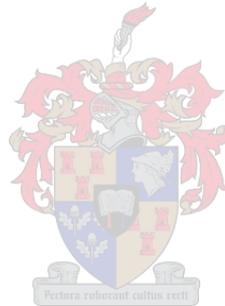


The achievement gap between learners who are assessed in a primary language and those assessed in a non-primary language in the Natural Sciences learning area.

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**Dissertation submitted in partial fulfillment
of the requirements for a
Master's degree in Social Science Methods
in the department of Sociology & Social Anthropology
at the University of Stellenbosch**



**STELLENBOSCH
MARCH 2009**

SUPERVISOR: PROF. LL le GRANGE

DECLARATION

By submitting this dissertation electronically, I declare that the entirety of the work contained therein is my own, original work, that I am the owner of the copyright thereof (unless to the extent explicitly otherwise stated) and that I have not previously in its entirety or in part submitted it for obtaining any qualification.

A handwritten signature in black ink, appearing to read 'E. J. J. J.', written over a dotted line.

Signature:

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Abstract

In the TIMMS-R report, which compared the performance of a South African cohort of learners with international peers in Science (and Mathematics), Howie (1999) highlighted that:

- The biographical information of the South African cohort who performed below par in comparison with international peers indicated that they wrote the TIMMS literacy test in a second or third language.
- Non-primary language learners spend considerably more time on homework compared to primary language learners.
- There is no linear relationship between the amount of time spent on homework in Science and the average literacy level in the learning area amongst South African learners.

Leveraging on the TIMMS report cited above, this study sought to establish the inter-relationship between learning and being assessed in a non-primary language on one the hand and related performance on the other. Specifically, this study sought to establish the performance of non-primary language learners compared to primary language learners in the Natural Sciences Common Task for Assessment (CTA). There is a groundswell of evidence mounting that tends to suggest that primary language learners outperform their non-primary language counterparts in batteries of assessment instruments. This, however, is always clouded by other extraneous factors, chief amongst which, in the South African context at least, is the strong correlation between studying in a non-primary language and family socio-economic status (SES). SES has been identified elsewhere as a determinant of scholastic achievements (Blignaut, 1981; HCDS –WC, 2006).

This cross-sectional study is located within the epistemological paradigm of the Humean conception of causality. According to Hume, causality can only be best understood when a covariance between observable events can be formalized in law-like statements (Babbie & Mouton, 2003). The main conceptualization of this study can thus be fully understood within the framework of naturalistic experiments, however with no benefit of pre-testing.

Data was collected using Grade 9 CTA for the Natural Sciences. The CTA is an instrument which is used in standardising and assuring quality of performance amongst Grade 9 learners. Though the original CTA instrument was in English, which is an official Language of Learning and Teaching (LOLT) at the school, it was translated into isiXhosa. The isiXhosa version was translated back into English in order to track the original meaning and ensure validity of the instrument. The main snag experienced in the translation was that the isiXhosa sentences became longer, thus making the reading of the isiXhosa text more time-consuming. However, this did not prejudice the operation and findings of the study in any way as learners had ample time in which to complete the task.

Data was analysed through a hybrid of quantitative and qualitative analyses methods. In the quantitative data analysis, the software package SPSS was employed. CAQDAS *Atlasti* was used in the qualitative analysis. The focus of the quantitative data analysis was to determine whether there are any differences in the performance of the two cohorts of learners when they respond to a Natural Sciences test set in a primary and a non-primary language. In addition, the quantitative study gave consideration to gender/sex differences in performance as a way of regressing against some extraneous factors. The qualitative study was more focused on learner interpretative styles and linguistic deficiencies exhibited as a result of the interpretation of the given text. The qualitative study also focused its attention on the manner in which learners retrieve chunks of words or sentences from the passage and package their answers as a result of those chosen words.

From the quantitative data analysis, it could be inferred that in dichotomous questions requiring true-false, yes-no answers, the performance of primary and non-primary language learners was similar. However, in language-rich non-dichotomous questions, primary language learners out-performed non-primary language learners. It was also observed that when dichotomous questions were made more tricky and indirect, primary language learners slightly outperformed their non-primary language counterparts. The conclusion read from this was that language discriminates against non-primary language

learners incrementally and in the form of a continuum. The extreme ends of the continuum are direct dichotomous questions and language-rich questions, with the centre of the continuum being tricky and indirect dichotomous questions. The comparison on gender revealed little evidence of either of the sexes outsmarting the other. In all of these cases involving sex, the significance levels were negligible.

The quantitative results also showed that:

- Non-primary language learners read Natural Sciences questions with a degree of superficiality compared to primary language learners who showed a deeper understanding of the texts.
- Non-primary language learners are distracted by pictures accompanying texts whereas primary language learners take advantage of pictures to clarify their understanding.
- Non-primary language learners' strategy of answering questions seemed to be based on consistently trying to link words used in the questions with those in the passage. Thus, if a question used the word "male mosquito", they would pick up any sentence from the passage with similar adjacent words and paste into their answer books as the correct answer.
- Non-primary language learners find it difficult to locate answers that are embedded deeply in the passages compared to primary language learners.
- Non-primary language learners were not at ease in displaying lateral thinking skills.

What emanated from the study is that undoubtedly, assessments in non-primary language lack validity and cannot be used as an apt demonstration of knowledge. Learners in township schools need to be assisted through a hybrid mix of strategies in order to ensure that they have a firm grasp of English. Chief amongst the strategies should be to ensure good grounding in their LOLT from the early on in primary schools. The current cadre of English educators seems to be themselves victims of the system, merely reinforcing the system of gutter education which spawned them.

Opsomming

In die TIMMS-R verslag, wat die prestasie van 'n groep Suid-Afrikaanse leerders met dié van internasionale portuurgroepe in Wetenskap (en Wiskunde) vergelyk het, lig Howie (1999) uit dat:

- Die biografiese inligting rakende die Suid-Afrikaanse groep leerders wat in vergelyking met hul internasionale eweknieë onder standaard presteer het, aandui dat hulle die TIMMS geletterdheidstoets in 'n tweede of derde taal geskryf het.
- Nie-eerstetaal leerders, in vergelyking met eerstetaal leerders, aansienlik meer tyd aan huiswerk bestee.
- Daar geen lineêre verwantskap bestaan tussen die hoeveelheid tyd wat aan Wetenskap huiswerk bestee word en die gemiddelde geletterdheidspeil in die leerarea onder Suid-Afrikaanse leerders nie.

Deur voort te bou op bogenoemde TIMMS verslag, het hierdie studie gepoog om die interrelasie tussen leer en assessering in 'n nie-eerstetaal aan die een hand, en verwante prestasie aan die ander, vas te stel. Hierdie studie het spesifiek gepoog om die prestasie van nie-eerstetaal leerders in vergelyking met eerstetaal leerders in die Natuurwetenskap Gemeenskaplike Asseseringstaak (GAT) vas te stel. Daar is 'n gronddeining van bewyse wat voorstel dat eerstetaal leerders hul nie-eerstetaal eweknieë in 'n battery van assesseringsinstrumente uitpresteer. Dit word egter deur eksterne faktore verduister, waaronder die kernprobleme die sterk korrelasie tussen leer in 'n nie-eerstetaal asook die sosio-ekonomiese status van families is. SES is al elders as 'n determinant van skoolastiese prestasie geïdentifiseer (Blignaut, 1981; HCDS – WC, 2006).

Dié kruis-seksionele studie is geleë binne die epistemologiese paradigma van die Humeaanse opvatting van oorsaaklikheidsleer. Volgens Hume kan oorsaaklikheidsleer slegs ten beste begryp word wanneer daar 'n ooreenkoms tussen waarneembare gebeure in regs-soortige terme geformaliseer kan word (Babbie & Mouton, 2003). Die hoof konseptualisering van hierdie studie kan dus ten volle begryp word binne die raamwerk van naturalistiese eksperimente, hoewel sonder die voordeel van voor-assesering. Data is

versamel deur die Graad 9 GAT vir Natuurwetenskap te gebruik. Die GAT is 'n instrument wat gebruik word in die standardisering en versekering van kwaliteit van prestasie onder Graad 9 leerders. Alhoewel die oorspronklike GAT instrument in Engels was, wat 'n amptelike Taal van Leer en Onderrig (TLO) op skool is, is dit vertaal in isiXhosa. Die isiXhosa weergawe is terug in Engels vertaal om sodoende die oorspronklike betekenis op te spoor en die geldigheid van die instrument te verseker. Die vertaling het egter teweë gebring dat die isiXhosa sinne langer geword het, en dus die lees van die isiXhosa tekste meer tydrowend gemaak het. Dit het egter nie die werking en bevindings van die studie op enige wyse bevooroordeel nie, aangesien leerders oorgenoeg tyd gehad het om die opdrag te voltooi.

Data is geanaliseer deur 'n hibride van kwantatiewe en kwalitatiewe analise metodes te gebruik. Die sagteware SPSS was in die kwantatiewe data analise aangewend en CAQDAS *Atlasti* was in die kwalitatiewe analise gebruik. Die fokus van die kwantatiewe data-analise was om vas te stel of daar enige verskille in die prestasie van die twee groepe leerders was in die afneem van 'n Natuurwetenskaptoets wat in 'n eerstetaal en nie-eerstetaal opgestel is. Die kwantatiewe studie het ook geslagsverskille in prestasie in ag geneem as teenwerking vir sekere eksterne faktore. Die kwalitatiewe studie het veral gefokus op interpretatiewe style van leerders en linguistiese gebreke as gevolg van die interpretasie van die gegewe teks. Die kwalitatiewe studie het ook aandag gegee aan die wyse waarop leerders dele van woorde of sinne vanuit 'n passasie terugkry en hul antwoorde verpak as gevolg van die geselekteerde woorde.

Dit kan uit die kwantatiewe data-analise afgelei word dat in tweeledige vrae met waarvals en ja-nee antwoorde die prestasie van eerstetaal en nie-eerstetaal leerders soortgelyk is. In die taalryk nie-tweeledige vrae het eerstetaal leerders egter nie-eerstetaal leerders uitpresteer. Dit is ook waargeneem dat wanneer tweeledige vrae meer bedrieglik en indirek gestel is, eerstetaal leerders hul nie-eerstetaal eweknieë effens uitpresteer het. Die gevolgtrekking is dat taal toenemend teen nie-eerstetaal leerders diskrimineer en in die vorm van 'n kontinuüm. Die uiterstes van die kontinuüm is direkte tweeledige vrae en taalryke vrae, met bedrieglike en indirekte tweeledige vrae in middelpunt van die

kontinuüm. Die geslagsvergelyking het weinig bewys getoon dat een geslag die ander uitoorlê. In al die gevalle waarby geslag betrokke was, was die belangrikheidsvlakke onbeduidend.

Die kwantatiewe resultate het ook getoon dat:

- Nie-eerstetaal leerders Natuurwetenskap vrae met 'n graad van oppervlakkigheid lees in vergelyking met eerstetaal leerders, wie 'n dieper begrip van die tekste toon.
- Nie-eerstetaal leerders se aandag afgelei word deur prente bykomend tot die teks, terwyl eerstetaal leerders gebruik maak van die prente om hul begrip te versterk.
- Nie-eerstetaal leerders se strategie van vrae beantwoord word oënskynlik gebaseer op konstante pogings om woorde wat in die vrae verskyn met woorde in die stuk te verbind. Dus, as die woorde 'manlike muskiet' in die vraag verskyn, sal nie-eerstetaal leerders enige sin met soortegelyke woorde uitlig en aanbied as die korrekte antwoord.
- In vergelyking met eerstetaal leerders vind nie-eerstetaal leerders dit moeilik om antwoorde op te spoor wat diep in die teks opgesluit lê.
- Nie-eerstetaal leerders was nie gemaklik instaat om laterale denkvaardighede ten toon te stel nie.

Wat voortgevloei het uit die studie is dat die geldigheidswaarde van assesserings in nie-eerstetaal toetse ongetwyfeld tekort skiet en nie gebruik kan word as 'n gepaste demonstrasie van kennis nie. Leerders in township skole moet bygestaan word deur 'n versameling van strategië om te verseker dat hulle 'n goeie begrip van Engels het. Die hoofstrategie moet wees om te verseker dat hulle 'n goeie grondslag in hul TLO het op laerskool. Die huidige kadre van Engels-onderwysers blyk om self slagoffers van die stelsel te wees en dra by tot die powere onderrig waarvan hulle 'n produk is.

Acknowledgements

This project is highly indebted to the following people for their selfless support and motivation:

- Prof. Lesley le Grange for academic support.
- Prof. Johan Mouton for giving me the chance to know the difference between qualitative and quantitative research and empowering me to execute both with meticulous precision.
- Wife Doris and children who provided me with the physical space to continue with this project.
- Mom Mamowedi, sister Georgina (who passed away during the most crucial time of the project) and all siblings for courage and moral-spiritual support.
- Learners at Intsebenziswano High School, Cape Town, who provided me with the need for such a project.
- Marthie van Niekerk, the programme coordinator who was always there, except on Friday afternoons.

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LIST OF ACRONYMS

CA	Continuous Assessment
CO	Critical Outcomes
CTA	Common Task for Assessment
DET	Department of Education & Training
DoE	Department of Education
ESL	English Second Language
FET	Further Education & Training
FETC	Further Education & Training Certificate
GET	General Education & Training
GETC	General Education & Training Certificate
HDI	Human Development Index
L1	Primary or First Language
L2	Second Language
L3	Third language
LEP	Limited English Proficiency
LO	Learning Outcomes
LOLT	Language of Learning & Teaching (see MOI)
MCQ	Multiple Choice Questions
MOI	Medium of Instruction (see LOLT)
NCS	National Curriculum Statement
NS	Natural Sciences
OBE	Outcomes-based Education
RNCS	Revised National Curriculum Statement
SES	Socio-Economic Status
SO	Specific Outcomes
TIMSS	Trends in International Mathematics & Science Study
TIMSS-R	Trends in International Mathematics & Science Study- Repeat
WCED	Western Cape Education Department

CHAPTER 1 -

INTRODUCTION

AND RESEARCH

QUESTIONS

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1.1 Introduction

This study is carried against the backdrop of a major curriculum overhaul in the South African education system. Underpinning this overhaul and framing the distinctive features of the new education system are the principles of social transformation, outcomes-based education (OBE) and high knowledge and high skills expected from learners (DoE, 2003). OBE, in itself, has come to be the catchphrase and flagship of this curriculum. At the centre of OBE is the need to maximize learner potential. This, it is argued, should be achieved by setting learning outcomes and encouraging a learner-centred and activity-based approach to teaching and learning. Also, the new curriculum initiatives seek to foster and promote values and build a national South African identity which is opposed to that underpinning apartheid education (DoE, 2003;p1).

Principally, this study is a response to learners, educators and parents' often repeated complaint about the level of difficulty of the language in which Grade 9 examination instruments are couched. These instruments, referred to as the Common Task for Assessment (CTA), were introduced so as to standardize the new Grade 9 curriculum. The CTA's are set annually by the Department of Education (DoE) and administered to all Grade 9 learners in public schools in the country. CTA's are therefore the equivalent of the matriculation examination (Grade 12) for Grade 9, which serves as the official exit point of compulsory education at the end of the General Education and Training band (GET). The end of the GET marks the onset of the Further Education and Training band which spans from Grade 10 to Grade 12.

As the deputy principal of a school in charge of examinations, it is my line function to establish reasons for failure amongst learners. The most common response that normally comes from Grade 9 educators as the likely reason for high failure amongst learners is that the language employed in the CTA's is above the comprehension of learners. The same line of argument reverberates throughout our cluster meetings. A cluster comprises a number of schools in proximal neighbourhoods and they are established so as to create an enabling environment for the cross-pollination of curriculum issues amongst

educators. In my cluster, which comprises schools in the sprawling residential areas of Philippi, Nyanga and Gugulethu, all situated North-East of Cape Town, learners study through the medium of English, which is a non-primary language for all of them.

The aim of this study is thus to investigate issues related to the language of the CTA in the Natural Sciences, the learning area that I teach at school. In particular, the study is circumscribed to the manner in which the language of assessment tasks in the Natural Sciences CTA relates to the realization of learning outcomes. OBE demands of learners not to be passive *tabula rasa*. In contrast, it demands of learners to interact with the curriculum which stipulates the concepts, skills and values to be achieved at the end of each grade (DoE, 2003). It is my assumption that learners interact meaningfully with the curriculum when they possess the necessary communication skills. The study will thus attempt to investigate ways in which the language of assessment tasks in the Natural Sciences CTA for grade 9 plays itself out in a non-primary language environment. Also, the study is aimed at deciphering ways in which the language of assessment tasks impacts on learners' understanding of questions framed in the OBE mode. OBE, in my understanding, is a shift away from the rote learning system of education, which was the mainstay of Bantu Education¹ and puts emphasis on the realization of learning outcomes (what learners must know and do).

1.2 Background to the study

Science, like Mathematics, has the status of being a gateway subject in the South African academic and business worlds (Swain & Cummins, 1986; HCDS-WC², 2006; AsgiSA³, 2006). The elevation of Science to this status has been accompanied by some negative-positive spin-offs. One of the spin-offs is the persistent glare of the public in general and the taxpayer in particular, on the performance of learners in this subject. As a further spin-off, this public glare has put enormous pressure on learners to perform and educators

¹ System of education intended for Black Africans under apartheid.

² Human Capital Development Strategy for the Western Cape

³ Accelerated and Shared Growth Initiative, a government intervention programme aimed at addressing issues of poverty and underdevelopment

to double their efforts in curriculum delivery of this learning area. A more positive spin-off is the massive investment in projects aimed at increasing learner performance and educator confidence and output in this subject (WCED⁴, 2006/2007). Business has also come to the party in public-private initiatives aimed at realising that the performance targets are met.

Since April 1994, the government *per capita* expenditure on education has come to be tilted in favour of learners from the previously marginalised communities. This is being done through the application of a poverty index measure in funding for schools. A substantial majority of learners in these schools learn through the medium of a second or third language. Also worth noting is that the investment in the education of the previously marginalized is not consonant with learner attainment in the same schools (HCDS-WC, 2006). This poses a dilemma for government, as she continues to search for answers as to the high failure rate, particularly in schools where learners learn through a medium which is not their primary language.

The high correlation between learning and being assessed in a second language on the one hand and high failure rate on the other can no longer be ascribed to a mere coincidence or as a result of lack of motivation from learners and educators (Spurlin, 1995; Kocakulah, Ustunluoglu, & Kocakulah, 2005). Deeper, underlying factors need to be extricated from the abyss which threatens to derail a national project aimed at a much more knowledgeable public in matters of Science and Technology. This is one of the Government's PUSSET⁵ strategy, which, in order to be successful, needs to be rooted at schools before it can filter down to society in general (White Paper, Science & Technology, 1997). However, when learners are not afforded the opportunity to engage meaningfully with Science and Technology issues in the language they command best, an opportunity is lost to build a strong foundation for a future scientifically literate citizenship. Thus issues of the language of learning, teaching and assessment become paramount in any educational turnaround strategy.

⁴ Western Cape Education Department

⁵ Public Understanding of Science, Engineering and Technology

The South African curriculum has undergone a major shake-up in the past decade. This has ushered in an exciting period for some practitioners and anxious moments for others. One factor that many people seem oblivious about is the issue of the medium of instruction (MOI) or Language of Learning and Teaching (LOLT). This is an issue that I contend, based on my experience of teaching in a township⁶ school, plays a pivotal role on learner achievement. Whether this is the case, must, however, be investigated systematically and this is the intention of this study.

1.3 Rationale for the study

The rationale for the study stems from my 14 years experience as a Science educator. Having started my career in semi-rural Mpumalanga prior to the dawn of democracy, I had been able to assemble subtle anecdotes of how teaching Science in an English Second Language (ESL) environment elicit responses from learners, particularly during assessment that requires of learners to go beyond symbolic representation of knowledge. One of the frequent observations I made is the emotional connection between teaching and assessing (both written and oral) in a primary language (L1) and a non-primary language (L2). More often than not, when one conveys information in English, learners stare blankly into the educators' face. However, when the communication code is switched to their primary language, learners immediately assume a settled posture, indicating that the effort spend on listening is much more relaxed. My experience informs me that a tense atmosphere makes comprehension of information difficult as compared to when the atmosphere is more relaxed.

The main rationale for the study is thus to produce information and understanding of the ways in which language might affect the understanding of Science concepts. Science, on its own, comprises esoteric concepts which are not used in ordinary day-to-day communication. In a second language learning environment, what obfuscates the understanding of concepts even further is that they are relayed to learners in a language whose idiom they find difficult to relate to.

⁶ A residential area previously designated for Black people, which today more or less remains so.

It is also my understanding that the high failure rate in ex-DET⁷ schools can no longer be explained in terms of lack of resources only. As a matter of fact, schools in the Western Cape, including ex-DET schools, are fairly well resourced compared to the rest of the country, particularly the more rural Provinces. With the introduction of the Khanya Project, all high schools and a substantial majority of primary schools have installed a modern computer laboratory in addition to the under-utilised but well-equipped Science laboratory. This is indicative of the level of technological sophistication of the Province. However, performance in most ex-DET schools remains mediocre, with most passes in the matriculation examination registered in the standard grade (Western Cape Education Department, 2006). The rationale for this study is thus to establish the connection between the language of the assessment instrument (as preceded by teaching in the same language) and learner comprehension of the questions as captured in the instrument.

1.4 Research Questions

One of the central pillars of the NCS is that "... learners should be able to identify and solve problems and make decisions using critical and creative thinking". In addition, they should be able to "... communicate effectively using visual, symbolic and or language skills in various modes" (DoE, 2003; p2). However, other studies conducted indicate that learners' ability to communicate is severely restricted if they learn through the medium of a non-primary language (Marsch, Hau and Kong, 2000). Also, it has been documented elsewhere that when learners are instructed in L2, they elicit alternative frameworks of thought, an issue that gives rise to matters of invalidity in L2 assessment (Lynch and Jones, 1996; Rollnick and Rutherford, 1996).

In relation to the challenges posed above, the study will ask the following questions based on the Natural Sciences CTA:

⁷ Department of Education and Training, an education department assigned with the administration of the education of Black African children under apartheid government

- Does assessing learners in L2 elicit similar types of responses from an academically equivalent cohort of learners when the same questions are posed in their L1?
- Is there any significant difference in the performance of learners when they respond to questions set in L1 and L2? (Alternatively, does the language of assessment predetermine whether or not learners will succeed academically?)
- Do learners display alternative frameworks of thought when they respond to questions set in L2? If this is so, can these alternative frameworks be explained in terms of linguistic factors?

A response to the questions above may assist practitioners to make certain choices in the instruction and assessment of learners in the Science classroom.

1.5 Significance of the study

One of the often repeated complaints from educators in my school and surrounding ones is how the language of assessment (and teaching) impacts negatively on learner achievement. What is often not mentioned is the extent to which language might be implicated on learner achievement. Further, it is often not clear whether learner inability to demonstrate the requisite knowledge is solely due to language constraints. Whilst it might be assumed that language only impacts on learner achievement in as far as it impedes the interpretation of questions, however, exactly what other role language plays in influencing thought processes is seldom talked about.

The significance of this study lies in its ambition to determine whether assessing learners in L2 has an impact on their understanding of questions posed in CTA's and ultimately on their achievement. Many parallel studies have been conducted which showed that assessing learners in L2 impacts on their performance (Tobin and McRobbie, 1996; Bird and Welford, 1995). However, what those studies failed to draw on was the performance of learners with equivalent academic abilities on similar questions set in their primary language. The significance of this study is that it poses similar questions set in English

(L2) and isiXhosa (L1) to a group of learners with comparable academic abilities. Since the learners were randomly assigned to the two groups, conclusions will be drawn on the influence of language on their performance.

Also, the study is geared at deciphering alternative frameworks of thought elicited when learners have to answer NS questions in a primary language and in a second language. The objective is to assist practitioners, particularly those practicing in schooling environments where code-switching is the norm, in designing their pedagogical approaches. In addition, practitioners can package the language of instruction in a manner intended to convey meaningful instruction to learners who struggle to come to terms with the language of learning. I am convinced that the way we teach is to a large extent influenced by the manner in which we assess our learners. With this perspective in mind, the language of learning should thus be guided and find its relevance from the language that is used in assessment instruments.

Whilst many educators use both L1 and L2 interchangeably in their teaching, as alluded to earlier, what is often ignored by educators is that the thought patterns (system of ideas) that are associated with each language spoken might be different (Kaplan, 1980). In code-switching, educators need to be aware of the differences in discrete sentences and the rhetorical level as well (Kaplan, 1980). One other aim of this study is to highlight the fact that thought patterns in learners' L1 might be different from thought patterns in their L2. Educators in language sensitive classroom environments need to be reflective practitioners, who understand the language needs of their learners.

The main significance of this study thus lies in how the research questions framed above are answered. Should the first question be affirmed, classroom pedagogy will have to be revamped from the current system where educators in L2 schooling environments employ L1 during lessons whereas learners are assessed in L2 during class tests and examinations. In the second research question, should it be established that learners think differently when they respond to questions set in L1 compared to questions set in L2, the current system of learner assessment would have to be looked at critically with the aim of

assisting L2 learners in the comprehension of questions. Should the third research question be confirmed, then teaching would have to take on a whole new meaning in as far as language issues are concerned.

1.6 Clarification of terms applied in the study

Responses - patterns of answers given by learners as elicited from the given questions.

Performance - production of answers as dictated to by what is academically perceived to be true or false.

Framework of thought- rule system, patterns of thought and interpretation of a given world as tied to the logic and rhetoric of a particular language.

Thought patterns – systems of ideas as characteristic of a particular culture

Common Task for Assessment (CTA) – these are the instruments used for assessing learners in grade 9 during the last term of each year. CTA's are set in all learning areas and contribute 25% of the final grade 9 mark unlike in grade 12 where external examinations contribute 75% of the final mark. Also, unlike in the grade 12 examinations, each CTA in a learning area is not a once-off examination. It however, consists of a series of activities or tasks that normally take place over several days. Some of the tasks might require research that is conducted outside of the formal classroom.

Outcomes-based Education (OBE) – this is a system of education introduced in South Africa after the dawn of democracy. It forms the foundation for the new curriculum in South Africa. The main focus of this new system of education is to shift away from the rote-learning based education dispensation of the apartheid era and to usher in an educational system that fosters a learner-centred and activity-based approach to education. Also, it puts more emphasis on what learners can do rather than what they can memorise. Further, it "... strives to enable all learners to reach their maximum learning potential by setting learning outcomes to be achieved at the end of the education process" (DoE (NCS), - 2003).

