in six months, majority of us non Spanish speakers passed.”*
- Educator B: *“. The moment learners change a language they have to start learning the language first before they start to learn the subject matter and this hinders science understanding”*
- Educator F: *“Even if young learners grasp languages faster than adults a language change will disrupt learners in learning science.*
- Educator G: *” I have not experienced situations where learners change from English to Afrikaans, but the learners who changed from Afrikaans to English faced no major challenges because they used both languages at primary.”*

7.2. Are you challenged switching from one language of teaching and learning to another?

- Learner 3(10): *”It is challenging and difficult to understand science concepts when the language of teaching and learning is changed.”*
- Learner 5(10): *“A change in language of teaching and learning will result in difficulties I think.”*
- Learner 2(11): *“ Changing languages will confuse us”*
- Learner 3(11): *“ There will be too many new words and terms and they will make us fail”*
- Educator C: *“There are so many cases in which learners have switched languages completely e.g. from English to Spanish and they never faced immense challenges”.*

ANNEXURE D

Cell: 074 263 4037

_____ Giants Castle
Lanasia South Ext 4
Johannesburg
1829
20 February 2013

The Principal

Dear Sir/Madam

Re: PERMISSION TO CONDUCT ACADEMIC RESEARCH

I am a Masters of Education (Natural Science Specialisation) student at the University of South Africa (UNISA). Permission has been granted by Gauteng Department of Education. I am undertaking a study entitled: "Challenges of using English as a medium of science instruction in a South African context: A view from FET learners."

The study will explore the challenges posed by the use of English as an instruction for learning science to FET learners in order to gain an in-depth understanding thereof. This exploratory study aims to add to the literature by building rich descriptions of complex situations, to give directions for future research and to increase understanding of how language affects learning of science. It aims to make recommendations for educational and community-based strategies which can be implemented nationally and internationally.

Your school has been purposefully selected due to its multi cultural nature and linguistic diversity among learner population. It would be greatly appreciated if the FET Science (Physical Science and Life Science) educators and also 20% per grade of grade 10, 11 and 12 Science learners participate in the research. The research will involve survey questionnaires for FET educators and FET learners, focus in depth interviews with six learners per grade 10, 11 and 12 and checking of learner books.

I undertake to ensure strict confidentiality with the information collected and all respondents will remain anonymous. A copy of the report would be made available to the department of Education and also made available to the school.

I trust this will be given your kind consideration and time.

Kind regards

Daniel Zisanhi

Cell: 074 263 4037

_____ Giants Castle
Lanasia South Ext 4
Johannesburg
1829

20 February 2013

The SGB Chairperson

Dear Sir/Madam

Re: PERMISSION TO CONDUCT ACADEMIC RESEARCH

I am a Masters of Education (Natural Science Specialisation) student at the University of South Africa (UNISA). Permission has been granted by Gauteng Department of Education. I am undertaking a study entitled: "Challenges of using English as a medium of science instruction in a South African context: A view from FET learners."

The study will explore the challenges posed by the use of English as an instruction for learning science to FET learners in order to gain an in-depth understanding thereof. This exploratory study aims to add to the literature by building rich descriptions of complex situations, to give directions for future research and to increase understanding of how language affects learning of science. It aims to make recommendations for educational and community-based strategies which can be implemented nationally and internationally.

Your school has been purposefully selected due to its multi cultural nature and linguistic diversity among learner population. It would be greatly appreciated if the FET Science (Physical Science and Life Science) educators and also 20% per grade of grade 10, 11 and 12 Science learners participate in the research. The research will involve survey questionnaires for FET educators and FET learners, focus in depth interviews with six learners per grade 10, 11 and 12 and checking of learner books.

I undertake to ensure strict confidentiality with the information collected and all respondents will remain anonymous. A copy of the report would be made available to the department of Education and also made available to the school.

I trust this will be given your kind consideration and time.

Kind regards

Daniel Zisanhi

Cell: 074 263 4037

_____ Giants Castle
Lanasia South Ext 4
Johannesburg
1829

25 February 2012

Dear Colleague

Re: PERMISSION TO CONDUCT ACADEMIC RESEARCH

I am a Masters of Education (Natural Science Specialisation) student at the University of South Africa (UNISA). I am undertaking a study entitled: "Challenges of using English as a medium of science instruction in a South African context: A view from FET learners."

The study will explore the challenges posed by the use of English as an instruction for learning science to FET learners in order to gain an in-depth understanding thereof. This exploratory study aims to add to the literature by building rich descriptions of complex situations, to give directions for future research and to increase understanding of how language affects learning of science.

