DEVELOPING ISINDEBELE SCIENTIFIC LANGUAGE REGISTER FOR NATURAL SCIENCES AND ITS CLASSROOM APPLICATIONS IN SIYABUSWA 2 CIRCUIT, SOUTH AFRICA

by

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DECLARATION

I, *Thulu Gladys Ntuli,* with student number 52923505 declare that this thesis entitled Developing isiNdebele scientific language register for Natural Sciences and its classroom applications in Siyabuswa 2 circuit, South Africa is my own work and that all the sources that I have used or quoted have been indicated and acknowledged by means of complete references.

I further declare that I submitted the thesis to originality checking software and that it falls within the accepted requirements for originality.

I further declare that I have not previously submitted this work, or part of it, for examination at Unisa for another qualification or at any other higher education institution.

SIGNATURE

11 April 2022
DATE

DEDICATION

This Thesis is dedicated to my late grandfather Daniel Dagvaar Kabini. Who once said in my sleep “Thatha isikhali sefundo uyokuncoba izizwe” which means use education to conquer the world. Ngiyathokoza Kabini May you continue to rest in peace, HLALITHWA!!!

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ABSTRACT

South Africa is a multilingual country with 11 official languages recognised by constitution. Out of the eleven official languages nine are Indigenous languages: isiNdebele; seTswana; sePedi; seSotho; tshiVenda; siSwati; isiZulu, xiTsonga and isiXhosa. English and Afrikaans are the only two that not only enjoys the status of being regarded as official languages but also regarded as the medium of instructions in South African schools. These two languages are also the only ones that have scientific language registers for Natural Sciences.

With South African government aiming to shift the status quo and introducing the use of indigenous languages as a medium of instructions in South African schools (Writer, 2020). This is a boundless opportunity for black African learners as they will also be learning content subjects in their mother tongue just like their counterparts. With this proposed enormous change, the big question is do we have adequate resources (such as scientific languages registers for Natural Sciences and other science subject) written in indigenous languages to advance this initiative? The answer is no. Hence, this was the purpose of this study to add a resource which will advance this initiative. Hence the isiNdebele scientific language register for Natural Sciences was developed, but only focusing on Matter and Material in the senior phase.

When isiNdebele scientific language register was developed, the researcher was made aware that there are limited scientific terms in isiNdebele. Hence, the researcher involved different stakeholder's such as the chairperson of isiNdebele Pan South African Language Board (PANSALB), authors of isiNdebele textbooks, isiNdebele teachers, isiNdebele Curriculum Implementors (CI)'s and senior citizens around her village. The role of these stakeholder's in the development of this register was to assist in developing scientific terms or finding equivalent terms where the researcher failed to do so. Their recommendations and contributions greatly assisted in the development of this register.

This is a qualitative interpretative case study. Which was guided by the following research questions: What are the opportunities and challenges in the development of the IsiNdebele Natural Sciences scientific register and its application? What are the stakeholder's perceptions about the use of isiNdebele as the language of learning and

teaching Natural Sciences? How did the developed isiNdebele Natural Sciences scientific language register shape learner's classroom interactions and discourses? Observations, semi-structured interviews and a diary were used to collect data from teachers, learners and parents. Purposive sampling was used to ensure that relevant data was collected. The collected data was analysed thematically. This study was informed by the social constructivism theory wherein amongst other aspects language is the most critical tool for communication and thought as it develops through social interaction. Language is further referred to as a medium through which meaningful learning takes place.

The findings of this study reveal that the launching of isiNdebele bilingual dictionary in 2006 attest to the steadiness of the development of this language, as it was the last one to launch a dictionary compared to other indigenous languages. Further to that the lack of scientific terms in this language negatively influences the stakeholder's perceptions on the use of this language to teach Natural Sciences. Moreover, this would have been a hindrance to the government's enormous transition which is giving African learners a chance to learn all the subjects in their mother tongue. However, the use of the developed isiNdebele scientific language register for Natural Sciences has shown that it can positively shape classroom interactions and discourses which is key for meaningful learning that leads to better performance in the subject. This study therefore, recommends the development of scientific language registers for Natural Sciences at school level focusing on other science topics beside Matter and Material.

Key words: *isiNdebele, Scientific language register, Natural Sciences, Challenges and Opportunities, Stakeholder's perceptions, Classroom interactions and discourses.*

INGCIKITSI (ISISWATI)

INingizimu Afrika live lelinetilwimi letinyenti kantsi letisemtsetfweni tingu-11 letihlonishwa ngokwentsetfo sisekelo. Kuleti letilishumi nanye letisishaga lolunye temdzabu, ngunati: isiNdebele; isiTswana; i-sePedi; isiSuthu; tshiVenda; isiSwati; isiZulu, xiTsonga nesiXhosa. Lulwinmi lwesiNgisi nesiBhunu ngutona todvwa letingajabulelwa ngoba titsatfwa njengetilimi letisemtsetfweni phindze tibuye titsatfwe njengetilimi tokufundzisa ezikolweni taseNingizimu Afrika. Leti letimbili ngitona kuphela etinerejista yolimi lwesayensi yeMvelo.

Njengoba hulumende waseNingizimu Afrika uhlosa kushintsha simo lesikhona kanye nokwetfulwa kusetshentiswa kwetilimi tomdzabu njengendlela yokufundzisa etikoleni taseNingizimu Afrika. Leli litfuba lelingenakulinganiswa kubafundzi labamnyama base-Afrika njengoba batobe bafunda tifundvo leticuketfwe ngelulwimi lwabo lwebele njengozakwabo. Ngalolu shintsho lolukhulu loluhlongotwayo, umbuto lomkhulu utsi ngabe sinetinsita letanele (njengemarejista etilimi tesayensi yeNatural Sciences naletinye tifundo tesayensi) letibhalwe ngetilimi temdzabu kute siqhubekisele phambili leluhlelo? Imphendvulo itsi cha. Ngako-ke, lena bekuyinhloso yolu cwaningo lokungeta tinsita tokuqhubekisela phambili loluhlelo. Ngako-ke irejista yelulwimi lwesayensi yesiNdebele yeSayensi yeteMvelo yasungulwa, kodvwa igcile kuphela kuMatter ne Material esigabeni lesikhulu.

Lapho irejista yelulwimi lwesayensi yesiNdebele yasungulwa. Umcwaningi watiswa kutsi lamagama esayensi alinganiselwe esiNdebeleni. Ngako-ke, umcwaningi ubandzakanya ngokubabamba-iqhaza abehlukene abafana nongusihlalo webhodi leSiNdebele Pan South African Language Board (PANSALB), lababhali betincwadzi tesiNdebele, bothishela besiNdebele, labeSiNdebele Curriculum Implementors (CI) kanye nabantfu labadzala endzaweni yangakubo. liqhaza lalaba lababambe-liqhaza ekutfutfukisweni kwaleli rejista kwaba ukusita ekutfutfukiseni lamagama esayensi noma ekutfoleni lamagama lafanayo lapho umcwaningi ehlulekile kwenta loko. Tincumo kanye nemagalelo abo kusite kakhulu ekutfutfukiseni kuleli rejista.

Lolu lucwaningo lwekucala lokutolika. Lobeholwa yimibuto yocwaningo lelilandzelako: Yimaphi ematfuba netintselelo ekutfutfukisweni kwerejista yesayensi yeSiNdebele

yeSayensi yeMvelo kanye nokusetshentiswa kwayo? Itsini imibono yababambe iqcaza ngokusetjentiswa kwesiNdebele njengolwimi lokufundza nokufundzisa iSayensi yeteMvelo? Irejista yetilwimi lwesayensi yesiNdebele yeSayensi yeMvelo etfutfukisiwe ikulolonge kanjani ukusebentelana netinkulumo tebafundi ekilasini? Kubhekwa, izingcoco letingahletiwe kanye nedayari kusetshentiswe ukucoca idatha kubothishela, labafundzi nebatali. Ukusampula lokuhlosiwe kwasetsjentiswa kute kuqinisekiswe kutsi idatha lefanele icociwe. Idatha ecociwe yahlaziywa ngokwetilimu. Lolucwaningo lwakhiwe yithiyori ye-social constructivism lapho phakatsi kwetinye tici telulwimi loluyitfuluti lelibaluleke kakhulu ekuxhumaneni nasekucabangeni njengoba lutfutfuka ngokuxhumana kwemiphakatsi. Lulwimi luphindze lubitwe ngokutsi yindlela yokufundza lokuphusile lokwentekayo.

Lemiphumela yalolucwaningo iveta kutsi kwetfulwa kwesichazamavi setilimi letimbili tesiNdebele nga-2006 kufakazela kusimama kokutfutfuka kwalolu limi njengoba kwaba ngesokugcina ukwetfulwa kwesichazamavi uma kucatsaniswa naletinye tilimi temdzabu. Ngalokunye kuntuleka kwemagama esayensi kulolulimi kuba nomtselela omubi emibonweni yabatsintsekayo ngokusetshentiswa kwalolu limi ukufundzisa iSayensi yeNdalo. Ngaphezu kwalokho, loku bekutoba sitsiyo ekugucukweni lolukhulu lwahulumende loluniketa bafundzi base-Afrika litfuba lokufundza tonke tifundo ngelulwimi lwabo lwemdzabu. Noko, kusetshentiswa kwerejista yelulwimi lwesayensi yesiNdebele etfutfukisiwe yeSayensi yeteMvelo kubonise kutsi kungabumba kahle kusebentelana ekilasini kanye netinkulumo letiyisihlutfulelo sokufundza lokuphusile lokuholela ekwenteni kancono esifundweni. Ngako-ke lolu cwaningo luncoma ukutfutfukiswa kwamarejista olimi esayensi Yesayensi Yetemvelo ezingeni lesikolwa kugcilwe kwetinye tihloko tesayensi ngaphandle kwe-Matter ne Material.

Emagama labalulekile *: isiNdebele, irejista yelulwimi lwesayensi, Isayensi Yemvelo, Izinselele Namatfuba, Imibono yababambe iqcaza, Kukusebentisana kwasekilasini kanye netinkulumo.*

MANWELEDZO (TSHIVENDA)

Afurika Tshipembe ndi shango line hu ambiwa nyambo dza fumi-nthihi dzine dzo themendelwa nga ndayotewa ya shango. Kha idzo nyambo dza fumi-nthihi, dza tahe ndi dza sialala/tshirema: Tshindevhele; Tshitswana; Tshibeli; Tshisuthu; Tshivenda; Tshiswati; Tshizulu, Tshitsonga na Tshithoza. Luambo lwa Tshiisimane na Tshivhuru ndi dzone nyambo dzo themendelwaho u vha dza vhudavhidzani na u funza zwikoloni zwa Afurika Tshipembe. Hedzi nyambo mbili, ndi dzone dzi dzothe dzo nwaliswaho kha luambo lwa u divha saintsi ya mupo.

Muvhuso wa Afurika Tshipembe wo pika u tshintsha na u disa u shumiswa ha nyambo dza sialala/tshirema sa dzone nyambo dza vhudavhidzani na u funza zwikoloni. Hezwi zwi do fha tshikhala tshihulu vhana vha vharema sa musi vha tshi dovha vha khou guda dzithero dzavho nga luambo lwavho lwa damuni. Musi ho dzinginyiwa iyi tshanduko khulu ngaurali, mbudziso khulwane ndi ya uri ri na zwishumiswa zwo linganelaho naa zwine zwo nwaliwa nga nyambo dza sialala/tshirema u bveledza uyu muhumbulo? Phindulo ndi hai. Hone-ha, iyi ngudo tshipikwa tshayo tshihulwane ndi u kuvhanganya zwishumiswa zwine zwa do bveledza u funza vhana nga nyambo dza damuni. Fhedzi-ha luambo lwa tshindevhele ndi lwone lwo bveledzwaho kha saintsi ya mupo, fhedzi kha fhungo na masila kha murole wa sumbe u swika kha wa tahe.

Musi saintsi ya Tshindevhele itshi bveledzwa. Rathoduluso o do wana uri maipfi a tshisaintsi ha ngo dala kha ulu luambo lwa Tshindevhele. Fhedzi-ha, rathoduluso o da ya a kwamana na vhathu vhoyaho nga u fhambana mudzulatshidulo wa isiNdebele Pan South African Language Board (PANSALB), vhanwali vha dzibugu dza Tshindevhele, vhadededzi vha Tshindevhele, vhabveledzi vha silabasi na vhadzulapo vhahulwane vha vhupo hune a dzula khaho. Mushumo muhulwane wa havho vhathu wo vha u thusedza u wana maipfi e mutodulusi a balelwa u a wana. Themendele na u dzhenelela havho zwo thusedza u bveledzisa regisitara ya tshisaintsi ya Tshindevhele.

Iyi ndi ngudo I si ya lisalambalo. Ine yo tutuwedzwa nga mbudziso dzi tevhelaho: Ndi zwifhio zwifhinga/zwikhala na zwikhakhisi kha u bveledza regisitara ya saintsi ya mupo ya Tshindivhele na khumbelo dza hone? Avha vhono kwamea kha u bveledza thero,

vhari mini nga ha u shumisiwa ha luambo lwa Tshindevhele kha u guda na u funza ngalwo saintsi ya mupo? Iyi regisitara ya luambo lwa tshisaintsi lwa Tshindevhele kha saintsi ya mupo I do tutuwedza hani vhudavhidzani nga ngomu kilasini? U lavhelesa, nyambedzano, na dayari zwo shumiswa u kuvhanganya mawanwa u bva kha vhadededzi, vhagudiswa na vhabebi. Mutodulusi oto nanga vhane vha tea u vha tshipida tsha mawanwa haya. Mawanwa o senguluswa uya nga thoho ya thoduluso. Heyi ngudo yo tutuwedzwa nga ngudo dza khonsitiravisithizimu ine i dzhiela ntha vhudavhidzani. Luambo lu laedza sa tshithu tsha vhukati hune u guda zwa bvelela hone.

Mawana o bvukulula uri kha vhutambo ha u tana thalusa maipfi ya Tshindevhele nga nwaha wa gidi-mbili rathi (2006) kha u bveledza ulu luambo, lwo vha lwone luambo lwa u fhedzisela u bveledza thalusa maipfi kha dzinwe nyambo dza tshirema. U Konda u wanala ha maipfi a tshisaintsi kha ulu luambo zwi na masiandoitwa kha vho no kwamea u dzudzanya uri luambo ulu lu kone u funziwa kha saintsi ya mupo. Hezwi, zwi do ita uri muvhuso u kone u dzhenelela kha uri vhana vha vharema vha kone u guda dzi thero kha nyambo dzavho dza damuni. Fhedzi-ha, u shumisa tshisaintsi tsha Tshindevhele u funza saintsi ya mupo zwo sumbedza uvha na vhudavhidzani havhudi zwine huvha na ngudo ya mathakheni kha thero. Iyi ngundo I khou themendela u bveledziwa ha dzi regisitara dza tshisaintsi tsha saintsi ya mupo zwikoloni kha dzinwe thoho dza saints inga u angaredza.

***Khii ya maipfi**: Tshindevhele, Regisitara ya tshisaintsi, Saintsi ya mupo, zwifhinga/zwikhala na zwikhakhisi, vhudavhidzani nga ngomu kilasini*

GLOSSARY OF ACRONYMS

CALP	Cognitive Academic Language Proficiency
CAPS	Curriculum and Assessment Policy Statements
CLAF	Classroom Language Analytical Framework
CONTRALESA	Congress of Traditional Leaders of South Africa
CPA	Comprehensive Peace Agreement
CPDF	Classroom Practice Diagnostic Framework
DoBE	Department of Basic Education
DHET	Department of Higher Education and Training
DoE	Department of Education
eNCA	eNews Channel Africa
IRF	Initiation, Response and Feedback
IRFRF	Initiation, Response, Feedback, Response and Feedback
ISS	International Space Station
LiEP	Language-in-Education Policy
LoLT	Language of Learning and Teaching
NAP	Ncleos de Aprendizaje Prioritario
OECD	Organization for Economic Cooperation and Development
PanSALB	Pan South African Language Board
PISA	Programme for International Student Assessment
SADTU	South African Democratic Teachers Union
SASA	South African School Act
SGB	School Governing Body
TIMSS	Trends in International Mathematics and Science Study
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNICEF	United Nations Children's Emergency Fund
US	United States

GLOSSARY OF TERMS

- **Authoritative discourse:** one way of communication from the teacher to the learners
- **Constructivism**: a theory that perceives languages as a tool for meaningful learning
- **Dialogic discourse:** engagements/interactions with the content is the priority
- **Interactive-authoritative approach**: the teacher only considers the correct answers
- **Interactive-dialogic approach:** all answers are welcome but only the scientifically correct ones are accepted
- **IsiNdebele:** South African official and indigenous language
- **Natural Sciences:** Science discipline that deals with the physical world, e.g. (Physics, Chemistry, Geography and Biology) taught at Senior Phase
- **Register:** a set of lexical items which are distinct and for specific topics and social situations
- **Scientific language resister for natural sciences in isiNdebele:** a register with set of natural science lexical items written in isiNdebele

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CHAPTER 1:
INTRODUCTION

This chapter introduces the research background and problem statement of the study. It further presents the research questions, aims, rationale, and delimitations of the study. It concludes with the structure of each chapter.