National Curriculum Statement (NCS) – it is a document that specifies the minimum standards of knowledge, skills values and attitudes to be achieved at the end of each grade. It operates in the Further Education and Training Band (FET) of schooling (Grades 10 – 12). The main principles of NCS are:

- Social transformation
- OBE
- High knowledge and high skills
- Integration and applied competence
- Progression
- Articulation and portability
- Human rights, inclusivity, environmental and social justice
- Valuing indigenous knowledge systems and
- Credibility, quality and efficiency

(Source: DoE, National Curriculum Statement- 2003)

Revised National Curriculum Statement (RNCS) – it is a document that specifies the minimum standards of knowledge, skills, values and attitudes to be achieved at each grade in the General Education and Training Band of schooling (Grades R – 9). With respect to the National Sciences learning area, the eight specific outcomes of the Curriculum 2005 framework were replaced by three learning outcomes of the RNCS.

Learning Outcomes (LO) - this is a statement of intended results of learning and teaching. In the main, it describes knowledge, skills and values that learners should acquire by the end of each grade (MacMillan, 2006). In the Natural Sciences, three learning outcomes are specified, i.e. scientific inquiry and problem-solving skills, constructing and applying knowledge in a variety of contexts and finally recognizing the nature of Science and its relationship to Technology, society and the environment.

Critical Outcomes (CO) – these are the supposed outcomes of learning for the entire system and therefore are common to all learning areas. The main aim of the CO's is in

developing the whole person (MacMillan, *op cit*). In all, seven critical outcomes can be identified, *viz*,

- Ability to communicate effectively
- Using Science and Technology effectively
- Working effectively with other members of a team
- Ability to organize and manage oneself responsibly
- Ability to collect, analyse and evaluate data
- Ability to identify and solve problems using critical thinking and lastly
- The ability to demonstrate an understanding of the world as a set of related systems.

(Source: D. van der Lith, 2007)

1.7 Organisation of the remainder of the study

Chapter 2 of the study reviews the literature that was conducted on issues related to the assessment (and teaching) of learners in a non-primary language. Whilst much of the literature was conducted in the United States of America and South-East Asia, it also finds relevance in the South African educational context. Specifically, chapter 2 will focus on research done elsewhere to determine the performance of learners in a learning environment where their primary language is not the language used in assessment instruments. Also, it will focus on learners in bilingual, immersion and submersion educational programmes.

In **chapter 3**, focus will be placed on the experimental design and methodological strategies employed in the collection and analysis of data. Chapter 3 will also depict the assessment instrument used in the collection of data. Finally, in the chapter, the framework used in analyzing results will be presented.

In **chapter 4**, quantitative results will be presented. This section will show the frequencies of responses, with a focus on the performance of learners from each of the

two language cohorts. Emphasis will be placed on the numbers of learners scoring correct answers from each of the two response categories, i.e. English and isiXhosa.

Qualitative results will be presented in **chapter 5**. This chapter will particularly place emphasis on the quality of interpretation of questions as shown by the answers given by learners. The quality of interpretation will be deciphered from the quality of responses in relation to the questions posed.

The results of both the quantitative and qualitative studies will be discussed and analysed in **chapter 6**. The analysis will focus on the major research questions posed by the study. The research questions of the study are based on quantitatively determining whether learners are in a way prejudiced by answering to assessment questions in the NS grade 9 CTA in a non-primary language. From a qualitative point of view, the study wishes to find out whether learners elicit alternative frameworks of thought when they respond to CTA's in a non-primary language.

The closing chapter, **chapter 7**, will extrapolate on the findings made in chapters 4, 5 and 6 in order to arrive at conclusions and implications of the study. The implications will be focused on what strategies should be put in place with respect to assessment tools in order to ensure that non-primary language learners are fairly assessed in the NS CTA.

**CHAPTER 2 -
LITERATURE
OVERVIEW**

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2.1 Introduction

This chapter represents a constellation of the main body of literature done on second language pedagogy and second language assessment. As indicated in chapter 1, the main hunches of the study are encapsulated within a broader framework on how assessing learners in a L2 might negatively influence their understanding and performance and ultimately lead them to elicit alternative frameworks of thought. References cited below thus lend credence and corroborate the hypotheses of the study.

In the opening sections of the chapter, an attempt will be made to link the “value for money concept” to the whole enterprise of the overhaul of the South African education system. The logical connection between cost-benefit analysis and this section of the dissertation is aimed at pontificating that government intervention strategies aimed at improving the performance of English Second Language (ESL) learners’ performance in the Natural Sciences bore little fruit. The ultimate intention is thus to buttress the main thesis of the study, i.e. when learners are assessed in L2, they perform poorly compared to when they are assessed in L1. This happens irrespective of the amount of money and type of resources that are put in place to support such an endeavour. Inferences in this case will mainly be drawn from archives from The South African Institute of Race Relations, Department of Education, Western Cape Education Department Annual Reports, Statistics South Africa and The National Treasury.

This chapter will also draw its inducement from a research project titled “Trends in International Mathematics and Science Study (TIMSS)”. TIMSS, which is a comprehensive study that compares the performance of a South African cohort of learners with international peers, lends credence to the assertion that when learners are assessed in L2, their performance in Science is abysmal, irrespective of how resourceful the system is. Evidence provided in TIMSS points out that most other countries with poor Human Development Indices where learners were assessed in their L1, performed better compared to an academically equivalent South African cohort. This strong correlation between assessment in L1 and good performance in the Sciences is what the study aims to focus on.

The latter part of the chapter will draw its trajectory from studies performed elsewhere in the following areas related to this study:

- Language planning and political considerations.
- Bilingual proficiency, immersion programmes and academic achievement.
- Learner performance (in the Natural Sciences) as compared to improved English language proficiency.
- Language proficiency, logical thinking and communication.
- Causative effects of L2 on alternative frameworks of thought.
- Modifying language on assessment instruments to assist learners.
- Impact of English second language on classroom pedagogy and classroom coping strategies.
- Language versus culture.
- Bilingualism in the classroom.
- Learner achievement in language-rich and non-language questions.
- Performance of ESL on tasks demanding higher cognitive tasks.

Since the dawn of democracy in South Africa, government-initiated programmes in education have become tilted in favour of what has become known as priority skills, notably critical¹ and scarce² skills. Topping all priority skills in Education is the improvement in the performance of learners in Mathematics and the Natural Sciences. Government is thus investing massively in these subjects with a view to ensuring higher standards of performance from learners and educators. Linked to the investment in Science and Mathematics, is the government's *per capita* expenditure on education. This has also come to be tilted in favour learners from the previously marginalized communities. A walk down memory lane shows that during the (apartheid) financial year 1976 – 1977, the *per capita* expenditure per population group was as follows:

¹ The type of skills necessary for a department or organisation to function effectively.

² Skills that are in dire shortage and render an organisation or department ineffective.

Table 2.1: Per capita expenditure in education for the years 1976 – 1977

African	R54, 08
Coloured	R185, 16
Indian	R236,13
White	R551,00

SOURCE: Blignaut, S (1981). Statistics in education in South Africa; 1968 – 79. South African Institute of Race Relations.

The table above is but a prologue of the evolution of the expenditure patterns of successive governments in education.

As late as 1994/95 when a new democratic government was sworn into power, the *per capita* expenditure per learner stood at the ratio 4: 3: 2,6: 1 for White, Indian, Coloured and African learners respectively (DoE³; 1995). From available Government Annual Reports, it is shown that since the dawn of democracy, educational expenditure has almost doubled. During the financial year 2004/2005, government expenditure in education had risen to R4 892 for learners in primary schools and R5 615 for learners in secondary schools (WCED-Annual Reports, 2006). All this demonstrates the extent to which the South African government has gone to ensure that education in general, and education of the marginalised in particular, receives priority in its budget allocation.

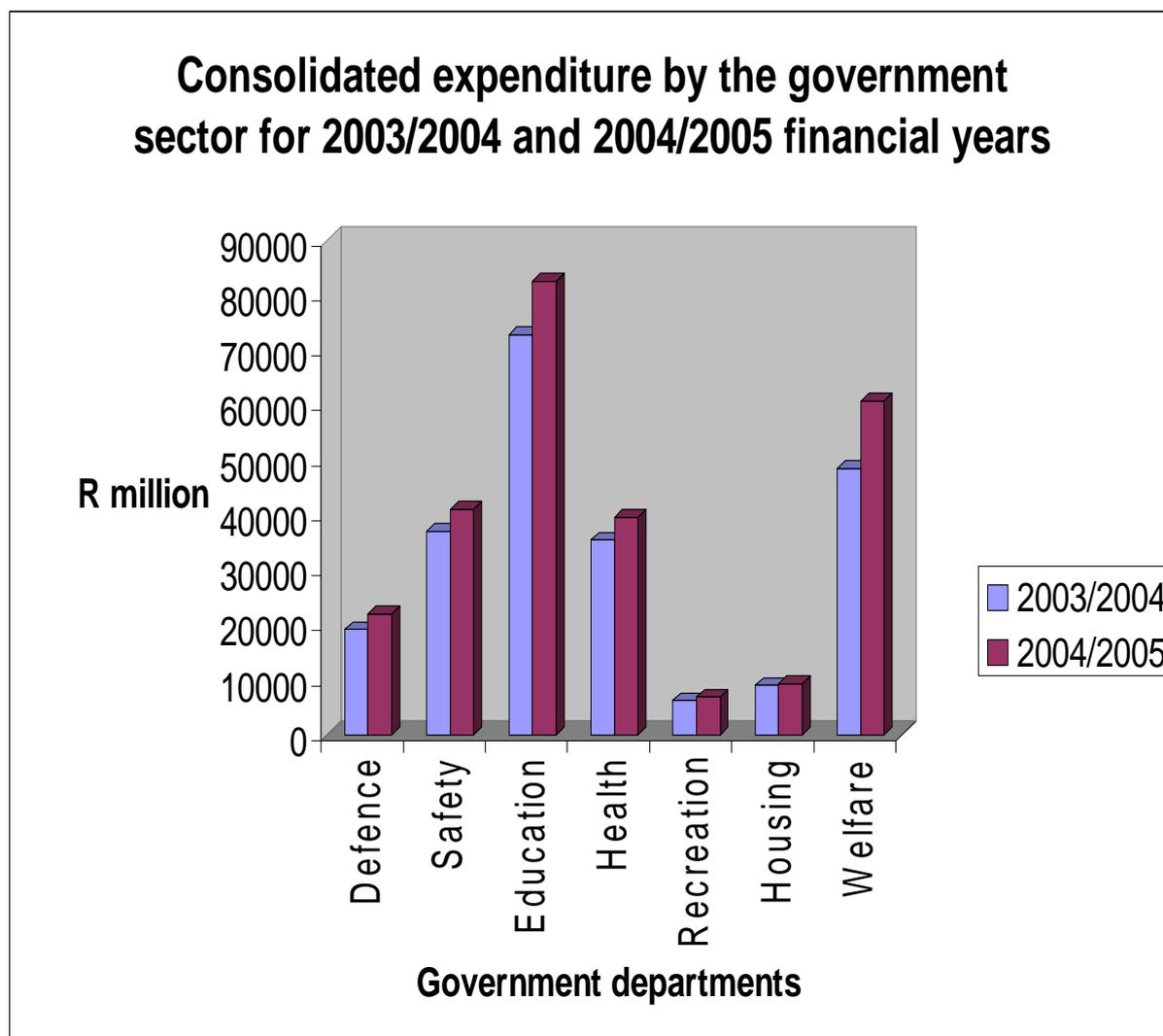
The National Treasury noted that between the years 1992 and 1993, real growth in education was 1,6% (National Treasury, 2004). Statistics South Africa (2005) shows that there was an increase in expenditure in education from R72 879 million in the financial year 2002/2003 to R82 566 million in 2003/2004 financial year. It needs to be noted that even though the bulk of the budget goes towards the salaries of personnel (HCDS-WC⁴, 2006), the tilt in education provision is towards the previously marginalised with a focus in the gateway subjects, i.e. Mathematics and Science.

³ Department of Education

⁴ Human Capital Development Strategy for the Western Cape

The Education Department is one of the departments which receive a high budget allocation from government. Figure 2.1 below shows the priority that education enjoys in the government budget allocation relative to other departments. The picture depicts government allocation for the financial years 2003/2004 and 2004/2005.

Figure 2.1:



Source: Statistics South Africa (2005). Consolidated expenditure by the general government sector- 2003/2004. Pretoria.

The picture above shows that education does not only receive a lion's share of the budget, but also its budget increases sharply from year to year. The picture also depicts a percentage increase of 13,3% between the two financial years on educational services. It also highlights the that Education Department draws 19,5% of the

government fiscus. In addition, the information shows how earnest government is in uplifting the education standards of ordinary South Africans who cannot afford private education.

An issue that poses a perennial dilemma to the government is that the investment in education is not consonant with performance in the gateway subjects. A particular problem is the high failure rate in Science (and Mathematics) experienced in disadvantaged schools. A substantial majority of learners in disadvantaged schools learn through the medium of a second or third language. The correlation between high failure rate and learning in a non-primary language might no longer be assumed to be coincidental. Much deeper underlying factors need to be extricated from the abyss which threatens to derail a national project aimed at producing a much more knowledgeable public in matters of Science and Technology. This is one of the cornerstones of the government's PUSE⁵ strategy. I hold the view that, for the PUSE strategy to be successful, it needs to be rooted in schools before it can filter through to society in general.

When the new government came into power in 1994, it could not overlook the imperative of transforming education. For this reason, the South African curriculum has undergone a major overhaul in the past decade. This has ushered in an exciting period for some practitioners and anxious moments for others. One factor that everyone seems oblivious of is the issue of the medium of instruction (MOI) or Language of Learning and Teaching (LOLT), an issue that I contend, based on my experience of teaching in a township⁶ school, might play a pivotal role in learner achievement. Needless to say that most of the questions in examinations test more of learners' linguistic competence than their content knowledge.

Looking with hindsight at the issues mentioned above, my study hinges mostly on outcomes of the Third International Mathematics and Science Study (1999), which is now referred to as Trends in International Mathematics and Science Study (Repeat) (TIMSS- R). The latter was a sequel to the study conducted in 1995, hence the suffix

⁵ Public Understanding of Science, Engineering and Technology

⁶ A residential area previously designated for Black people, which today more or less remains so.

repeat. Though reference will be made to related studies done elsewhere, the main reason for doing the study emanated from TIMSS-R as reported in Gonzalez, Calsyn, Jocelyn, Mak, Kastberg, Arafeh, Williams and Tsen (2000). The latter part of the next section will also make reference to TIMSS as commissioned by the Human Sciences Research Council in South Africa. TIMSS (1999) was carried out to compare the Mathematics and Science performance of learners in the United States of America with that of learners in 37 other countries. South Africa was one of the 37 other countries. It was in this context that I took advantage of available statistics and piggybacked on TIMSS to do a cross-national comparison of the performance of South African learners in the Natural Sciences.

2.2 The TIMSS⁷ report

The TIMSS study (Gonzalez *et al*; 2000) revealed certain anomalies in the performance of South African learners in Mathematics and Science as compared to their peers internationally. The study was carried out cross-nationally with the specific aim of assessing the following issues:

- How does the Mathematics and Science knowledge of U.S. eighth-grade students compare to that of students in other nations?
- Has the relative international standing of US eighth grade students changed in 4 years since the original TIMSS (1995)?
- How does the relative performance of U.S. eighth-grade students in 1999 compare to the relative performance of U.S. fourth-grade students earlier?
- How do nations compare on education-related background factors studied in TIMSS- R?

Table 2.2 below shows the national average score in Science for the 38 nations sampled.

⁷ Third International Mathematics and Science Survey

Table 2.2 Average performance in Science of grade 8 learners by country

Nation	Average	Nation	Average
Chinese Taipei	569	Latvia -LSS ⁸	503
Singapore	568	Italy	493
Hungary	552	Malaysia	492
Japan	550	Lithuania	488
Korea, Republic of	549	Thailand	482
Netherlands	545	Romania	472
Australia	540	Israel	468
Czech Republic	539	Cyprus	460
England	538	Moldova	459
Finland	535	Macedonia, Republic of	458
Slovak Republic	535	Jordan	450
Belgium-Flemish	535	Iran, Islamic Republic of	448
Slovenia	533	Indonesia	435
Canada	533	Turkey	433
Hong Kong SAR	530	Tunisia	430
Russian Federation	529	Chile	420
Bulgaria	518	Philippines	345
United States of America	515	Morocco	323
New Zealand	510	South Africa	243

International Average of 38 nations = 488

SOURCE: Gonzalez *et al* (2000). Pursuing Excellence: Comparisons of International Eighth-Grade Mathematics and Science Achievement from a U.S. Perspective, 1995 and 1999. U.S. Department of Education

The table above shows that South African learners performed poorly compared to the other 37 nations, scoring only half of the international average. Whilst the most handy and common excuse would be to decry the availability of resources, it may as well be argued that most of the countries polled are not in a favourable economic position

⁸ Only Latvian-speaking schools were tested.

either. As a matter of fact, most of the countries which outperformed South Africa had a comparable Human Development Index (HDI)⁹ with South Africa. Looking at the two African countries on the list, Moroccan learners with an HDI of 0.640 outperformed South African learners with an HDI of 0.653 ([http://en.wikipedia.org/wiki/List of countries by Human Development Index](http://en.wikipedia.org/wiki/List_of_countries_by_Human_Development_Index) – 25 September 2007). In addition, most of the countries in the picture, including developed countries, invest a little proportion of their GDP on education (Howie, 1999). The main contrast between South Africa and the rest of the countries is that in South Africa, the majority of respondents (70%) used a language which is not their primary language. Howie (*op cit*) noted that:

The majority of pupils tested in South Africa were not fluent in the languages of testing, be it English or Afrikaans, and struggled to communicate. The possible lack of fluency on the part of the teachers would exacerbate this situation further and disadvantage the pupils even more (p 21)

An interesting parallel can be drawn between the South African and the United States of America samples. Below is tabled the results of the USA cohort, with a specific focus on learners who are non-primary language speakers of English though they had to write the test in English:

⁹ A comparative measure of life expectancy, literacy, education and standards of living for countries worldwide. It is a standard means of measuring well-being, especially child welfare.

Table 2.3 U.S. grade 8 Science achievement by selected characteristics

<i>Characteristics</i>	<i>Science average</i>	<i>Significance</i>
Race/ethnicity		
White students	547	White students outperformed Black and Hispanic students
Black students	438	
Hispanic students	462	
National origin of parents		
Both U.S. born	527	Students whose parents were U.S. born outperformed students whose parents were both foreign born.
Both foreign born	472	
1 U.S. born and 1 foreign born	509	

SOURCE: Gonzalez *et al* (2000) Pursuing Excellence: Comparisons of International Eighth-Grade Mathematics and Science Achievement from a U.S. Perspective, 1995 and 1999. U.S. Department of Education.

Noteworthy from the table above is that White students outperformed Black and Hispanic learners. One may vouch for socio-economic status (SES) as one plausible explanation for the disparity in the performance of the groups under scrutiny. However, when the SES is regressed against the national origin of parents, data indicate that learners whose parents were both born in the USA outperformed those whose parents were born outside the USA. Interestingly, the relationship between the country of origin of parents *vis-à-vis* learner performance in Science function in the form of a continuum. Learners whose parents originate from a non-English speaking country performed poorly compared to those whose parents were born in the USA (Gonzalez *et al, op cit*). Those of whom only one parent was born in the USA served as a buffer in between. In relation to this situation, Gonzalez et al (*op cit*) state that:

a sizeable proportion of students with parents born outside the United States may not speak English as their first language or may not speak English at home with great frequency, if at all. Since English is generally the language of instruction in U.S. classrooms, students' facility with language may play a

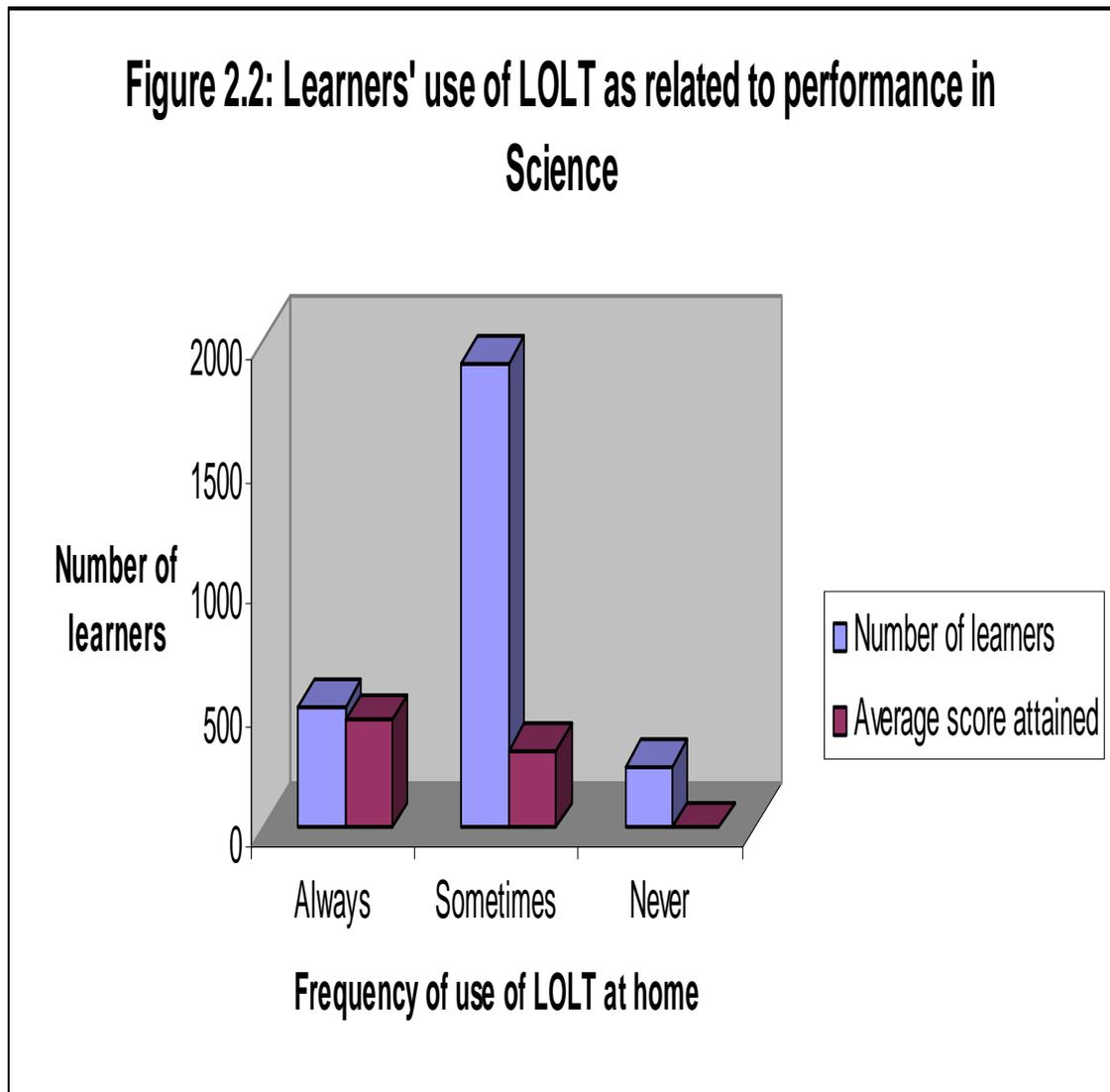
role in their ability to adequately understand school subjects” (Gonzalez et al, 2000; p31)

The situation above can correctly be tallied with the language spoken in the family. Learners whose parents were born in the USA are most likely to speak English as a primary language. Those learners with only one parent having been born in the USA are likely to speak English only 50% of the time at home (at least from a mathematical point of view). At the extreme end of the continuum, learners whose parents were both foreign born are not likely to speak English at home. This tends to disadvantage them in an environment where English is used as a primary language of learning.

From a South African perspective of the TIMSS-R report, Howie (1999) highlights the following issues:

- Second language (L2) learners spend considerably more time deciphering the written work as compared to primary language (L1) learners. Concerning homework, the study noted that learners in most countries reported spending lesser hours compared to the South African group. On average, learners from other countries reported spending $\frac{1}{2}$ – 1 hour on homework in Science per week compared to the South African average of 1,5 hours.
- Also related to the amount of time spent on homework, the study revealed that whereas in most countries a linear relationship was evident between the amount of time spent on homework in Science (and Mathematics) and average literacy in the learning areas, the case was different for the South African cohort. In the case of South Africa, the study showed that more time devoted to homework did not result in higher scores. As a matter of fact, it was shown that the highest achievement for the South African group is found to be associated with a moderate amount of time spent on homework per day. The only extrapolation to be made from this information was that for the majority of South African learners, the rewards associated with academic industriousness are minimal. The question that needs to be answered is, who are these learners who spend so much time on books even though they do not reap the rewards associated with the effort they invest in hard work?

- The biographical information of the South African group showed that a large proportion of the learners wrote the Science and Mathematics literacy test in their L2 or third language (L3). On the question of whether learners spoke the language of learning and teaching (LOLT) at home, 19% of the learners indicated they always or almost always spoke the language of instruction at home. 72% of the learners indicated they sometimes spoke LOLT at home. The balance of the learners never spoke LOLT at home. Figure 2.3 below shows the frequency at which learners spoke LOLT at home and the related performance in the Science literacy test.