Your participation in this research is voluntary and you will remain anonymous as the research will be treated with strict confidentiality. The findings of the research will be shared with all interested stakeholders and role players in education.

The information you provide from the interviews and the survey questionnaire will assist in identifying challenges learners face when learning science using English as a medium of instruction and to make recommendations that will assist schools, educators, policy implementers to implement strategies to overcome the challenges faced.

I undertake to ensure strict confidentiality with the information collected and all respondents will remain anonymous. A copy of the report would be made available to the department of education and also made available to the school.

I trust this appeal will be given your kind consideration and time.

Kind regards

Daniel Zisanhi

Cell: 074 263 4037

____Giants Castle
Lanasia South Ext 4
Johannesburg
1829

25 February 2013

Dear Parents

REQUEST: PERMISSION TO PARTICIPATE IN ACADEMIC RESEARCH STUDY

I am a Masters of Education (Natural Science Specialisation) student at the University of South Africa (UNISA) and also a G.D.E science educator. I am undertaking a study entitled: "Challenges of using English as a medium of science instruction in a South African context: A view from FET learners."

The study will explore the challenges posed by the use of English as an instruction for learning science to FET learners in order to gain an in-depth understanding thereof. This exploratory study aims to add to the literature by building rich descriptions of complex situations, to give directions for future research and to increase understanding of how language affects learning of science.

Your child has been chosen to participate in this research and is voluntary .Your child will remain anonymous and the research will be treated with strict confidentiality. The findings of the research will be shared with all interested stakeholders in the education fraternity.

The information your child provide from the interviews and the survey questionnaire will assist in identifying challenges learners face when learning science using English as a medium of instruction and to make recommendations that will assist schools, educators and policy implementers to implement strategies to overcome the challenges faced.

I undertake to ensure strict confidentiality with the information collected and all respondents including your child will remain anonymous. A copy of the report would be made available to the department of Education and also made available to the school on request.

I trust this appeal will be given your kind consideration and time.

Kind regards

Daniel Zisanhi

Cell: 074 263 4037

Giants Castle
Lanasia South Ext 4
Johannesburg
1829

25 February 2012

Dear F.E.T Science Learner

Re: REQUEST TO PARTICIPATE IN ACADEMIC RESEARCH STUDY

I am a Masters of Education (Natural Science Specialisation) student at the University of South Africa (UNISA). I am undertaking a study entitled: "Challenges of using English as a medium of science instruction in a South African context: A view from FET learners."

The study will explore the challenges posed by the use of English as an instruction for learning science to FET learners in order to gain an in-depth understanding thereof. This exploratory study aims to add to the literature by building rich descriptions of complex situations, to give directions for future research and to increase understanding of how language affects learning of science.

Your participation in this research is highly appreciated .You will remain anonymous and the research will be treated with strict confidentiality. The findings of the research will be shared with all interested stakeholders and role players in education.

The information you provide from the interviews and the survey questionnaire will assist in identifying challenges learners face when learning science using English as a medium of instruction and to make recommendations that will assist schools, educators to implement strategies to overcome the challenges faced.

I undertake to ensure strict confidentiality with the information collected and all respondents will remain anonymous. A copy of the report would be made available to the department of Education and also made available to the school on request.

I trust this appeal will be given your kind consideration and time.

Kind regards

Mr .D. Zisanhi

Cell: 0742634037

Giants Castle
Lanasia South
1829

20 February 2013

The District Director
Johannesburg South D11

Dear Madam

REQUEST: PERMISSION TO CONDUCT ACADEMIC RESEARCH

I hereby seek permission to conduct research at xxxxxx Secondary school in your district Johannesburg South. The school has been purposefully selected due to its multi cultural nature and rich linguistic diversity among learner population. Permission has been granted by the Gauteng department of education.

I am a Masters of Education (Natural Science Specialisation) student at the University of South Africa (UNISA). I am currently employed by the GDE as a Physical Sciences educator. I am undertaking a study entitled: "Challenges of using English as a medium of science instruction in a South African context: A view from FET learners."

The study will explore the challenges posed by the use of English as an instruction for learning science to FET learners in order to gain an in-depth understanding thereof. This exploratory study aims to add to the literature by building rich descriptions of complex situations, to give directions for future research and to increase understanding of how language affects learning of science. FET Science(Physical Science and Life Science) educators and also 20% of grade 10,11 and 12 Science learners will participate in the research which involve survey questionnaires, focus in depth interviews with six learners per grade 10, 11 and12 and checking of learner books. Science educators and FET Science learners will be required to complete the questionnaire based on challenges science learners face when learning science via the medium of English at their schools.