1.1 BACKGROUND

The Minister of Basic Education Angie Motshekga, when answering a parliamentary question and answer session on Wednesday, (March 9, 2022),noted that one of the biggest reasons why South African children have such poor reading comprehension skills is that they are essentially learning in a foreign language by being taught in English (Writer, 2022). Previously, on June 12, 2020, the Minister of Basic Education, Angie Motshekga, said that the Department of Basic Education will look at piloting new language changes to assist learners who do not study in their home-language (Writer, 2020). She further noted that as grade 12 learners are taught in English or Afrikaans and only assessed in those languages, they are investigating options to change it so that learners can have more options when writing examinations, wherein question papers will be presented in both the language of learning and teaching and mother-tongue, however she also highlighted that this option will be piloted either in Grade 10 or Grade 11. The implementation of this option for high-stake Grade 12 examinations will only be considered and solely dependent on the outcome of the pilot.

In a separate parliamentary question and answer, the basic education minister said that her department now intends to introduce African languages incrementally beyond the foundation phase (Grade R -Grade 3). She further alluded that this change follows a successful “Mother-tongue Based Bilingual Education pilot” run by the Eastern Cape Department of Education (Writer; 2020). As part of the pilot, she noted that 2 015 schools are using isiXhosa and Sesotho as Language of Learning and Teaching (LoLT) beyond the foundation phase, which is grade 4. This initiative was first observed in 72 schools in Cofimvaba in the Eastern Cape in 2012 and incrementally in the subsequent

grades, with the cohort in Grade 12 in 2020. She further added that learners in the pilot outperformed those not in the cohort in the June examinations on 17 out of 18 questions.

When delivering a speech at an event to celebrate indigenous languages at the University of Johannesburg's Soweto Campus on the 22nd of February 2019, the Honourable Chief Justice of the Constitutional Court of South Africa, Mogoeng Mogoeng, said the government should encourage people to study and make use of indigenous languages. He further encouraged South Africans to prioritise their mother-tongues to ensure that they do not lose their identity. Dr Somadoda Fikeni, who is a notable political commentator, also agreed with the Chief Justice as he asserted that when you lose your language, you lose your soul, you lose your history. The Honourable Minister of Sports, Arts and Culture, Mr Nathi Mthethwa, further agreed with Chief Justice Mogoeng and Dr Fikeni as he alluded that it is through the mastery of the mother language that the basic skills of reading, writing and numeracy are acquired (Sithole, 2020).

Similarly, President Cyril Ramaphosa, in his address on the 24th of September 2019 (Heritage Day), urged South Africans to embrace their indigenous languages and further encouraged the nation to learn their indigenous languages in order to understand their identities. He also noted that by the end of the year 2020, the Department of Basic Education (DBE) is aiming to ensure that all 23 000 South African public schools offer African languages where African learners can learn their home languages (2019).

Furthermore, Historian and Cultural Analyst Professor Pitika Ntuli, in his interview on eNews Channel Africa (eNCA) on the 23rd of October 2019 on the preservation of indigenous languages, indicated that in Africa, where learners are taught in their languages, their knowledge growth is faster, as being taught in an additional language can be a barrier to educational quality.

The South African Democratic Teachers' Union (SADTU) has also made a pledge to the DBE to consider teaching in indigenous languages as it will boost learners' performance in schools. While addressing the 2018 Education Indaba in Pretoria Mugwena Maluleka, argued that teachers need to be instructed to

teach learners using their mother-tongue, as doing so will yield better teachers and results (Jordaan, 2018). However, the question is, are there enough scientific registers in the various official indigenous languages for the different subjects? Thus, this study tries to develop one for Natural Sciences in isiNdebele.

The issue of language is not only a pertinent issue for the Department of Basic Education (DBE) but it goes beyond that as it affects many fraternities across the board, such as constitutional law, traditionalists, politicians and academics. From a policy perspective, the South African constitution recognises eleven official languages. Nine African languages: isiNdebele; Setswana; Sepedi; Sesotho; Tshivenda; siSwati; IsiZulu, Xitsonga and isiXhosa have been added to English and Afrikaans as official languages (Oyoo & Nkopodi, 2020; Probyn, 2006). Of the latter two official languages, English is regarded as the medium of instruction. In terms of The National Department of Education's Language-in-Education Policy (LiEP) (Department of Education, 1997), schools are at liberty to choose any of the 11 official languages as their preferred Language of Learning and Teaching (LoLT). The Revised National Curriculum Statement (DoBE, 2002) further clarified the LiEP by stipulating that all learners should study in their mother-tongue and at least one additional language as a subject in the first four years of schooling, which is from Grade R to Grade 3.

Further, the Curriculum and Assessment Policy Statements (CAPS) DBE (2012) have added to this. As a result, all South African learners have the right to be educated in the official language(s) of their choice in educational institutions, despite the fact that this is still a "paper-policy" in many South African schools.

Most schools tend to choose English as a LoLT, especially rural schools (Oyoo & Nkopodi, 2020; Probyn, 2006; Adler, 2001), even where most or all of the learners and teachers do not have English as their home language. The reason for such a decision is because Natural Sciences learning and teaching materials are offered in English and Afrikaans as well as all of the assessments, and none are offered in indigenous languages (Setati, Chitera & Essien, 2009).

Furthermore, Black Africans continue to believe that English is the language of learning and teaching, which is necessary for economic empowerment (de Wet,

2002). Researchers such as Adesemowo (2017) have made assertions that there are benefits to using an indigenous language to teach African learners because learners are able to relate to concepts in their own language and culture. This is further noted by traditionalist Zolani Mkiva, the general-secretary of the Congress of Traditional Leaders of South Africa (CONTRALESA), as he asserts that indigenous wisdom should be streamlined in the curriculum so that it may not be forgotten as decades pass (Ngobeni, 2020). He also believes that the intellect of people is better tested when they use their mother tongue because it takes longer for one to learn in a foreign language, and he noted that better results will be achieved across the board if learners are taught in their home languages.

Veronica McKay, Acting Vice-Principal of Teaching and Learning, Community Engagement, and Student Support (2020) at the University of South Africa (UNISA), agreed with Mkiva, implying that learning in one's mother tongue could help learners understand better and improve performance (Liam, 2020).

Observing that the use of indigenous languages is a prominent issue in South Africa and moves need to be made to redress it, the Universities of KwaZulu-Natal, University of Limpopo and University of Cape Town have started training teachers to use indigenous languages. The University of KwaZulu-Natal has classes in isiZulu, the University of Limpopo has classes in Sepedi, and the University of Cape Town has classes in isiXhosa. In her speech at Tsietsi Mashini’s memorial service on the 15th of January 2019, Professor Mamokgethi Phakeng indicated that in UCT they have made isiXhosa compulsory for students who study to become medical doctors.Based on the foregoing assertions, the researcher wishes to position her research in the development of an scientific language register for Natural Sciences in isiNdebele.However, some researchers, such as Desai (2003) and Phindane (2015), still argue that English should be maintained as a LoLT due to the lack of resources for other indigenous languages. Consequently, this study should add to the resources which he says are lacking.

1.2. PROBLEM STATEMENT

In South African schools, English or Afrikaans is considered as a medium of instruction. Hence, all subjects except home-languages are offered in English in most, if not all, rural schools, and in Afrikaans in some former model "C" schools. However, there are schools that offer content subjects in both English and Afrikaans, such as Natural Science, Mathematics, and other content subjects, and out of eleven South African official languages, only these two have scientific registers (Strevens, 1976). In rural schools, these content subjects are offered only in English, which could possibly disadvantage the learners as they are not fluent in the language (Webb, 2005). Unlike in former Model "C" schools, where some learners' home languages are English and Afrikaans, and therefore they learn scientific concepts in their mother tongue, this is not the case with the counterpart schools. None of the South African schools offer Natural Science in isiNdebele or have an scientific language register for Natural Sciences in IsiNdebele. Furthermore, the researcher, as a Natural Science teacher, has observed learners struggling with understanding science concepts. This could be because they are taught in a language that is alien to them. Hence, the researcher observes a dire need to conduct this study. Consequently, the study should explore the development of isiNdebele scientific language register for Natural Sciences and its classroom applications in Siyabuswa 2 circuit, South Africa.

1.3. RESEARCH QUESTIONS

1. What are the opportunities and challenges in the development of the scientific language register for Natural Sciences in isiNdebele and its application?
2. What are the stakeholder’s perceptions about the use of isiNdebele as the language of learning and teaching Natural Science?
3. How did the developed scientific language register for Natural Sciences in isiNdebele shape classroom interactions and discourses?

1.4. AIMS

- To explore the opportunities and challenges of developing the scientific language register for Natural Sciences in isiNdebele and its application

- To understand stakeholder's perceptions about the use of isiNdebele as the language of learning and teaching Natural Science

- To evaluate how the developed scientific language register for Natural Sciences in isiNdebele shape classroom interactions and discourses

1.5. RATIONALE

Observing the issue of indigenous languages being a prominent issue in South Africa, the department of education and other fraternities, the South African education system is moving towards making an enormous transition in schools. The eminent issue is introducing indigenous languages in schools and allowing every learner to learn in their mother-tongue, as it is argued by researchers, politicians, and academics that it will improve learners' results. However, there are still challenges that come with such a transition, as some researchers, such as Desai (2003) and Phindane (2015) , argue that the South African education system is not yet ready for such an enormous transition simply because there are still no teaching and learning materials written in indigenous languages that are readily available, which is true. Hence, this study is aimed at developing isiNdebele scientific language register for Natural Sciences. The results of this study should illustrate whether the assertions made by academics, politicians, and researchers are true or not, paving the way for further research into the use of indigenous languages and the impact they have on learners' performance in South African schools.

1.6. DELIMITATION OF THE STUDY

This study focused on three Natural Sciences teachers, one class of learners, and five parents from each of the three selected schools in the Siyabuswa 2 circuit to be participants in this study. For this study, this number was chosen to be able to manage the data collected. The literature review was restricted to that

which helped answer the research questions of this study. So, all of the literature that was not relevant to the study did not make it into the review of the literature that we did.

1.7. RESEARCH STRUCTURE

This section highlights the outline and organisation of all the chapters included in this study.

Chapter 1: Introduction- In this section, the following are presented: research background, problem of the study, research questions, rationale, aims and delimitation of the study, structure of the research, chapter summary, and conclusion.

Chapter 2: Literature review - This section focuses on scientific register, South African language policy, and isiNdebele as an official language and its development as an official language. Furthermore, it reviews literature on studies that have been conducted on issues of language use in science in the African, European, and other parts of the world.

Chapter 3: The Conceptual and Theoretical Framework -This section presents the conceptual and theoretical framework underpinning this study. Vygotskian theory of social constructivism is discussed.

Chapter 4: Methodology and Design - This section presents a detailed discussion of the methodology of this study. This includes research approach, research design, research paradigm, sampling, data collection tools, presentation and analysis, as well as reliability and validity. Purposive sampling was applied to select teachers, learners, and parents. Three tools for collecting data are discussed in detail, namely: interviews, observations, and diaries.

Chapter 5: Dynamics of the Scientific language register for Natural Sciences in isiNdebele - This section presents data discussion and findings from the Natural Sciences teachers, learners, and parents.

Chapter 6: Using the scientific language register for Natural Sciences in isiNdebele - This section presents data discussions and findings from theNatural Sciences teachers, learners, and parents.

Chapter 7: Summary of findings and recommendations. - This chapter presents the answers to the research questions, the contributions of the research, as well as recommendations for the study.

1.8. SUMMARY OF THE CHAPTER

This section provides data on the research background, followed by the problem of the study. The research questions, rationale, aims, and delimitation of the study. This section also indicates what the next six chapters comprise. In conclusion, the next chapter presents the literature review of this study.

CHAPTER 2:
LITERATURE REVIEW

2.1. INTRODUCTION

Even after 27 years of democracy have dawned in South Africa, there are still footprints left by apartheid in South African education. In terms of educational quality, everyone expected a lot of change and improvement in this era. Apartheid education did not only create racial segregation but further used language as a powerful tool to create more confusion and molest humanity in black child. The South African system is still faced with many challenges, such as a lack of resources, particularly in rural and some township schools, teachers with inadequate qualifications, and linguistic issues (Ntuli, 2019; Bantwini, 2010). This study is aimed at developing isiNdebele scientific language register for Natural Sciences and its classroom applications Siyabuswa 2 circuit, South Africa. The department of education is planning to introduce indigenous languages in schools wherein every learner will be given a fair chance to learn all the subjects in their mother tongue, (Zulu, 2019). The current status of this matter is the issue of teaching and learning resources written in indigenous languages which are not available (Magwa & Mutasa, 2017; Nel & Müller, 2010; Foley, 2008; Muwanga-Zake, 2009; Desai, 2003). This study is focusing on changing this status quo as it is aimed at adding the resources which will be accessible when the implementation time comes. Since isiNdebele is one of the eleven indigenous languages in South Africa, the focus is on developing isiNdebele scientific language register for Natural Sciences. It is therefore imperative to review literature around language issues in the South African context and abroad. This chapter will investigate factors such as South African language policy, the use of indigenous languages in schools, language policy versus the use of indigenous languages in higher education institutions, and lastly, the issue of language in science in the African, European, and other parts of the world.

2.2. SCIENTIFIC LANGUAGE REGISTER

A register is a set of lexical items which are distinct and used for specific topics and social situations. Lekganyane (2006); Agha (1998) and Sekhukhune (1988) defines a register as a different "type" of a language used in different social situations by different people. This means that a register has a lexical entry and it is used by different people in different social situations. Science, History, and Law, for example (Kabellow et al., 2019). No register is the same as the others. Kabellow et al. (2019) asserted that developing a scientific register entails using a set of lexical terms for specific people and situations. In this study, a scientific language register for Natural Sciences in isiNdebele will have isiNdebele lexical entries or terms that will be used by Natural Sciences teachers to teach the concepts of Natural Sciences.

2.3. THE DEVELOPMENT OF AFRIKAANS LANGUAGE

Afrikaans is one of the non-indigenous languages in South Africa. However, in the 1920s, it dominated different South African fraternities, such as courts of law, schools, parliaments, and higher education institutions. Afrikaans evolved from Dutch modifications developed at Africa's southern tip during the seventeenth and eighteenth centuries. Afrikaans evolved as a new language due to the daily contact with Dutch and other African languages (Uys,1983).

Initially, Afrikaans was the language of communication for slaves from Africa and Asia and the local Khoikhoin, who had to learn Dutch in order to communicate with their masters and with one another (Giliomee, 2003). During the twentieth century, Afrikaans expanded and made its way until the language could take its place alongside Dutch as a high-function language and, later, it could stand with equal status next to the other official language, English. The linguist Fritz Ponelis (1994) referred to this period as the "golden age of Standard Afrikaans." During its "golden age," Afrikaners pushed the limits by fighting for Afrikaans' status as being the medium of instruction in schools and being regarded as an official language in different fraternities. That initiative was declared null as Afrikaans then did not meet the necessary criteria, which was that it should have an orthography that was well developed and usable for official purposes.

In order to meet the requirements of an official language alongside English, language planning was essential: a generally polished standard, a system of spelling, and a vocabulary that could holds its own in all spheres of society, including scientific language were the prerequisites. During its development, many materials were also developed, such as the Bible and the Psalm and Hymn Book. During the development of Afrikaans, preference was given to the unique Afrikaans word or expression, but where Afrikaans terminologists, translators, and lexicographers were unable to come up with suitable Afrikaans words, they resorted to borrowing from Dutch (Uys, 1983).

Having satisfied the necessary criteria for becoming an official language, Afrikaans was recognised as an official language in 1925. Hence, it then took a stand and got the same status as English, which was then the only medium of instruction. The Afrikaners developed their language so it could also be used as an official language of parliaments and courts of law. Soon after it gained official status as an official language, it made its way into schools and was regarded as a medium of instruction in both rural and suburban areas. To date, Afrikaans is still regarded as a medium of instruction in some South African schools and is still an official language.