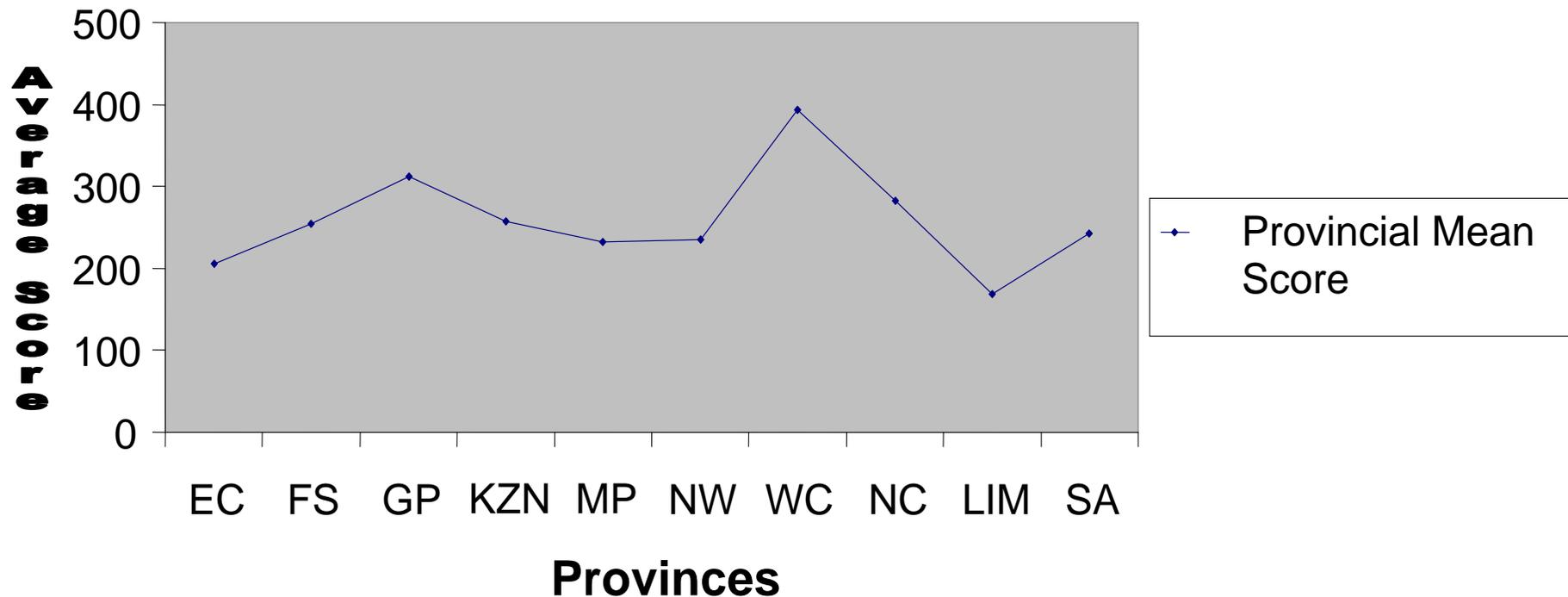
Source: Howie (1999): Third International Mathematics and Science Study–Repeat (TIMSS-R). Human Sciences research Council Executive Summary.

From figure 2.2 above, it would seem that there is a strong positive correlation between speaking LOLT at home and performance in the literacy test. However, it cannot be ruled out that learners speaking either English or Afrikaans which are the main LOLT in the South African education system, also come from favourable socio-economic backgrounds. This factor needs to be linearly regressed in the analysis of learner performance in order to ascertain what influence it has on performance.

Also worth noting is that for the 72% of learners who sometimes spoke LOLT at home, it can be safely assumed that the LOLT is not their L1. Primary language speakers are expected to speak their L1 at home all of the time or almost all of the time, particularly when they are together as a family. Howie (*op cit*) also points out that;

- The average results of the South African group compared with the international group showed that on a scale of 800 points, South African learners scored an average of 243 compared with the international average of 488. It was also noted that amongst the pool of countries surveyed, the Gross National Product (GNP) *per capita* of South Africa was amongst the last three. The GNP was measured in US dollars. Also revealing was that besides the lowest GNP *per capita*, public expenditure in education in SA was amongst the highest. The only prognosis to be made is that the return obtained is not worth investment made in education in SA.
- TIMSS-R was made up of different types of questions, namely, multiple choice (MCQ) type questions and free response items. In all, there were 104 MCQ on the Science instrument. The performance of learners on free response items was very poor compared to that for the MCQ. Further, it was noted that for MCQ, many pupils depended on guessing the correct option and thereby achieving a higher score than they might have attained. This underlies the importance of language on learners' ability to decipher the written word.
- The Western Cape, Northern Cape and Gauteng provinces scored above the South African average. Figure 2.3 below depicts learners' average score in Science per province.

Figure 2.3: Provincial Mean Score in Science Literacy



Key: EC- Eastern Cape, FS - Free State, GP - Gauteng, KZN - Kwa-Zulu Natal, MP -Mpumalanga, NW - North West, WC - Western Cape, NC-Northern Cape, LIM - Limpopo (Northern Province), SA - South Africa

Source: Adapted from Howie (1999): TIMSS-R (SA)

From figure 2.3, it could be safely inferred that in provinces where the majority of learners speak LOLT, there has been a higher performance recorded in the test. In the Northern Cape, the majority of learners, including African learners, speak Afrikaans which is intermingled with English, at home. Though the two languages are not spoken with L1 command, however, learners have the edge when it comes to dealing with academic work compared to those for whom the languages are only spoken in the academic domain. Since the majority of learners in the Northern Cape come from deprived and economically indigent backgrounds, it can be assumed that family background played some role in influencing learner performance.

In the Western Cape, the percentage of learners who do not speak LOLT at home is marginal. This group comprises mainly Black African learners in the townships who comprise slightly over 30% of the learner population in the province. For the majority of learners, English or Afrikaans is a primary language. This includes Black African learners from other Provinces and the rest of the African continent who cannot speak isiXhosa and stay in the affluent suburbs where English is spoken with L1 proficiency (HCDS-WC - 2006).

2.3 Language planning and political considerations

In South Africa, as is elsewhere, the issue of language across the curriculum has always been political rather than academic (Swain & Cummins; 1986). When the National Party came into power in 1948, it became law that LOLT in African schools becomes Afrikaans, or at least half the subjects should be learned through the medium of Afrikaans. This was done solely for the purposes of political control, cultural domination and economic subjugation (Hartshorne, 1987). The latter two objectives can clearly be seen in the involvement of extra-statal organisations such as the Dutch Reformed Church, Federasie van Afrikaanse Kultuurvereneginge, Afrikaanse Handels Instituut etc. (Hartshorne, 1987) in decisions related to LOLT at African schools.

Hartshorne (*op cit*) also noted that after the National Party came into power in 1948, the FAK (Federasie van Afrikaanse Kultuurvereneginge), which had very close links

with the Broederbond¹⁰, held a ‘volkskongres’ at which a policy of Christian National Education, formulated by the ICNO (Die Instituut vir Christelike Nasionale Onderwys) was adopted. Article 15 of the statement, which dealt with African education, stated that;

“... any system of teaching and education of natives (sic) must be based on these same principles (trusteeship, no equality and segregation), ...must be grounded in the life and worldview of the Whites, most especially those of the Boer nation as the senior white trustees of the native... (who) must be led to an independent acceptance of the Christian and the National principles in our teaching... the mother-tongue must be the basis of native education and teaching but...the two official languages must be taught as subjects because they are official languages and ... the keys to the cultural loans that are necessary to his (sic) own cultural progress” (Hartshorne, op cit; p68).

Since the promulgation of the South African Schools Act in 1997, it has become a competency of School Governing Bodies to choose LOLT for their schools (SASA¹¹; 1997). For African schools, this has been a Hobson’s choice as parents regard English as a gateway to economic prosperity and a licence to accessing the global cultural and economic stage (National Education Policy Investigation “NEPI”; 1992). For this reason, LOLT in African schools has remained English. One of the reasons parents opt for English is that they perceive the learning of subjects in L1 as a return to the years of apartheid education (NEPI, *op cit*). This is despite the fact that many learners are not able to communicate in English by the time they exit the schooling system.

¹⁰ A shadowy, underground organisation constituted of mainly white male Afrikaners whose objective was to prop up the Apartheid machinery and protect white privilege.

¹¹ South African Schools Act

2.4 Bilingual proficiency, immersion programmes and academic achievement in Science

Swain and Lapkin (1977) conducted a study in order to ascertain achievement in Science (and Mathematics) associated with early immersion¹² amongst Canadian students. The learners spoke English L1 though their LOLT was French. The study established that early immersion learners performed as well as their French L1 counterparts when examined in French. However, results for partial¹³ and late immersion programmes did not provide evidence for equivalent performance between immersion and L1 comparison groups. French L1 learners outperformed their French L2 (English L1) in partial and late immersion programmes. The conclusion to be drawn from this is that in a multi-lingual setting, L1 learners always outperform those to whom the language of assessment is not their L1.

Warren, Ballenger, Ogonowski, Rosebury and Hudicourt-Barnes (2000), in a study conducted in the USA, noted the many ways in which to understand the gap in Science learning and achievement separating low-income, ethnic minority and linguistic minority (L2 speakers) children from more economically privileged learners. In this study, the relationship between everyday and scientific knowledge is approached from two perspectives. One of the perspectives views the relationship as fundamentally discontinuous whereas the other views it as fundamentally continuous. Basing their research on the latter tradition, they propose a framework for understanding the every day sense-making practices of learners from diverse communities as an intellectual resource in science learning and teaching (p529).

Further, Warren, Ballenger, Ogonowski, Rosebury and Hudicourt-Barnes (*op cit*) argue that too little attention is paid by researchers and teachers alike to the potentially profound continuities between everyday and scientific ways of knowing and talking. They further state that the pedagogical possibilities that may be derived from such an analysis, especially for the marginalized children, are seldom realised. The conclusion from this study is that what children from low-income, linguistic, racial and ethnic

¹² When children from the same linguistic and cultural background are put together in a classroom setting in which the second language is used as LOLT (Cummins and Swain, 1986)

¹³ An immersion program where learners study through a mix of L1 and L2.

minority communities do as they make sense of the world is different from what European Americans are socialized to do, even though what is done is intellectually rigorous and generatively connected with academic disciplinary knowledge.

In a related study, Barik and Swain (1978) noted that in Science, inferior performance has been recorded amongst some groups of early partial immersion from Grade 5 onwards. They also did a study which established that in late immersion programmes, the immersion group's performance was inferior to that of a comparison group in Science and Mathematics. In addition, they found out that when late immersion learners had French second language each year through to the immersion year, the level of mastery of content in Science and Mathematics taught in French was comparable to that attained by their English-instructed comparison.

The above observation illustrates the rather complicated interplay between the LOLT *versus* learners' L1. In South Africa, we have early partial immersion programmes taught by poorly trained educators. The educators are themselves victims of the same system, making the situation even more complicated (Howie, 1999). Academic measurement is thus rendered inaccurate under such circumstances due to lack of validity and reliability. In the study by Barik and Swain (1978), it was noted that "... testing in second language is a risky business if one wished to measure accurately subject content knowledge" p40.

Studies done by Swain and Cummins (1986) in order to compare the academic performance of L2 learners in early immersion programmes with those in core French L2¹⁴ revealed a significant difference in favour of the immersion group. The study established that giving some test to immersion and core French L2 was ill-advised as the latter group under-performed consistently. This was due to the fact that, the study showed, if the level of difficulty was appropriate to the immersion group, the core French L2 learners would become frustrated to the point of emotional breakdown at being unable to do any part of the test. On the other hand, if the level of difficulty was appropriate to the core French L2 learners, the immersion learners would become

¹⁴ This group was exposed to 20 – 40 minutes of daily French L2 instruction which was focussed on teaching specified vocabulary and grammatical structures.

bored and quickly lose interest in the task. The conclusion from this study was that the combination of increased time in French and the communicative methodology in immersion programmes vastly improves the proficiency of L2 learners in content subjects.

The study above is corroborated by the hue and cry that reverberated throughout the education corridors when CTA's¹⁵ were introduced in grade 9 (Cape Argus, 10-17.11.05). L2 learners, parents and educators, who predominantly reside in townships, felt the level of difficulty of the language used in the papers was too high for learners to make any headway with the questions posed. On the other hand, L1 learners, parents and educators felt the questions were easy, as evidenced in comments made in newspaper headlines and in 'letters to the editor'. In a letter addressed to "The Cape Argus" dated 17th November 2005, the author, seemingly a white parent, indicated that the "CTAs fail to give a true reflection of skills" mainly as a result of "the usage of language" that is not clear (Appendix A). One of the reasons for the complaint amongst L2 learners is that the CTA's are couched in a language which is inappropriate for them. Making the language more appropriate for L2 learners resulted in the language of the test becoming inappropriate for L1 learners.

2.5 Learners' performance as related to improved English language proficiency

Tobin and McRobbie (1996) conducted an investigation with Chinese-Australian learners in order to establish the extent to which learning in L2 was incapacitating them in Chemistry. It was established from the study that despite learners' efforts to learn Chemistry with understanding, difficulties in speaking and writing were factors that limited performance. A 'hegemony' based on the use of English to learn Chemistry and assess performance placed learners with Limited English Proficiency (LEP) in a position of potential failure. This study supported the assertion that learning Chemistry could be best facilitated when LEP learners are provided with opportunities to fully employ their native language tools and when the micro-culture of the classroom fits the macro-culture of life outside the classroom.

¹⁵ Common Task for Assessment, an instrument administered to all Grade 9 learners in South Africa in all learning areas. The CTA's serve as a mock examination, standard setter and quality assurance for grade 9's.

The study also found out that there was a strong positive correlative relationship between learners who passed Chemistry and those who learned English quickly. Those Chinese learners who studied English quickly were able to overcome the barrier of having LEP in a system built on an hegemony of learning and being assessed in English. Specifically, the study also found out that preparedness to use Cantonese (one of the Chinese languages) even in a milieu where it was not encouraged, high levels of task orientation and a will to attain goals were salient features of a cultural capital that led to success.

In a related study, Greenfield (1996) compared the performance of LEP Asian-Americans with those of Caucasian Americans who speak English as L1 across all grades. The study was aimed at unravelling whether Asian-Americans with LEP would perform differently from Caucasian Americans who speak English L1 on verbal and non-verbal subtests of a Science test. The findings revealed that the Asian-Americans outscored the Caucasian learners across all grade levels on all non-verbal sub-items of the Science test. However, the performance of the two groups on verbal sub-items revealed no significant difference in performance. The conclusion was that language had an impediment on the performance of the Asian-Americans, hence they performed equally with the Caucasian learners on sub-items which were of a verbal nature. Should the field have been level enough, Asian-Americans would have been expected to outperform the English L1 learners on both the verbal and non-verbal sub-items of the test.

Oller and Perkins (1980) reviewed research which tended to suggest that one global factor underlies most aspects of linguistic, academic and intellectual performance. Following from the research, they expressed the view that:

A single factor of global language proficiency seems to account for the lion's share of variance in a wide variety of educational tests including non-verbal and verbal IQ measures, achievement batteries, and even personality inventories and effective measures... the results to date are ... preponderantly in favour of the assumption that language skill pervades every area of the school curriculum even more strongly than was ever thought by curriculum writers or testers. (p1)

They thus suggested that the strong relationship between language proficiency on the one hand and academic and cognitive variables on the other exists across all the four general language skills, *viz* listening, speaking, writing and reading. Further, they argued that a ‘pragmatic expectancy grammar’ must be functional from a psycholinguistic point of view for language to be meaningful. The pragmatic expectancy grammar is defined as “... a psychologically real system that sequentially orders linguistic elements in meaningful ways” (Oller and Perkins, 1979; p34).

Hammond (2000) describes a unique and ongoing collaboration involving educators, students and community members. According to this model, “funds of knowledge” were gathered by teachers, students and members of the community with the intention of enriching science matter to be studied in the classroom. Upon the funds of knowledge gathered, a new kind of multi science emerged which was accessible to all collaborating members of the team. In this way, participation, understanding and performance improved in the science class.

2.6 Language proficiency, logical thinking and communication

In multilingual classrooms, there is a strong correlation between failure and learning in L2 (Cummins, 1986). This phenomenon is also observed in rich countries where poverty index can be safely ruled out as an extraneous variable in determining factors that result in failure in the Natural Sciences. Cummins (*op cit*) argues that:

“... much of the impetus for compensatory education programmes... derived from the belief that language proficiency was a crucial component in educational success. The educational difficulties of many lower-class and minority group children were attributed to lack of verbal stimulation in the home, and the remedy, thereof, was to expose the child to an intensive programme of verbal stimulation prior to the start of formal schooling. (p144)

In relation to the matter raised above, Learning Outcome 1 (LO1) for the Physical Sciences states that learners should be able to “...interpret data and draw conclusions”. In addition, they should be able to “...communicate and present information and scientific arguments” (NCS- Grades 10 –12: Physical Sciences; p17). This is reinforced by Critical Outcome 5 (CO5) which puts an emphasis on learners

being able to “...communicate effectively using visual, symbolic and or language skills in various modes”. The underlying assumption flowing from LO1 and CO5 is that even in L2 learning environments, learners are able to express themselves freely in LOLT. Experience of teaching in township schools paints a bleak picture in relation to the ability of learners being able to express themselves in LOLT (English).

With regard to communicative competence in academic discourse, Cummins (*op cit*) makes a distinction between ‘Basic Interpersonal Communication Skills (BICS)’ and ‘Cognitive Academic Language Proficiency (CALP)’. The former, he notes, includes cognitively undemanding, context-embedded language skills used for communication. In context-embedded communication, the participants actively negotiate meaning and the language is supported by a wide range of meaningful paralinguistic and situational cues. In CALP, he refers to context-reduced communication which relies on linguistic cues to meaning and may in some instance involve suspending knowledge of the real world in order to interpret the logic of communication appropriately. Further, he states that;

“... context-embedded communication derives from the interpersonal involvement in a shared reality which obviates the need for explicit linguistic elaboration of the message. Context-reduced communication, on the other, derives from the fact that this shared reality cannot be assumed, and thus linguistic messages must be elaborated precisely and explicitly so that the risk of misinterpretation is minimized” (p153).

In the South African schooling system, communication for L2 learners is neither at the level of context-reduced nor context-embedded communication. Torres and Zeidler (2002) studied the effects of English language proficiency and scientific reasoning skills on the acquisition of science content knowledge by Hispanic English language learners and native English language speaking students. In this study, they employed a state-wide standardised science test. The major finding emanating from this study was that the levels of English language proficiency appear to influence the acquisition of science content knowledge of Hispanic English language learners.

2.7 Role of second language on learners' understanding and generation of alternative frameworks of thought.

Lynch and Jones (1996) explored questions regarding the possible causes of students' alternative frameworks in Science and whether or not these alternative frameworks could be explained in terms of linguistic and or cultural effects. In the same study, groups of learners from Tasmania and the Philippines were interviewed in their primary languages (L1), *viz* English, Tagalog and Ilcano. In order to deal with the task of differentiating between cultural and linguistic effects, triangulation methods were employed. The triangulation process primarily involved comparing learners' interview responses.

The major finding to emerge from the study was the observation of linguistic types of alternative frameworks. These frameworks could be classified as being syntactical, lexical or semantic in nature. The alternative frameworks were found to be largely due to structures both common and unique in Tagalog and Ilcano.

In a sequel to the study above, Lynch (1996) undertook a study on students' understanding of the Earth and Moon systems. This study was conducted in Tasmania and the Phillipines. Learners in these two countries speak Tagalog and Blaah languages at home though their classroom instruction takes place through the medium of English which is their second language. Comparable groups of learners were interviewed in their home languages. The study established that alternative frameworks elicited in relation to shape, size and solar models would suggest that linguistic and cultural factors were in operation. The linguistic requirement for dealing with solar models was found to be simple as they dealt with arguments on shape and relative size. In particular, the conceptual distinction related mostly to circle, sphere and rotate. The absence of these terms in the first language (L1) made it difficult for the learners to have a grounded meaning in these concepts.

The study also established that the Tagalogs and Blaahs explain the Earth, Sun and Moon systems in terms of what these celestial bodies do (operational definition) rather than what they are. In the case of the Blaahs, it was found that the tone of explanation was more consistent with an organic rather than a mechanical model of

the solar system. Whilst in the Western culture the world is regarded as lifeless matter controlled by impersonal forces or laws of nature with no moral reference, the Blaahs tended to see the world as alive. Their language and thought patterns are constructed in such a manner that plants, rocks and water are thought to have personalities and they are related in a way that is analogous to personal relationships.

Kocakulah, Ustunluoglu, and Kocakulah, (2005) studied the effect of teaching in a native and foreign language on students' conceptual understanding of science concepts. The results of their study indicated that there was considerable difference between learners taught in a native and those taught in a foreign language. Their findings also indicated that the native language students gave more scientifically acceptable answers whereas the foreign language students struggled to explain reasons for their answers and as such the foreign language employed had become a barrier to their learning. They thus concluded that the native language of students should be preferred in mediating scientific concepts to students.

2.8 Modifying language on assessment instruments and making science comprehensible to assist L2 learners

Bird and Wellford (1995) studied the General Certificate of Secondary Education (iGCSE) and the General Certificate of Education (GCE) in the United Kingdom for Science questions in which the language could be simplified and modified in order to assist Limited English Proficiency learners. Performance of learners was then compared on the original and the modified versions of the assessment instruments. No statistically significant difference was observed on the two versions of instruments for a sample of British learners who spoke English as L1. However, when performance was compared on the same sets of original and modified versions for a sample for whom English was a L2 or even a third language (L3), there were significant differences in their performances. The three most common factors which could account for the changes in performance on the modified version were found to be:

- Reduction in the length of the question. The wording of longer types of questions was found to have serious consequences on learners' final marks. The longer the sentence, the more confusing it was found to be by L2 learners.

- Omission of extraneous information from the questions.
- Change in the individual length of sentences. The more concise the sentence, the easier it was found by L2 learners.

Lee and Avalos (2002) studied issues of instruction and assessment with students who are learning English as a new language (ELL). They discovered that allowing students to communicate science knowledge in their home language promotes both general literacy and academic learning. They also observed that despite efforts to ensure that all students receive equivalent content instruction and fair assessment; opportunities are more limited for ELL students than for English proficient students. They thus concluded that educators at various levels should make efforts to provide resources and opportunities to meet the learning needs of all students.

Spurlin (1995) made the observation that language minority students in science classrooms are confronted with a set of complex challenges that emanate in part from the power issues of schools. They also noted that many bilingual, English as second language students are expected to learn science content through English which is their non-native language. He makes the suggestion that non-native science students need to be rescued as well from the institutionalised racism and classicism.

2.9 Impact of English L2 on classroom pedagogy and classroom coping strategies

In a study conducted by Probyn (1998), reflections of educators on teaching in L2 were recorded. Educators' reflections were mainly based on the impact that teaching in L2 has on learning and teaching and the coping strategies that educators and learners employ in order to navigate the curricula. Some of the coping strategies that educators mentioned were:

- Code-switching
- Africanising English words
- 'Xhosalising',¹⁶ the LOLT
- Increasing more time in teaching new concepts due the fact that:

¹⁶ Converting English words into isiXhosa

1. one has to speak more slowly in order for learners to be able to follow.
 2. educators speak with frequent pauses in between.
 3. teaching one concept at a time.
 4. role playing
- Using non-verbal cues

On issues related to classroom pedagogy, the study noted that learners left Grade 12 unable to express themselves fluently in English. Another observation was that learners had problems communicating what they know. This factor consequently led to a high failure rate amongst learners. Another observation by Probyn (*op cit*) was that at times learners had a feeling of helplessness as a result of the inability to comprehend the language of learning.

Learners' main language should be harnessed as a resource for learning in a context where there is immense pressure to access and acquire English is of immeasurable proportions (Setati, Adler, Reed and Bapoo; 2002). In this study of urban and rural primary and secondary schools in South Africa, the authors attempted to describe and discuss practices of Mathematics, Science and English learners. The study focused on the reception and production of language through code-switching, exploratory talk and discourse-specific talk. A key finding of the study was that learners and teachers ever manage to move from the point of informal exploratory talk to discourse specific talk. In this way, educational inequalities are exacerbated as teachers and learners are left stranded at some point in their educational journey.

In a related study, Shaffer (2007) makes an attempt to provide a bridge between learning principles and teaching strategy. She notes that ESL (English Second Language) students are unique and heterogeneous and as such teaching such a group is accompanied by challenges that can be addressed through creativity and tactfulness on the part of educators. She further posits that lessons can be tailored to the cognitive and verbal ability through simple modifications. In this way, she argues, benefits to students will be carried throughout their academic careers and help provide a strong foundation for later learning.

2.10 Language as related to culture

Norman, Ault, Bentz and Meskimen (2001) explored ways in which socio-cultural factors could account on the achievement gap between Afro-Americans and Euro-Americans. In their study, they observed that the achievement gap had existed earlier between Euro-Americans and other groups even though it eventually disappeared. Taking advantage of the latter observation, they explored ways in which this “achievement gap” may also be dealt with in the case of Afro-Americans.

The conclusion reached above was that the socio-cultural position of groups is crucial to understanding and interpreting the scholastic performance of learners from various backgrounds. They thus argue for a research framework that incorporates the cultural-ecological theory¹⁷ as well as goal theory¹⁸ and identity theory¹⁹ (Ogbu; 1994). In conclusion, Norman, Ault, Bentz and Meskimen (*op cit*) note that the “... socio-cultural position of learners holds sway over a large portion of the achievement patterns of urban Black students in Science” (p1111). They thus propose the establishment of professional development programs to help teachers develop insight into the cultural orientations of minority children.

Baker, Islands and Taylor (1995) observed that any attempt to nationalise Western Science curricula in non-Western countries is likely to prove ineffective. This was so noting the poor fit between learners’ world views, language meanings and prior beliefs inherent in the subject. It was established that not only does language name and label objects and occurrences, but also importantly, it communicates abstract meanings about the concepts embedded within the names of the labels.

In a related study, Sutherland and Dennick (2002) explored the views of Grade 7 Cree and Euro-Canadians. The study was conducted in Manitoba (Canada). The aim of the

¹⁷ This theory is based on the notion that individual development is influenced by the qualities of the social systems in which the family lives or participates, i.e. individual development is nested within a series of social systems.

¹⁸ The theory that adult development and theories about development are affected by what we believe is the goal of development. It also states that development goals typically reflect cultural values.

¹⁹ This theory attempts to construct a broadview of personality that will explain many types of individual behaviour in a variety of situations, i.e. perceptions of oneself and others of one’s selfsameness and continuity in time.

study was to establish the views that learners held about the nature of Science. Qualitative and quantitative instruments were employed in exploring learners' views. The major finding that emerged from the study was that in open-ended questions where pre-formulated responses were absent, there was a significant difference in the responses given by learners. Learners' culture was found to have had a significant contribution in the manner in which learners' responses were packaged.

Solano-Flores and Nelson-Barber (2000) propose a concept of "... cultural validity as a form of test validity in science assessment" (p553). They further argue that the conceptual relevance of cultural validity is supported by evidence that culture and society shape an individual's mind and thinking. From this perspective, it is posited that the process of assessment development must consider how the socio-cultural context in which students live influences the ways in which they make sense of Science items and the ways in which they solve them. These socio-cultural influences include values, beliefs, experiences, communication patterns, teaching and learning styles and epistemologies inherent in the students' cultural backgrounds as well as the socio-economic conditions prevailing in their cultural groups.

Flowing from the above assessment, Solano-Flores and Nelson-Barber (*op cit*) contend that current approaches to handling student diversity in assessment, including adapting or translating tests, providing assessment accommodations, estimating test cultural bias are limited and lack a socio-cultural perspective. They thus conclude that cultural validity may conflict with current basic principles and assumptions in testing, such as item independence and standardization. Also, they state that adopting cultural validity as a criterion for test validity makes it necessary to shift assessment paradigms and adopt new procedures for assessment development.