All information obtained from the schools will be held in strict confidence and the participants in this survey will remain anonymous. A copy of the final document will be made available to the Gauteng Department of Education and the District.

Thanking you for your kind consideration of the above.

Kind Regards

Daniel Zisanhi

ANNEXURE E

INFORMATION TO GAUTENG DEPARTMENT OF EDUCATION, DISTRICT AND SCHOOLS FOR APPROVAL TO CONDUCT RESEARCH

1. RESEARCHER DETAILS

SURNAME: ZISANHI
NAME : DANIEL
INSTITUTION: UNIVERSITY OF SOUTH AFRICA (UNISA)
SUPERVISOR: DR. A.T. MOTLHABANE (UNISA)
STUDENT NUMBER: 46285873
ID NUMBER: BN254875
PERSAL NUMBER: 22842934
EMPLOYER: GAUTENG DEPARTMENT OF EDUCATION

2. PURPOSE OF RESEARCH

The purpose of the study is to explore the challenges posed by the use of English as a medium of instruction for learning science to FET learners in order to gain an in-depth understanding thereof. This exploratory study aims to add to the literature by building rich descriptions of complex situations, to give directions for future research and to increase understanding of how language affects learning of science.

3. DISSERTATION TITLE

Challenges of using English as a medium of science instruction in a South African context: A view from FET learners and educators

4. VALUE OF RESEARCH TO EDUCATION

This study on how language affects the learning of science will help educators to understand educational processes and help them to make professional decisions in delivering science lessons. These decisions will have immediate and long term effects on learners, teachers, parents, communities and the nation at large. Challenges faced by science learners in the learning of science using English as medium of communication will be understood better by non educational policy groups. This will be possible because the study will investigate challenges of using English as a medium of instruction in the learning of science. The findings of this study will help policy formulation by policy makers seeking to improve educational practices.

5. PROPOSED RESEARCH METHODS.

The research data to be collected during the research is both quantitative and qualitative. These types of data are suitable because qualitative methods provide research opportunities which extend the type of information which can be collected and, it implies an interpretive or subjective approach with the focus being on how the respondents experience and understand the particular situation.

5.1 Focus group interviews: interviews will be conducted with science educators and a sample of learners at xxxxxxxx secondary in October 2012 and from February 2013 onwards.

5.2 Questionnaires: These will be given to the all science educators and to 20% of all science volunteer learners from the sample.

5.3 Documents: Official documents like registers will be used to select purposefully participants' .Learner notes, activities will also be required to gather challenges learners face.

6 ETHICAL CONSIDERATIONS

Since the research is both quantitative and qualitative research there is anticipation of personal intrusive thus ethical considerations prioritised. Policies regarding informed consent, deception, confidentiality, anonymity, privacy and caring will be adopted. The research design not only involves selecting informants but will also adhere to research ethics.

6.1 Informed consent: To gain permission participants will sign protocol for informed consent .Informants will select interview times and places so as to establish trusting relationships and handle the dialogue. The time required for participation will be none interfering and will be in the natural setting as possible.

6.2 Confidentiality and anonymity: The settings and participants will be disguised so as to appear similar to several possible places and give code names of people and places if anonymity is requested .There will be dual responsibility to protect the individual's confidences from other persons in the setting and to protect the informants from the general reading public. In survey research there will be dissociation of names from responses during the coding and recording process.

6.3 Privacy and empowerment: There will be negotiation with participants so that they understand the power that they have in the research process. This power and the mutual problem solving that those results will not be an exchange for their privacy if they participate in the study.

6.4 Caring and fairness: Open discussion and negotiations will be carried out to promote fairness to the participants and to the research inquiry .A sense of caring and fairness will be part of the researcher's thinking, actions and personal morality in the research.

7. THE PURPOSEFULLY SELECTED INSTITUTION

7.1 TYPE OF INSTITUTION: Co-Educational Government School

7.2 NAME OF INSTITUTION: XXXXXXXXXX Secondary School

7.3 DISTRICT : Johannesburg South D 11

7.4 No OF LEARNERS INVOLVED: 20% of all F.E.T Science learners= 112 learners

7.5 No OF EDUCATORS INVOLVED: Science Educators= 7

7.6 AVERAGE TIME PER PARTICIPANT: Interview and Questionnaire = 1 hour

7.7 SCHOOL TERMS FOR RESEARCH: Term 4- 2012 and Term 1 and 2- 2013

8 DECLARATIONS

I DANIEL ZISANHI hereby declare that the information that I have supplied is true and that I agree to abide by the conditions as prescribed by G.D.E.