The development of the Afrikaans language clearly demonstrates that a language can be developed until it becomes a medium of instruction. IsiNdebele still has terms that are not known, particularly science terms. However, that does not mean they can not be developed. With patience and commitment, I personally believe that IsiNdebele can enjoy the status of not only being recognised as the official language but also as the medium of instruction, just like Afrikaans.

2.4. SOUTH AFRICAN LANGUAGE POLICY.

Prior to 1994, South African education was multilingual, with just two official languages, English and Afrikaans. South Africa's systems had to be altered when it attained independence in 1994 and became a democratic republic. These adjustments were made to correct historical inequalities (Tshotsho, 2013; Heugh, 2013; Heugh, 2008). The education system is one of the systems that has been

altered. Basic education amended and applied apartheid practises. The language policy was one of the amended policies intended to promote multilingualism in schools, and it remains in effect to this day. The South African Constitution (1996), Section 6 (3), endorsed this approach, which intended to emphasise the following:

i) The right of the person to choose the language or languages to study and utilise as a medium of teaching (medium of instruction).

ii) The right of a person to acquire the linguistic skills necessary for full participation in national, provincial, and local life in the language or languages of his or her choice.

iii) The need of promoting and developing South African languages that have historically been marginalised and neglected (ANC, 1994: 124-134).

The Department of Basic Education's (DBE, 2010) language policy and the South African Schools Act (SASA) (84 of 1996) mandate that parents and the school governing body (SGB) have the option of selecting the medium of instruction beyond grade 3. This remark, however, is still unfeasible in rural schools where English remains the hegemonic language (McKinney & Tyler, 2019; Mweli, 2018; Milligan & Tikly, 2016; Kamwangamalu, 2001).

Even while it is not explicitly specified in the policy that learners should be taught in English beyond Grade 3, this is precisely what happens in the South African educational system. Despite the power conferred on parents and the SGB by (DBE, 2010) and (SASA, 1996) to choose the school language policy and medium of instruction beyond the third grade, according to the 1996 Education Act and the Department of Education (2002), the South African education system is structured in such a way that learners in grades 1–3 learn content subjects in their mother tongue and English as a subject. Beyond the third grade, the Act (SASA) (84 of 1996) stipulates that parents and the school governing body (SGB) have the option of selecting the medium of instruction.

However, learners in rural schools will face a massive shift in which they will be taught all courses in English and their mother tongue as a topic owing to a

shortage of indigenous language resources (Abongdia, 2013). This changeover impacts only rural and a few township schools (McKinney & Tyler, 2019; Nomlomo, 2017; Milligan & Tikly, 2016; Heugh, 2013). From kindergarten through higher education, learners who speak English or Afrikaans get instruction in their native language (Heugh, 2013). (Tshotsho, 2013; Manyike, 2013; Heugh, 2003) stated that this massive transformation disadvantaged black learners from rural regions and certain township schools whose native languages are indigenous. Abongdia (2013) and Desai (2003) all mentioned that the primary reason for such a shift is a shortage of teaching and learning materials published in indigenous languages beyond the third grade, which is accurate. According to Muwanga-Zake (2009), the problem of a lack of teaching and learning materials in indigenous languages will exist in perpetuity since indigenous languages lack direct translations of ideas. Desai and Muwanga-Zake's therefore expose a gap in language policy, which Chigona et al. (2009) refers to as a policy "caught between purpose and performance" (p. 16) As a researcher, I strongly disagree with Muwanga-Zake's remarks believing that any language may be developed to the point where it becomes a medium of education.

The choice of medium of teaching in rural schools is influenced not just by the absence of resources written in indigenous languages, but also by the attitudes of black parents (Gudula, 2017; Ball, 2010; Kishindo, 2010). According to studies conducted by the United Nations Children's Emergency Fund (UNICEF, 2016; Tshotsho, 2013; Tembe & Norton, 2011 ; Kishindo, 2010), black parents continue to believe that educating their children in English will provide them with better employment opportunities because English is the market and prestige language. The importance these parents have on using indigenous languages to educate their children jeopardises the survival of these languages. These parents' attitudes on the use of indigenous languages as a medium of teaching are comparable to those of the apartheid regime, which devalued indigenous languages in favour of English and Afrikaans (Tshotsho, 2013; Heugh, 2013). Their behaviour may be described as "self-hatred." Chief Justice Mogoeng Mogoeng riticise this practise, stating that the concept that English would help one advance in the corporate world is incorrect, since the Chinese, Koreans, and many others are thriving in their own tongues. Black parents must learn from the

developed countries of Europe, such as Japan and China.Wherein they use their mother tongue as a medium of instruction. Learners in these countries are excelling beyond reasonable doubt because they learn in the language they understand better, which researchers such as Motloung et al. (2021) and Adesemowo (2017), political commentators such as Dr Somadoda Fikeni, traditionalists such as Zolani Mkiva, and Historian and Cultural Analyst Professor Pitika Ntuli affirm that learning in the mother tongue improves a learner's performance. This is even more true because of the research and technology that these countries have done.

The above discussions serve as a blueprint on how this research will bridge a gap, which is the unavailability of resources in indigenous languages, by adding a resource which will enable South African learners to learn Natural Sciences in their mother tongue, much like their counterparts, believing that this will improve their performance in the subject, as researchers and other fraternities noted.

2.5. ISINDEBELE AS AN OFFICIAL LANGUAGE AND ITS DEVELOPMENT

1985 has marked the history of the Ndebele nation in two ways. Firstly, IsiNdebele as a language was officially recognised by the KwaNdebele national state, which was then referred to as Umbuso wakwaNdebele (homeland) (Jiyane & Onyancha, 2010; Mnguni, 2004). Secondly, this language was officially introduced in schools that were under the KwaNdebele national state as a subject. This was a milepost for the Ndebele nation as this language has always been referred to as a marginalised language and was never featured in the school curriculum before 1985 (Mamabolo, 2009). Ndebele learners were forced to learn isiZulu and Northern Sotho (Sepedi) as their home languages. After this recognition, the KwaNdebele national state was forced to introduce the language irrespective of the lack of resources and teacher training in the language.

In 1994, when the Constitution of the Republic of South Africa, 1996 (Act 108 of 1996) Section 6 (1) was recognised, isiNdebele was already being learned in schools. Even though isiNdebele is recognised as an official language, we cannot ignore the fact that there is not much research and development that has

been done on this language (Skhosana, 2002). This is evidenced by the progress made so far. In comparison to other Nguni languages such as isiZulu and isiXhosa, which have long had dictionaries, isiNdebele only published its first bilingual dictionary in 2006, the IsiNdebele–English/English–IsiNdebele IsiHlathuli-mezwi (also known as the IsiNdebele–English IsiHlathuli-magama) is a bilingual and explanatory dictionary.

This language has two dialects: isiNdzunza (Southern Ndebele) and isiNala (Northern Ndebele) (Mnguni, 2004). In South Africa, the isiNdebele that is recognised as an official language is referred to as the Southern Ndebele, and most of its speakers are found in Mpumalanga KwaNdebele. Irrespective of the recognition of this indigenous language, we cannot do away with the fact that this language is dominated by borrowed or loaned lexical terms (Mahlangu, 2014). This language has more than 2.1 million terms, which are borrowed from Sepedi, English, and Afrikaans (Mahlangu, 2014; Skhosana, 2010). Skhosana and Mahlangu further noted this is so because there are no terms that have been derived that are suitable and that Ndebele-speaking people have been in contact with Afrikaans, English and Sepedi-speaking people. Mahlangu (2014) and Calteaux (1996) further reiterated that borrowed lexical words are used to bridge a communication gap. Below is a list of some of the borrowed lexical terms from Afrikaans and English, which are recognised as official terms in isiNdebele until the suitable ones are derived.

IsiNdebele	**English**	**Afrikaans**
umtjhini	**machine**	**masjien**
umbhede	**bed’**	**bed**
umsorodo	**type/kind/sort**	**soor**

The preceding phrases corroborate Mahlangu (2014) and Calteaux (1996) arguments that Ndebele vocabulary are derived from Afrikaans and English terminology, which were regarded as prestige languages under apartheid and continue to be so.

Not only are IsiNdebele terms borrowed; Afrikaans, a long-established and sophisticated language, continues to employ borrowed English words. This

demonstrates that a language is not static; rather, it is always evolving. The following is a list of Afrikaans terms that are derived from English.

English	Afrikaans
January	Januarie
February	Februarie
April	Aprel
May	Mei

The preceding topics provide a roadmap for the work that remains to be done to create isiNdebele's corpus and vocabulary. As a result, this project will add one of the corpora, which will be a scientific language register for Natural Sciences in isiNdebele. However, since language is dynamic and always evolving, it may continue to be dominated by borrowed/loaned lexical terms from prestige languages until appropriate words are generated (Mahlangu, 2014).

2.6. THE USE OF INDIGENOUS LANGUAGES IN SCHOOLS

Not just in South Africa, but also in other African nations, the use of indigenous languages in schools has been a long-debated subject. Numerous scholars, including Seti, Bornman, and Mosquera (2015) and Mutasa (2015) have undertaken studies in this field. The purpose of this study is to develop isiNdebele scientific language register for Natural Sciences. Although the Language in Education Policy (DoE, 1997) recognises 11 official languages in South Africa, namely English, Afrikaans, isiXhosa, isiZulu, isiNdebele, isiSwati, seswana, seSotho, sePedi, tshiVenda, and xiTsonga, and further promotes multilingualism in schools, we cannot ignore the fact that this policy pays scant attention to how to develop and promote the use of indigenous languages so that they will be used as a medium of instruction for African learners as is demanded by section 6(2) of the Constitution.

English and Afrikaans have a long and illustrious history in South African education. This is shown by its continued existence throughout the apartheid period (Mutasa, 2015 and Serfontein, 2013) English is still employed as a medium of teaching in South African schools and is seen as a language of power

associated with increased possibilities (Phindane, 2015). South Africa already has regulations in place that provide indigenous languages equal status, such as English and Afrikaans. On the other hand, these policies remain "Paper-Policies" because little or no action has been taken to execute them. This is because learners whose mother tongue is an indigenous language are still denied a fair opportunity to continue learning in their mother tongue beyond third grade (Lubbe, 2006; Malan, 2010). Essentially, nothing has changed in South African education under the new democratic system save the recognition of nine indigenous languages, which distinguishes South Africa from other African nations, although this recognition does not assist the indigenous languages' speakers (Nyamende, 2008).

African learners whose mother tongue is an indigenous language are still disadvantaged by these "Paper-Policies" as they are still subjected to learning in English as their medium of instruction after third grade (Sakati, 2016; Serfointein, 2013; Naudé, 2010) While their counterparts benefit from being thought in their native language, their performance is exceptional (Heugh,2012). Language is referred to by Sibanda and Baxen (2016) as a barrier to effective teaching and learning. Kwenda and Robinson (2010) further opines that language is one of the detrimental factors to a learner's poor performance. They affirm that the development and cognitive skills of learners befall more effectively in a language that the learner understands better, which provides a strong foundation for all learning. Smart and Marshall (2012) further asserts that using indigenous languages positively shapes learner's classroom interactions and discourses which yields to meaningful learning and better performance.

Cummins (1984) promotes for the use of the mother language in the classroom and throughout the learning process. He based his statements on his past knowledge of his native tongue. He asserts that cognitive abilities gained in the mother tongue of the first language may be transferred to comprehend ideas in the second language, which serves as the medium of education. Additionally, he said that this transformation would result in improved learner performance.

The above discussion demonstrates how critical it is for African learners to get teaching in their mother language. Until South African education adopts the

practise of incorporating indigenous languages as a medium of teaching, it will be unable to address poverty, low performance, and socioeconomic position in an expedient manner.

2.7. THE STATUS OF LANGUAGE OF LEARNING AND TEACHING (LOLT) IN SOUTH AFRICAN SCHOOLS

The issue of English as a medium of teaching has long been a source of contention in South Africa. Several research studies on the use of English as a medium of teaching in South African schools have been done by (McKinney & Tyler, 2019; Mweli, 2018; Milligan & Tikly, 2016) These studies indicate that language proficiency is another impediment to learners achieving well in Natural Sciences. Roy-Campbell (2019) and Motala (2013) contends that since English is the medium of teaching in South African schools, learners are compelled to be competent in the language. According to Pinxteren (2022) & Tan and Tan (2008), studying any topic in a second language, particularly the sciences, has been shown to be harder and more difficult for students whose native language is not English. According to Motloung et al. (2021) & Mokiwa and Msila (2013), language may not only be the optimal medium for teaching and learning about science, but it may also be a significant barrier.

Even though English is still the most commonly used language of learning and teaching in the majority of African countries, including Namibia, Nigeria, Tanzania, and Zimbabwe, despite the difficulties it poses for the vast majority of learners who speak an African indigenous language at home and encounter English as the primary language of learning and teaching in school (Rollnick, 1998). However, African parents continue to prefer that their children be educated in English because they see it as a language of learning and instruction, which is critical for economic empowerment and is capable of clearly explaining scientific ideas (de Wet, 2002; Rollnick, 1998). Setati (1998) also referred to the fact that parents in South Africa see English as the language of domination and socioeconomic advancement. As a result, they believe that utilising English as a language of learning and teaching is in their children's best interests. However, Chief Justice of the South African Constitutional Court,

Mogoeng Mogoeng, completely dispelled such a perception held by African parents on the 22nd of February 2019 during a speech at an event celebrating indigenous languages at the University of Johannesburg's Soweto Campus. He argued that the notion that English will help one advance in the corporate world is incorrect because the Chinese, Koreans, and many others are surviving using their native languages.

Researchers have shown a persistent challenge in teaching African learners with little English language competency using English as LoLT (Hugo & Lenyai, 2013; Sibanda & Baxen, 2016). This challenge is faced not just by learners, but also by African teachers. According to Kirui, Osman and Naisujaki (2017), African teachers fail to communicate in English and have trouble utilising English as a medium of education. As a result, such classrooms do not facilitate effective teaching and learning of Natural Sciences. Malekela (2003) said that "continuing to use English as a medium of teaching in school is torturous for the majority of Black youngsters" (p.111). Ferreira (2011) and Schaffer (2007) disputed against Malekela, arguing that although natural sciences are a language that must be learnt, they are also a language and substance in their own right. As a result, learners whose first language is not English often struggle with natural science since both the language and the topic are strange to them. Since a consequence, the learner will underperform, as Cummins et al. (2012) believe that learner and teacher expertise in the medium of instruction is a significant predictor of academic achievement.

English as a medium of instruction is also one of the variables that contribute to learners losing interest in science. Murphy and Beggs (2003) recognised this pattern, stating that although learners in elementary school may have an interest in science, their interest diminishes as they go to secondary and high school because of the LoLT utilised.

Setati (2002) and Rakgokong (1994) argued that using English exclusively as a LoLT in South African classrooms when English is not the first language of the learners has a detrimental impact on their ability to make sense and solve problems. Furthermore, they indicated that in classrooms where English is the

exclusive language of instruction, learners are unable to participate in procedural or conceptual discourse. As a result, these classrooms are incapable of effective teaching and learning.

2.8. BILINGUALISM IN EDUCATION

Bilingual education has been a long-debated subject in South Africa. Though UNESCO (2007) indicated that educating African learners in their home language would benefit them. This is not the case, however, in South African schools. South African schools use the African language up to Grade 3 and then move to English as the medium of teaching. According to Manyike (2013), a common method in black schools is to utilise the mother tongue from Grades 1 to 3 with English as an extra language, and then to shift to English as the LoLT for the whole primary curriculum in Grade 4. As a result of this transformation, bilingualism is practised in most South African classrooms, particularly in rural schools, where two languages are taught concurrently, namely one African language and one medium of instruction, English (Setati, 2002).

Researchers define bilingualism differently. Bilingualism, according to Butler (2012), is the capacity to communicate in more than one language. Butler's definition is identical to Grosjean's (2010), who defines bilingualism as the ability to communicate effectively in more than one language (or dialect). Bassetti and Cook (2011) & Baker (2011) extend the definition of bilingualism to include the acquisition of two languages in the same environment. Bilingualism will be defined in this research as the practise of speaking more than one language in a classroom context.

While researchers such as Reyes (2006) and Hoffman (1991) criticise the use of bilingualism on the grounds that it verifies only the learners' native languages, it does not guarantee that they will acquire reading and writing literacy abilities in both languages. Furthermore, they discovered that teaching two languages concurrently would render learner’s illiterate in one of them. This will jeopardise both languages' competency and must be avoided at all costs. Similarly, other researches emphasised the advantages of bilingualism in schools.