2.11 Bilingualism in the Science classroom

In a study commissioned in Swaziland amongst isiSwati-speaking learners, Rollnick and Rutherford (1996) observed that the use of isiSwati L1 served important functions. Once learners were allowed to employ L1, isiSwati was found to be useful in the articulation and elimination of alternative conceptions. It was also found to be useful in the clarification of concepts and formulating ideas. In addition, learners were

requested to use their own L1 (isiSwati) in order to decipher alternative frameworks that might remain hidden if they use L2 English only. By so doing, learners' hidden misconceptions were exposed and discussed.

Foudzer and Markwick (1999) performed a study whose aim was to find out the effectiveness of using L1 for bilingual learners in the Science classroom. In the study, they discovered that L1 as well as past experience helped clarify a difficult concept, leading to a better understanding of the phenomenon and the learning of Science. This study also established the importance of using learners' L1 in enhancing their cognitive development. In addition, the study elicited that when learners are allowed to converse in L1, they understood concepts better as a result of the relaxed atmosphere that is created.

In a related study to the one above, Krugly-Smolka (1995) discovered that difficulties in language were not significant when only one word responses were required of learners. This was even more so when learners were allowed to use their own language in the classroom. It was also established that learners doing well spoke more than one language, which supports theories about the cognitive advantages of bilingualism or multilingualism.

Roscigno, Velez and Ainsworth-Darnell (2002) looked at the relationship between language minority achievement, family inequality and the impact of bilingual education. Particularly, they investigated the background disadvantages language minority students face. They thus concluded that language minority students face depressed patterns of achievement on average compared to their native English speaking counterparts. They also discovered a positive influence of early bilingual education program and that enrolment in later elementary grades has no impact while prolonged involvement has a weak negative influence.

2.12 L2 learners' achievement in language-rich and language-deficient questions

Marsh, Hau and Kong (2000) evaluated the effectiveness of instruction in L1 (Chinese) and L2 (English) amongst Hong Kong learners. This was done using multi-level growth models for a large representative sample during the first three years of

schooling. The study was done in the learning areas of Science, Mathematics, History and Geography. The initial aptitude of learners in English was tested.

It was found out that learners who initially had better English skills were less disadvantaged by instruction in English. The results also confirmed that irrespective of prior academic aptitude, English (LOLT) plays an important role in determining success in an English medium school. In addition, the study revealed that the effects of instruction in L2 varied across different school subjects. For Mathematics, which is language deficient, it was found out that the effects were less negative than for Science (and History and Geography). The reasoning established was that unlike in Mathematics, the other three subjects involve relatively new content areas and students are required to learn new terminology in order to understand the conceptual underpinnings of these subjects. Learners would thus have to pay attention to the mastery of basic terminology that might preclude gaining a deeper conceptual understanding of these subjects and actively participating in classroom discussion.

Lastly, the study found out that for Mathematics, the English instruction effects were negative on attainment compared to the other learning areas. Teaching Mathematics is mostly based on symbolic terminology that may not be so dependent upon the language of instruction and may have been more adequately mastered prior to Grade 7 relative to other subjects which involve a lot of new terminology.

2.13 Performance of ESL learners on tasks demanding higher cognitive skills

One of the demands of outcomes-based education (OBE) is for learners “... to be able to identify and solve problems and make decisions using critical and creative thinking”. Also, they “...need to be able to communicate effectively using visual, symbolic and or language skills in various modes” (National Curriculum Statement Grades 10 – 12, General; 2005, p2). However, for learners communicating through the medium of a non-primary language, it will be an onerous task to be able to communicate scientifically constructive arguments through a medium whose idiom they cannot fathom.

Case (2000) observed in his study with Guatemalan, Iranian and Mexican learners that tasks with higher level cognitive demands such as analysis, synthesis and evaluation can present a serious challenge to ESL learners who have not mastered English. In his study, he observed ESL learners doing a Science experiment that required of them to employ higher level cognitive skills. He concluded that learners were able to use language for description and documentation of the experiment during the first phase of the experiment. However, they could not cope with the second and third phases of the experiment that required of them to explore the given topic through analysis and synthesis. Though many of the learners could write what they had learned in short lists, they struggled to join the lists of words and sentences into coherent paragraphs. When ESL learners were instructed on electric circuits, it was established that Guatemalan learners did quite well compared to Iranian and Mexican learners who had been instructed in English for less than a year. Learners with poor English literacy skills were thus unable to cope on tasks demanding higher order skills.

2.14 An appraisal of language and teaching approaches in a second language environment

Rollnick (2000) reviewed some recent findings related to the learning of Science through a second language. In this review, she noted that the learning of Science through a second language could not be tackled by language considerations only. She suggested that most theories emanating from social constructivist and situated cognition perspectives provide cogent arguments to suggest that the issue of language needs to be considered in a social context. Further, she suggested that if the discipline to be studied is Science, then learners need to become participants in the social practice which is Science and master the genres particular to the discourse community.

Rollnick (*op cit*) further stated that second language learners faced impediments to the process of mastering the language of Science discourse. She notes that L1 speakers need to learn to talk the language of Science whilst L2 learners have to talk the language of Science through the medium of a second language. In this case, she makes the observation that for L1 learners, the process of learning to talk Science

becomes one of adopting a different medium, a process which slows them down initially, but becoming less of a problem once the new language of Science is mastered. On the other hand, she notes that L2 learners face a much larger problem with a background of language disadvantage.

In conclusion, Rollnick (*op cit*) makes the suggestion that there are two pointers to a strategy aimed at assisting L2 learners. In the first pointer, she suggests that L2 learners need to be given the opportunity to practise Science in the presence of more capable peers. In this way, they could be introduced to the genres characteristic of the discipline. Secondly and more radically, she argues for primary language instruction in schools.

2.15 Chapter Summary

This chapter surveyed the main body of literature on second language pedagogy and assessment. Initially, a link was forged between second language learning and the cost-benefit aspect in order to expose the dichotomy between the amount of resources invested in Science education and the rewards emanating from such investment, with particular emphasis on schools where learning takes place through the medium of a second language.

Secondly, the chapter drew lessons from TIMSS, which is a cross-national comparison of the performance of learners in Mathematics and Science. The TIMSS study indicated that by and large, South African learners, particularly those studying through a medium of a second language, are grossly disadvantaged in the Science classroom. Reference was also made to studies relating second language assessment to concepts that are important in determining the performance of learners in a L2 Science classroom.

In **chapter 3**, the experimental design of the study will be discussed. This will include aspects of data collection, methodology and the type of instruments used in collecting data. Also included in chapter 3 is the framework for analysing the results.

CHAPTER 3-

DATA

COLLECTION &

ANALYTICAL

METHODS

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3.1 Introduction

Data was collected using the Common Task for Assessment (CTA)¹ for the Natural Sciences. Every year, the National Department of Education (DoE), as a way of standardizing, setting benchmarks and assuring quality for grade 9 curricula, tests all grade 9 learners with common examinations referred to as CTAs. Initially, it was contemplated by the DoE that the CTAs would serve as exit examinations at the end of General Education and Training (GET) phase. On the other hand, the matriculation examinations would continue to function as the final exit point for the Further Education and Training (FET) phase of schooling. However, my view is that due to differing standards across schools and parents' dislike of children leaving school at this precocious age, the idea of Grade 9 serving as the exit point fell into disfavour.

The main difference between CTAs and grade 12 examinations is that in Grade 9, CTAs cannot determine whether a learner progresses to the next grade or not. In contrast, Grade 12 final examinations contribute a lot in determining whether a learner progresses or not. This is so because CTAs only contribute 25% of the final pass-mark, while the 75% is determined by continuous assessment (CA) marks collated through a portfolio of academic activities. In grade 12, the final examination contributes 75% towards the final pass mark with the balance coming from the continuous assessment portfolios.

Data was collected in order to fit in with the main object of the study. The object of the study was to unravel whether grade 9 learners are in any way disadvantaged when they have to answer the Natural Sciences CTA in a non-primary language. The language of learning and teaching (LOLT) at the school where the study was conducted is English. The original English CTA was translated into isiXhosa and then translated back into English in order to ensure that the original message was not lost. This was done with the assistance of language educators at the school and a professional language editor and translator. My observation has been that in translating an Anglo-Saxon language into an African language, one of the snags encountered in the process is that the length of the sentences and paragraphs increase

¹ CTA's are examinations set each year by the DoE grade 9 learners, which is the final phase of compulsory schooling.

in the African versions. Therefore in cases where a test was written in an African language additional time should be allocated to the test for the African version. However, it needs to be acknowledged that reading one's primary language is easier and faster compared to simultaneously reading and translating a non-primary language. Also, it needs to be stated that none of the learners in the sample was in any way disadvantaged by time as they were able to finish within the allocated time.

Learners were randomly assigned to write either the isiXhosa or English version of the CTA. Since the author does not teach grade 9 Natural Sciences, the Natural Sciences educator was asked to administer the test in order to minimize possible effects of the Hawthorne effect. The test was given during normal school periods. In accordance with the law, learners are supposed to be informed whether a piece of work they do would contribute towards their continuous assessment portfolio or not. At this school, like in many others, there is an assumption that any piece of work contributes towards continuous assessment portfolio and therefore learners are never informed. In this case also, learners were not informed as to the contribution that the test will have towards their CA mark and what mark they had obtained from the task. However, the subject teacher concerned used the marks obtained in the study towards learners' final marks.

Though ethical issues could be raised concerning one or the other group being severely prejudiced by the nature of this assessment which was posed in two languages, it needs to be noted that the overall mark of this task was only 5 out of a possible 100 that comprises the whole Natural Sciences CTA. The 100 marks of the CTA would still be reduced into a score of 25. The 25 marks emanating from the CTA would be added to the 75 from continuous assessment (CA), to give an overall of 100. This means that the 5 marks from this assessment task will finally contribute to only 1% of the final mark for the Natural Sciences. No learner would in any case, in any learning area, be allowed to fail because of 1 mark.

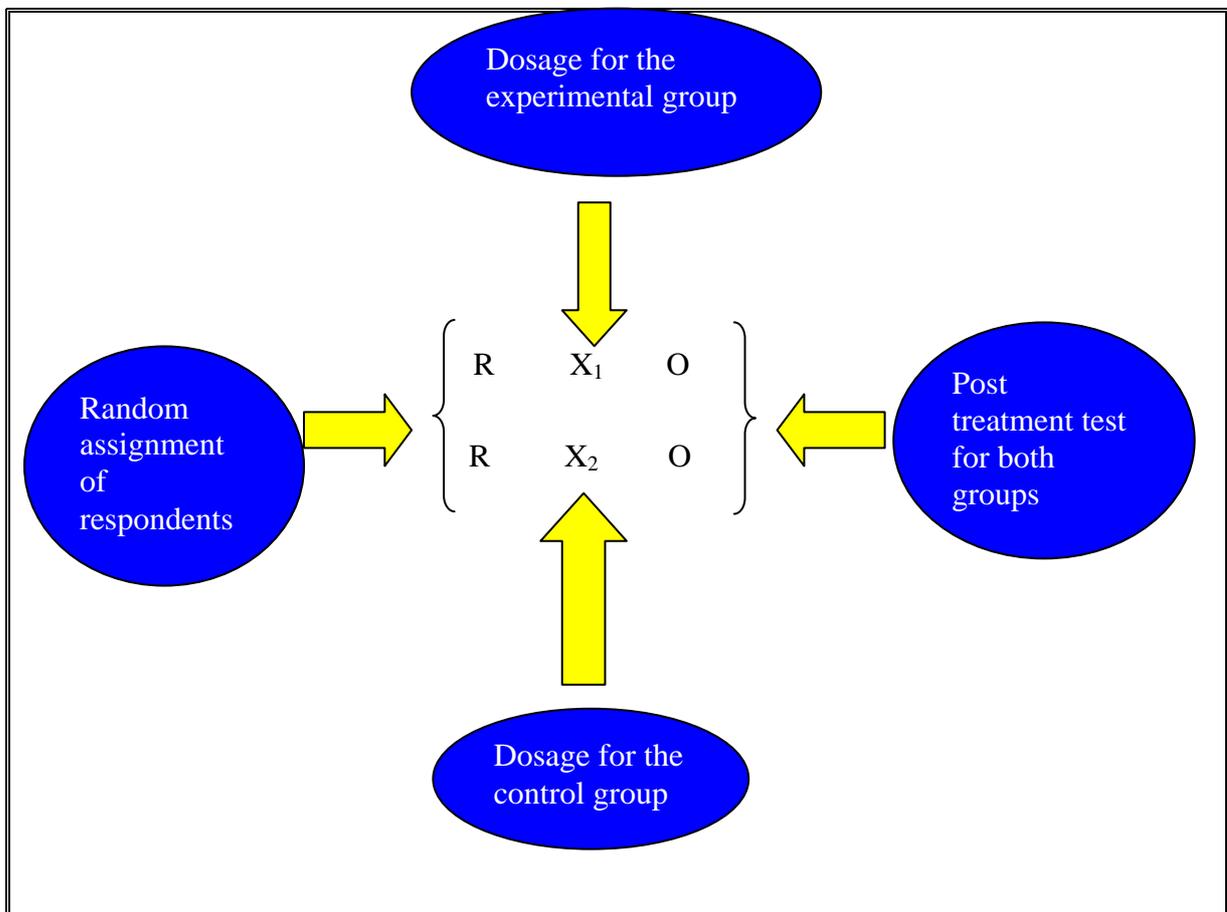
3.2 Research Design

Two grade 9 classes were randomly selected from amongst three classes to participate in the study. Mathematically, each of the three classes had a 33.3% chance of being

included in the sample. In each of the two classes selected, learners were randomly assigned to either the English or isiXhosa version of the CTA instrument. A systematic random sampling technique was employed in assigning learners to the two groups. In this method, learners are determined systematically by first randomly determining the first element and from the first element, determining the sampling ratio and sampling interval.

The design structure for the experiment can be represented diagrammatically as follows:

Figure 3.1: Diagrammatic representation of the design structure for the study



As represented in the diagram above, the two groups were randomly assigned to the treatment and control groups (R). No pre-test was administered to any of the two groups. As the study was based on a true experimentation model with an experimental

and control group, the randomization process presupposed equivalence prior to treatment.

Different dosages were however, administered in the post intervention to the groups (O). The X_1 represents the dosage that was administered to the primary language group (experimental group) and the X_2 represents the dosage administered to the non-primary language group (control group).

As alluded to earlier, a systemic randomization process was used in assigning respondents to the two groups. Babbie and Mouton (2003) explain a systemic sampling method as; “In systematic sampling, every k^{th} element in the total list is chosen for inclusion in the list. To insure against any possible human bias in using this method, you should select the first element at random” (p190). In a similar vein, Neuman (1997) defines systematic sampling as “... a simple random sampling with a short cut for random selection... the first step is to number each element in the sampling frame. Instead of using a list of random numbers, a researcher calculates a sampling interval, and the interval becomes his or her quasi-random selection method. The sampling interval tells the researcher how to select elements from a sampling frame by skipping elements in the frame before selecting one for the sample” (p211).

In my sampling frame of two grade 9 classes, I obtained an alphabetical class-list for both classes. Since each learner could be assigned to write either the isiXhosa or English version of the test, my sampling interval for each version was 1. The sampling ratio for the groups was 0.5. Elements of the sample were not predetermined as to which version of the test they would write. This was done in order to allow for possible absentees. If on the day of the test learner A, who according to the alphabetical list was supposed to write the English version of the test was absent, learner B would substitute learner A and learner C would thus write the isiXhosa version. Learners were seated alphabetically in the venue.

3.3 Context of the study

The study was done in a township school in the Western Cape, one of the nine Provinces of the Republic of South Africa. Though currently over-enrolled with a figure of 1500, at the time the study was commissioned (a year earlier), learner

enrolment was at a figure of 1039. The male-female ratio is quite stark, in most classes being 1:3 or less. The only explanation one can extrapolate from this is that since most learners do not stay with their biological parents, non-biological parents prefer staying with girl relatives than boys as girls add value in as far as performance of domestic chores. However, it needs to be stated that there is no research that can back up this claim or provide an alternative explanation.

The physical building of the school is comprised of a modern brick and mortar structure with facilities such as Physical Science laboratories, a computer laboratory, Arts and Culture room and other facilities necessary for effective implementation of modern-day curricula. In addition to the brick structure, there are 13 mobile classroom units that were used previously as the main classrooms before completion of the building. The mobile classrooms have remained on campus so as to alleviate overcrowding experienced at the beginning of each year. Our school is one of two high schools in the area of Phillipi. The neighboring high school, which is much older than the one I teach at, is bursting at the seams with an enrolment of 1700 learners.

The school has a staff establishment of 36 educators. The number of educators in schools is based on the number of learners. In terms of the applicable learner-educator rules that determine the number of educators in secondary schools, the school is currently under-staffed by 9 educators. Whilst the WCED is fully aware of the problem, it has however, brought other issues into play. Chief amongst those issues is the oversubscribed argument based on the red-herring of budgetary constraints. For this reason, learners are packed to maximum capacity in the classrooms. The average class size for the grades 8 and 9 is 60.

The medium of instruction at the school is English, with isiXhosa being the primary language of most learners. Due to the fact that learners at the school only enroll for the two languages, i.e. English and isiXhosa, they are compelled to pass both languages. In accordance with departmental regulations, a learner has to pass at least two languages to be considered for promotion to the next grade in all government schools. One of the languages should be at the level of a primary language and the other at the level of an additional language. Learners are thus forced to pass English, in addition to isiXhosa, in order to move to the next grade.

Most of the learners at the school originate from the Eastern Cape and came to the Western Cape in search for better educational opportunities. The difference in matriculation examination pass rates between the Eastern Cape and the Western Cape is unbridgeable, with the latter miles ahead. The dilemma faced by learners is that they do not do Afrikaans as a school subject in most Eastern Cape schools. For this reason, most schools in Phillipi do not offer Afrikaans as a subject, leaving learners with only two languages which they have to pass. IsiXhosa is a primary language and most learners find it easy to pass. English, on the other hand, offers a real challenge to the majority of learners. The school is thus forced to mobilize resources in order to ensure that learners master the rules of English.

As indicated earlier, the catchment area of the school is the sprawling informal settlement of Phillipi. Though initially a sub-formal settlement with no prospect for sanitation and electricity, the area is now being developed. The majority of households now live in habitable two bed-roomed houses. Official statistics indicate that unemployment rate in this area stands at over 60%. Our learners thus provide cannon-fodder for the *lumpen proletariat* who dispossess them of anything from earrings to calculators in order to sell to the “black market”. With the school burgled four times in three months, crime is at its peak in the area. In the last two cases, the burglaries were carried out in two consecutive days. This left learners and educators unwilling to commit to the business of teaching and learning beyond ordinary banking hours, thus frustrating the school’s turn-around strategy.

The school caters, to all intents and purposes, for African learners even though schooling has been desegregated for almost two decades in South Africa. Though Black learners are enticed by the well resourced schools in the shadows of Table Mountain initially meant for White children, the movement in the opposite direction has not been noticeable. In addition to lack of resources, there are many reasons that explain why township schools are not favourable academic destinations. The most prime reason is the fact that township schools do not offer a better alternative to the education of formerly White schools. The annual matriculation pass rates point to the yawning gap in performance between learners in the two ex-schooling systems. It needs to be added that even the better resourced township schools still have their facilities under utilized due to poor training of educators. Science laboratories have in

many schools been turned into staff-rooms in order to alleviate the cramped staff-rooms, this in itself resulting in the formation of cliques at school.

3.4 Profile of the subjects

The subjects in the study comprised a convenient sample of grade 9 learners at the school I teach at. Two classes out of a total of three classes were randomly chosen to be part of the study. Classes at the school are not arranged in terms of merit. Any class chosen to be part of the sample would thus be representative enough and constitute a cross-section of the grade that needs to be studied. All the subjects in the study spoke isiXhosa as L1.

As alluded to earlier, the majority of learners in the sample come from the Eastern Cape and continue to maintain sentimental and emotional relationship with the Province. Their only drive to the Western Cape is the massive infrastructure it has in comparison to the mud and cow-dung facilities that make for a normal school building in the Eastern Cape. An overwhelming majority of learners do not stay at home with biological parents. They either stay with aunts, uncles or older siblings who provide for their general welfare. For this reason, the incidence of child abuse, sexual or physical, is alarming in this area. The school was forced by these circumstances to assign an official from the Life Orientation Department to deal specifically with such incidences on a daily basis.

Learners in the sample do not have a sustained contact with English outside of the classroom. Even in the classroom, educators communicate unofficially through the medium of isiXhosa, which has come to be regarded as the *de facto lingua franca*. Teaching is mainly in the form of code-switching between English and isiXhosa, with isiXhosa being the predominant language used. This they do mainly by pre-fixing main ideas with *i-* at the beginning of each concept, such as, *i-acid* *i-photosynthesis* (to be read ee-photosynthesis) etc. This *i-* at the beginning of each concept is a common prefix in isiXhosa. The implication is that although learners are instructed through a hybrid language dominated by isiXhosa, they have to struggle during the examinations that are entirely set in English. For this reason, subject

educators are always on standby during examinations in order to help translate examination questions into isiXhosa.

3.5 The research instruments

Two similar CTAs were administered to the two cohorts identified. The isiXhosa version was a translation of the original English version. However, as South African indigenous languages are not used beyond Grade 3 as LOLT, they thus lack much of the technical concepts that English has acquired since it was first used as LOLT. For this reason, the isiXhosa version of the instrument was lengthier, as some of the condensed concepts in English had to be expanded in isiXhosa to make them more meaningful to the intended audience.

The instrument was comprised in the main of a comprehension task through which learners had to read and answer five questions at the end. All answers to the questions were suggested in the comprehension task, with no need for prior knowledge implied anywhere in the questions. From conversations with colleagues from other schools, one of the major pitfalls of the CTAs is that they offer no opportunity for learners to make any serious preparation for the assessment tasks. With the exception of Mathematics, in all other learning areas, comprehension tests are provided which learners have to read through and then answer questions, all of which come from the comprehension task. This thus gives learners who are unable to read and understand English with L1 command a difficulty. The majority of these learners come from township schools.

In terms of the instruction given, learners had 15 minutes in which to complete the task. The English passage (shown below) comprised only two pages whilst the isiXhosa version comprised three pages (Appendix B). Learners writing the English version thus had an unfair advantage in as far as management of time was concerned. However, no learner was pressured to complete in the allocated time. However, it needs to be stated that all of them finished within the stipulated time.

The instruments related to testing Specific Outcome 2 (SO 2) of the Natural Sciences in the Senior Phase. SO 2 is about the construction, understanding and applying

knowledge in socially, technologically and environmentally responsible ways (DoE; 2003). Below is the English version of the instrument.

Name:.....

 **Activity 3.2: The Male and Female *Anopheles* Mosquitoes**

 **Time: 15 min**

Specific Outcomes

- NS SO2 APPLYING KNOWLEDGE

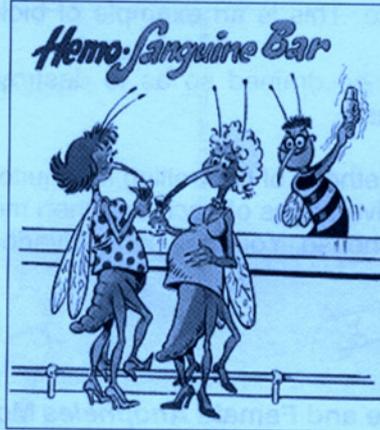
Instructions

- For this task you will be working in pairs
- Read the following extract

Male mosquitoes drink only sugary fluids such as flower nectar. Both in the wild and in the laboratory, mosquitoes will visit certain flowers and will feed on fruit placed in their cage. Interestingly the male's proboscis is not strong enough to pierce the skin of an animal or human. The male mosquito has feathery antennae to enable him to pick up the sounds made by the female to locate a mate for breeding.

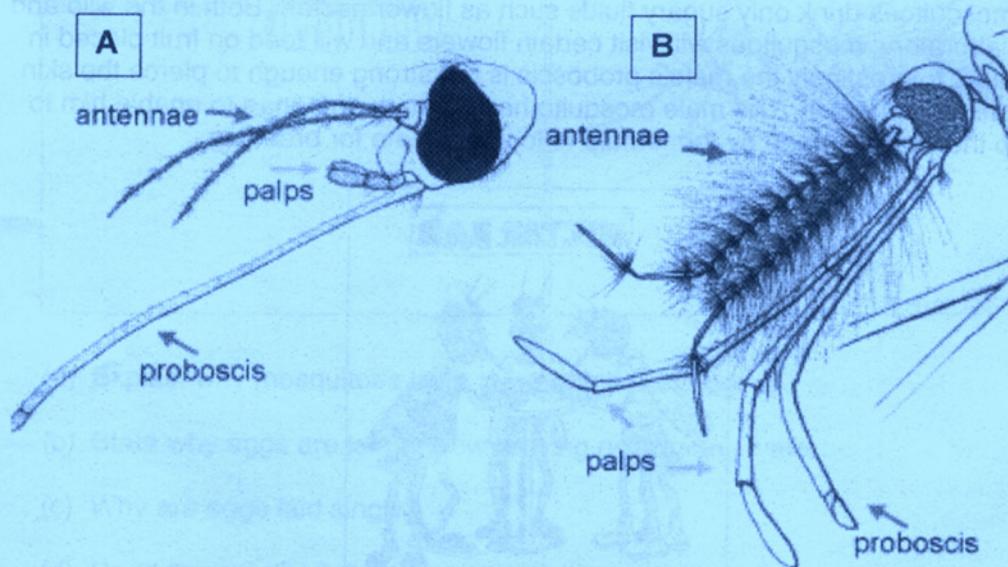
Female mosquitoes also feed on nectar but they require a blood meal in order to feed their developing eggs. It is therefore only the female mosquitoes that consume blood from humans. They have a strong proboscis with parts that pierce and saw into skin. Remember malaria is not caused by the mosquito but the *Plasmodium* parasite in the mosquito's body. Mosquitoes don't pass on the parasites into new hosts through blood. While they sip infected blood through a stylet (one of the straws) inside their

NS GRADE 9 CTA 2005: LEARNER'S BOOK 17



proboscis, the path of blood is one-directional inside the mosquito. Blood ingested is channelled to the mosquito's belly and later eliminated as waste. Blood is not returned to the proboscis. The parasite goes through several developmental stages inside the mosquito's body before eventually invading its saliva glands. It is through the mosquito's saliva that parasites such as malaria are injected into an otherwise healthy host. This means that a person cannot be infected by another person; it is the female *Anopheles* mosquito that infects the person.