Signature: _____

Date: 03/ 06/2012

**GAUTENG PROVINCE**Department: Education
REPUBLIC OF SOUTH AFRICAFor administrative use:
Reference no. D2013/292**GDE RESEARCH APPROVAL LETTER**

Date:	18 February 2013
Validity of Research Approval:	18 February 2013 to 27 September 2013
Name of Researcher:	Zisanhi D.
Address of Researcher:	5734 Giants Castle
	Lenasia South
	Extension 4
	1829
Telephone Number:	073 686 2206 / 074 263 4037
Email address:	zisanhidan@yahoo.com
Research Topic:	Challenges of using English as a medium of instruction in a South African context: A view from FET learners
Number and type of schools:	ONE Secondary school
District/s/HO	Johannesburg South

Re: Approval in Respect of Request to Conduct Research

This letter serves to indicate that approval is hereby granted to the above-mentioned researcher to proceed with research in respect of the study indicated above. The onus rests with the researcher to negotiate appropriate and relevant time schedules with the school/s and/or offices involved to conduct the research. A separate copy of this letter must be presented to both the School (both Principal and SGB) and the District/Head Office Senior Manager confirming that permission has been granted for the research to be conducted.

The following conditions apply to GDE research. The researcher may proceed with the above study subject to the conditions listed below being met. Approval may be withdrawn should any of the conditions listed below be flouted:

Making education a societal priority

Office of the Director: Knowledge Management and Research9th Floor, 111 Commissioner Street, Johannesburg, 2001
P.O. Box 7710, Johannesburg, 2000 Tel: (011) 355 0508
Email: David.Makhado@gauteng.gov.za
Website: www.education.gpg.gov.za*Makhado*
2013/02/18

1. The District/Head Office Senior Manager/s concerned must be presented with a copy of this letter that would indicate that the said researcher/s has/have been granted permission from the Gauteng Department of Education to conduct the research study.
2. The District/Head Office Senior Manager/s must be approached separately, and in writing, for permission to involve District/Head Office Officials in the project.
3. A copy of this letter must be forwarded to the school principal and the chairperson of the School Governing Body (SGB) that would indicate that the researcher/s have been granted permission from the Gauteng Department of Education to conduct the research study.
4. A letter / document that outlines the purpose of the research and the anticipated outcomes of such research must be made available to the principals, SGBs and District/Head Office Senior Managers of the schools and districts/offices concerned, respectively.
5. The Researcher will make every effort obtain the goodwill and co-operation of all the GDE officials, principals, and chairpersons of the SGBs, teachers and learners involved. Persons who offer their co-operation will not receive additional remuneration from the Department while those that opt not to participate will not be penalised in any way.
6. Research may only be conducted after school hours so that the normal school programme is not interrupted. The Principal (if at a school) and/or Director (if at a district/head office) must be consulted about an appropriate time when the researcher/s may carry out their research at the sites that they manage.
7. Research may only commence from the second week of February and must be concluded before the beginning of the last quarter of the academic year. If incomplete, an amended Research Approval letter may be requested to conduct research in the following year.
8. Items 6 and 7 will not apply to any research effort being undertaken on behalf of the GDE. Such research will have been commissioned and be paid for by the Gauteng Department of Education.
9. It is the researcher's responsibility to obtain written parental consent of all learners that are expected to participate in the study.
10. The researcher is responsible for supplying and utilising his/her own research resources, such as stationery, photocopies, transport, faxes and telephones and should not depend on the goodwill of the institutions and/or the offices visited for supplying such resources.
11. The names of the GDE officials, schools, principals, parents, teachers and learners that participate in the study may not appear in the research report without the written consent of each of these individuals and/or organisations.
12. On completion of the study the researcher/s must supply the Director: Knowledge Management & Research with one Hard Cover bound and an electronic copy of the research.
13. The researcher may be expected to provide short presentations on the purpose, findings and recommendations of his/her research to both GDE officials and the schools concerned.
14. Should the researcher have been involved with research at a school and/or a district/head office level, the Director concerned must also be supplied with a brief summary of the purpose, findings and recommendations of the research study.

The Gauteng Department of Education wishes you well in this important undertaking and looks forward to examining the findings of your research study.

Kind regards

David Makhado
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Dr David Makhado
Director: Knowledge Management and Research

DATE: 2013/02/18

Making education a societal priority

Office of the Director: Knowledge Management and Research

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