According to a research done by Bialystok et al. (2012), bilinguals outperform monolinguals (learners who are proficient in only one language). Bialystok et al. (2012) results were corroborated by a comparable research on the performance of monolinguals and bilinguals done by (Keshavarz & Astanch, 2004). Additionally, their findings demonstrate that bilinguals outperform monolinguals with less effort. Additionally, MacWhinney (2017) and Murphy (2003) stated that bilinguals have a greater probability of transferring information from one language to the other, making learning simpler for them than monolinguals. De Klerk (1995) stated that multilingual practise had advantages beyond overall performance. Additionally, De Klerk said that bilinguals have a larger capacity for thought than monolinguals, who constantly perceive things through a single lens (1995).

Cummins (2008) asserts that mastery of the first language, which is an African language, may be utilised or transferred to mastery or learning of the second language, which is English. Cummins continues by arguing that unless cognitive academic language proficiency (CALP) is established in the mother tongue, it is impossible to make an appropriate shift to the medium of instruction (1991). De Klerk (1995) takes a similar stance, claiming that learners must succeed in their native tongue before becoming fluent in the language of power, English.

One of the causes that sparked this investigation is bilingual schooling. Reflecting on previous research on the benefits of bilingualism in schools and the transition in terms of language usage in teaching and learning in schools, the researcher considered how developing the scientific language register for Natural Sciences in isiNdebele might yield positive results and boost learners' performance and mastery of natural science concepts, as they will be taught and learned in their mother tongue, which studies have demonstrated increases learners' performance and mastery of natural science concepts.

2.9. MULTILINGUALISM EDUCATION IN SOUTH AFRICAN SCHOOLS

The prominent issue of the use of indigenous languages in South African schools will draw attention to the multilingualism of education. Because different African languages will be introduced in schools, resulting in multilingual classrooms

wherein every learner will have the privilege of learning in their mother tongue (United Nations Educational, Scientific and Cultural Organization (UNESCO, 2007). Multilingualism is defined differently by different scholars. According to Skutnabb-Kangas (1988), multilingualism refers to the proficiency in more than one language. Skutnabb-Kangas' definition has to do with competency rather than the use of language itself. In the same vein, Edwards (1994); McArthur (1992) and Vildomec (1963) define multilingualism as the ability to use more than three languages. Their definition, in this case, clashes with Skutnabb-Kangas' as they indicate that the concern is about the number of languages rather than proficiency. Edwards (1994); McArthur (1992) and Vildomec (1963) definitions of multilingualism supported Webb's (1998) definition, which alluded to the fact that multilingualism can be defined into two aspects, which are: quantitatively as well as qualitatively. Webb refers to quantitative multilingualism as the number of languages one is proficient in, which should be three or more. He then refers to qualitative multilingualism as the attitude that people have towards the language. In this case, how much do they value that language and do they use it in which context, whether formal or informal?

Several studies have been done on multilingualism education, but researchers still have different views on this practice. Mabiletja (2008) asserted that multilingualism is viewed by researchers in two aspects: as a learning barrier that impedes teaching and learning in schools and as a resource for effective teaching and learning. Tokuhama-Espinosa (2003) considers multilingualism a learning barrier that impedes effective teaching and learning in the classroom. She argues that teaching learners more than two languages results in them being confused and failing to master any of the languages. In her argument, she further noted that teaching learners more than one language leads to compromising both languages. Tokuhama-Espinosa believes that learners need to be taught and be prominent in LoLT as it is the language of power (2003). However, Cummins (2008) differed with Tokuhama-Espinosa's arguments as he alluded that the mastery of ideas and skills of the first language, which is an African language, can be used or transferred to master or learn the concepts, ideas, and skills of the second language, which is English. Hence, this means that learners need to acquire skills in more than one language.

dissimilar to the opinion that multilingualism is a learning barrier and hinders effective teaching and learning. There are researchers who view multilingualism as a resource for effective teaching and learning. Research conducted by researchers such as Komorowska (2011); Garcia (2009) and MacKenzie (2009) proves that multilingualism could be a resource rather than a barrier to effective teaching. The above researchers argue that multilingualism improves learners' critical thinking skills as they view things from different perspectives. Furthermore, multilingualism helps learners to be proficient in many languages, which could work to their advantage in the outside world as they will be regarded as assets (De Klerk, 1995). This implies that they will have a good chance to take part in the multilingual world (Mabiletja, 2015).

The above assertions on multilingualism should make South African education feel a sense of emergency in implementing the use of indigenous languages in South African classrooms as it is the starting point of effective multilingual education.

2.10. CODE-SWITCHING

In the study conducted by Sibanda and Baxen (2016) & Hugo and Lenyai (2013), it was revealed that not only are African learners not proficient in English, but the struggle with LoLT goes beyond that, as African teachers are not proficient as well. Hence, that leads to their code-switching when teaching in classrooms. Code-switching is defined differently by different researchers. Baker (1993) defines code-switching as the practise where "an individual (more or less deliberately) alternates between two or more languages” (p.76-77). Setati (2005) noted that code-switching can be between languages, registers, and discourses. De Klerk (2006:602) defines code-switching as "the use of more than one variety or language in the same conversation". Maluleke (2019) further defines code-switching as a communicative practise where the speaker skilfully switches from one language to another without disturbing the flow of ideas. From all the researcher’s definitions, there is a common denominator, which is a switch from one language to the other while keeping the same meaning. In this study, code-

switching is defined as a switch from one language to the other without changing the meaning.

Code-switching in this context will be from English to an indigenous language. Such a practise is discouraged by many researchers, such as Msila (2013), who alluded to the fact that code-switching could be a disadvantage to learners and further compromise the quality of science education. Rollnick (1998) opines code-switching as a possible compromise of the medium of instruction which should be discouraged. Sanders et al. (1993) further argues that code-switching may result in incorrect concept formation during formal learning and may further cause misconceptions as some concepts in English may have a different meaning in an indigenous language. In the same vein, Probyn (2009) asserted that using indigenous languages in the classroom has an undesirable effect as it disrupts learners from acquiring proficiency in English, which is the LoLT, hence it should be avoided at all cost.

Even though code-switching is criticised by many researchers, there are those who are in support of it. In the study conducted by Yusob, Nassir and Nor (2018), they indicated that teachers practise code-switching in delivering lessons, and they consider this practise very beneficial to both them and learners. Uys (2010) noted that teachers code-switched for various reasons, which are: to explain the concepts better, especially when their English proficiency fails; to help learners understand the concepts better; and to create an environment where teaching and learning occur at ease. Abad (2010) alluded that code-switching can be used as a tool for learners' active participation as it boosts their confidence to participate at ease during teaching and learning. Muoz and Mora (2006) further agreed with Abad as they further alluded that code-switching permits learners to be active participants as they enjoy the lesson without worrying much about the language use.

Code-switching can be used as a tool to promote classroom interactions and discourse (Sibanda & Baxen, 2016). Learners are observed interacting much better with each other and with the teacher when using indigenous languages. Furthermore, high participation is also observed because learners are only

concerned about stating their views on the concepts rather than worrying about the use of language, which is English. This practise does not only promote classroom interactions and discourse but also the learner's performance as well. In the study conducted by Setati (1998), she alluded that code-switching serves a sociolinguistic purpose where learners could switch from their indigenous language to English to assist in the betterment of their performance. Krause and Prinsloo (2016) agreed with Setati (2005) as they further noted that bilingual classroom teachers always practise code-switching to help learners improve their performance. This is because concepts can be easily understood by learners if the teachers code-switch, especially when they are not proficient in English.

If code-switching could benefit learners this much, one could argue about how much being taught in their mother tongue could possibly do to their performance. For example, if IsiNdebele-speaking learners are being taught natural sciences in their mother tongue, there are greater chances that they will perform at their best. Hence, this shows a dire need to introduce indeginous langauges in schools.

2.11. PARENTS PERCEPTION ON THE USE OF INDIGENOUS LANGUAGES AS LOLT

According to Roy-Campbell (2019) and Phiri et al. (2013), a lack of indigenous language teacher training and a dearth of indigenous language teaching and learning materials make the adoption of indigenous languages as LoLT in South African schools almost difficult. These difficulties are exacerbated by parents' aversion to the use of indigenous languages as LoLT. They prefer that their children be taught in English rather than indigenous languages (Jankie et al., 2010). These parents prefer English because they feel it is the language of power and is necessary for economic emancipation (de Wet, 2002). Additionally, they see English as more than a language; they view it as a resource that may help their children achieve greater chances, since being proficient in English is viewed as a sign of superiority (Taylor & Vinjevold, 1999). English proficiency is highly

prized by black African parents, who see it as a prerequisite for success in the corporate sector (Oyoo, 2017; Tembe & Norton 2011). In comparison, Chief Justice of the South African Constitutional Court, Mogoeng Mogoeng, completely dispelled such a perception held by African parents on the 22nd of February 2019 during a speech at an event celebrating indigenous languages at the University of Johannesburg's Soweto Campus. He argued that the notion that English will help one advance in the corporate world is incorrect because the Chinese, Koreans, and many others are surviving using their indigenous languages.

Even though many black African parents see the use of indigenous languages as LoLT and believe that it jeopardises their children's capacity to communicate fluently in English (Jankie et al., 2010 & Webb, 2005). However, their thesis is in direct opposition to Cummins'. Cummins (2001) asserts that education in an indigenous language may aid in the development of abilities not just in the mother tongue but also in other languages. Additionally, he suggested that abilities acquired in the first language, in this example, the mother tongue, may be transferred to the second language, English. Additionally, black African parents have a negative attitude about the use of indigenous languages, believing that LoLT black devalues local languages. Their actions are undermining indigenous African languages and elevating the dominant language at the detriment of indigenous languages (Bloch, 2009). Cummins (2001) said that favouring the dominant language may have negative consequences since it may act as a barrier between children and their identity by preventing them from communicating in their mother tongue while proficient in English, which is a foreign language to them.

While black African parents may discourage the use of indigenous languages, they remain the foundation for mastery of other languages (Guvercin, 2011). As such, it should be prioritised and implemented in South African schools, as the president said during his Heritage Day address on September 24th, 2019. It should not be only a written policy with no application. This may alter parents' unfavourable opinions and provide the school with a new perspective on the usage of indigenous languages.

2.12. LANGUAGE POLICIES VS THE USE OF INDIGENOUS LANGUAGES IN HIGHER EDUCATION INSTITUTION

According to Section 29 (2) of the South African Constitution, everyone has the right to an education in the official language or languages of their choice at public educational institutions if this is practically possible. This clause states that all educational institutions, including higher institutes of learning, are required to comply. Each higher education institution has its own language policy, which is based on the 1997 language policy. Given that this study's construction of the register will concentrate on the senior phase, it is critical to analyse the Department of Higher Education and Training's (DHET) language rules, as they will serve as a connection to the Department of Basic Education (DBE). This register cannot operate without a connection between DBE and DHET. This would ensure that African learners, like their counterparts, have an equal opportunity to study in their mother language from kindergarten through higher education.

Language policy of University of South Africa (Unisa)

The language policy adopted by Unisa (2010) aims to foster multilingualism and linguistic variety inside the university. This policy establishes guidelines for the community's use of language in all domains, including internal and external communication and instruction. Additionally, Unisa (2010) specifies that its language implementation will be decided by the availability of resources and most language speakers. South African universities are similarly committed to promoting multilingualism; however, it may take time (Mutasa, 2015). Because English remains the primary language of communication and teaching at this institution (2016). However, Unisa language policy is bound to change as the Constituational Court has given this institution until start of 2023 to revise its language policy after finding out about University’s decision to scrap Afrikaans as a medium of instruction which was in violation of the constitution.

University of Western Cape language policy

The University of the Western Cape's language policy aims to encourage multilingualism, since the institution itself is multilingual. According to the policy, the availability of resources continues to be a decisive element in achieving its goals. Form assessments are conducted in three languages at this varsity: English, Afrikaans, and isiXhosa when possible (University of the Western Cape, 2003: 1). English is still used for teaching and learning. This is because they are designed to improve student' conversational English abilities and academic literacy (University of the Western Cape, 2003: 2). If English retains this position, it is apparent that it will continue to be the dominant language at this university for some time.

University of Witwatersrand

The University of the Witwatersrand's language policy (2003) supports linguistic diversity. The institution views language variety as a valuable resource that must be safeguarded. On the other hand, the diversity of languages spoken in Johannesburg acts as a hindrance to this university's language policy. This plurality complicates the task of this institution in terms of determining which languages to grow and promote. However, two indigenous languages are widely spoken: isiZulu and seSotho. English will continue to be the medium of teaching at this university until the two indigenous languages are established to replace it (University of Witwatersrand, 2003).

University of the Free State

The University of the Free State's language policy recognises South Africa's linguistic variety in accordance with Section 29(2) of the South African Constitution. This university recognises multilingualism and strives to promote it via the use of the two primary mediums of teaching, English and Afrikaans, as well as SeSotho, the province's indigenous language. SeSotho will stay on the fringe of this institution till it is established (University of the Free State, 2003). However, the language policy of this institution has been revised after the

judgement handed down by the Constituional Court on the 29th of December 2017, where-in the court endorsed the decision of the University to change its language policy from a dual medium of instruction (English and Afrikkans) to English as the primary medium of instruction.

University of Pretoria

The University of Pretoria recognises the constitutional guarantee of linguistic variety and affirms that everyone has the right to an education in their official language or languages of choice at public educational institutions provided such education is practically possible. However, this university continues to teach both English and Afrikaans. This university is not interested in the development and use of indigenous languages as a medium of education. As there is no overt plan/framework for the development and promotion of indigenous languages, their usage will stay on the periphery of this institution (Mutasa, 2015).

University of KwaZulu-Natal

The University of KwaZulu-Natal acknowledges the linguistic variety entrenched in South Africa's constitution and the University of KwaZulu-mission Natal's statement (2003). Additionally, this institution encourages multilingualism by creating and promoting isiZulu as the province's indigenous language. This institution has already begun executing its aim to establish isiZulu, since it currently offers programmes in the language. However, owing to a lack of resources in indigenous languages, English continues to be the medium of teaching at this university.

Stellenbosch University

Stellenbosch University's (2002) language policy promotes linguistic variety and multilingualism via the growth of Afrikaans as an academic language. This university communicates in English since it is a prestige language. This university recognises IsiXhosa as an indigenous language spoken in this area. Additionally, the institution is committed to the growth and promotion of IsiXhosa as an

academic language. However, Afrikaans continues to be the dominant language at this university.

University of North West

North West University (2006) is devoted to supporting multilingualism in this province by creating and promoting indigenous languages. English and Afrikaans continue to be the varsity's primary languages. On the other hand, different languages are employed to facilitate learning on other campuses via single-medium instruction, parallel and double-medium instruction, and interpretation.

Rhodes university

The language policy of Rhodes University (2005) specifies English as the medium of teaching. While this university recognises linguistic variety and is committed to developing and promoting isiXhosa as an indigenous language, it recognises three official languages: English, Afrikaans, and isiXhosa. It is also committed to promoting and teaching sign language.

University of Cape town

The University of Cape Town values linguistic variety and is committed to encouraging multilingualism via the promotion of indigenous languages. English is the primary medium of teaching at this university. English proficiency is required for admission to this university. Multilingualism has been promoted at this university, as Vice Professor Mamokgethi Phakeng said during her statement at Tsietsi Mashini's funeral ceremony on the 15th of January 2019 that UCT has made IsiXhosa mandatory for students studying to become medical physicians. Furthermore, in her opening address during the Africa Month panel discussion, on the 26th of May 2022. She mentioned that University of Cape Town will introduce Swahili as elective language from the year 2023.

Tshwane University of technology

The Tshwane University of Technology (2005) recognises the use of English as an instructional medium. Additionally, it recognises multilingualism by promoting and nurturing indigenous languages. This university is devoted to promote Setswana as the region's most widely spoken language. However, there is no clear structure or strategy for how this will be accomplished.

From the assessments of several institutions' language policies, it is obvious that each institution is eager to adopt innovative languages as a medium of teaching. Their execution, on the other hand, is gloomy. This is because resources continue to be a barrier to making indigenous languages the primary medium of education. This identifies a research deficit and sets the path for future study on indigenous language registers in higher education institutions.

2.13. ISSUE OF LANGUAGE USE IN SCIENCE IN AFRICAN, EUROPEAN CONTEXT AND OTHER PARTS OF THE WORLD.

Language is a global crisis, not just a South African one. The researcher determined that it was necessary to investigate language concerns in other African nations in order to reflect on the difficulties they face in using English and Indigenous languages as mediums of instruction and how their usage affects learners' academic performance in science.