Study the picture below of the heads of two *Anopheles* mosquitoes.



- a) Is mosquito A, a male or a female mosquito? (1)
 - b) Give ONE reason for your answer in (a). (1)
 - c) If you are bitten by a mosquito, could you tell whether it is a male or female? (1)
 - d) What would it be? Why? Give ONE reason for your answer in (c). (2)
- (5)**

3.6 Response categories

Learner responses were based on the comprehension test which learners had to read through. Question (a) on the questionnaire demanded of learners to identify a physical structure of an *Anopheles* mosquito. Since the physical structure had been described in the passage, learners who read the passage with understanding were not expected to find it problematic in identifying which mouthparts belonged to a female and which to a male mosquito. Question (b) demanded of learners to provide a reason for the answer they provided to (a). Each learner had a 50% probability of obtaining the Question (a) correct. Question (b) was thus aimed at validating the answer in Question (a). The objective is to discourage guesswork in the Sciences.

Question (c) was also a test on learner comprehension levels. In paragraph 2, two statements were given to the effect that “Female mosquitoes also feed on nectar but they require a blood meal in order to feed their developing eggs. It is therefore only the female mosquitoes that consume blood from humans”. Learners had to unravel concepts such as “consume” in order for them to be able to decipher the full meaning of the paragraph. Question (d), which was broken into two parts, conveniently referred to as (d.1) and (d.2), was also a validation of the response given to question “c”.

In all, learners had five questions which they had to respond to. The questionnaire thus comprised three questions with dichotomous answers and two questions which tested whether answers given to previous questions were a thumb-suck or based on an honest understanding of the questions posed.

3.7 Coding of learner answers

As indicated earlier, the questionnaire used for capturing the data was based on Specific Outcome 2 (SO 2) of the Natural Sciences. In SO 2, learners have to apply knowledge and demonstrate an understanding of concepts used in Science literature. Also, SO 2 fosters a meaningful understanding of Natural Sciences concepts and knowledge, processes and skills (DoE, Curriculum 2005 Assessment Guidelines, NS

Senior Phase). In coding learner answers, emphasis was thus placed on instances where correct understanding of concepts applied in the passage was demonstrated.

The format of the questions was in a way that the first question (a) was a sequel to the second one (b) and the third question (c) was a sequel to the fourth and fifth questions (d.1) and (d.2). In order to discourage guesswork, which remains an anathema in the understanding of the Sciences; learners had to obtain part (b) correct to be considered for part (a). The same principle was applied for part (c), (d.1) and (d.2), where part (d.1) was a precondition for (c) and (d.2) for (d.1). Learners who correctly answered part (a) and incorrectly answered part (b) were deemed to have guessed the former and were duly “penalized” and *mutatis mutandis* for parts (c), (d.1) and (d2).

3.8 Data capturing and framework for analyzing results

Data was captured using the coded responses of learners as indicated in the paragraph above. Each question was given a code for the sake of statistical analysis. Learners who could not supply a response to a question were assumed to have had problems in understanding the particular question. In cases where all questions were not answered, the particular answer sheet was deemed to have been spoilt. In such cases the answer sheet was not considered in the analysis of the results.

Data was analysed both quantitatively and qualitatively. In the quantitative analysis of results, the distribution of responses given to each question was analysed for the two groups. A statistical software package Statistical Package for the Social Sciences (SPSS) was employed in the analysis of the quantitative results. Also, a comparison was done between the two groups of responses (English and isiXhosa) in terms of their overall achievement using descriptive statistics and chi-square analysis. From this comparison, conclusions were made to ascertain which of the two groups had a superior understanding of questions and subsequently performed better compared to the other language group. Results were rejected at the significance level of 0,05. Since the number of learners in both groups was balanced, raw data was used in the analysis instead of percentages. From the raw data, tables and graphical profiles of results were given.

In the qualitative analysis of results, content analysis methods were used for capturing and analysing the data. In addition to content analysis methods, the qualitative software package *Atlasti* was employed in analysing the data captured for only questions (b) and (d.2). For its proper application, *Atlasti* demands that raw data should be in the form of thick description of contexts. Since questions (a), (c) and (d.1) did not involve thick descriptions of the situations at hand, no rich data was therefore available for a proper use of *Atlasti* in them. Also, noting the limited amount of descriptions for (b) and (d.2), answers from all learners were lumped together and analysed simultaneously in order to mitigate this limitation. In this way, common trends from each group will emerge and such similarities will form the basis of the qualitative analysis. This will also assist in highlighting alternative frameworks of thought that might be elicited as a result of answering questions in a particular language.

3.9 Limitations in the data

The aim of the study was to establish whether assessing learners in a non-primary language prejudices their understanding of questions posed in the Natural Sciences CTA. Also, the study sought to find out whether learners elicit alternative frameworks of thought when they respond to questions in a non-primary language. These questions were answered based on learners reading through a comprehension test and then answering questions based on the same comprehension test.

One of the limitations of the data collection methods is that learners' prior knowledge was not factored into the conceptualization and design of the study. Embedded into this data collection method is the inherent assumption that learners would be seeing this type of information for the first time. Though the Natural Sciences educator for grade 9s indicated to me that she never presented a lesson on mosquitoes or malaria in class, it could, however, not be safely assumed that learners came into contact with this type of material for the first time. Malaria is one of the foremost killers in tropical Africa and some of the hottest and humid parts of South Africa. The topic on malaria is thus topical in Africa and learners could have had prior access into this topic. This would in a way compromise the study in that learners might answer the questions without reading through the comprehension paragraphs. Since the study is designed

around learners reading through and answering the questions based on the comprehension test, the integrity of the study would in this way be undermined.

In addition to the above, this study will base its results on learners' correct interpretation of the questions posed. In the qualitative presentation of results, CAQDAS *Atlasti* was used in the analysis of these data pieces. Naturally, in the application of *Atlasti*, a rich data source is a necessary prerequisite. In the case of this study, responses from learners are not expected to be "thick descriptions" of the situations being questioned. For this reason, the author will lump together all answers from each of the language groups in the analysis of qualitative results. The unintended consequence of the lumping together is in itself is a major strength of the study in that the qualitative data analysis will comprise all learners' responses. This feat is hardly ever achievable in qualitative research.

3.10 Chapter Summary

In this chapter, I specifically focussed on the methodological aspects of isolating my sample and collecting data. Particularly, this chapter paid attention to research design, characteristics of the sample, research instruments, the data capturing exercise and limitations in the data capturing process.

In **chapter 4**, I will present the quantitative results as captured from the data.

CHAPTER 4 –

QUANTITATIVE

DATA

ANALYSIS

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4.1 Introduction

In this chapter, I will compare the responses of the isiXhosa and English respondents to the five questions administered. The main focus of this study was to determine whether there are any differences in the performance of isiXhosa primary language learners when they are presented with Natural Sciences questions in their primary language and in a non-primary language. In this case, the non-primary language, i.e. English, also serves as the Language of Learning and Teaching (LOLT). This chapter thus compares the performance of learners when they respond to Natural Sciences questions set in English and isiXhosa. The comparison will be done quantitatively for the five questions administered.

Specifically, this chapter will initially carry out the comparisons from a linguistic perspective and then followed by a consideration of the gender/sex perspective. The latter comparison will serve mainly as a buttress for and further validation of whether linguistic factors may interact with the sex of the respondent in predetermining academic success. This is particularly so since there is now a groundswell of opinion which tends to suggest that androcentric issues do play a role in the Sciences. The argument presented in this case is that the sciences are pre-packaged so as to advantage boys over girls (Harding; 1993). Language and gender/sex will thus form the independent variables whereas performance will form the dependent variable.

The following categories of responses will be compared:

1. Performance will be compared for the isiXhosa and English respondents on each of the five questions, (a) to (d). Noting that question (d) has been broken down into two sub-questions; these will be labelled (d.1) and (d.2). In this first section, learners will be compared solely in relation to performance versus linguistic factors. The relevant data will be presented in the following tables and figures:
 - Responses to question (a) will be presented in table 4.1 and figure 4.1.
 - Responses to question (b) will be presented in table 4.2 and figure 4.2.
 - Responses to question (c) will be presented in table 4.3 and figure 4.3.

- Responses to question (d.1) will be presented in table 4.4 and figure 4.4.
 - Responses to question (d.2) will be presented in table 4.5 and figure 4.5.
2. A comparison will be done on the overall performance of the two groups of respondents. This will highlight the average performance of the isiXhosa respondents compared to the English respondents. The relevant data will be presented in figure 4.6.
 3. A comparison will be done to determine whether gender/sex factors interact with linguistic factors when it comes to performance. In this instance, the two language groups will be lumped together and a consideration given to gender factors only. The relevant data will be presented in the following tables and figures:
 - Responses to question (a) will be presented in table 4.6 and figure 4.7.
 - Responses to question (b) will be presented in table 4.7 and figure 4.8.
 - Responses to question (c) will be presented in table 4.8 and figure 4.9.
 - Responses to question (d.1) will be presented in table 4.9 and figure 4.10.
 - Responses to question (d.2) will be presented in table 4.10 and figure 4.11.
 4. A comparison will be carried out for the average performance of male and female learners on all of the questions. The relevant data will be presented in figure 4.12.
 5. An analysis will be carried out on the interaction effect between gender and language. This will be done so as to determine the effect of the interplay between gender and language in determining performance when learners in Grade 9 respond to Natural Sciences questions set on CTA's. The relevant data will be presented in table 4.11.

In summarising paragraphs 1 to 5 above:

Table 1 and **figure 1** will compare the performance of isiXhosa and English respondents to question (a).

Table 2 and **figure 2** will compare the performance of isiXhosa and English respondents to question (b).

Table 3 and **figure 3** will compare the performance of isiXhosa and English respondents to question (c).

Table 4 and **figure 4** will compare the performance of isiXhosa and English respondents to question (d.1).

Table 5 and **figure 5** will compare the performance of isiXhosa and English respondents to question (d.2).

Figure 6 will present the average performance of the two groups of respondents, i.e. English and isiXhosa.

Table 6 and **figure 7** will compare the performance of boys and girls on question (a) irrespective of the language in which the test instrument was administered.

Table 7 and **figure 8** will compare the performance of boys and girls on question (b) irrespective of the language in which the test instrument was administered.

Table 8 and **figure 9** will compare the performance of boys and girls on question (c) irrespective of the language in which the test instrument was administered.

Table 9 and **figure 10** will compare the performance of boys and girls on question (d.1) irrespective of the language in which the test instrument was administered.

Table 10 and **figure 11** will compare the performance of boys and girls on question (d.2) irrespective of the language in which the test instrument was administered.

Figure 12 will present the average performance of boys and girls.

Table 4.11 will show the interaction effects between language and gender in relation to the independent variable of performance.

4.2 A comparison of isiXhosa and English respondents to Question (a)

Table 4.1 and figure 4.1 below depict the performance of the two groups of learners to question (a). In the table below, the first column depicts the two groups of learners in raw and percentage scores. The second column indicated Q(a)- 0 refers to the number of learners who gave an incorrect answer to question (a). The third column, indicated Q(a)- 1 refers to the number of learners who gave the correct answer to question (a). The fourth column merely shows the number of learners in each language category and the total number of learners in both categories. The table format will be the same in all other tables that follow in this chapter.

The diagram below depicts the performance for both the primary (Language X) and non-primary (Language E) language learners. In both cases, the block with 0 indicates the percentage of learners who obtained an incorrect answer and the second block with a 1 indicates those learners providing a correct answer to the question. This format will be maintained in all the other diagrams that follow in this chapter.

Table 4.1 2-Way Summary Table: Observed Frequencies for Question (a) on Language

Language	Q (a) 0	Q(a) 1	Row Totals
isiXhosa	16	22	38
Row %	42.11	57.89	
English	18	19	37
Row %	48.65	51.35	
Totals	34	41	75
Chi-square test: $p = 0.56916$			

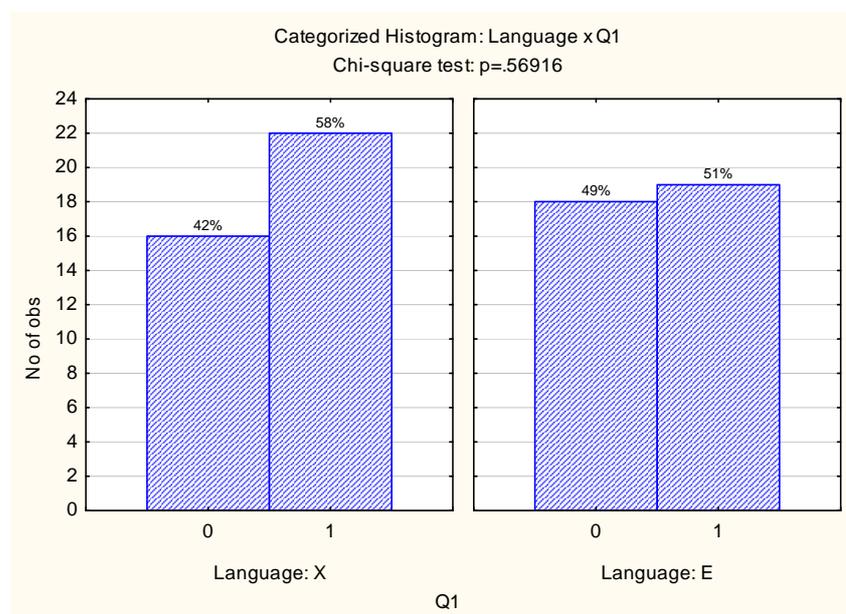
Figure 4.1 Categorized Histogram: Language x Question (a)

Table 4.1 and figure 4.1 show the performance for the two language groups of learners in question (a). Question (a) related to learners choosing whether mosquito A was male or female. In essence, each learner had a 50% chance of obtaining a correct

answer. The table and figure above indicate that the margin of difference in the performance of respondents for this question was minimal.

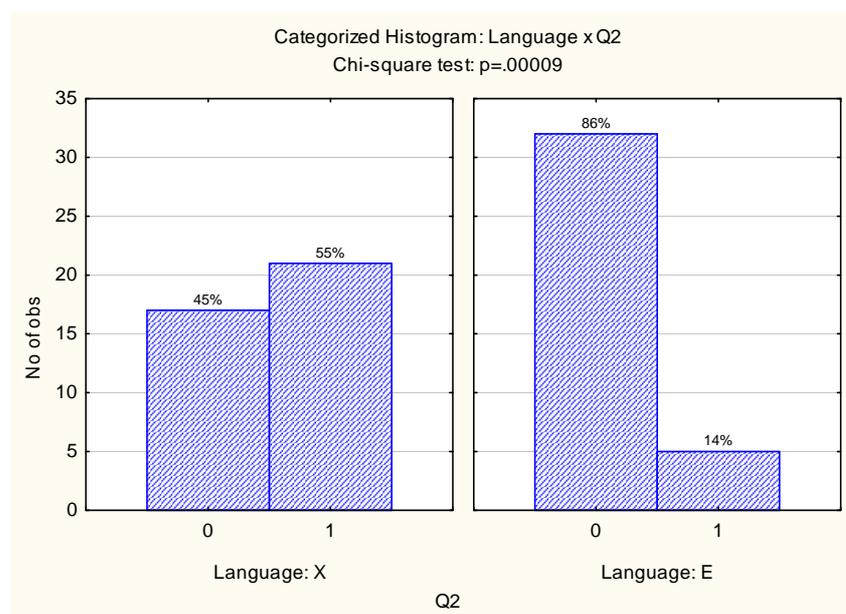
The chi-square value 0.56916 shows that the hypothesis of equal means can be accepted for $p < 0.05$. There was no significant difference in the performance of the two groups of learners to this question. In the TIMSS-R study cited earlier, it was observed that when it comes to multiple-choice and typically true-false questions, learners tend to perform equally well, irrespective of the language in which the test instrument was administered (Howie, 1999).

4.3 A comparison of isiXhosa and English respondents to Question (b)

A comparison of isiXhosa and English respondents' performance to question (b) is shown below in figure 4.2 and table 4.2. The configuration of the table and the histogram is as in paragraph 4.2 above.

Table 4.2 2-Way Summary Table: Observed Frequencies for Question (b) on Language

Language	Q (b) 0	Q (b) 1	Row Totals
isiXhosa	17	21	38
Row %	44.74	55.26	
English	32	5	37
Row %	86.49	13.51	
Totals	47	26	75
Chi-square test: $p = 0.00009$			

Figure 4.2 Categorized Histogram: Language x Question (b)

In question (b), learners were requested to mention a reason for the answer they gave in question (a). Science is normally presented to learners as a subject that demands rigorous analysis of facts and systemic presentation of arguments. In this manner, the way in which the answer is obtained is equally important as the answer itself. It was within this understanding and academic context that learners were asked to give a reason for their answer to the first question, chiefly in order to discourage guesswork.

The results show that there was a significant difference in the performance of the two groups. 86.49% of those responding in the English version of the test could not provide a plausible reason for the answer to question 1 as compared to 44,74% of those responding to the isiXhosa version. It should be noted that learners' answers to this question were marked according to the answer they provided to question (a).

The table and graph also show that 55.26% of the isiXhosa group obtained a correct answer to the question compared to 13.51% of those who answered in English. The value of p for the above relationship was 0.00009. This shows that the relationship between language and performance for this question is unlikely to have been influenced by discrepancies between the observed and expected values. There was indeed a significant difference in the performance of the learners when they had to answer questions set in their primary language as compared to their non-primary

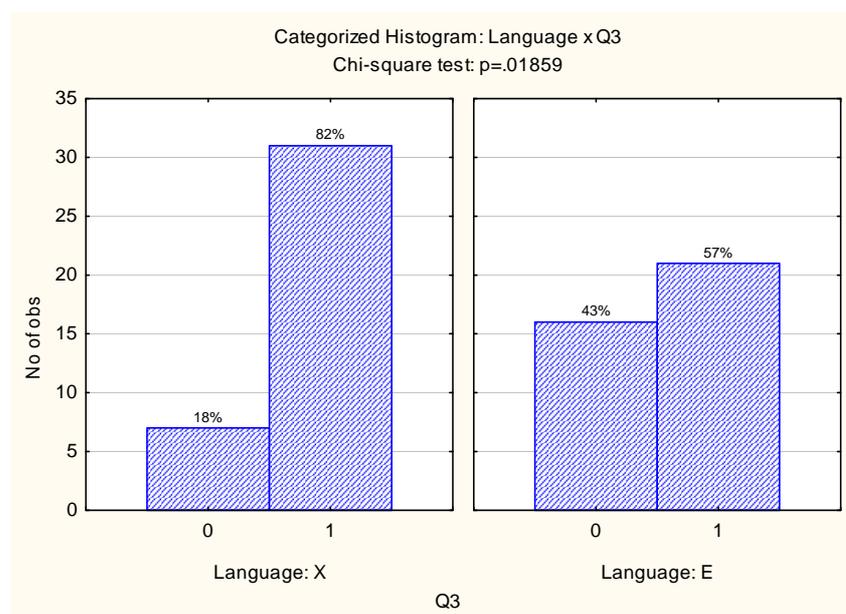
language. In the case above, the hypothesis of equal means is rejected at $p < 0.05$. The results confirm the alternative hypothesis that learners respond poorly to questions set in their non-primary language.

4.4 A comparison of isiXhosa and English respondents to Question (c)

A comparison of isiXhosa and English respondents' performance to question (c) is shown in table 4.3 and figure 4.3 below. The configuration of the table and histogram is as in paragraphs 4.2 and 4.3 above.

Table 4.3 2-Way Summary Table: Observed Frequencies for Question (c) on Language

Language	Q(c) 0	Q(c) 1	Row Totals
isiXhosa	7	31	38
Row %	18.42	81.58	
English	16	21	37
Row %	43.24	56.76	
Totals	23	52	75
Chi-square test: $p = 0.01859$			

Figure 4.3 Categorized Histogram: Language x Question (c)

In question (c), 81.58 % of those responding in isiXhosa gave a right answer compared to 18,42% who gave a wrong answer. Of those who responded to the English version, 56.76% gave a correct answer as compared to 43.24% of those who gave a wrong answer. Question (c) was an indirect question that related to identifying a female from a male mosquito. Though not stated succinctly, the question could be answered with either a yes or a no as it asked of learners whether they could tell the sex of a mosquito if bitten by the insect. The type of responses that followed will be provided in the qualitative section of data analysis. However, it needs to be noted that the majority of learners responding in English could not unpack the question, as reflected in the number of those who got it wrong.

The level of significance for this question was at $p= 0.01859$. This gives credence to the hypothesis that there is a statistically significant difference in performance between learners responding in isiXhosa and those responding in English.

Importantly, a significantly higher number of those responding in isiXhosa obtained a correct answer compared to those who obtained a wrong answer. On the other hand, the number of those responding in English is more or less split equally between those obtaining a correct answer and those obtaining an incorrect answer. The value of p for this question was less than 0.05, which suggests that the hypothesis of equal means could be rejected.

One might surmise that the reasons in the deviation of performance in this question lie in the manner in which the question was structured. In typically dichotomous questions, it is expected that the difference in performance of learners should not be significant. A chi-square value of 0.01859 however, is suggestive of a difference in the performance of the two groups. The best plausible explanation for the observed difference in the performance, one might suggest, lies in the structuring of the question. It might thus be argued that primary and non-primary language learners perform equally well in dichotomous questions when the wording of the questions is straight-forward. However, when the structure of dichotomous questions is altered, the performance of non-primary language learners tends to drop. One might also pontificate that this is mainly so because the 50% chance they enjoy in true-false questions is usurped from them. This is evidently so because they fail to comprehend the question.

4.5 A comparison of isiXhosa and English respondents to Question (d.1)

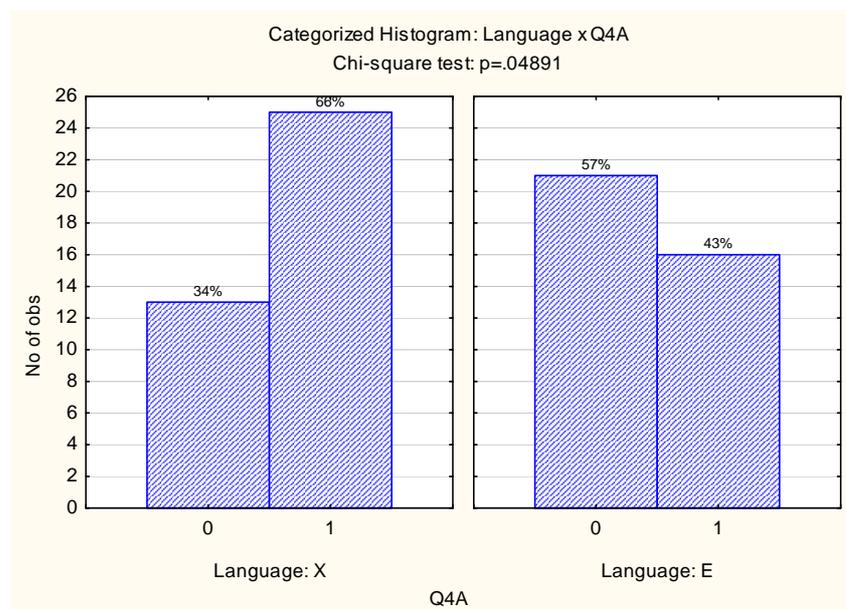
The performance of the two groups of respondents to question (d.1) will be presented in figure 4.4 and table 4.4 below.

Table 4.4 2-Way Summary Table: Observed Frequencies for Question (d.1) on Language

Language	Q(d.1)		Row Totals
	0	1	
isiXhosa	13	25	38
Row %	34.21	65.79	
English	21	16	37
Row %	56.76	43.24	
Totals	34	41	75

Chi-square test: $p = 0.04891$

Figure 4.4 Categorized Histogram: Language x Question (d.1)



The last question was set in a manner that needed an answer with a supporting statement. The first part of this last question is the one labeled question (d1) for the sake of facilitating easy analysis. In this question, learners were requested to indicate

whether, if bitten by a mosquito, they would be able to tell whether it was male or female.

This was by far not the easiest of the questions in terms of marking. The reason was that most learners assumed the answer to this question when they subsequently supplied a reason for the answer in question (d.2). Learners did this by packaging the (d.1) and (d.2) answers together, without regard for the fact that the question itself was split into two sections. For this reason, learners were not penalized for not giving an answer in (d.1), provided there was prove that the answer to (d.1) was assumed in answer to (d.2). Typical examples of answers provided were:

Question: (if you were bitten by a mosquito) What would it be? Why?

Answer 1: *It make you feel weak and you get illnesses from a female mosquito such as malaria. A male mosquito does not drink blood it does produce eggs.*

Answer 2: *Because the female is very strong than the male. Males are not strong for pierce the skins and also the female they did feed the eggs.*

Answer 3: *Because to have male mosquitoes drink sugary fluid such as flower nectar.*

The table and figure above show that there were differences in the way learners understood the question. For those answering the isiXhosa version of the instrument, 34.21% gave an incorrect answer compared to 65.79% of those who gave a correct answer. For the English group, 56.76% gave an incorrect answer compared to 43.24% who gave a correct answer. In this question, the chi-square value of 0.04891 is indicative of a stronger confidence in the relationship between language and performance for this question. This shows that the difference in the performance of the two groups cannot be ascribed to sampling error alone. The isiXhosa group had a relatively better understanding of the questions compared to the English group. Since the value of p is less than 0.05, the hypothesis of equal means could also be rejected for this question.

However, it needs to be noted that poor performance in this question could in many respects be tied to question (d.2) below. Most learners who packaged (d.1) and (d.2) together had a poor chance of obtaining this answer correctly, particularly as they were judged by their performance in question (d.2). For this reason, the poor performance in this question, as compared to other true-false questions, could be

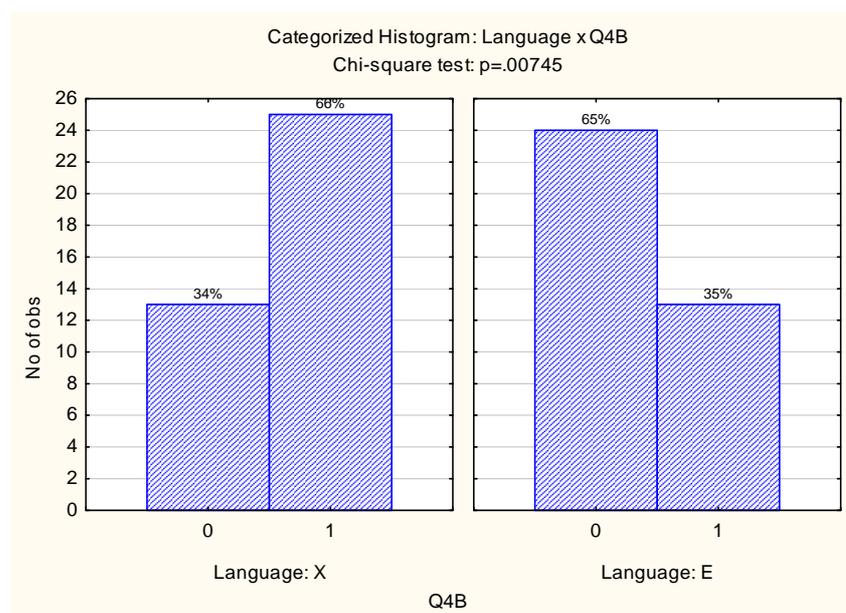
ascribed to this factor. Question (d.2) demanded an explanation for the observation made in question (d.1).