Ethiopia

Ethiopia is one of the African nations that suffered under British colonial authority and was educated in English (Heugh, 2008). Prior to 1994, Ethiopia used an indigenous language, Amharic, as a lingua franca due to the country's over 20 indigenous languages. As a result, Amharic was utilised as the country's working language even though it was not recognised as a national language (Taye et al., 2019). Following 1994, when its language policy was reviewed, it adopted a fresh stance. When they reviewed the language policy, they prioritised the use of Amharic as the medium of teaching. While UNESCO (2003) recommended that education be conducted in the learner's mother tongue, Ethiopian stakeholder groups and parents argued that Amharic should be phased out of Ethiopian

schools and replaced with English as the medium of instruction because English is a globally recognised language of competence and power (Victoria, 2010). The mother language has a critical role in the creation of culture, identity, and knowledge acquisition (Singh et al., 2012).

The discussion over whether to eliminate Amharic as a medium of instruction in Ethiopian schools has become relevant because Amharic was a highly developed language in comparison to other indigenous languages at the time, and it was recognised by the constitution as the country's working language for the state (Taye et al., 2019). As a result, it had to be retained as a medium of teaching but only in the lower years, from kindergarten to grade six or eight, depending on regional circumstances. Then, from secondary schools through higher education, a complete transfer to English as the language of teaching occurs (Government of Ethiopia, 1994). (MoE, 2002).

Ethiopia implemented an educational strategy similar to that of South Africa, in which the mother tongue is utilised as the medium of teaching in the lower years and subsequently English is employed as the language of instruction in grades 6 and 7, notwithstanding the difficulties it poses for African black learners. According to Heugh et al. (2017) most Ethiopian learners are unable to write or read both English and Amharic. This is due to their early transfer to English before their original language is fully established. Additionally, it was determined that English competence among learners and teachers is severely poor in schools. Additionally, they highlighted that even at higher education institutions, most graduates' lack fundamental English communication abilities, and the quality of English usage among the learner population is low. Since a result, it becomes difficult for teacherss to teach and for learners to absorb the subject being taught, as both teachers and learners are unable to comprehend the topic. Ethiopian schools' use of English as a medium of teaching has resulted in learners doing poorly in disciplines like as mathematics and science. This is corroborated by Getahun and Jibat's (2018) study, which discovered that using English to educate Ethiopian learners results in increased irritation for both teachers and learnerts. Owu-Ewie (2006) bolstered Getahun and Jibat's thesis by stating that utilising English as a medium of instruction to educate African

black learners is more akin to perpetrating "linguistic genocide" in education by exposing them to a language they are not skilled in and is alien to them. Additionally, these researchers indicated that these frustrations stem from the fact that both teachers and learners lack the necessary English language skills to succeed because the language is foreign to them, making effective teaching and learning difficult, if not impossible, resulting in poor performance.

South Sudan

English has surpassed French as the most widely spoken language in most African nations. It has also established a stranglehold on the South Sudanese educational system. South Sudan is an African country that was subjugated by Arab colonial overlords and achieved independence only in 2011. South Sudan possessed more than 40 languages at the time, but only Arabic was utilised as a medium of teaching and was recognised as an official language, while English was referred to by the United Nations Children's Fund as a foreign language, not a second language (UNICEF, 2016). After South Sudan obtained independence, they revised language regulations and instituted English as a medium of teaching, in part to distinguish themselves from Arabic, which was perceived as the oppressive language.

While South Sudan adopted English as the medium of instruction, it created an exemption to reconsider teaching in the home language, notably in pre-schools and lower classes between grades 1 and 3, according to the Ministry of General Education and Instruction (MoGEI, policy paper 2016). This decision to commence the adoption of mother language education in lower elementary schools was bolstered by the 2005 Comprehensive Peace Agreement (CPA) and the country's Transitional Constitution, both of which encourage this method (Yoasa, 2012).

The transition from Arabic to English as the language of teaching in South Sudan caused several obstacles for South Sudanese education (Abdel et al., 2012). This obstacle took a toll on South Sudanese who had relocated to Sudan and utilised Arabic as their native language for more than 40 years and were forced

to convert to English as their new medium of instruction (Breidlid, 2010). According to a 2012 World Bank assessment, South Sudan's level of English competence, especially in mathematics and sciences, is very poor, making teaching and learning extremely challenging. Therefore, the learner's performance is very poor. This might be because these residents continue to favour Arabic as their primary language of instruction. This very weak English proficiency is one of the reasons behind the Ministry of Education's intentions to employ indigenous languages in early elementary schools rather than English.

Apart from Arabic being viewed as an oppressive language, Mohammed Nur (2014) cites globalisation as a primary factor for English being utilised as a medium of teaching in South Sudan. South Sudan felt the need to participate in globalisation as well, since English has become the international language of the globe and a source of power. There was no alternative to adjust to English as the medium of education. As a result, English became firmly ingrained and eventually supplanted Spanish as the primary language of teaching in this nation. Despite the difficulties that English as a medium of instruction poses in South Sudanese education, such as learners' lower academic achievements, particularly in Science and Mathematics, as a result of the language used, the status quo persists, that is, English continues to be used as a medium of instruction and is considered the country's official language.

Egypt

Egypt is dominated by Arabs, who speak Arabic as their native language. According to the United Nations Human Development Index, Egypt's fast-growing economy has compelled the government to abandon its prioritisation of English as a foreign language, restructure its education system, and make English the medium of teaching in Egyptian schools (UNHDI, 2008). However, McIlwraith and Fortune (2016) discovered that several individuals were opposed to the new policy of English as the medium of teaching, which they feared would have a detrimental effect on Arab culture. Despite their reservations and fears, English was deemed a mandatory subject in certain schools and a medium of teaching in others.

Egypt's education system is divided into two fraternities, public and private. The public sector operates educational institutions such as Arabic public schools. These schools follow the government-mandated national curriculum but teach in the Arabic language. English is considered a foreign language and is taught in Grade 4 as a core subject. Arabic schools are the most prevalent in the nation, and they are mostly attended by lower-income families (El-Fiki, 2012). Then there are private schools, such as private national language schools, sometimes known as "national" or "language" schools. These schools offer most of the government curriculum in English beginning in Grade 3. These schools are well-resourced and pricey, which is why they are attended by upper-class families (El-Fiki, 2012).

While English is required in both sectors, the standing of English in both educational sectors is not the same. Public schools use an indigenous language, Arabic, as their medium of instruction, with disciplines like as science and mathematics taught and studied in the home tongue. Education in public schools is substandard owing to a lack of suitable teaching and learning resources (El-Fiki, 2012). In contrast to private sector schools, which are distinguished by using suitable teaching and learning materials, up-to-date technology, and conducive learning environments, learners in public schools are taught by highly qualified English teachers using English as the language of instruction (El-Fiki, 2012).

Notwithstanding of the Egyptian educational system, learners at public schools consistently outperform their peers in private schools. This is because learners in public schools benefit from learning fundamental courses in their native language, which they grasp and master more easily, despite having low or no resources. Snow et al. (2004) make a similar argument, arguing that even if private school sectors have ample resources and competent teachers, their academic achievement is subpar owing to the language utilised as a medium of teaching. Snow et al. (2004) thesis paints a vivid picture of the influence that medium of instruction has on learners' performance in the educational system (El-Fiki, 2012).

China

English has been ingrained in the Chinese educational system as a result of globalisation for obvious reasons, such as its recognition as an international language and its importance in the global globe (O'Sullivan, 2018). Additionally, Pennycock (2001) said that "With English occupying such a prominent role in so many educational systems worldwide, it has developed into one of the most potent tools for inclusion or exclusion from further study, work, or social positions." While other nations have adopted English as the primary medium of teaching, China has taken a different stance compared to South Africa and other African countries, by choosing and retaining one of thirteen its indigenous language as the primary medium of instruction. Mandarin is the primary language of teaching in China's schools. All topics are taught and learned in the learner's native tongue, apart from foreign languages such as English, which is regarded a mandatory subject (Qi & Lemmer, 2013). To prepare this nation for globalisation, the Chinese Ministry of Education (MOE, 2001) mandated English as a compulsory subject in secondary and higher education. It was eventually implemented in lower schools, beginning with elementary (Qi, 2016).
Even though English is considered a required subject in Chinese schools, its formal standing remains in doubt since it receives less contact hours in schools than the other core courses. Second, English is not recognised as a legal language in China (Gil & Adamson, 2011). English is one of the three basic courses in the national curriculum (2011), together with Chinese and mathematics, and is required to be taught in elementary schools (Qi, 2016). That, however, is contingent upon the school's resource availability, since some are presented in English in primary one and two, while others in primary three (Qi, 2016).

English instruction in Chinese schools has had no adverse effect on indigenous language teaching and learning. This is because China exemplifies how teaching and learning in indigenous languages can bring out the best in learnrs. Even though China is one of the world's top nations, ranking second only to the United States of America (USA) in terms of technical innovation and proficiency in science, technology, and mathematics, its learners continue to study in their

indigenous language (Coughlin, 2019). To name a few In 2017, China developed Xiaoyi, the world's first certified robot doctor. They developed the world's biggest floating solar power station in 2010. They built the world's first passenger drone in 2016, and more recently, a 3D-printed electric automobile and a solar-powered fake sun. Is it because of all these breakthroughs why China is recognised as one of the greatest technological hive countries? This statement reaffirms the Chief Justice's argument that English is necessary for advancement in the corporate world, which is false because Chinese, Koreans, and many other countries that use their mother tongue as a medium of instruction are surviving and performing significantly better in science and technology than those that use a foreign language as a medium of instruction.

If China can survive and rank among the world's best in science performance and technological innovation while learning in the mother tongue, it is clear how much influence using the indigenous language as a medium of instruction has on the educational system and on learner performance.

Cuba

Since 1510, Cuba has had its own education system based on Cuban ideals, which include speaking and studying Spanish and adhering to communist beliefs (MacDonald, 2009). However, the English language gained prominence in Cuban society following the United States' (US) victory over Spain in 1898, and with the rapid global expansion of English as an international language and language of power, Cuba was forced to restructure its education system to accommodate the change (Ellis, 2006). The Cuban curriculum was revised to include elements of the US curriculum, which mandated English as a compulsory subject in Cuban schools (Smith, 2016).

Corona and Garcia (1996) assert that English was largely taught in Cuban schools to further US commercial and political goals. However, with the growing need for English in Cuba, the language's demand has increased significantly since that time. The language has grown in importance as a means of communication, commerce, tourism, and medical and scientific study (Smith,

2016). English thus acquired prestige in Cuba, since it was recognised as a critical component of a learner's education (Farrell, 2008).

Despite the introduction of English as a mandatory subject in Cuba, the use of Spanish as the medium of teaching was retained (Smith, 2016). Spanish is the mother tongue; as such, it is also utilised as the country's official language and as a medium of instruction and learning. Learners in this nation are taught and study all topics in their native language, including natural sciences, biology, and mathematics. This provides them with an edge in terms of performance, since they are taught in their own tongue. Using Spanish as a medium of teaching has had a significant influence on the Cuban educational system, particularly in the fields of science and medicine (Cole et al., 2018).

Cuba is a global leader in medical education and produces the top physicians in the world while teaching them in their own vernacular (Cole et al., 2018). Additionally, it has achieved significant medicinal advancements. Cuba was recognised by the World Health Organization in 2015 as the first nation to eradicate HIV transmission from mother to child. Cuba was also the first country in the world to develop a lung cancer vaccine, dubbed "Cima Vax." With all these medical advancements, it iss self-evident how this country's scientific performance and use of indigenous languages as a medium of teaching improve the country's education.

Mozambique

Mozambique is an African country located on the continent's extreme southern east coast. This nation is mostly black (African World Population Prospects, 2019). It contains sixteen national languages, although none are recognised as an official language or as a medium of teaching (Chimbutane, 2009). This nation is still monolingual, with Portuguese serving as the only language of instruction in schools and higher educational institutions (Lopes et al., 2004). However, the gradual implementation of bilingual education in this country is critical, but it is moving at a snail's pace owing to other problems such as a lack of teaching and learning materials and competent teachers (UNICEF, 2017). Additionally, the

country's economic situation is a significant role, since it is one of the poorest nations in Africa. As a result, establishing bilingual education in this nation and integrating other languages on an equal basis remains a significant problem (Chimbutane, 2011).

Even after obtaining independence from Portuguese rulers in 1992, many Mozambican schools continue to provide instruction in a single language (Ngoenha, 2000). Due to the country's budgetary limits, it is difficult to alter the curriculum in this area (Canhanga, 2017). There are around 16 indigenous languages in this nation, including Xishangana, Cinyanja, and others, although none are employed as a medium of teaching. The sole official language in this nation is Portuguese, which is not even its indigenous language, having been adopted from Portuguese colonial overlords. Henriksen (2010) contends that Portuguese was imposed as a medium of instruction in Mozambique as a means of developing literacy skills while entirely disregarding the language's proficiency level.

Most learners in this nation continue to be taught and educated in Portuguese. Even at bilingual schools, pupils continue to study all topics in Portuguese, including science and mathematics (UNICEF, 2017). Teaching learners in a foreign language has shown that this is not the greatest choice, since they do not do well in science (Mario & Nandja, 2005). Additionally, Henriksen (2010) discovered that these learners struggle to comprehend the grammar of the medium of teaching, which makes grasping scientific topics much more challenging.

According to Henriksen (2010), when learners are taught in their mother tongue, or the language in which they are skilled, they gain cognitive skills, self-esteem, and perform better. Canhanga (2017) said that self-esteem is critical throughout the learning process because it enables learners to express their thoughts and viewpoints without regard for language usage. Additionally, Anzaldua (2017) argued that language deprivation impairs the user's self-esteem, which may result in an educational obstacle.

Angola

Angola, like Mozambique, is an African country that was colonised by the Portuguese. The consequences of this country's colonialism are still visible to this day. This nation is dominated by black Africans, who account for around 90% of the total population (Instituto Nacional de Estadistica, 2016). Angola contains about 38 indigenous languages, including Umbudu, which accounts for approximately 23% of the country's African ethnolinguistic group. According to Jimbi (2018), Ambudu is the second largest ethnolinguistic group, accounting for approximately 8% of the population, followed by Kikongo (which accounts for approximately 8% of Angolans) and Chokwe (which accounts for approximately 7%), but none of these indigenous languages is used as a medium of instruction (Jimbi, 2018). In this nation, the colonial language, Portuguese, is still employed as a medium of teaching (UNICEF, 2018). This language is not only utilised in schools as a medium of instruction, but it is also recognised as the official language of a nation since it is employed in several fraternities such as economic, political, social, and diplomatic (Jimbi, 2018).

In Angola, like in other African nations such as South Africa, Ethiopia, and others, the topic of utilising local languages to educate has long been a point of contention. This is established in their constitution, which ensures the conservation and promotion of the Angolan population's African languages (Article 19, promulgated in 2010). Additionally, this policy states that the state shall promote the use of indigenous languages by including them as "Lingua de Ensino" in the curriculum (Language of Instruction). However, according to Jimbi (2018), this policy remains a paper policy since Portuguese is the dominant language and medium of teaching in this nation.

Even though Angola's education policy emphasises the use of indigenous languages in schools as a medium of teaching. UNICEF (2016) claimed that efforts to execute the strategy have been undertaken, with textbooks prepared in seven Angolan languages, including Cokwe, Kikongo, Kimbundu, Ngangela, Olunyaneka, Oshikwanyama, and Umbundu. These textbooks comprised alphabet exercises, easy maths puzzles, colour and form activities, and written

vocabulary and grammar exercises. Additionally, that primary curriculum courses include Portuguese and a national language (Nsiangengo et al., 2014). The national language, on the other hand, is decided by the region and the predominant language spoken in that area of the country. The process of incorporating national languages into the curriculum is yet experimental, since there is still disagreement about which national language should be included owing to conflicting interests of many stakeholders (UNICEF, 2016). As a result, little implementation has occurred, which confirms Jimbi's thesis that the paper policy is ineffective (2018).

Due to a lack of resources and insufficiently educated teacherrs of indigenous languages in this nation, implementation of this programme is proceeding slowly, leaving the Portuguese language as the primary medium of teaching (Diarra, 2003). In this nation, the employment of the Portuguese language has not resulted in successful teaching and learning, notably in science. Diarra (2003) elaborates on the influence of teaching in the Portuguese language, asserting that the overall weak outcomes of scientific performance in Portuguese are attributable in great part to teachers' and learners' insufficient mastery of the language. This implies that learners and teachers are not skilled in Portuguese; as a consequence, the pace of learning is slowed, the quality of instruction suffers substantially, and science achievement suffers adversely (Diarra, 2003). The assertions made by Diarra (2003) regarding Portuguese language command in teaching and learning and poor science performance in Angola serve as a blueprint for the effect of using the Portuguese language as a medium of instruction rather than the Angolan indigenous languages, which learners are more familiar with and understand, as a medium of instruction.

Portugal

Unlike Mozambique and Angola, Portugal is one of the nations that actively promotes the use of indigenous languages in education and higher education (Leal, 2012). That is not to say, however, that they do not recognise other languages, including English and Spanish. In Portugal, Portuguese is recognised as a medium of instruction and is the indigenous language, in contrast to Mozambique, where colonial rulers forced it. All courses are taught and learnt in

Portuguese in this nation, from basic schools to post-secondary institutions. English and French are also taught and studied in this nation, however they are strictly recognised as foreign languages (Cabral & Nobre, 2015). English is required in this nation from the second cycle (grades 5–6) through the third cycle (grades 7–9) and the secondary cycle (grades 10–11), where it plays a significant part in the curriculum (Lourenço & Mouro, 2017).

Teaching and studying science in this nation has benefited from the use of Portuguese as a medium of instruction, resulting in positive outcomes in scientific performance The Programme for International Student Assessment reported this (PISA, 2018). Portugal is recognised as one of the Organization for Economic Cooperation and Development's (OECD) top performers in mathematics and science (PISA, 2018). The use of the mother tongue as a medium of education, a language in which learners are fluent and comprehend better, may contribute to such performance (Henriksen, 2010). It facilitates learners' comprehension of scientific topics. Numerous scholars, like Cohetho (2013), have argued that teaching and learning in the native language increases learners' performance. This is particularly obvious among Portuguese learners.

While learners' performance in science is good in this nation, other issues such as insufficient teaching and learning resources and the learner's socioeconomic background continue to be impediments to education (PISA, 2018). That, however, is not the subject of this research. However, the advantage of utilising the mother tongue as a medium of teaching is that, like in Portugal, language will not be a significant role in a learner's poor performance. According to PISA (2018), Portugal's education system faces fewer educational challenges than other countries, particularly African countries such as South Africa, Ethiopia, and Mozambique, which struggle with English as the medium of instruction and dominant language despite the difficulties it poses to the educational system.
The performance of Portuguese learners in science is readily apparent from researchers' comments about the advantages of employing the mother language as a medium of teaching in school. since this will mitigate the difficulties that education systems may confront.

Spain

English's effect on national and international levels has been shown and recorded in several European nations, including Spain, Germany, and Italy (Erling, 2017). English's rising standing as a language in European nations presented a significant obstacle to these countries' capacity to maintain their indigenous languages while participating in globalisation (Caraker, 2016). The European Union (EU) increased the number of languages to 23 in 2007. Additionally, the (European Commission, 2015) mandated that three languages be taught in schools, one of which should be the native tongue. In this environment, Spanish became the language of education in Spain. Additionally, the regulation required that English must be included among the taught languages. This was done to counteract the use of English as the medium of education, while also participating in globalisation (Hilgendorf, 2005). Although English is required in this nation, it is treated as a foreign language and is taught from the very beginning of learners' education (Sabaté-Dalmau, 2016).

Spanish is the official language of instruction in Spain, and it coexists alongside Basque, Catalan, and Galician, which are all indigenous and mother-tongue languages and are regarded official languages in the nation. Their use, however, is contingent upon their speakers' authority and the existence of separate independent territories. Mathematics, natural sciences, and other topic courses are taught in Spain in Spanish and other co-official languages that are indigenous to the nation (European Commission, 2015). Learners in this nation get education in their mother tongues, which benefits their performance in sciences, mathematics, and other curriculum areas since they are exposed to and taught in their native languages (Henriksen, 2010). This is corroborated by PISA (2018), which revealed that Spanish learners perform well in the sciences. Several academics, such as Henriksen (2010), have claimed that utilising their mother language as a medium of education may be a significant component, citing the clear correlation between using their mother tongue as a medium of instruction and performance.

Brazil

Brazil is a nation in Latin America. This nation is home to around 170 indigenous languages (Massini-Cagliari, 2004). Even though this nation has a large number of languages, it is nonetheless regarded a monolingual country since it employs just one indigenous language as a medium of education and in all fraternities (Liu, 2019). Brazilian Portuguese is the country's official language and medium of instruction, ranking as the world's eighth most spoken language (Liu, 2019). All topics are taught and learnt in Portuguese in Brazilian schools. Brazilian Portuguese's supremacy ensures that it will remain the language of higher education in Brazil. According to Finardi (2016), the learning of foreign languages like as English, Italian, and French is seen as an extracurricular activity rather than a prerequisite of public education in this nation. Foreign language instruction accounts for a negligible portion of the Brazilian curriculum. This is because they are defending their language and are fearful that other languages such as English will take over, as they have in other countries, and will have a detrimental effect on the Portuguese educational system, as they have in a number of African nations (Rajagopalan, 2003).

While schools are free to offer these languages, they are classified as foreign languages and do not get priority. Foreign language education is mandated beginning in elementary school, with learners required to study a foreign language beginning in fifth grade. However, each school is free to choose whatever foreign language to teach. On the one hand, the Brazilian Instruction Law declared that schools are free to pick the language of foreign language education, but specifically advocated the teaching of Spanish as an example (Finardi, 2016). As a result of this School Law, English as a foreign language instruction will become required in elementary education beginning in 2020. (Montes, 2016).

Monolingualism promotion in Brazil has and continues to restrict its residents employment opportunities in other nations since they are not proficient in other languages such as English, which is an international and global language, and it views Brazil as a country of oppressors (Montes, 2016). While this is a significant

deficiency for this nation, it does not prevent it from being one of the highest performing countries in Latin America in science and mathematics. This is demonstrated in a study conducted by Gimenez, Sarmento, Archanjo, Zichman and Firnadi (2016), who discovered that Brazil has launched rockets, manufactured satellites, developed submarines and aircraft, and is involved in space research, as well as having a Vehicle Launch Centre Light, making Brazil the only country in the Southern Hemisphere to have an integrated International Space Station team (ISS). Additionally, Brazil is one of just three Latin American nations with an active Synchrotron Laboratory, a research facility for physics, chemistry, material science, and life sciences, and the only Latin American country with its own semiconductor production factory. This demonstrates that even with indigenous languages as the only medium of teaching, the nation may nevertheless be technologically sophisticated and among the greatest in the world.

Argentina

Argentina, like Brazil, is a monolingual nation in Latin America since it recognises just one official language as the medium of instruction, which is Spanish, which is also the indigenous language in this country, according to the British Council (2015). Bilingual education, on the other hand, is authorised. Because there are schools that educate in two languages, for example, Spanish and English, these schools are classified as bilingual schools. These schools are private, are mostly located in metropolitan areas, and are available to upper-class individuals. This nation permits the teaching and study of foreign languages (López Barrios & Villanueva de Debat, 2011). According to the Ncleos de aprendizaje prioritario (NAP, 2012), the school may teach English, French, German, Portuguese, or Italian. However, English is the most preferred foreign language in this country for obvious reasons, such as its recognition as an international language of communication and its introduction as a mandatory subject in the fourth grade, even though schools are not permitted to teach more than 40% of material in English (NAP, 2012).

Argentina teaches all topics in Spanish, including mathematics and science, which gives Argentine learners an edge in terms of academic performance since they are taught and learn in their home languages.

This viewpoint is backed up by PISA (2018), which found that 78% of Argentine learners do very well in science. The medium of education may be the most important aspect in such performance, since various researches have suggested that employing indigenous language as a medium of instruction produces positive effects. The performance of the Argentine learners in the sciences serves as a model for the benefits of employing indigenous languages as a medium of instruction in schools and how indigenous languages affect learners' performance in the sciences. As a result of the preceding talks, it is obvious how the employment of English and indigenous languages as mediums of teaching has a mixed effect on the educational systems of various nations.

2.14. THE USE OF MOTHER TONGUE AS MEDIUM OF INSTRUCTION IN EUROPEAN COUNTRIES VS THE USE OF FOREIGN LANGUAGE AS A MEDIUM OF INSTRUCTION IN AFRICAN COUNTRIES.

From the above deliberations on the medium of instruction in both African and European countries, The researcher saw it as imperative to bring to the attention of the reader the impact the medium of instruction has on the performance of learners in both African and European contexts by comparing the performance of learners in African countries that use a foreign language as a medium of instruction and those in European countries that use the same language as a medium of instruction, which to them is their mother tongue.

Mozambique vs Portugal

Mozambique

Mozambique is one of the African countries situated in the far east of Africa. It is dominated by blacks and it was once colonised like any other African country. See African World Population Prospects (2019). In this country, they have more than 16 indigenous languages, but none of them is regarded as an official language (Chimbutane, 2009). Portuguese is the medium of instruction in this country and it is also a foreign language (Lopes et al., 2004). The use of

Portuguese in this country has posed so many threats to its education system, as is evinced by the poor performance of learners. The medium of instruction is to be blamed for such a performance. It is reported that not only learners are incompetent in the language but teachers as well. This means there is no effective teaching and learning in these classrooms, hence the performance (Henriksen, 2010).

Portugal

Contrary to Mozambique, Portugal also uses Portuguese as the medium of instructions and it is their mother tongue and indigenous language (Leal, 2012). Meaning learners in this country are learning all the concepts in the language that they understand better. Hence their good performance in sciences and mathematics International Student Assessment (PISA, 2018). Learners in Portugal have an advantage as they learn throughout their schooling years up to higher education in their mother tongue. Unlike learners in Mozambique who learn throughout until higher education in a language that is alien to them.

South Sudan vs England

South Sudan

South Sudan, like every other African nation, was colonised, and English permeated its educational system owing to its status as the language of prestige and power. South Sudanese indigenous languages number in the hundreds, however none are employed as a medium of teaching by the United Nations Children's Fund (UNICEF, 2016). English is considered an official language and a medium of teaching in this nation. Learners in this nation acquire all ideas in a foreign language (Abdel et al., 2012). The widespread usage of English in this nation has had a significant impact on its educational system. South Sudan is one of the nations with the lowest rates of mathematics and science accomplishment. This is because the language employed to educate and learn is inept for both learners and teachers, resulting in substandard performance.

England

England is a European nation in which English is the primary medium of education. It is also the country's indigenous language. This benefits the learners in this nation, since they study all ideas in their own dialect. England is ranked as one of the top performing nations in the sciences and maths by TIMSS (2015 and 2011). Over the last two decades, TIMSS has shown that learners' performance in England has been steady. According to PISA (2018), this places this nation above the OECD's average performance. As noted by (TIMSS, 2016), this country's use of indigenous languages has benefited its educational system.

Reflection

The comparisons above demonstrate how the medium of teaching may influence education, especially on a learner's performance. This is shown in European nations that educate in their original languages, where learners excel, notably in math and science. In comparison to African countries that prioritise English as a medium of instruction over indigenous languages, the issue of medium of instruction and performance, particularly in these African countries, paints a clear picture of a sense of urgency in developing teaching and learning resources in African indigenous languages. Developing a scientific language register for Natural Sciences in isiNdebele would assist in improving learner’s performance since it will provide learners with the option to study natural sciences in their native tongue for the first time in South African school history. The construction of this register aims to alter the status quo in South Africa's education system, most notably by contributing to a solution for black isiNdebele-speaking learner’ performance.

2.15. CLASSROOM INTERACTIONS AND DISCOURSES

According to Smart and Marshall (2012), classroom discourse is the interaction between a teacher and a learner that occurs in the classroom. Additionally, he highlighted that this kind of contact may take the shape of spoken conversations and arguments. Mortimer and Scott (2003) emphasised the significance of these interactions between teachers and learners, stating that learners get a thorough

understanding of subjects via questions, discussions, and arguments. Gee (2004) defines discourses as linked chunks of language that, when combined, create meaning to a group of individuals. The group of persons referred to in this research is the teacher and learners in a Natural Sciences classroom. Many strategies are utilised in the classroom to encourage learners to feel comfortable expressing themselves to teachers. Classroom interactions and discourse are defined in this research in two ways: first, as interaction, which is the teacher's contact with the learners, and second, as discourse. According to Mudau (2013), classroom interaction entails teachers and learners collaborating closely in order to discover or resolve certain scientific ideas and concepts.

Smart and Marshall (2012) noted other aspects of classroom interaction and discourse. These discourses are described by Smart and Marshall (2012) as different interactions between teachers and learners in a form of communication. Mudau (2013) has named these types of discourses as; Authoritative discourse, Dialogic discourse and Reflective discourse. He describes Authoritative discourse as the type of discourse where teachers invite learners' answers through questions and realistic statements. Dialogic discourse incites and inspires debate between teachers and learners to determine and further develop understanding by learners. Lastly, Reflective discourse teachers engage with learners and with an aim of getting different ideas or ways of solving or understanding concepts and ideas from learners. This is a way of determining or finding out the extent to which learners comprehend concepts and ideas.

The classroom interactions and discourse also emphasise on communicative approach (Mudau, 2013). There are four classes of communicative approach, namely interactive/authoritative, interactive/dialogic, non-interactive/dialogic and non-interactive/authoritative (Mortimer & Scott, 2003). According to Mudau (2013), there are definitions and descriptions to these approaches. The Interactive-authoritative approach describes the teachers' way of encouraging answers from learners, but discards them if they are incorrect, as the focus here is only on correct answers. An interactive-dialogic approach takes place during an open discussion, this is where there are no incorrect answers, and learners' views are considered even though they may not be the same as the ones

considered to have accepted scientific meaning. Non-interactive-authoritative approach is the opposite of interactive authoritative and interactive dialogue. This is where information communication is one sided, and learners are expected or required to grasp and understand the information without questioning or making any suggestions. Non-interactive-dialogic approach, according to Mudau (2013), is when teachers can make their own additions on top of the formal guide. This is aimed at making learners understand the ideas or concepts better, however learners are still not requested or allowed to make any inputs.

Interactions and discourses serve as the conceptual underpinning for this research; hence they are considered as the most critical parts of it.

2.16. CONCLUSION

In conclusion, the researchers' literature study explored in depth language policy, the use of indigenous languages in schools and higher education institutions, as well as language concerns in African and European settings and their influence on teaching and learning. The next chapter describes the conceptual and theoretical framework.

CHAPTER 3:
THEORETICAL AND CONCEPTUAL FRAMEWORK

3.1. INTRODUCTION

Antonenko (2015) defines a conceptual framework as a collection of concepts that serves as a summary of all the data presented at the conclusion of the investigation. Antonenko also referred to the notion that this collection of thoughts acts as a thread or a chain indicating why the research was done (2015). Regoniel (2010) adds that a conceptual framework is created when a researcher connects ideas from the literature in order to produce evidence for the research question's need. These assumptions were included into the conceptual framework for this investigation. The following research questions serve as a guide for this study:

- What are the opportunities and challenges in the development of the scientific language register for Natural Sciences in isiNdebele and its application?
- What are the stakeholder's perceptions about the use of isiNdebele as the language of learning and teaching Natural Science?
- How did the developed scientific language register for Natural Sciences in isiNdebele shape classroom interactions and discourses?

3.2. THEORETICAL FRAMEWORK

This study is guided by Vygotsky's social constructivism theory. Although language is seen as the primary means of communication and cognition, it evolves via social interaction (Vygotsky, 1978). Language is also referred to as a medium for teaching and learning, as well as a means of communication (Learning Programme Guidelines, 2001).

Language and culture are seen as the primary means through which individuals communicate and comprehend reality in this idea (Ernest, 2012). Constructivism

is not a method of instruction but rather a philosophy of knowledge and learning, emphasising interaction between learners and material as well as between learners themselves (Hausfather, 2001). According to Leach and Scott (2003), the teacher's duty in constructivism is to "present and promote the application of new information on the social plane (p.102)," but the learner's responsibility is to "internalise the concepts for personal use." Additionally, Hausfather adds that the teacher facilitates the acquisition of new information by establishing settings in which learners engage with the new knowledge via discussions and questions and answers (2001).

Vygotsky views language and culture as the frameworks for human intellectual growth and the ways in which they impact how people see the world. This indicates that language may be used to communicate notions learned via contact with the cultural environment. Thus, social constructivists see knowledge as the central aspect of social interaction that leads to increased levels of thinking and learning (O'Connor, 1998). Jones and Brader-Araje (2002), as well as Von Glasersfeld (1989), assert that intellectual abilities can be gained exclusively via social interaction.