4.6 A comparison of isiXhosa and English respondents to Question (d.2)

Table 4.5 and figure 4.5 below present the results to question d.2 for the isiXhosa and English respondents.

Table 4.5 2-Way Summary Table: Observed Frequencies for Question (d.2) on Language

Language	Q(d.2)		Row Totals
	0	1	
isiXhosa	13	25	38
Row %	34.21	65.79	
English	24	13	37
Row %	64.86	35.14	
Totals	37	38	75
Chi-square test: $p = 0.00745$			

Figure 4.5 Categorized Histogram: Language x Question (d.2)

Question d.2 was a sequel to question d.1. In d.2, learners were requested to supply a reason for the answer they provided to the first part of the question. This was aimed at gauging whether learners had a real understanding of the question in question (d.1). In the comprehension test, several answers were suggested which learners could supply as the correct answer.

The table and figure above show that 34.21% and 65.79% of the isiXhosa group gave incorrect and correct answers respectively. A closer look at the figures above also shows that they are similar to the ones obtained for question d.1 above. In questions d1 and d.2, learners were not penalised for getting d.1 correct and d.2 incorrect and *vice versa*. Interestingly enough, the same number of learners in the isiXhosa group who got a correct d.1 also obtained a correct answer to question d.2.

For the English group, 64.86% gave an incorrect answer compared to 35.14% of learners who gave a correct answer. The situation prevailing here is a direct opposite of the one explained above for the isiXhosa respondents. Whereas in the case of the isiXhosa group two-thirds gave a correct answer, for the English group two-thirds gave an incorrect answer. Also, for the isiXhosa group, performance was stable for questions d.1 and d.2, for the English group there was a drop in performance moving

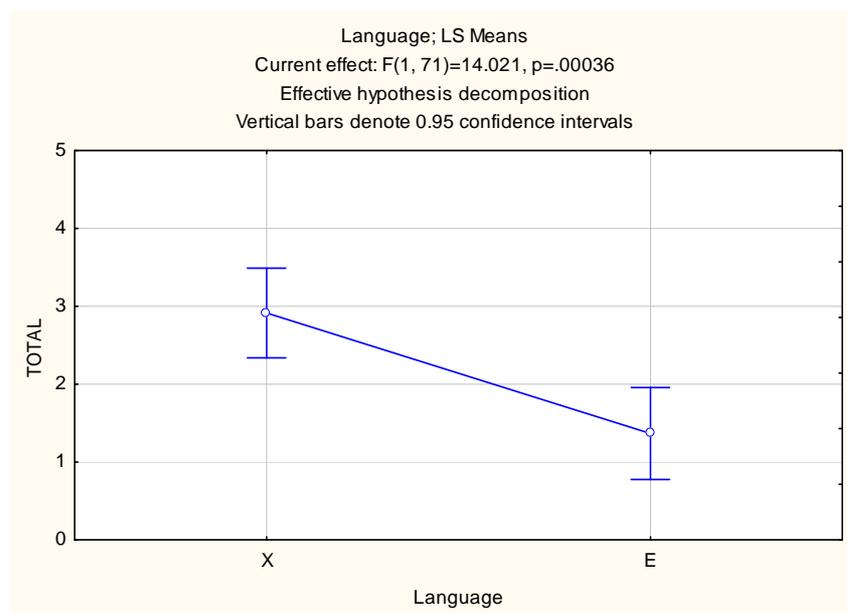
from d.1. to d.2. Most of the learners in the English group could thus not provide a reason for the answer they obtained in d.1.

The value of p for the above relationship is particularly small at 0.00745, showing that it certainly is not by chance that the isiXhosa group outperformed the English group. The relationship between language and performance is statistically significant. It is thus unlikely that the observed relationship could have resulted from sampling error alone.

4.7 A comparison of the average performance of the isiXhosa and English respondents.

Figure 4.6 below shows the average performance of the two groups of respondents in all of the questions.

Figure 4.6 Language; LS Means



In the figure, the averages for the isiXhosa and English respondents groups are put together for the 5 questions. The X in the figure represents the average performance for the isiXhosa group whereas the E represents the average performance for the English group.

What can be deciphered from the figure is that the isiXhosa group obtained a mean of just under 3, compared with the English group who obtained a mean of about 1.5. From this, one can make the connection between the average performance in the five questions and the language in which the test instrument was set. What is revealed is that generally, the primary language group outperformed the non-primary group of respondents.

If one considers the pass requirement of 40% in the Higher Grade and 33.3% in the Standard Grade in the matriculation examinations, then the English group would, on the average, have failed to cut through the threshold for a pass in the HG and barely scrapped through in the SG.

The χ^2 test of significance gives a figure of $p = 0.00036$. The figure is very small, indicative of the fact that indeed language issues play a significant role in learners' understanding of the questions as posed in a non-primary language. It is thus unlikely that discrepancies between the observed and expected values represent a sampling or chance fluctuations. The small value of p also implies a rejection of the hypothesis of equal means.

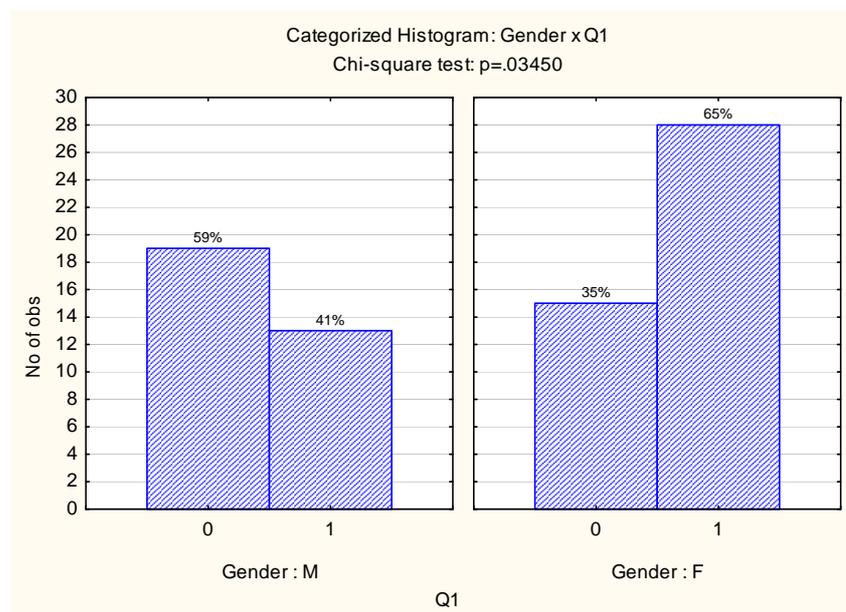
4.8 A comparison of boys and girls' responses to Question (a)

The table and figure below compares the performance of boys and girls in question (a).

Table 4.6 2-Way Summary Table: Observed Frequencies for Question (a) on Gender

Gender	Q(a) 0	Q(a) 1	Row Totals
Male	19	13	32
Row %	59.38	40.63	
Female	15	28	43
Row %	34.88	65.12	
	34	41	75
Chi-square test: $p = 0.03450$			

Figure 4.7 Categorized Histogram: Gender x Question (a)



The ratio of boys to girls above shows that girls are the predominant gender/sex at the school. As a matter of fact, as one goes up the grades, the numbers of boys dwindle rapidly, evidence of the dropout rates amongst boys in particular. There are several

explanations for this, chief amongst which is the pressure for older boys to start providing for their indigent families and above all, the incidence of crime and gangsterism that is so prevalent in the Cape Town townships pressures boys to drop out of school early. Another pressure which might be brought to bear on boys is that upon reaching adolescence and beyond, they are culturally initiated into manhood. As society expects of men to do men's duties, some may drop out of school in order to impress girlfriends with some freebies.

The figures above show that when gender is included in the equation as an independent variable, there seemingly is a trend of girls outperforming boys. In question (a), which needed either "male" or "female" as the correct answer, 59.38% boys gave an incorrect answer compared to 34.88% of girls. For those who provided the correct answer, 40.63% were boys and 60.12% were girls.

It needs to be stated that one of the major weaknesses of the study lie in the fact that it failed to set up a comparison between boys and girls in the same language group, i.e. compare boys and girls responding in isiXhosa and also set up another study comparing performance between boys and girls in English. In the manner in which the current study is set up, one may not know whether it was in the isiXhosa or English version where girls outperformed boys. This is one of the issues that emerged during the analysis of the results and as an issue of interest; it could probably be carried forward into a sequel study.

The chi-square test of $p = 0.03450$ is indicative that the relationship between gender and performance is not due to chance factors only or could have resulted from sampling error. The relationship between performance and gender for this question is thus statistically significant. The above association is accepted at the level of $p < 0.05$. Girls clearly outperformed boys in Question (b). Any explanation of this observation will rather be ambivalent as there are no known genes for Science that resides in the female specimen of humanity only.

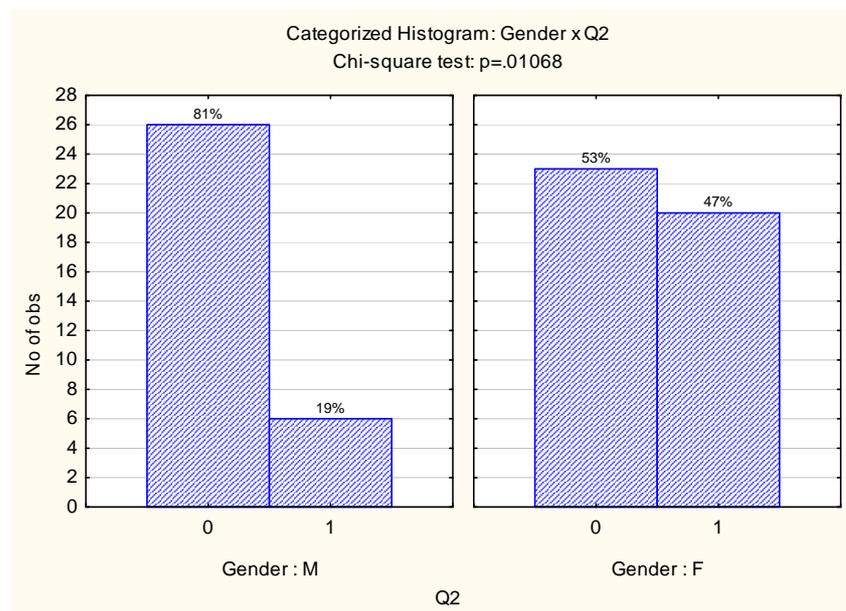
4.9 A comparison of boys and girls' responses to Question (b)

Table 4.7 and figure 4.8 below compare the performance of boys and girls to question (b), which was open-ended.

Table 4.7 2-Way Summary Table: Observed Frequencies for Question (b) on Gender

Gender	Q(b) 0	Q(b) 1	Row Totals
Male	26	6	32
Row %	81.25	18.75	
Female	23	20	43
Row %	53.49	46.51	
	49	26	75
Chi-square test: $p = 0.01068$			

Figure 4.8 Categorized Histogram: Gender x Question (b)



Question (b) proved rather challenging to both groups. This could probably be understood because of the manner in which it was structured. For this question, 81.75% of boys gave an incorrect answer compared to 53.49% of girls. Also, comparing for correct answers, 18.75% of boys gave a correct answer compared to 46.51% of girls. This is a rather striking difference in the level of performance,

showing a strong positive correlation between the sex of the respondent and performance.

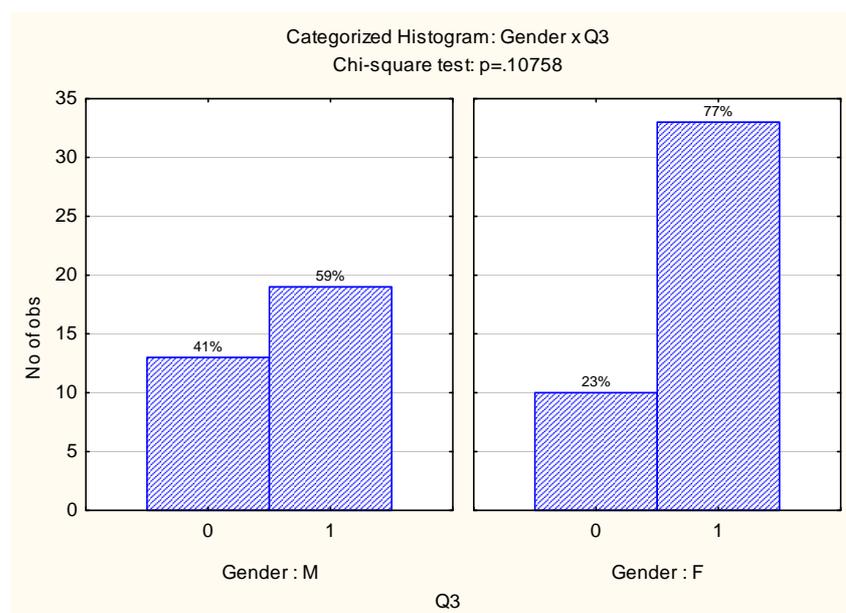
A look at the relationship between performance and sex gives a value of $p=0.01065$, which is smaller than the threshold of $p=0.05$. From this, one may conclude that gender played a role in the performance of learners. It remains to be argued as to how sex plays itself out in these circumstances. It, however interesting, needs to be stated that this observation does not fall within the ambit of the current study.

4.10 A comparison of boys and girls' responses to Question (c)

Table 4.8 and figure 4.9 below compare the performance of boys and girls to question (c), which was a dichotomous question.

Table 4.8 2-Way Summary Table: Observed Frequencies for Question (c) on Gender

Gender	Q(c) 0	Q(c) 1	Row Totals
Male	13	19	32
Row %	40.63	59.38	
Female	10	33	43
Row %	23.26	76.74	
	23	52	75
Chi-square test: $p = 0.10758$			

Figure 4.9 Categorized Histogram: Gender x Question (c)

The figures above show that in the case of learners who provided a correct answer, 59.38% of boys and 76.74% of girls fell under this category. In this case, a slightly higher percentage of girls did better as compared to boys. For those learners providing and incorrect answer, 40.63% and 23.26% of boys and girls fell under this category respectively. The chi-square value of $p = 0.10758$ indicates that the discrepancy between the expected and observed values could as well be explained by chance factors.

Question 3 above shows a consistent difference in the performances of boys and girls. Also noteworthy in this question is that the majority of both boys and girls managed to give a correct answer. Question 3 could be deciphered by guesswork, as it demanded of learners to mention either “male” or “female” as the answer.

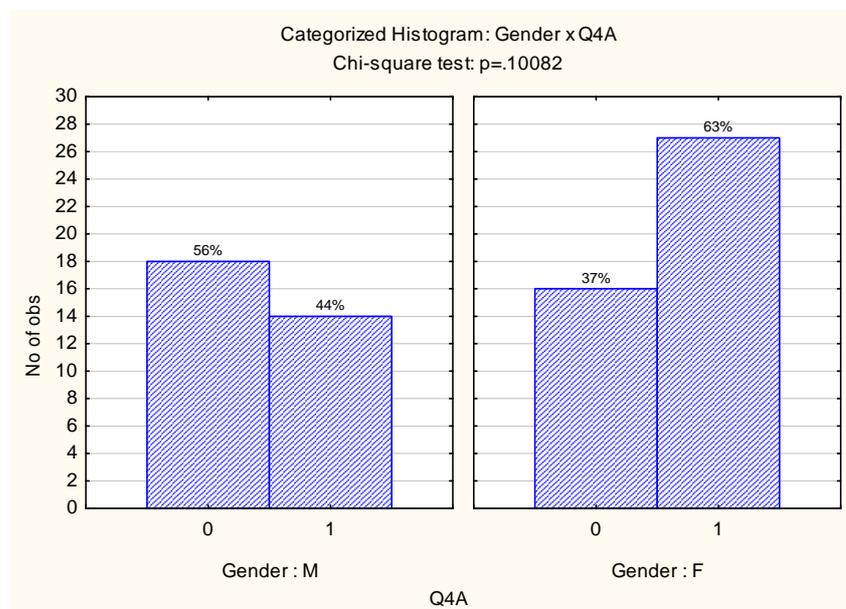
4.11 A comparison of boys and girls’ responses to Question (d.1)

Table 4.9 and figure 4.10 below compare the performance of boys and girls to question (d.1), which was a dichotomous yes-no question.

Table 4.9 2-Way Summary Table: Observed Frequencies for Question (d.1) on Gender

Gender	Q(d.1) 0	Q(d.1) 1	Row Totals
Male	18	14	32
Row %	56.25	43.75	
Female	16	27	43
Row %	37.21	62.79	
	34	41	75
Chi-square test: $p = 0.10082$			

Figure 4.10 Categorized Histogram: Gender x Question (d.1)



The observation made in d.1 shows a repeat of the observations made earlier in the previous questions involving the performance of boys and girls. In the case of learners giving an incorrect answer, 56.25% of boys fell into this category compared to

37.21% of girls. On the other hand, 43.75% and 62.79% of boys and girls respectively gave a correct answer. What emerges from all of the questions is that many girls performed better than many boys. In all of the previous questions, the majority of girls also managed to give a correct answer compared to boys, with the exception of question (b), which proved a major challenge for all learners.

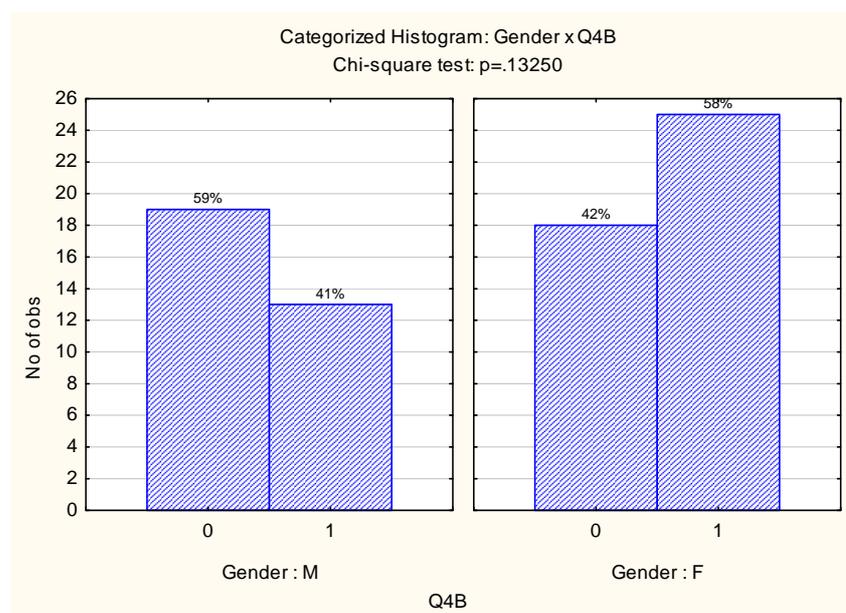
The association between gender and performance is indicated by a chi-square value of $p = 0.10082$. This value indicates that we cannot be confident that the relationship between sex and performance for this question is not generated by chance factors only.

4.12 A comparison of boys and girls' responses to Question (d.2)

Table 4.10 and figure 4.11 below compare the performance of boys and girls to question (d.2), which was open-ended.

Table 4.10 2-Way Summary Table: Observed Frequencies for Question (d.2) on Gender

Gender	Q(d.2) 0	Q(d.2) 1	Row Totals
Male	19	13	32
Row %	59.38	40.63	
Female	18	25	43
Row %	41.86	58.14	
	37	38	75
Chi-square test: $p = 0.13250$			

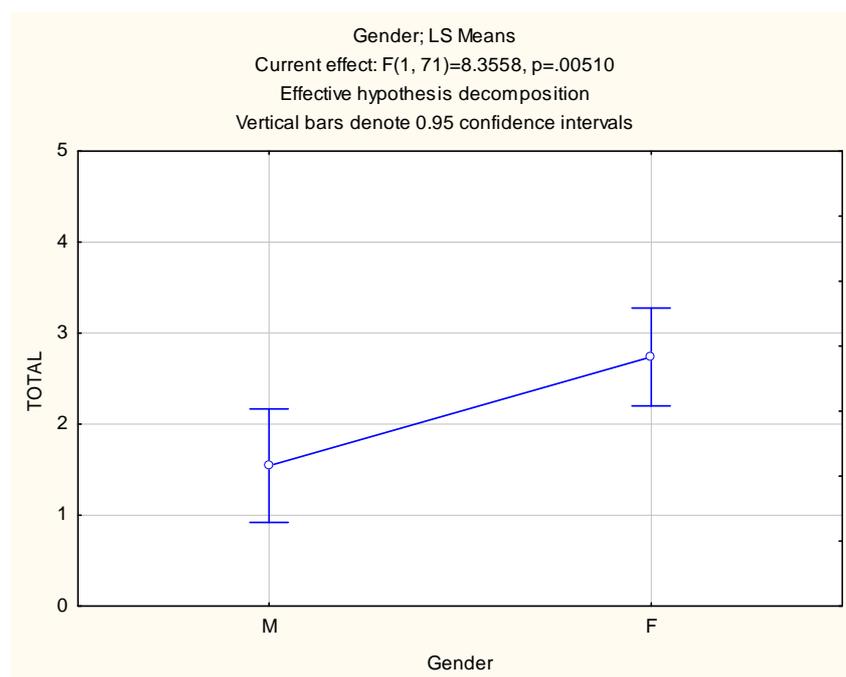
Figure 4.11 Categorized Histogram: Gender x Question (d.2)

In question d.2, the performance of both groups was moderate enough. 40.63% of boys gave a correct answer compared to 58.14% of girls. In this question also, girls did moderately better compared to boys. Also worth noting is that not only did girls do slightly better, but more than 50% of them gave a correct answer, a figure which is the most acceptable in the academic world. In the schooling system, results are deemed disastrous when less than 50% of learners fail to get a pass-mark.

On the question of learners giving an incorrect answer, 59.39% of boys and 41.86% of girls fell under this category. The chi-square value of $p = 0.13250$ shows that the discrepancies between the observed and expected values may as well be ascribed by chance factors only.

4.13 A comparison of the average performance of boys and girls

Figure 4.12 below depicts the average performance of both boys and girls in all five questions. In the picture, the M refers to boys and the F refers to girls.

Figure 4.12 Gender; LS Means

From the picture above, it can be deciphered that the average performance of boys was 1.54 whilst that for girls was 2.73. A similar picture was also evident in the comparisons carried out earlier between boys and girls for the different questions. The p-value of 0.00510 presents a rather strong support that on the average, girls outperformed boys. This is probably as a result of the cumulative consistent performance of girls throughout the instrument, compared to boys who elicited a weak kneed performance in all of the questions.

4.14 Gender-Language interaction

The table below compares the interaction-effect between language and gender in influencing the performance of learners. Whilst the central hypothesis of this study was to find out whether language might affect learners who respond to Natural Sciences CTA's in a non-primary language, issues of gender-related performance in the Natural Sciences have always been contentious as well. Also, the pictures painted in the above paragraphs seem to be highlighting that gender might indeed have a hand in the manner in which boys and girls respond to Natural Sciences questions. The table below depicts this relationship and the probable interplay between the dynamic of language and gender.

Table 4.11 Inter-action effects between Language and Gender

Univariate tests of Significance for Total sigma-restricted parameterization					
Effect	SS	Degree Of Freedom	MS	F	p
Intercept	335.4435	1	335.4435	107.2555	0.000000
Gender	26.1329	1	26.1329	8.3558	0.005097
Language	43.8497	1	43.8497	14.0206	0.000364
Gender*Language	0.0941	1	0.0941	0.0301	0.862779

The table above captures the essentials of what was discussed earlier on the interplay between language and performance on the one hand and gender and performance on the other. Also highlighted in the table is the interaction effect between the gender*language dichotomy in influencing the performance of learners in the Natural Sciences CTA. The hypothesis is that if indeed there is interaction between gender and language, then the differences observed between isiXhosa and English respondents are not the same for males and females in a particular language. In other words, language on its own cannot account for the observed differences in performance, an argument which could throw earlier observations under the spotlight.

The value of p for the gender*language interaction is 0.862779. This value is way above the 0.05 threshold level of significance. In a way, this suggests that gender and language do not interact significantly in influencing the performance of learners in the Natural Sciences. The difference in performance between the two languages is also the same between boys and girls. This implies that besides boys doing slightly poorer than girls, isiXhosa boy respondents still performed better compared to English girl respondents. It could thus be suggested that this is a confirmation that language on its

own is pivotal in influencing the performance of learners in the natural Sciences, irrespective of other factors at play.

4.15 Chapter Summary

This chapter considered the differences in the performance between isiXhosa and English respondents. The comparison was done from a quantitative point of view. In the comparisons, not only were the influences of language on performance looked at, but also the interplay between language and gender was factored in. This was done so as to determine whether other effects might be as important in influencing the performance of learners in the Natural Sciences. The quantitative study concluded that gender does interact, though insignificantly, with language in influencing the performance of learners.

In **chapter 5**, the study will focus on the qualitative aspects of data analysis. More emphasis will be placed on commonalities and differences as a result of interpretative styles between the groups of learners as they respond to CTA's.

CHAPTER 5 -

QUALITATIVE

DATA

ANALYSIS

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5.1 Introduction

In this chapter, I focus my attention on learner interpretative styles and lines of answering Natural Sciences questions based on a comprehension test. This chapter will pay attention to the linguistic strengths of the two language cohorts under study. In addition, the main concern of this chapter will be to decipher whether learners exhibit linguistic deficiencies when they respond to Natural Sciences CTA-based questions in a language whose idiom they do not fully comprehend. The methodology used in this chapter will be to unpack learners' answers, with the purpose of drawing attention to the manner in which learners from primary and non-primary language backgrounds interpret questions. CAQDAS *Atlas.ti* will be used to achieve this purpose.