In the theory of social constructivism, language is one of the most important tools because it is used to build knowledge in learning (Fox et al., 2001; Wertsch, 1998). From the claim that "communication is the primary function of language", we can conclude that language is a social phenomenon in its fundamental right. Language is mostly used in a social setting, such as when we use language to communicate with people and, through language, we are able to perform social functions (Jackendoff & Pinker, 2005).

Furthermore, Vygotsky (1978) emphasises the importance of language in social constructivism. He concentrated his research on the effects of social connection, individual engagement with society, language acquisition, and cultural learning on the learning process. He discussed the significance of language in knowledge construction and how it facilitates social interaction. Vygotsky (1978) asserts that knowledge is acquired via contact and interaction with others, which occurs through communication or the use of language. He also emphasised the dynamic character of the relationship between learners and teachers, and that learning

occurs as a consequence of this interaction. This demonstrates how social contact and language aid in the process of learning.

3.3. CONCEPTUAL FRAMEWORK

With the theoretical framework guiding the research, it was critical to create a conceptual framework from the examined literature to aid in data management and analysis.

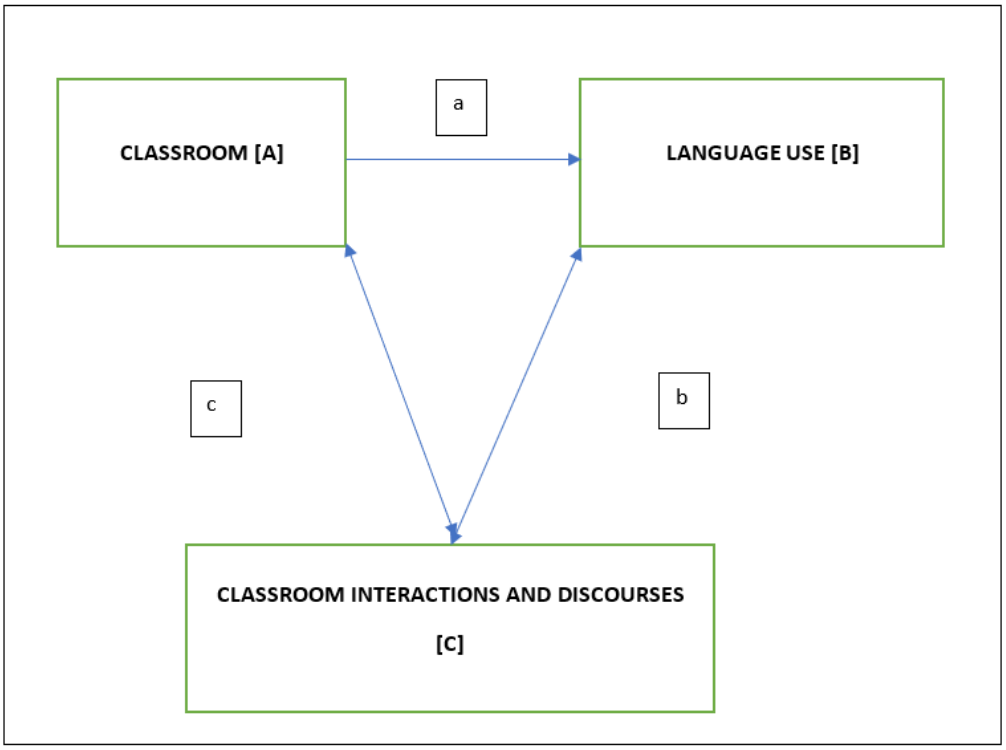


Figure 3.1. Describing the framework

Three spheres comprise the Classroom Language Analytical Framework (CLAF) (A, B, and C). The classroom is a social space in which teaching and learning occur. This research included both teachers and learners. Frame B is a teaching and learning tool. In this study is referred to the use of two languages isiNdebele and English. Frame C receives information from Frame B. Classroom interactions and discourses include exchanges between learners and teachers as well as between learners themselves and are influenced by the classroom language utilised. The CLAF demonstrates the frames' interdependence. The relationships between these frames [(a), (b), and (c)] are used to connect them. Wherein (b) and (c) indicates their interdependent flow.

Application of the Classroom Language Analytical Framework (CLAF)

The CLAF was used to analyse how the developed scientific language register for Natural Sciences in isiNdebele shape classroom interactions and discourses. A classroom is a social plane, as referred to by Vygotsky, where teaching and learning take place. According to Vygotsky, teaching and learning will only take place when there is communication, which includes the use of language (1978). In this frame, language use is referred to as the tool that is used in the classroom to transfer content knowledge from teachers to learners. The use of two languages was analysed by this framework, which is isiNdebele and English.

However, Vygotsky (1978) noted that language is a tool which could be used to convey information, but he further noted that learners are able to construct knowledge through social interaction. Hence, this framework analysed how the developed scientific language register for Natural Sciences in isiNdebele shape classroom interactions and discourses, focusing on the types and patterns of discourse and communicative approaches used by teachers in the classroom. Furthermore, it gave a clear picture of which language learners find it easier to interact with in the classroom as far as participation is concerned.

According to Smart and Marshall (2012), clssroom discourse is a multifaceted interaction between teacher and learner that is best carried out verbally via discussions and debates. Mortimer and Scott (2003) emphasised the significance of these interactions between teachers and learners, stating that learners get a thorough understanding of subjects via questions, discussions, and arguments. Gee (2004) defines discourse as a collection of related pieces of words that are put together to make meaning to a group of individuals. The group of persons referred to in this research is the teachers and learners in a Natural Sciences classroom.

Within this approach, classroom interactions and discourse are divided into two components: interaction, which refers to the teacher's involvement with the learners, and learners themselves. According to Mudau (2013), classroom interaction entails teachers and learners collaborating closely in order to discover or resolve certain scientific ideas and concepts. Two is the discourse, which was

discussedabove. Mudau continues by defining discourse as one of three types: authoritative discourse, dialogic discourse, and reflective discourse (2013). He describes authoritative discourse as a kind of communication in which teachers perceive factual statements and inquiries as learners' answers. Discussions between teachers and learners are sparked by dialogic discourse. Finally, teachers employ reflective discourse to ascertain the extent to which a learner has mastered a subject.

There are four distinct approaches to communication: interactive/authoritative, interactive/dialogic, non-interactive/dialogic, and non-interactive/authoritative (Mortimer & Scott, 2003). According to Mudau (2013), various techniques are as follows: The interactive-authoritative method requires teachers to promote learners' replies but to reject them if they are erroneous, since the focus is on proper responses exclusively. An open discussion characterises an interactive-dialogic approach. This is the time for learners to provide whatever replies they have, since the emphasis is not on proper responses but on their engagement. Non-interactive-authoritative: this kind of instruction assumes that learners are passive consumers of information and are expected to grasp it without questioning or providing recommendations. When teachers are authorised to make additions to the formal guide, this is referred to as the non-interactive-dialogic method. This aids in learners' comprehension of ideas or concepts, but their contributions are still prohibited.

In teaching and learning, interactions, discourse, and language usage have been identified as contributing elements to a learner's performance. According to Adesemowo (2017) & Krause and Prinsloo (2016), when learners are taught ideas in their native language, they perform better than when the concepts are taught in a foreign language. Additionally, Abad (2010) & Muoz and Mora (2006) highlighted that learners find it simpler to participate in their mother tongue since they are focused on providing answers and enjoying the session, rather than on how they would express themselves due to their lack of linguistic confidence. This framework was used to examine the effect on the use of scientific language register for Natural Sciences in isiNdebele and how teachers and learners interact and converse in the classroom.

3.4. CONCLUSION

This chapter discussed the conceptual and theoretical foundations that guided this investigation, which were founded on Vygotskian theory (Social Constructivism). This chapter covered the CLAF, which serves as the framework for this research and its components. The next chapter will go into depth about the approach used in this research.

CHAPTER 4:
METHODOLOGY AND DESIGN

4.1. INTRODUCTION

The aim of this study was to develop isiNdebele scientific language register for Natural Sciences and apply it in some of the classes in the Siyabuswa 2 circuit, South Africa. This study was guided by the following research questions:

- What are the opportunities and challenges in the development of the scientific language register for Natural Sciences in isiNdebele and its application?
- What are the stakeholder's perceptions about the use of isiNdebele as the language of learning and teaching Natural Science?
- How did the developed scientific language register for Natural Scineces in isiNdebele shape classroom interactions and discourses?

This chapter gives an explicit overview of how the design was applied in this research study. Methodology is an operational framework within which the data are placed in order for their meaning to be seen more clearly. This means that research methodology defines the kind of data relevant to the research study, and how it was collected, organised, interpreted, and analysed. Research methodology is an umbrella term used to refer to the research methods, techniques, and procedures that are employed in the process of implementing a research design or plan, as well as the underlying principles and assumptions that underlie their use. Research methodology comprises the description of the research instruments, data collection and data analysis methods that were applied in this study.

4.2. RESEARCH APPROACH (QUALITATIVE APPROACH)

Mouton (2001) defines a research approach as a detailed plan for how the researcher will conduct the research. This approach provided a framework for how this study was based and gave clear guidelines and instructions on how the

data was collected and analysed to assist in answering the research questions of this study (McMillan & Shumacher 2010; Mouton, 1996). For this study, a qualitative approach was used to investigate the opportunities and challenges in the development of the scientific language register for Natural Sceinces in isiNdebele and its application. This was done to stakeholder's perceptions of the use of isiNdebele as the language of learning and teaching Natural Science. Furthermore, to understand how the developed scientific language register for Natural Sciences in isiNdebele shape classroom interactions and discourses.

This was a qualitative study, which implies that it did not rely on numerical data. Hence, it was explorative as it investigated the depth of the underlying phenomena, which are the perceptions of stakeholder's in using isiNdebele as the language of learning and teaching Natural Science (Creswell, 2017). A qualitative approach was chosen as it assisted in deducing first-hand information from participants through observations, interviews and diary because it dealt with how people view the world and make sense of their experiences. In this study, the methods of research that seek to describe and analyse the behaviour, attitudes, and culture of a sampled group of people were considered as it was a qualitative study.

The qualitative approach takes place in a natural setting where events occur practically. In this study, teachers were observed teaching in the classroom using both isiNdebele and English scientific registers for Natural Sciences. It is also distinguished by a focus on the perspectives of participants in a situation under investigation. As a result, it employs interviews as part of the data collection techniques, allowing participants to share their experiences with the situation. Participants in this study discussed their perceptions on using isiNdebele as the language of learning and teaching Natural Science.This approach is further characterised using a small sample size so that the data will be manageable. In this study, a purposively sampled number of teachers, learners, and parents were used as the participants.

Since a qualitative approach focuses on making sense of the central phenomena Newby (2014) and Maree (2010), it was used for this study because it gave possible explanations of the phenomena under investigation, which are the

perceptions of stakeholders on the use of isiNdebele as the language of learning and teaching Natural Science. This approach best fitted this study as it permits interaction between a researcher and participants. Due to the nature of this study, it was pertinent for the researcher to maintain close contact with the participants as they were deemed to be the primary source of information for this study, and their responses assisted the researcher in answering the research questions of this study. Hence, a qualitative approach was an appropriate approach for this study.

4.3. CASE-STUDY APPROACH

A case-study is defined by Miles (2015) and Sitsebe (2012) as an approach that permits rigorous data collection using different methods (triangulation), and it further allows the situation to speak for itself rather than being interpreted by the researcher. This approach is regarded as researcher-centered and involves observation of participants with the aim of providing an understanding of the research setting. The nature of this study required the researcher to maintain close contact or interaction with the participants in order to elicit data that assisted in answering the research question of this study. Hence, the researcher employed an observer as a participant type of observation wherein she focused on observing the participants but remained uninvolved and did not influence the dynamics of the setting.

Since there was more than one school, a multiple case was used. This was so because stakeholders came from different backgrounds and had different experiences, hence making them unique (Punch & Oancea 2014; Stake & Schwandt, 2006). With each school serving as a case study, the researcher was able to examine their perceptions on the use of isiNdebele as the language of learning and teaching Natural Science, as well as how the developed scientific language register for Natural Sciences in isiNdebele shape classroom interactions and discourses. The focus of this study was not on comparing the participants of this study but on understanding the phenomenon under investigation from the participants' perspective. Therefore, the case study was appropriate for this study.

4.4. RESEARCH PARADIGM

A paradigm is defined differently by different researchers. According to Babbie et al. (2017), a paradigm is a basic frame of reference used by researchers to organise their reasons and observations. While it is a representation of what we think about the world (but cannot see) for (Lincoln and Guba, 1985). Lincoln and Guba further refer to a "paradigm" as a set of beliefs that guide an action. According to Creswell (2003), qualitative researchers deal with socially constructed realities and qualities that are complex, which makes their tasks attempt to comprehend, interpret, and describe how different participants think about the world around them in their social setting.

This study followed an interpretivist paradigm as it was the best approach for this study. In this study, interpretivism focuses on various forms of truth and places the focus on people's lived experiences and the individual nature of knowledge and understanding. In this study, different stakeholder's perceptions were the focus.

The researcher followed an interpretivist approach that pursues a worldview where attitudes and perceptions are impacted by people's individual experiences (Maree, 2010). This study aimed at understanding and exploring staheholder's perceptions about the use of isiNdebele as the language of learning and teaching Natural Science. The researcher adopted an interpretivist perspective because this study was based on reality being socially constructed and the situation of the study should be kept in mind to make sense of the findings (Maree, 2010). Neuman and Fawcett (2011) maintain that the interpretivist approach in qualitative research analyses social actions in their natural setting, through direct and comprehensive observation, in order to comprehend and interpret how people create meaning in their social world. The researcher, therefore, observed the interaction and discourse between the teacher and the learners in the classroom.

The researcher was also be open to another approach, which is constructivism. The paradigm of constructivism is closely related to interpretivism (Maree, 2010),

because of the focus knowledge was transferred from a teacher to a learner. Further to that constructivism is one of the theories that forms the theorical and conceptual framework of this study. Due to the choice of the research design and the nature of this study, these two approaches formed the paradigm of this study.

4.5. RESEARCH CONTEXT

4.5.1 Research setting

The setting of this study was in the Mpumalanga province. The Mpumalanga province is one of the nine provinces of South Africa. Mpumalanga lies in eastern South Africa, bordering Swaziland and Mozambique (see Figure 4.1). The province has four districts, namely: Nkangala, Gert-Sibande, eHlanzeni, and Bohlabela district. Most of the population in these districts speak isiNdebele. Learners from this district come from semi-rural areas. The Nkangala district consists of schools and circuits. This district consists of 21 circuits, in which the Siyabuswa 2 circuit lies where there are 9 senior phase schools.

This study was conducted in the Siyabuswa 2 circuit, which is one of the circuits in the Nkangala district, because that is where the researcher is based. Other factors that influenced the researcher's decision to conduct the study in this circuit and district included the fact that all schools in this circuit offer isiNdebele as a home language.

In this study, the data was collected in the Nkangala district from three senior phase schools in the Siyabuswa 2 circuit.