Chapter 5 will also focus attention on the manner in which learners package their responses in answering a Natural Sciences comprehension test. In particular, this section of the study will base its search on the chunks of words or sentences learners retrieve from the passage in answering the questions. Questions may sometimes become ambiguous and "... the premise on which you base your search (for answers)¹ is that there are multiple meanings and that the clues to those meanings need to be found in the discourse, the rule governed language behaviour of the participants and the way in which they make sense of their reality" (Marshall & Rossman, 1999; p117). This gives rise to another aim of this chapter, which is to find out whether learners use the clues and keywords used in the comprehension test.

In order to highlight learner linguistic strengths alluded to above, questions (b) and (d.2) will be treated separately. Questions (a), (c) and (d.1) will be excluded from the qualitative study because these questions involve only yes-no answers. In the first part of this chapter, learner responses to questions (b) and (d.2) will be analysed in a tabular form. The table used will give categories of responses offered by primary and non-primary language learners for those questions. In this way, the frequency of responses from each given group will be highlighted. In the second part of the chapter, learner responses will be shown in the form of data networks generated from *Atlas.ti*. These networks will depict the inter-relationship between the correct answer(s) given by learners. In this way, learner patterns of thought will be related through an intricate set of networks to the correct answer(s). Question (b) will not be depicted in the networks as it relates more to an interpretation of the given pictures as described in the passage rather than the passage itself.

¹ My emphasis

5.2 Questions in context

As indicated earlier, this chapter would be based on an analysis of learners' answers to questions (b) and (d.2). The two questions analysed in this text were structured as follows:

Question (b) involved learners identifying whether mosquito A was male or female and providing a reason for the answer given.

Question (d.2) involved learners identifying whether if bitten by a mosquito, they would be able to tell whether it was male or female and provide a reason for their answer.

From the comprehension test, the strongest clue provided for question (b) was that a male has feathery antennae, thus making it impossible for mosquito A to be male (see instrument in chapter 3). This is what I will call an answer by contradiction since the question specifically relate to a female mosquito. However, by citing that mosquito A could not be male since it did not possess feathers, one of the most prominent features on display, learners will have correctly answered the question. One of the reasons provided by learners was that the proboscis of mosquito A is strong and as such it should be female, as indicated in the passage. This is what I would call a weaker form of reasoning since there is little evidence from the given pictures that either of the proboscides, for mosquito A and B, is weaker. However, a careful scrutiny of the pictures depict the male antennae as segmented, whereas the female one is shown as un-segmented. From this, learners might cleverly suggest that the female proboscis is the strongest, as it cannot bend easily due to lack of segments. This answer was also credited as a correct answer.

Relating to question (d.2), there were various clues provided in the passage that could be furnished as plausible reasons to the question. Amongst the hosts of plausible reasons, the following could be identified from the passage:

- Males only drink sugary fluids such as flower nectar and as such do not need a blood meal.
- Females require a blood meal and are thus responsible for the bite.
- Females are the ones with a strong proboscis that could pierce into skin.
- A male proboscis is not strong enough.
- It is a female Anopheles that infects a person.

Learners were thus at liberty to provide any of the above statements as responses to the question.

5.3 Learner responses to question (b)

Question (b), which was a sequel to question (a), required of learners to identify the sex (gender), of a particular mosquito. The identification of the mosquito had to be based on the description of the physical features and characteristics of the mouthparts of the particular mosquito as shown in the passage. The intellectual demand on learners was thus to read the passage with understanding, and based on the passage, tell whether mouthparts A belonged to a male or female mosquito.

Table 5.1 below, generated from *Atlasti*, depicts the frequency of phrases used by learners in answering question (b). In the table, primary document 1 (column 1) gives information about learners responding in English and primary document 2 (column 2) gives information about learners responding in isiXhosa. In cases where there is a zero in either of the primary documents, the explanation is that learners in that particular language group did not provide that particular answer. For example, the isiXhosa group did not provide “it has a big head” as one of the answers (first row).

Table 5.1 Learner responses to question (b)

CODES	PRIMARY DOCS		
	1	2	Totals
it has a big head	1	0	1
it has feathery antennae	0	16	16
female has developing eggs	3	0	3
has a Plasmodium parasite	1	0	1
it has eggs	1	0	1
males drink nectar	3	2	5
path of blood	2	0	2
proboscis can smell	0	1	1
require a blood meal	9	4	13
shape of antennae	3	0	3
strength of proboscis	9	10	19
Totals	32	33	65

The table above shows that:

1. 28% of learners in the English cohort based their answer on the strength of the proboscis compared to 30% of learners in the isiXhosa cohort (last row in the table). This was so despite the fact that the strength of the proboscis was not mentioned in the passage. In addition, the strength of the proboscis could not be easily deciphered from pictures of the mouthparts provided in the passage. Learners who reasoned in this way based their answer on a fact slightly hidden in the pictures.
2. None in the English cohort picked up on the fact that a female mosquito could be identified through its lack of a feathery antennae compared to 49% in the isiXhosa cohort (row 2). This is one feature that comes out clearly from the description of the antennae of the two mosquitoes in the paragraphs and also in the pictures provided. Also interestingly, I will contend that the primary language group were creative in their reasoning in that they provided their answer through a negation of the question. The question was specifically directed at mosquito A. In answering, learners were expected to focus their attention to that

particular mosquito, as did the non-primary language group. However, the primary language group took advantage of the prominence of the features of mosquito B. In giving effect to multi-tasking, they held a broader picture of the question asked and were not distracted from mosquito B. By answering that mosquito A should be female because its antennae are not feathery shows a level of sophistication in their answer as the question was not based on the mouthparts that were actually feathery. On the other hand, the primary language learners missed the golden opportunity of the feathery nature of the antennae of mosquito B. This, I believe, is due to the fact that they were forced to read the question with added effort and poor understanding of its other dimensions beyond the mosquito whose mouthparts were under scrutiny.

3. Related to the line of answering mentioned in 2 above, 9% of learners in the English cohort indicated the shape of the antennae as their answer compared to none in the isiXhosa cohort (row 10 in the table). This factor of the shape of the antennae is not mentioned anywhere in the passage provided. The only conclusion that could be made is that learners who mentioned this answer which was deemed correct did not go through the passage very well. They most probably read their answers directly from the pictures of the mouthparts provided. In the passage, the only reference made in relation to the proboscides was on their featheriness or not. Concerning the shape, whether segmented or not segmented, is a factor ignored in the passage. It is reasonable to conclude that learners who mentioned the shape of the proboscis as an answer did not go through the passage or did not read the passage with proper understanding.
4. The fourth group of learners mentioned dietary requirements of the two types of mosquitoes. This group comprises learners who either mentioned that “males feed on nectar only” or that “females require a blood meal” (rows 6 and 9 in the primary documents). An analysis of the answers provided shows that 38% of learners in the English cohort fell into this category compared to 18% in the isiXhosa cohort. The English group could be assumed as comprising learners who were less creative in their answers in that they picked up phrases from the passage without a careful understanding of the question. The issue of the type of meal could only be picked up by trained zoologists who would have studied how particular mouthparts of insects are best suited to specific dietary requirements. However, despite the scientific answer learners gave, at this level of academic study they could not be given the benefit of the doubt.

5. Another category of learners could be described as having given completely irrelevant answers. These constitute a group who provided answers not related to the question asked. The question was about identifying whether mouthparts A belonged to a male or a female mosquito. This group of learners picked up phrases from the paragraphs without making connections to the question. Answers that could be deemed out of sync with the question asked could broadly be categorised as follows:

- it has a big head (row 1).
- female has developing eggs (row 3).
- it has a Plasmodium parasite (row 4).
- It has eggs (row 5).
- path of blood (row 7).

A scrutiny of learners who provided answers not directly related to the question reveals the following:

28% of the English cohort fell into this category compared to none of the isiXhosa cohort. This shows that a sizeable number of the English cohort did understand the question asked. On the contrary, those who answered in a primary language, whether right or wrong, provided answers that fell within the ambit of the question asked.

5.4 Learner responses to question (d.2).

Unlike question (b), question (d.2) could be classified as related to aspects of correct interpretation of the comprehension test without the advantage of pictures. Question (d.2) was structured in a way so as to establish whether learners picked up from the passage that males do not need a blood meal and only females are responsible for biting the host. Alternatively, it is also suggested in the passage that only females have a strong proboscis that is capable of piercing into the skin of the host. Table 5.2 below as generated from *Atlasti* depicts the categories of responses offered by learners from the two language groups. In the table, primary document 1 (column 1) shows categories of responses given by the English respondents whereas primary document 2 (column 2) gives categories of responses from the isiXhosa respondents

Table 5.2 Learner responses to question (d.2)

CODES	PRIMARY DOCS		
	1	2	Totals
can't distinguish the right mosquito	5	4	9
only female has a strong proboscis	4	8	12
only female infects a person	1	5	6
female consume blood	14	7	21
male can pierce the skin	7	0	7
males feed on nectar	1	9	10
Totals	32	33	65

From table 5.2 above, the following information can be deduced:

1. 16% of the English respondents could not distinguish which of the two sexes is responsible for the itchy bite emanating from a mosquito compared to 12% of the isiXhosa respondents who were also at a loss as to which mosquito is responsible for the bite (row 1 in the table). This category of learners includes all those who indicated that you cannot tell when bitten which of the two mosquitoes is responsible “... because they bite in the dark”, “... they bite fast” , “... once bitten you are not concerned as to which mosquito actually bit you” or “... it is difficult to identify the sex of a mosquito”. Some learners also indicated that once bitten, the only concern is to rush for medical attention rather than being concerned one with the specific gender of the culprit. Learners who did not furnish any response were also classified under this category as they were deemed unable to distinguish which of the two mosquitoes is responsible for the bite. All similar responses were lumped together under this category. Though from a general point of view most of the responses were creative in a naturalistic way, they failed the academic demand of basing their answer on the comprehension test, as requested.
2. In the second category of responses, 13% of the English respondents picked up on the strength of the female proboscis compared to 24% of the isiXhosa respondents (row 2). A look at the comprehension test shows that this answer was more evident, thus making it easy target for learners to pick it up. However, the language used in reference to this question is more hidden. The concepts of “saw into skin” and “pierce” do not hold much

meaning for second language learners. The very marginal number of L2 learners picking up on this answer can be assumed to be related to the synonym used in the question, which might seem unrelated to the terms used in the passage.

3. One direct answer to the question was the one given in the third category of responses (third row). In this category, learners indicated that only a female would infect a person. 3% of the English respondents picked up on this answer compared to 15% of the isiXhosa respondents. This answer is interestingly enough, strategically placed at the end of the comprehension test. In ordinary communication, experts emphasize the importance of the primacy of the message one intends to relay to an intended audience. In other words, people tend to remember what was said first rather than the message relayed towards the end of a speech or passage. The mis-location of the sentence in the passage could thus possibly account on why only one of the English respondents picked it up. Also, my experience as a second language learner tells me that towards the end of a comprehension test, the brain has taken a lot of strain due to the to-and-fro translations from English to isiXhosa and back from isiXhosa to English. For this reason, the last paragraph to a passage brings much relief to any reader, more so for the second language reader, to the extent that little attention is paid to details at the end. However, for first language readers, the last sentence is remembered with ease in that they spend less energy and strain performing the to-and-fro translations.
4. Related to the answer provided in 4 above, 44% of the English respondents indicated that the female consumes blood compared to 21% of the isiXhosa respondents. This answer is placed in the second paragraph and is more connected with phrases such as “blood meal”, “bitten” and “consume blood”. Due to this relationship, it was convenient for learners from both groups to pick it up.
5. One answer provided by learners which was out of sync with the question was that males can pierce the skin of the host. Though tempting, it is, however, difficult to build a link between this answer and the dominant male chauvinistic influences which always considers the male to be the stronger of the sexes. 22% of the English respondents answered in this way compared to none of the isiXhosa respondents.
6. In the last category, learners provided a rather creative answer as the question did not specifically relate to a male mosquito diet. However, learners who correctly understood the question were able to state that because males feed only on nectar, they are not responsible for the itchy bite. 3% of the English group fell into this category compared to 27% of the

isiXhosa group. This also relates to what was discussed earlier under responses provided to question (b). This phenomenon whereby learners provided an answer which required them to look at the “bigger picture”, was referred to as answering by contradiction. In other words, when learners are asked about the female mosquito, they do not forget that there is also the male mosquito which can assist in finding the answer. The majority of learners answering in a primary language were able to provide an answer by indicating that the male mosquito cannot be the culprit, as it feeds only on nectar. This in itself is an indication of the level at which primary language learners are able to interpret data. An explanation might be that when learners have to think and assimilate information in a primary language, certain thought patterns are triggered which allows for multiple processing of the data. This is analogous to suggesting, from a biological point of view, that as a result of favourable circumstances, other people may be able to chew and digest different meals simultaneously (primary language), a feat that is denied another group operating under adverse condition (second language). From this point of view, it may be argued that reading and answering a Natural Sciences comprehension test in a primary language offers more advantages compared to when the task is taken in a non-primary language.

5.5 Visualising data networks

In this part of the qualitative data analysis, data networks for question (d.2) will be presented. Questions (a) (c) and (d.1) were not language-rich questions and could thus not be featured in the networks. Question (b) was also excluded even though it involved some rich language contexts. The reason for its exclusion was that it was based more on interpretation of pictures than the passage itself. The data networks are about making interconnections between answers learners picked up from the passage, and how learners could apply logic in a language-rich environment to unpack answers.

The networks thus model the main conceptual framework of the qualitative study. In the networks, learner patterns of thought are linked to the main ideas generated from the supposed correct answers based on the passage. The networks are created through the use of codes and links which are interactive and show some defined actions related to the main framework of the study. “Unlike the codes themselves, which capture the main domain knowledge of the issue under investigation, relations capture the epistemological framework, the methodology you use.

They generate questions that you can then ask your codes”

(<http://www.datanetworks.co./pages/default.aspx>)

The main relations, as generated by *Atlasti*, used to define the inter-relations to the main theoretical framework in the data networks are the following:

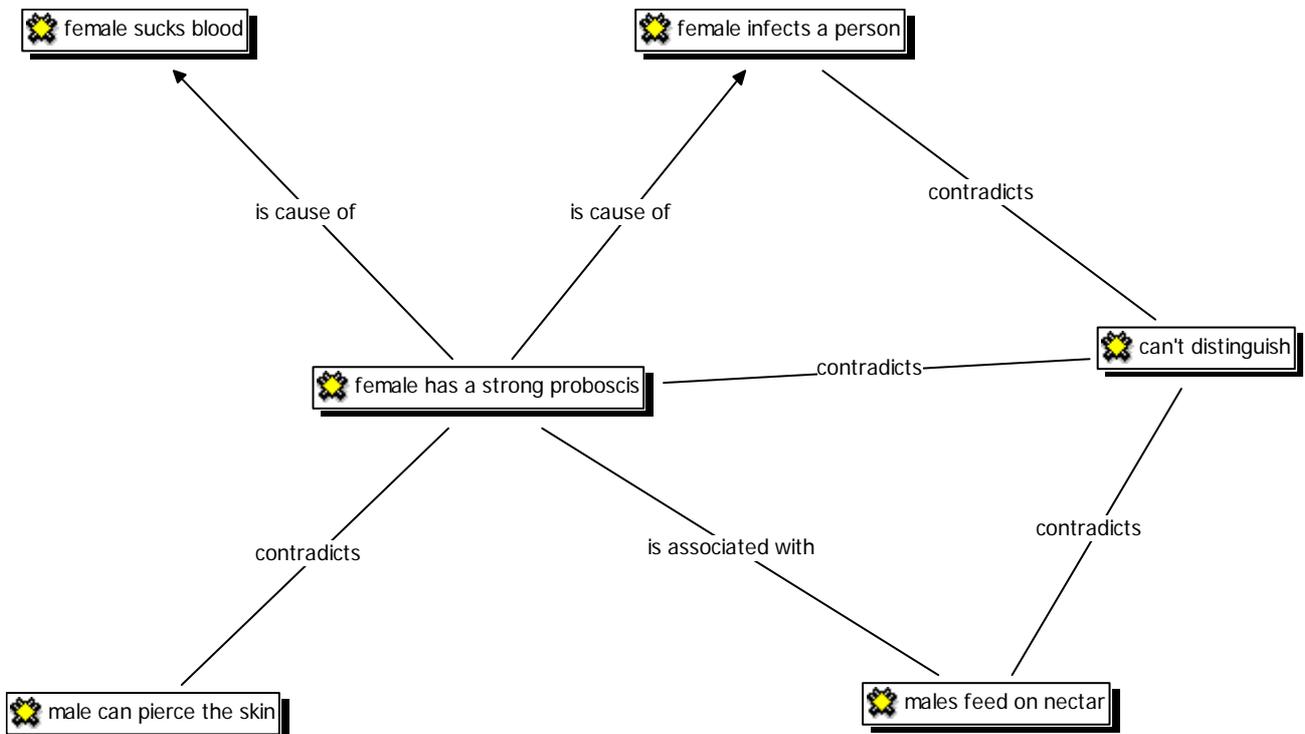
- is a part of
- is associated with
- is a cause of
- contradicts

In the relations indicated above, the first three will be grouped together as supportive of each other, hence forming part of the correct answer. The last category of the links will be deemed as contradictory of the correct answers.

5.5.1 Response of the English group to Question (d.2)

Responses of English learners to question (d.2) are depicted in the network below:

Figure 5.1 Network depicting non-primary language learners’ responses to question (d)

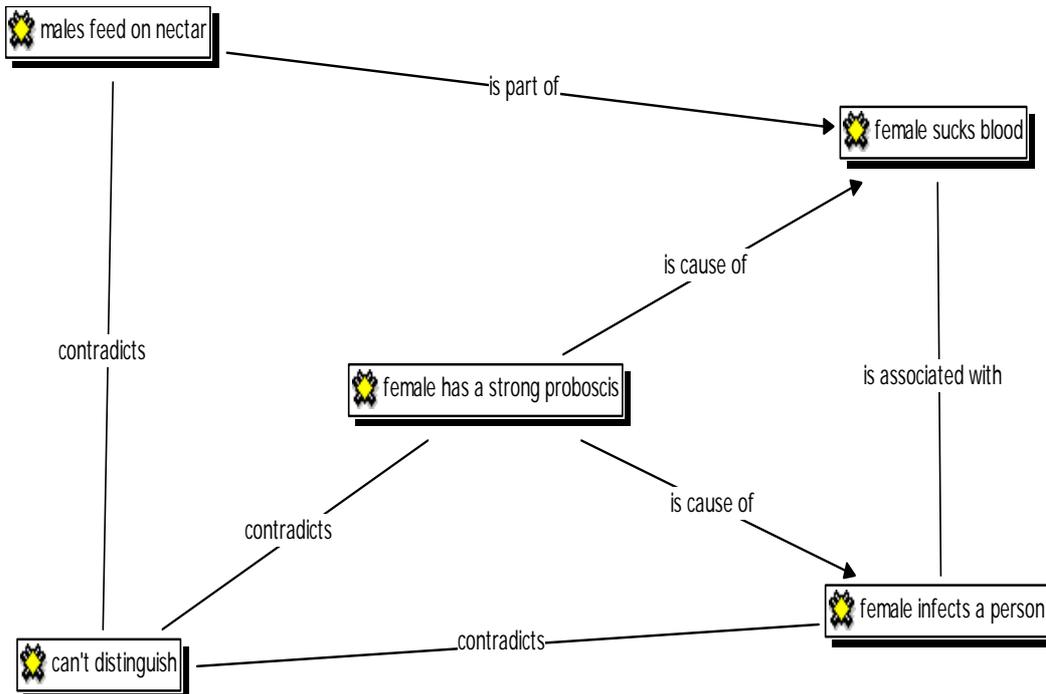


The picture above elicits the following:

- English learners were able to pick up the fact that the female has a strong proboscis and could thus pierce a human skin and suck blood. The two answers mentioned, “female sucks blood” and “female infects a person” are direct derivatives of the main central answer, that of a female possessing a stronger proboscis. All of these three answers were thus credited as being wholly correct. In all, 59% of the English group produced answers which were related to the correct answer as being “a cause of”.
- Also associated with the correct answer is that “males feed on nectar”. The question related specifically to the type of mosquito that is responsible for the bite and subsequently transfers the malaria virus. This answer, due to its association with the correct answer, was also deemed correct. One of the English learners mentioned this factor.
- There were also contradictions to the correct answer. These were answers that were deemed incorrect and were penalised as such. These mainly included answers such as “male can pierce the skin”. Also in this category were cases where learners were unable to give an answer. In all, 38% of the English cohort fell under this category.
- The picture above also shows that the English group gave a wide variety of answers as could be retrieved from the passage.

5.5.2 Response of the isiXhosa group to Question (d.2)

Responses of the isiXhosa group are pictured in the diagram below.

Figure 5.2 Network depicting primary language learners’ responses to question (d.2)

The picture elicits the following:

- Like the English cohort, the isiXhosa group were able to pick up the fact that due to its stronger proboscis, a female can suck blood and infect a person. In addition, the isiXhosa group indicated by contradiction that due to the fact that males feed on nectar, they thus cannot infect a person. The double pointed arrow indicates a mutual influence on the strong female proboscis and male sucking on nectar. Thus the answer “males feed on nectar” is indicated in the diagram as part of the correct answer. 88% of the isiXhosa learners fell into this category and were credited as such.
- The only group of learners in the isiXhosa group who contradicted the correct answer were those who indicated that it is improbable to determine the sex of the mosquito once bitten. The common reason they offered for this was that determining the gender will be difficult, noting the size of the mosquito and the fact that the only concern at that time is to receive medical attention. Also in this category is a learner who did not provide any answer.

5.6 Chapter Summary

In this chapter, I looked at the qualitative aspect of the study. Specifically, this chapter focussed on aspects of language in texts which may affect learner interpretation of those texts. Attention was also given to the manner in which primary and non-primary language learners respond to discussion-type questions. In the final section of the chapter, data networks were presented in order to illustrate the interconnectedness between learner answers and proposed correct answers.

In **chapter 6**, I will discuss the results of what was presented in chapters 4 and 5. I will initially look at quantitative results and finally discuss qualitative results.

**CHAPTER 6 -
DISCUSSION OF
QUANTITATIVE &
QUALITATIVE
RESULTS**

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6.1 Introduction

This chapter discusses the quantitative and qualitative results as presented in chapters 4 and 5 respectively. The quantitative results focused on the comparison of the performance of the two groups of learners based on how many marks were scored by each. On the other hand, the qualitative results were about the comparison of the interpretation of the language of texts in the Natural Sciences and the responses that flowed as a result of the interpretation of those texts. Chapter 4 was thus about how many learners in each group scored correct answers, whereas chapter 5 was about which group had a better understanding and used appropriate language in answering the questions.

Chapter 6 gives an account of the observations made in the previous two chapters. The discussion focuses on the salient points embraced within the epistemological and conceptual framework of the study. The study, on its own, is about establishing whether there is a gap in the performance of primary and non-primary language learners when they respond to CTA's in the Natural Sciences, mainly as a result of differences in the interpretation of questions.

The paragraphs that follow will initially discuss the quantitative results. The quantitative results have a bearing on all questions in the answer sheet. This will be followed by a discussion of the relationship between gender and performance. Finally, the discussion will focus on qualitative aspects of the study. The qualitative aspects will only focus on learner responses to questions (b) and (d.2) as indicated in chapter 5.

6.2 Discussion of Quantitative results

6.2.1 Learner responses to Question (a)

Question (a) was a typical true-false (dichotomous) question whereby learners were asked to identify from pictures whether a particular mosquito was male or female. The physical characteristics related to the sex of the mosquito were previously described in

the passage. Learners had to read the passage and then decide, whether mosquito A was male or female.

The margin of difference in the performance of learners in this question was marginal. A chi-square value of 0,569 confirmed that the hypothesis of equal means could be accepted when the level of significance is pegged at 0, 05. The fact that primary and non-primary language learners performed equally well could either be assumed to indicate that learners understood the questions equally well or that when the chance factor is increased to 50% (male-female), all learners had a better chance of obtaining a correct answer without a good understanding of the passage.

In the TIMSS-R study cited earlier (Howie, 1999), it was established that when a primary and non-primary group of learners are asked multiple choice questions, they perform equally well compared to when they respond to free-response, open-ended questions. The report also established that when learners are presented with choice questions, as in true-false questions, they depend more on guessing and gut feel of the correct option. This phenomenon is even more enhanced when learners have to respond to dichotomous questions.

6.2.2 Learner responses to Question (b)

Question (b) demanded of learners to justify why they made the choices in question (a). Science, by its very nature, demands of practitioners' rigorous analysis of facts and systemic presentation of arguments. Also, this serves to discourage learners from thumb-sucking and guessing answers, concepts that remain anathema within the realm of science.

The chi-square value of 0, 00009 shows a huge margin of difference in the performance of the primary and non-primary language learners in this question. When answers to question (b) are put *vis-à-vis* those for question (a), it becomes tempting for one to suggest that non-primary language learners perform poorly when they respond to

language-rich problems in the Natural Sciences when compared to primary language learners. Howie (1999) suggests that there is always a huge margin of difference in the performance of primary and non-primary language learners when they respond to free response questions.

A big question remains as to whether answers obtained in dichotomous questions are as a result of learners genuinely demonstrating knowledge or merely supplying thumb-sucked answers? The second question that needs to be answered is whether the knowledge that we claim is possessed by our Science students is genuine knowledge which is capable of being maneuvered rather than being regurgitated?

6.2.3 Learner responses to Question (c)

Question (c), as explained earlier, was an indirect true-false question. This I classify as being indirect because a direct question should have asked a question like “Which mosquito is responsible for biting a person” or “Is it a female or male mosquito that is responsible for biting a person?” By phrasing the question in the manner it was (see instrument in chapter 3), learners’ cognitive faculties were stretched to a higher level. In the case of this question, the first part served as a distracter for learners who had not mastered the language.

It may be suggested that a chi-square value of 0, 01859 is a reflection of a weaker association between the language in which the question was answered and performance for a significance level of 0, 05. In other words, one may suggest that language did not significantly influence the performance of learners in this case. However, to an extent, it is also tempting to state that in this case language may have had an influence in the manner in which the two cohorts performed. Naturally, it should have been expected that any two groups of learners at similar stages of academic development should perform equally well. However, the thumb-sucking strategy was dealt a blow by the manner in which the question was phrased. Unlike in question (a), the answer was not given away in a more simplistic way.

A closer look at the performance of learners in questions (a) and (c) shows that non-primary language learners were out-performed more in question (c) than in question (a). In TIMSS-R, Howie (1999) observed that one other reason that may lead non-primary language learners to perform poorly is the manner in which questions are phrased, particularly if questions are structured in a way that increases their verbosity. Question (c) was more verbose, compared to the other questions. The verbosity of the question lengthened the translation process, resulting in non-primary language learners having to face the strenuous task of translating from English to isiXhosa and back from isiXhosa to English when they have to provide answers. From my point of view, the combination of gut feel and chance did not work well for non-primary language learners in this instance.

6.2.4 Learner responses to Question (d.1)

This question was a sequel to question (d.2) and expected a yes or no answer. As in question (a) and (c), each learner had a 50% chance of obtaining a correct answer to the question. The chi-square value of 0,04891 shows that there was little difference in the performance of the two groups of learners in this question for a significance level of 0,05. In this question, unlike in question (c) above, the phrasing was more direct and my take is that learners could rely more on chance and gut feel.

The above statistic serves to support the common assertion that when learners are presented with true-false or multiple-choice questions, the performance between primary and non-primary language learners is more or less identical. However, from the questions above, it needs to be added that gut feel operates well in combination with less verbosity and the direct structuring of questions.

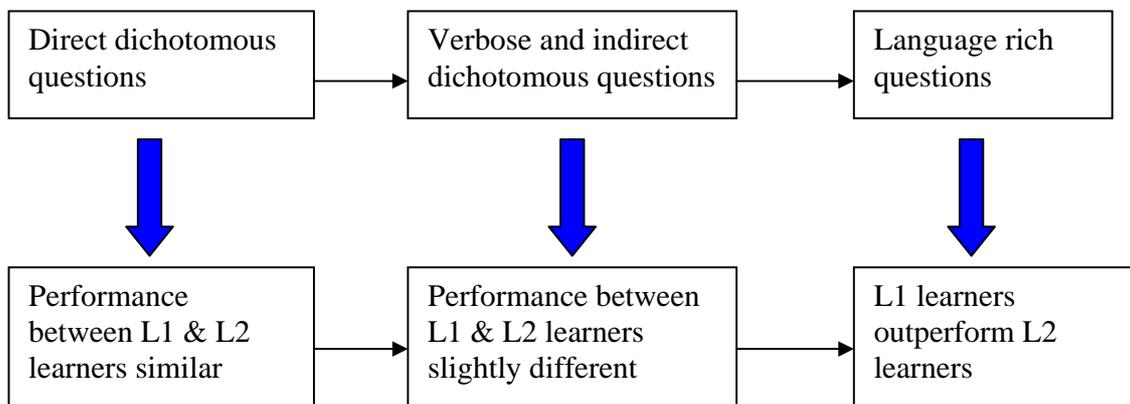
6.2.5 Learner responses to Question (d.2)

In this question, a chi-square value of 0,00745 was obtained, signaling a marked difference in the performance of primary and non-primary language learners. Consistent

with question (b), it confirms that when learners are requested to apply linguistic skills and related higher order skills in answering Natural Sciences questions, primary language learners outperform non-primary language learners. The commonly held assertion that the language of learning and teaching discriminates against non-speakers is thus given credence to.

In comparison with the questions discussed above, it becomes evident that the level of discrimination against non-primary language learners in Natural Sciences questions is incremental and functions in the form of a continuum (Figure 6.1 below). When questions are of a straightforward yes or no type, the level of discrimination seems minimal to non-existent. However, when dichotomous questions are verbose and indirect, the level of discrimination increases slightly. The level of discrimination with respect to non-primary language learners is highest when learners are asked questions that demand of them to justify their answers in words.

Figure 6.1: Relationship between performance and language operates in the form of continuum



6.2.6 A comparison between performance and gender

In the comparison between performance and gender, all the questions were pooled together. The object of this effort was to determine whether gender was a factor in

determining performance. The results showed that the hypothesis of equal means could be accepted in this case. With the exception of question (b) which was a discussion-type question, both boys and girls generally obtained similar averages. In question (d2), which was also a discussion-type question, the performance between boys and girls was comparable. In the former case (question b), one cannot convincingly assert that boys outperformed girls or whether the observations made could have been by chance only. The chi-square value of 0,862779 for the interaction between gender and performance rather confirms that in this case, gender did not play a significant role in determining performance.

It should, however, be acknowledged that the discussions in the above questions did not involve thick descriptions of contexts. It would be interesting to observe the differences in the performance of learners in cases where boys and girls are judged against the description of situations that are expressed in a richer language format.

6.3 Discussion of Qualitative results

6.3.1 Responses to question (b)

From analysis of question (b), the following conclusions are suggested.

- Non-primary language learners read texts with a higher degree of superficiality. Whilst primary language learners were able to show a deeper understanding of the text under review, including the fact that they were able to answer questions through contradictions, non-primary language learners showed lack of this skill. When requested to identify with a reason whether mosquito A was male or female, non-primary language learners' collective attention was diverted to the physical features of the particular mosquito to be identified, i.e. mosquito A. On the other hand, the majority of primary language learners recognised the prominent features of mosquito B, which was the one to which the question was not targeted. They thus indicated that mosquito A could not be male, as the physical characteristics of B are those of a male. This, in my view, represents a higher degree of better interpretation of the question. From this observation, one may conclude that primary language learners were capable

of using higher order cognitive skills in answering this question in particular. By answering a question through contradiction, primary language learners also showed a higher degree of sophistication in their answers. On the other hand, non-primary language learners were shallow in their understanding of the question.

- It seems that the presentation of questions accompanied by pictures seem to be the norm rather than the exception, in the Natural Sciences at least. However, according to what I have observed, the pictures seem to be a distracter to mainly non-primary language learners. In instances where questions were accompanied by pictures, non-primary language learners seemed to focus more on the pictures than the narrative forms. This, it seems, non-primary language learners adopt as a fall-back strategy as a result of the strain of having to read through paragraphs of unintelligible texts. On the other hand, primary language learners used the pictures as an added advantage to clarify their answers.
- Non-primary language learners seem to pick up prominent words from questions and link them up with words mentioned in the passage when they have to decide about answers. For instance, should a question include the phrase “male mosquito”, non-primary language learners would be tempted to look up in the passage a sentence having a similar phrase, ‘cut’ the set of adjacent words and paste that in their answer book as the correct answer. The major problem with using this type of strategy is that there are many instances in the passage where the words “male and mosquito” are adjacent to each other. Thus the variety of answers provided by learners answering in a non-primary language (see the paragraph below). On the other hand, primary language learners showed full understanding of the questions in their answers, to the extent of employing words not mentioned in the passage. Learners answering the questions in a primary language were also more consistent in the manner in which they answered their questions.
- A lack of understanding of questions by non-primary language learners led to them offering more diverse answers compared to primary language learners (as indicated above). This shows a lack of strategy when it comes to answering Natural Sciences CTA questions by these group of learners. There is also evidence that non-primary language learners, possibly due to frustration, pick up any sentence from the passage

as the most possible answer. This gave rise to the variety of answers they offered. On the other hand, primary language learners gave answers consistent with a better understanding of the passage.

6.3.2 Responses to question (d.2)

An analysis of question (d.2) revealed the following:

- When an answer to a question is positioned towards the end of the passage, it evidently proves difficult for learners answering in a non-primary language to pick it up compared to primary language learners. The answer to question (d.2) was positioned non-strategically at the end of the passage and this made it difficult for non-primary language learners to mention it as a possible answer, even though it seemed the easiest of all the answers possible. However, primary language learners took advantage of the position of this answer and remembered it easily mainly due to its position in the passage because they held a bigger picture of the passage.
- The structuring of questions seems to be very important for non-primary language learners. If questions employed language other than that used in the passage, non-primary language learners were left at a loss. Non-primary language learners were able to make sense of the answers only when questions used similar phrases as the passage. On the other hand, use of antonyms and synonyms did not seem to distract primary language learners. In a question that used the word “bitten” when the passage used a combination of “pierce” and “saw into skin”, non-primary language learners showed a higher degree of misunderstanding compared to primary language learners, even when in the primary language synonyms were used as well.
- Non-primary language learners fail to display lateral thinking skills, a concept that has become the catch-phrase in OBE-talk. They seem to rely more on what may be called “direct” thinking skills, whereby questions asked should be deciphered from the text with the minimal amount of mental output. On the other hand, primary language learners were able to utilize higher mental functions, to the extent of employing phrases which were not used in the passage.

6.4 Chapter Summary

In this chapter, I discussed the results as observed in chapters 4 and 5. In the discussion of both quantitative and qualitative results, the major outcomes were that primary language learners outperform non-primary language learners in language-rich questions. Another important finding was that language discriminates against non-speakers incrementally. In the yes or no questions, the level of performance between the two groups was similar. As the questions became more difficult and requested of learners to apply their minds, the learners answering in a non-primary language were outperformed by those answering in a primary language. The level of discrimination is highest when learners are requested to use rich language in describing Natural Sciences contexts.

In **chapter 7**, I will make conclusions based on the results of the study. From the conclusions, I will suggest some recommendations and academic implications of the study.

**CHAPTER 7 -
REVIEW,
IMPLICATIONS
FOR
ASSESSMENT &
CONCLUSIONS**

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7.1 Introduction

In this chapter, I review the study with the intention of eliciting major themes from earlier deliberations. The review will be followed by an appraisal of the implications that the study has for assessment in Grade 9, using the CTA instrument. Specifically, the appraisal will focus on schools where learning takes place through a medium which is not the primary language of learners. The chapter ends with conclusions followed by recommendations based on the major findings.

The review is a synopsis of the study. It will mainly focus on the literature study, data collection methods as well as the quantitative and qualitative data analysis carried out in the study. Mention will also be made of the discussions made earlier in chapter 6.

Finally, conclusions, implications and recommendations will be suggested. The conclusions, implications and recommendations hinge on the major hypotheses of the study. The hypotheses/research questions of this study were:

- Does assessing learners in a non-primary language (L2) elicit similar types of responses from the same learners when the questions are posed in a primary language (L1)?
- Is there any significant difference in the performance of learners when they respond to questions set in L1 and L2? (Does the language of assessment predetermine whether or not learners will succeed academically?)
- Do learners display alternative frameworks of thought when they respond to questions set in their non-primary language? If this is so, can these alternative frameworks be explained in terms of linguistic factors?

7.2 Review

In the first chapter, the background to the study was given. In the background, mention was made of the much vaunted outcomes based education (OBE), which is the hallmark of the new education dispensation in South Africa. In addition, it was also indicated that funds are being directed to the Natural Sciences as witnessed by the massive investment in projects such as Dinaledi¹. The intention of redirecting funds in this way is to drive the economy through Science and Technology Education. For this reason, there is a persistent focus in the media and by the taxpayer on the performance of learners in the Sciences in particular. It is the intention of the current study to establish the performance of learners in the Natural Sciences, albeit from a different perspective. The study wishes to probe the performance of learners on CTA questions in Grade 9, which is the exit point for compulsory schooling in South Africa. A particular bias will be placed on how examination questions set in a non-primary language impact on learners' understanding of those questions.

The second chapter comprised a survey of the relevant literature in this field. The major influence of this study was research carried out under the auspices of TIMSS, an international survey whose aim is to benchmark the performance of learners in Mathematics and Science. In the TIMSS study, also referred to as TIMSS-R, it was established that generally, the South African cohort performed poorly as compared to their peers from other countries, including the majority of countries whose Human Development Index is lower than that of South Africa. In particular, the performance of the South African cohort was dismal in free-response questions compared to multiple-choice questions. Amongst the host of findings emanating from the above study were that non-primary language learners spend considerably longer time deciphering the written language than is the case with primary language learners. Also, the study established that there was no linear relationship between the amount of time spent on homework and success in Science (and Mathematics) amongst South African learners. Importantly, the

¹ Dinaledi schools is a project of the Department of Education (RSA) that is aimed at increasing access to Mathematics and Physical Science at higher grade in less privileged schools.

study established that in Provinces where the majority of learners participated in their primary language, performance in the TIMSS study was better, irrespective of socio-economic status.

Data collection methods were described in chapter 3. The data was collected using a Natural Sciences CTA instrument from grade 9. The original instrument, which was printed in English, was translated into isiXhosa with the assistance of language experts. It was then translated back into English to ensure consistency and maintenance of the original meaning. For the grade 9's, the CTA is the equivalent of the grade 12 matriculation examination, with the difference being in the weighting. The CTA counts only 25% towards the final mark whereas the matriculation examination counts 75% of the final mark.

In the data analysis procedure, two grade 9 classes were randomly chosen from amongst three classes. From the two classes, learners were randomly assigned to either the English or isiXhosa version of the test, creating a sampling ratio of 0,5. The instrument comprised a comprehension task with four questions, the last being broken into two, resulting in five questions altogether. Though it could not be ruled out, there was no need for prior knowledge in answering the comprehension test. The instrument related to testing Learning Outcome 2 in the Natural Sciences learning area.

Chapter 4 compared the performance of learners from a quantitative point of view. A comparison was also carried out in respect of gender. In the former comparisons, questions (a), (c) and (d1) were dichotomous questions whereas questions (b) and (d2) were open-ended questions. The comparisons were carried out using tables and histograms generated from SPSS. Chi-square values were also included to test the hypotheses of equal means. In order to exclude extraneous effects in the test of equal means, the interaction effect between gender, language and performance was also carried out using SPSS.

In chapter 5, a qualitative study was carried out. The intention was to establish learner interpretative styles and hence the line of answering of the questions as a result of the level of the interpretation. In order to ascertain whether language had any influence on learner answers, the manner in which their answers were packaged was compared for the two cohorts of learners. Only questions (b) and (d), which were open-ended, were included in the qualitative study. The software programme *Atlas.ti* was used to generate tables and data networks for the analyses. Data networks were employed in order to illustrate the interconnectedness of answers supplied by learners.

Discussion of the findings is found in chapter 6. Initially, results from the quantitative study were done followed by results from the qualitative study. From the quantitative study, it was observed that there was no margin of difference when primary and non-primary language learners responded to dichotomous questions from questions (a), (c) and (d1). However, it was discovered that when the question was reversed as in question (c), the margin of difference in the performance increased slightly, with primary language learners outperforming non-primary language learners. In questions (b) and (d) which were open-ended, there was a huge difference in the performance of the primary and non-primary language learners. Primary language learners outperformed non-primary language learners in both language enriched questions. In the comparison of the performance of the two sexes, no real difference was observed.

From the qualitative results, it was observed that language usage as expressed in the passage and questions asked seemed to be an impediment to mainly non-primary language learners. When a different word or synonym was employed in the question as in the passage, non-primary language learners found it difficult to locate the correct answer from the passage. Also, it was established that the location of answers in the passage proved a hindrance to mostly non-primary language learners when an answer was placed at the end of the comprehension test. Non-primary language learners also displayed lack of lateral thinking skills, as shown by reliance on words and phrases directly mentioned in the passage. The most probable reason is that they do not have access to a wider

vocabulary, which limits them in terms of employing words which are different from those used in the passage.

7.3 Implications for Assessment using Natural Science CTA

Grade 9 has been touted as the exit point for the GETC phase of schooling. This is despite resistance from both parents and learners who perceive this level of education as too mediocre. Parents still wish for their children to receive at least the matriculation certificate. However, should grade 9 be certificated like grade 12, studies of this nature might have far-reaching implications for the number of learners who will exit the schooling system after grade 9 and number of learners reaching grade 12 after 13 years of schooling.

Also importantly, what emanated from the study are insights into benchmarking, that is, knowledge in the Natural Sciences would be worth learning at this particular level. Following from this question, there is also the issue of how this knowledge should be assessed. Furthermore, the question arises; do CTAs help teachers in assessing whether learners' knowledge is aptly demonstrated? These questions emanate from the fact that all forms of assessment cannot operate in isolation of the language of teaching and learning. Currently, only English and Afrikaans are used as the languages of assessment by the Western Cape Education Department (WCED). Whilst there are tentative moves to introduce isiXhosa as a language of assessment, the big question of relevance remains. How relevant will it be to test learners in a language that is not the medium of instruction? If one assumes that the process of learning is a negotiated process between learners (receivers), educators (implementers) and curriculum planners (intenders), then can and should the language of assessment tasks be negotiated between educators and learners? Should learners be tested in an academic language whose meanings are not properly communicated, which could impact negatively on their grasping of concepts? Also from a political point of view, most parents might view the re-introduction of indigenous languages as a return to apartheid education which they vigorously contested.

If the *status quo* continues then a strong English component need to be introduced from primary schools so as capacitate learners in their language of learning, particularly those for whom English is not their LOLT. The majority of English teachers in township schools are themselves victims of a system of gutter education, thereby merely reinforcing the system by teaching in a language which they do not adequately understand. If things are to be turned around, there might be a need for introducing an intensive programme of retraining the old cadre and recruiting a new cadre of educators who are well conversant with the required medium of instruction.

Moreover, education practitioners need to be fully sensitized to the implications of assessing learners in a language whose idiom they do not fully understand.

Understandably, the manner in which teaching occurs is invariably influenced by the manner in which we assess. Educators should thus make an attempt to scaffold learners' meaning-making both in the classroom and in the examination session. For any assessment tool to remain valid and reliable, outcomes as demonstrated by learners should be as a result of a full understanding of the messages conveyed in the assessment instrument.

An important outcome of the study as it relates to assessment is in the ability of learners to recall intuitive cognitive faculties. One aspect of learning that is normally given a backseat is the ability of learners to use intuition in learning. (Sedibe, 2002; unpublished dissertation). By giving correct answers which are not organically linked to the passage, primary language learners show what an important part language plays in rekindling cognitive faculties which are not available to non-primary language speakers. Whilst it remains a controversial issue to rekindle debate on second language discourse, it remains crucial that this issue be firmly placed in the public domain. This study helps to contribute to this effort.

7.4 Conclusions

Conclusions emanating from the quantitative and qualitative aspects of the study can broadly be summarised as follows:

From the quantitative study,

- It was confirmed that when it comes to performance in dichotomous questions, primary and non-primary language learners perform equally well. In all of these questions, the hypothesis of equal means was confirmed. It was also observed that when the structure of dichotomous questions was altered in a way that they were more verbose and questions posed in indirect ways, differences, though slight, began to emerge in the performance of primary and non primary language learners.
- It was also revealed that when questions that demand learners to express answers in a rich format are posed, primary language learners tended to outperform non-primary language learners. The hypothesis of equal means was rejected for all questions of this type. Verbose questions seemed to present a strain on the learning of non-primary language learners.

The qualitative study revealed that:

- Non-primary language learners read questions with a greater degree of superficiality. On the other hand, primary language learners demonstrated a deeper understanding of the questions.
- When pictures were added to questions, they seemed to distract non-primary language learners as they seemed to focus more on the pictures than on the passage itself. On the contrary, primary language learners used pictures to their advantage.
- Non-primary language learners appear unable to make a connection between words used in the passage and those used in the questions. It was discovered that if a similar word is used in the question as in the passage, the common tendency amongst non-primary language learners was to cut and paste the similar word

- together with adjacent phrases from the passage as the answer. This they do without due regard for what the question requires.
- The use of synonyms in the questions was also discovered to be a distracter for mainly non-primary language learners. They seem more comfortable when questions use similar words as in the passage.
 - It was also discovered that questions whose answers were deep in the passage or included in the last paragraphs of the passage seemed intractable to non-primary language learners as compared to primary language learners.
 - Non-primary language learners do not display the capacity for lateral thinking skills. In all the questions demanding some form of detailed answers, they seemed to rely more on direct thinking skills. They were more comfortable when a direct question demanding a direct answer was asked.

Based on the conclusions emanating from the qualitative and quantitative analyses above, one might thus finally conclude that learners perform better when they respond to assessment tasks posed in their own primary language languages. One would imagine that performance could be even better if they were initially taught in their primary language. Non-primary language learners tend to perform even poorly when the assessment task demands detailed answers.

7.5 Recommendations

The issue of the language of learning and teaching remains one of the controversial issues in the education of particularly black children in South Africa. This has remained more so in the aftermath of the June 1976 student uprisings which challenged Afrikaans as the language of learning and teaching. What makes the issue even more ironic is that whilst these learners from what one might call township schools display symptoms which indicate that language indeed plays a role in their high failure rate, there is at the same time resistance from parents at the thought of learners learning in their primary indigenous languages. Teaching in the vernacular is viewed with suspicion by parents

who see it as another strategy aimed at ensuring that township learners remain receivers of an inferior education (NEPI, 1992).

A recommendation emanating from this study is that a strong English component needs to be introduced in primary schools. An observation by the author is that English educators in township schools are themselves struggling to speak and write English. Thus, in order to overhaul the system, only people who speak English with primary language command, without regard to ethnicity and accent, should be employed in a concerted national project that will see primary language learners reaching the junior phase of schooling with a perfect understanding of their language of learning. At the moment, the junior phase is the final phase in which learners study in their primary language. From the intermediate phase, learners use English as LOLT.

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APPENDIX

A

CTAs fail to give a true reflection of skills

THE GRADE 9 learners of 2001, and others thereafter who have completed the country's first CTA (Common Tasks for Assessment), still have to receive their General Education and Training Certificate (GET certificate).

The provincial education department has still not given any clarity on the issuing of the certificates.

The annual CTAs for the different learning areas include grammatical/spelling errors and many changes that could have been avoided.

Proof-reading of the assessments is a concern. It also puts the department in a bad light. The usage of language context and words is not very clear and concise for the learners, hence the misinterpretations by the learners when they complete the various tasks/activities.

This in turn leads to achieving "incorrect" outcomes for a particular learning area.

Too much reading matter, which must be done prior to the start of the activities, is given in some learning areas.

I also share in the common concern of educators that this assessment cannot really give the educator a clear indication of the academic achievement of the various outcomes and/or of the learners.

I view the CTAs as a ripple effect of the new Outcomes Based Education (OBE) system implemented in 1998, which only affected our learners in 2001 at high school level, and expect even more changes with the introduction of the FET phase (Further Education and Training) in January.

K van Oordt
'Proudly vannie Plain'

APPENDIX

B

Umsebenzi 3.2 Ingcongconi ethwala isifo semalariya (induna nemazi)

IZiphumo ezinguNdoqo

NS SO2 Ukubonisa ulwazi

Imiyalelo

- Lo msebenzi ufuna ukuba nisebenze nibabini
- Funda isicatshulwa esilandelayo

Eyinduna

Ingcongconi eyinduna iphila ngeencindi eziswiti kuphela, njengencindi yeentyatyambo. Phaya endle ezi ngcongconi ziphila ngokumfifitha iintyatyambo, ze ukuba ngaba zibekwe elebhu zizincede ngencindi yeziqhamo ezikhoyo apho. Eyona nto inika umdla ngengcongconi eyinduna kukuba umboko lo wayo awomelelanga kwaphela, ngoko ke awunakho ukugqobhozela emzimbeni womntu okanye wesilwanyana. Iimpondo ezi zayo zilushica, ukwenzela ukuba ibe nakho ukuyiva intsholo yeemazi ngexesha leendibano zesondo.

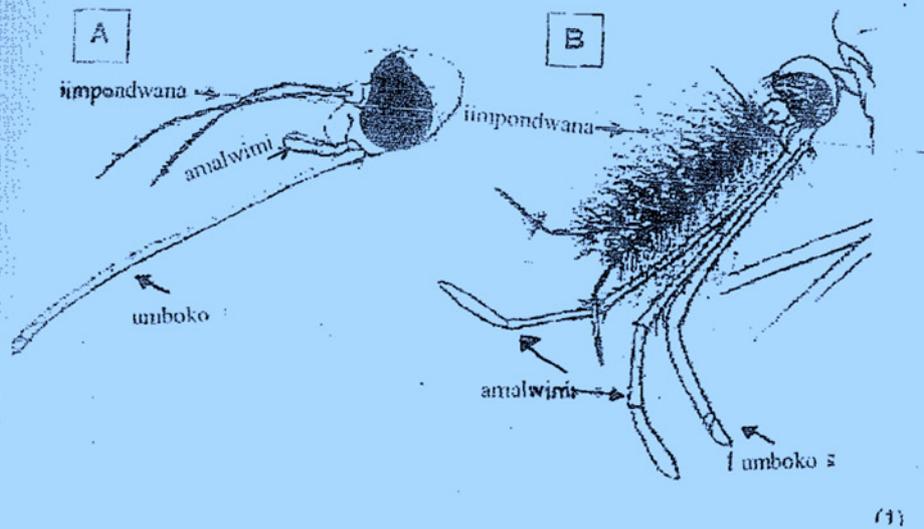
Picture UMPHANDA WENCINDI



Eyimazi

Ingcongconi eyimazi nayo iyaphila ngencindi, kodwa ke yona ikholwa ligazi khonukuze ibe nakho ukondla amaqanda ayo. Yiloo nto iyiyo kuphela emfifitha igazi lomntu. Umboko lo wayo womelele ngeyona ndlela ukuze ibe nakho ukugqobhozela emzimbeni womntu okanye wesilwanyana. Khumbula ukuba imalariya ayenziwa yingcongconi lebuqu, kuloko bubulembu nje obuncinane obulapha emzimbeni wayo obuncedisa ekumfifitheni igazi. Ingcongconi ayinakho ukugqithisela isimfifithi-gazi (obaa bulembu bungaphakathi emzimbeni wayo) emzimbeni wontu. Ngelixa imfifitha igazi lomntu (mhlawumbi linesifo esithile) isebenzisa isifunxi sibe sinye somboko wayo, ze igazi elo lenze loo ndlela yalo inye iya emzimbeni wengcongconi leyo. Elo gazi lifunxiweyo lifika lingene esiswini phaya, ze emva koko libuyele ngaphandle libubumdaka nje. Elo gazi alikwazi kuphinda libuyele embokweni wayo. Emva koko, isimfifithi gazi eso siye sizijikajike kaninzi apha ngaphakathi emzimbeni

wengcongconi, ze ethubeni sithi nca apha kumadlala amathe apha emzimbeni wayo, siwahlasela ngamandla. Ngaloo mathe ayo ke la ahambisa isifo semalariya ebantwini. Le nto iyabonisa nje ukuba abantu bona abanakho ukosulelana ngesi sifo, nto leyo ithetha ukuthi nabani na oye wosuleleka ulunywe yingcongconi eyimazi. Qwalasela le mifanekiso yeentloko zeengcongconi, wandule uphendule imibuzo elandelayo:



- Ingaba ingcongconi eku-A yinduna okanye yimazi
- Xhasa impendulo yakho eku-a ngesizathu sibe SINYE
- Ukuba ngaba uye walunywa yingcongconi, unganakho ukuxela ukuba ibiyinduna okanye imazi?
- Iza kube iyeyiphi kwezo zimbini le ikulumileyo? Utsho ngoba? Xhasa impendulo yakho eku-c ngesizathu sibe SINYE.