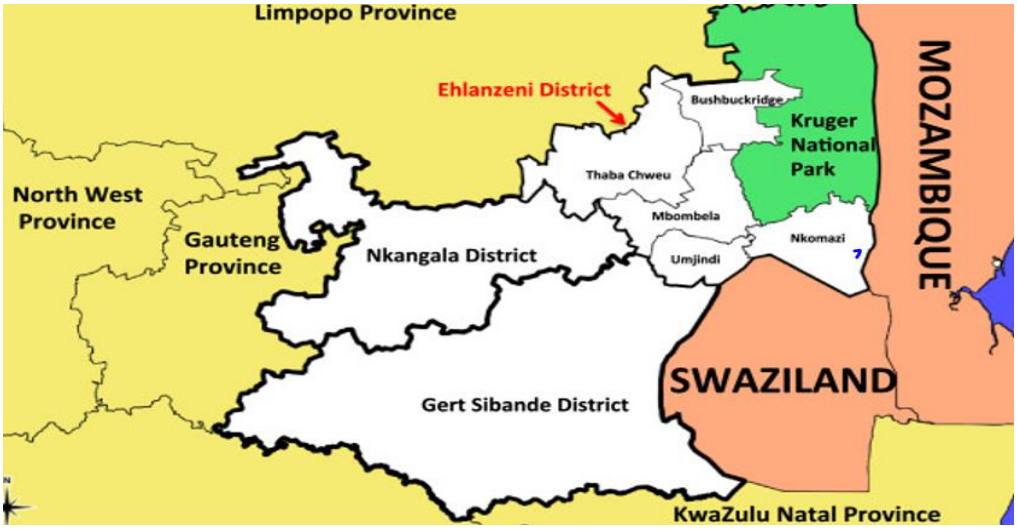


Figure: 4.1: **Districts found in Mpumalanga Province (Sheetal et al., 2014)**

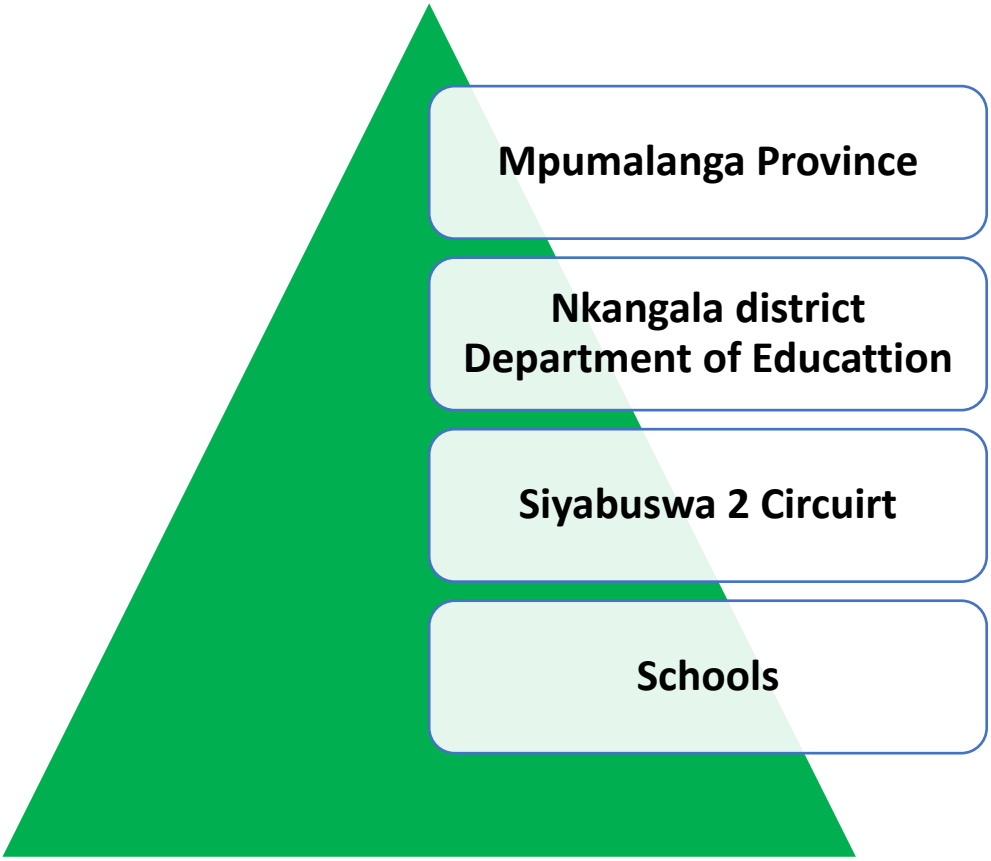


Figure 4.2: Research context

4.5.2. Population and sampling

Sampling is defined by Sahin-Topalcengiz and Yildirim (2020) as the drawing of a subset from the whole population for research purposes. This was a qualitative study; hence, purposive sampling was used to select participants for this study. As it was referred to by McMillan and Schumacher (2001) as the best selection of information-rich cases for an in-depth study using participants who are knowledgeable about the phenomenon under investigation,

This selection ensured that only the most suitable participants participated in the study. This study targeted participants who were teaching Natural Sciences and competent in isiNdebele, as well as learners in the senior phase, as they were deemed by the researcher to be information-rich sources that provided useful insights in answering the research questions of this study. The parents of the learners were also part of the study. For the feasibility of this study, a purposive sampling of three Natural Sciences teachers in each of the three selected senior

phase schools, one class of learners from each selected school, and five parents from each selected school participated in this study. The researcher chose this number of participants to ensure that the collected data was manageable. Data was collected from Natural Sciences teachers using interviews and observations. Only interviews were used to collect data from learners and parents.

The Nkangala district consists of schools and circuits. This district consists of 21 circuits, in which the Siyabuswa 2 circuit lies where there are 9 senior phase schools. However, only three of the nine senior phase schools were selected to participate in this study. To collect data for this study, three natural sciences teachers, five parents, and one class of learners from each selected school were used to collect data.

Purposive sampling was used to select the participants for this study. Sampling was done based on the following proposed criteria:

- Participants (teachers) must be teaching Natural Sciences in senior phase schools, particularly in the Siyabuswa 2 circuit.
- Participants (both teachers and learners) must be competent in isiNdebele.
- Participants were willing to participate in the study.
- Parents from the selected school.

The following is a brief overview of how each instrument will be used to collect data for this study.

4.5.3. Cases

For the development of isiNdebele scientific language register for Natural Sciences and its classroom applications in Siyabuswa 2 circuit, South Africa. The study focused on three senior phase schools with the specific focus on three senior phase teachers, three classes and fifteen parents. The participants and school names are not revealed in this study. Pseudonyms were used instead.

The cases of the study are detailed below:

CASE 1 JOHN FROM FUNDA COMBINED SCHOOL

Funda combined school is situated in the village. Learners and teachers in the Funda combined school speak isiNdebele. Funda combined school offers only isiNdebele as a home-language. Funda combined school offers grades 7-9. Many learners attending this school reside in or around the village where the school is located. John is a black male teacher and holds a BED degree in Natural Sciences, specialising in Mathematics and Physical Sciences. John has been teaching Natural Sciences for eight years. His home language is isiNdebele.

CASE 2: MANDLA FROM KHANYA COMBINED SCHOOL:

Khanya combined school is situated in an anonymous village in the Mpumalanga province. Khanya combined school offers grades 7-9. It is a bi-lingual school, offering both IsiNdebele and Sepedi as home languages. However, the school is dominated by Ndebele-speaking learners. Most of the teachers at the school speak isiNdebele, but they are all Pedi's.Most of the learners who go to this school live in the area where the school is.

Learners are taught in English as a medium of instruction as well. Mandla is a black male teacher and has been in the teaching field for five years. He has been teaching Natural Sciences for five years. He holds a BED degree, specialising in Natural Sciences. His major subjects are Mathematics, Physics and Chemistry. His home language is isiNdebele.

CASE 3: MAY FROM ZITHA COMBINED SCHOOL

Zitha combined school is situated in the village of Siyabuswa 2 circuit. Learners and teachers in this combined school speak IsiNdebele. From grade 7-9, Zitha combined school offers only isiNdebele as a home language. Most learners attending this school reside in or around the village where the school is located. May is a black female teacher and holds a BSc in Environmental Sciences and a post-graduate certificate specialising in Geography and Natural Sciences. May

has been teaching Natural Sciences for five years. Her home language is isiNdebele.

4.6. DATA MANAGEMENT

In this section of the chapter, the researcher gave a detailed discussion on data collection techniques, the process of collecting data, how the data was interpreted and analysed, as well as how the data was presented.

4.6.1. Data collection techniques (Phase 1)

This subsection is aimed at presenting all the different types of data collection techniques that were used in this study and how they were used. The techniques that were used to gather data for this study are interviews, observations, and diaries. These techniques are discussed in detail in the subsection below. The methodology of this study has two phases. The first phase discusses the data collection techniques that were used during the development of the scientific language register for Natural Sciences in isiNdebele. The second phase discusses the data collection instruments that were used after the register was developed.

4.6.2. Interviews

According to Maree (2017), an interview is a data collection method in which the researcher poses questions to a research participant with the aim of collecting data and learning about their views and opinions. While developing the register, the researcher had challenges with explaining some scientific concepts and terms in isiNdebele. This is because isiNdebele has limited scientific terms (Mahlangu, 2014). To find the explanations of these terms and concepts, the researcher informally conducted face-to-face interviews with some of the senior citizens in the village and further interviewed the isiNdebele Curriculum Implementor (CI) and some of the isiNdebele teachers telephonically. These interviews were continuous until the development of the register was completed. These participants were interviewed on the equivalent terms the researcher could use to explain these concepts in her register. Amongst other concepts the

researcher had difficulty explaining in isiNdebele were material, infiltration, particle, chromatography etc.

4.6.3. Diaries

Diaries are defined by Maree (2017) as "natural" documents, which are frequently used in qualitative research and contain personal understandings and meanings that are process orientated. The diary in this study was used as an open-ended data collection tool wherein the journey to developing the register was captured. Part of the information recorded in the diary includes the challenges encountered while developing the register, such as a lack of scientific terms in isiNdebele, as well as the opportunities, such as how consulting different people aided in developing and shaping the register and lessons learned throughout its development. Reflections made from consulting different people and all other information that shaped the development of the register were documented in this diary.

4.6.4. Scientific language register for Natural Sciences in isiNdebele

In developing the scientific language register for Natural Sciences in isiNdebele, I focused on the Matter and Material strand as it is the topic my learners perceived to be most difficult during my teaching years at a senior phase school. I identified one topic from this strand which is Separating mixtures. From this topic I developed three units namely: Mixtures, Methods of physical separation and Sorting and recycling materials. While developing this register I encountered challenges with finding scientific terms and concepts, I then consulted different stakeholders such as the chairperson of isiNdebele Pan South African Language Board (PANSALB), authors of isiNdebele textbooks, isiNdebele teachers, isiNdebele Curriculum Implementors (CI)’s and senior citizens around the village. The role of these stakeholders in the development of this register was to assist in developing scientific terms/concepts or finding equivalent terms/concepts where I was failing to do so. After the register was developed it was read by these stakeholders and the supervisor for quality check and rigour. Their recommendations and contributions greatly assisted the development of this scientific language register for Natural Sciences in isiNdebele (Appendix O).

Data collection techniques (Phase 2)

4.6.5. Data collection procedure

Letters seeking consent and access to conduct research were sent to the Siyabuswa 2 circuit office. After permission was granted by the office, the researcher arranged to meet with school principals and teachers in participating schools. On the first day of the meeting, the researcher explained the purpose of the visit and that of the research and how the data collection process was to take place. The principals were assured that there would be no disruptions to teaching and learning in the schools as all the data would be collected after school hours. During the meeting, teachers were asked to feel free to participate and were further assured that the information gathered was going to be used for research purposes only.

During her first visit to the schools, the researcher explained to teachers what the scientific language register was and what its purpose was. She thereafter provided teachers with both the isiNdebele and the English scientific registers for Natural Sciences, and they were given a week to go through it and make comments and inputs that the researcher was going to collect the following week. The researcher also requested the names of the school governing body (SGB) members who formed a parent component in this study with the aim of contacting them as well as requesting that they take part in the study and arranging the interviews with them that took place on the last day of data collection.

On the second week, the researcher went back to the selected schools to collect the register from the teachers and had a discussion with them on the inputs and comments they made on the register. All the inputs and comments made by teachers were recorded on the register after the discussions held with the teachers. After the researcher had discussions and administered inputs and comments made by teachers, she then conducted a workshop on how to use the language register, which was done after school hours. After teachers have been workshopped and have had an explicit understanding of how to use the register, In the third week of school, teachers were observed several times for one hour, wherein the first 45 minutes they taught Unit 1 using the isiNdebele scientific register for natural sciences and the remaining 15 minutes they used the English

scientific register for natural sciences. This was done to observe how classroom interactions and discourse differ when being taught in different registers.

4.6.6. Observations

In order to ensure that the data is valid and reliable, observations of the events in their natural setting in the school were used. In this study, three Natural Sciences teachers were observed using both English and isiNdebele scientific registers to teach Natural Sciences in the classroom. During the observations, the researcher paid attention to the types of interactions and discourses that emerge in the classroom as they can be easily observed and how teachers administer the scientific language registers to teach Natural Sciences. Furthermore, observing these aspects provided data that assisted in answering the research question of this study, which is: how did the developed scientific language register for Natural Sciences in isiNdebele shape classroom interactions and discourses? Notes about the use of language were also taken during observations. The register had three units; however, teachers were observed teaching only unit one. Observations were conducted continuously for a period of three weeks, followed by interviews. Each teacher was observed several times for an hour, this was done to ensure rigour, wherein the first 45 minutes they taught Unit 1 using the isiNdebele scientific register for natural sciences and the remaining 15 minutes they used the English scientific register for natural sciences. This was done to observe how classroom interactions and discourse differ when different registers are being used. The researcher employed an observer as a participant type of observation, as she remained uninvolved and did not influence the dynamics of the setting.

4.6.7. Interviews

In this study, verbal communication between a researcher and participants with the aim of deducing information from the participants was conducted in the form of interviews (Serrano et al., 2020). After the participants were observed in the classroom, interviews were conducted. The interviews were semi-structured and flexible to cater for emerging themes. This kind of interview allowed for spontaneous and in-depth responses from participants. Both teachers and

learners were interviewed based on the scheduled time at their respective schools. The interview tool was separated into two parts: The first part of the interview had a set of biographical questions, such as: how long have they been teaching Natural Sciences? The second section included a series of questions about the use of register, such as "what were their perceptions on the use of isiNdebele as the language of teaching Natural Sciences?"In these interviews, follow-up questions such as "why were their perceptions like that?" and "what impact does language have on the teaching and learning of Natural Sciences? They were asked to seek further clarity and capture more data.

The interviews were held with respective interviewees in the following manner:

Teachers

Three purposefully selected Natural Science teachers were interviewed at their respective schools. Individual face-to-face interviews were conducted after the observations had been completed. Teachers were interviewed using both parts of the interview tool, which is: In Part A, where they were asked biographical questions such as: how long have they been teaching Natural Sciences? Part B of the interview tool focused on the use of the register. Questions such as: what challenges did they experience when using the register to teach Natural Sciences were asked, as their responses to these questions assisted in answering the research questions such as: what were the opportunities and challenges in the development of the scientific language register for natural sciences in isiNdebele and its application? Furthermore, interviews with teachers were conducted to triangulate the data collected from the observation by (). The interview session lasted 10–15 minutes.

Learners

For the feasibility and data management of this study, only one class of learners was interviewed. Focus-group interviews were used to interview the learners. Each group consisted of five learners. The researcher posed a question to each group and recorded their responses. All the groups were asked the same set of questions which were on the use of language, questions such as: Do you

experience any challenges in learning Natural Sciences in English? Which assisted the researcher in answering the research questions such as: how did the developed scientific language register for natural sciences in isiNdeble shape classroom interactions and discourses? The researcher attended to one group at a time. This was done to avoid all the groups responding to the questions at the same time, which might have prevented the researcher from recording all the responses at the same time. The interviews were conducted for 10–15 minutes.

Parents (Members of the School Governing Body)

Five parents from each selected school were also involved in face-to-face interviews. The researcher chose this number so that she could be able to manage the data collected. Arrangements were made with these parents on where and when the interviews were to take place. Parents were only interviewed on language issues, such as what is their perception about using isiNdebele to teach natural sciences. And what language did they prefer their children to use to learn Natural Sciences which was the second set of questions in the interview instrument. Interviews were conducted in English, but isiNdebele was used where necessary or to clarify the questions for parents when they needed clarity. The interviews were conducted for 10–15 minutes.

All interviews were audio-taped to ensure that the researcher had correctly captured the participants' responses. After the interviews, participants were permitted to listen to the audio. This was done to ensure that the researcher had captured exactly what the participants wanted to say, and that there were no clarity-seeking questions from either the participants or the researcher. The audio-taped interviews were transcribed for data analysis purposes.

4.6.8. Data analysis and interpretation

Data analysis is defined by Creswell (1994) as a process of organising and interpreting the collected data. He further defines data interpretation as the process of attaching meaning to the collected data using patterns, themes, and categories to explain and analyse its relationships. Content analysis was used to analyse data collected from interviews and observations for this study. Audio-taped interviews and observations were analysed by listening to them several

times and transcribed into a word document. After transcribing the data from interviews, the researcher listened to the audio again. This was done to ensure that the transcribed data corresponded to the participants' responses. The same process was done with the video, which was played to verify if what was written on the transcripts was exactly what was captured in the video. The grammatical errors of the participants were not rectified, such as in the case where a participant code switched to English when using the isiNdebele sregister, were capturedas they were, as that formed a crucial part of the data. Furthermore, participants were permitted to read the transcribed data for corrections, additions, and comments before it was considered as a final product.

The transcribed data from interviews and observations were read, and the researcher highlighted significant statements that provided understanding of the participants to create themes and categories (Creswell, 2017). The researcher then coded and categorised data from observations, interviews and diary to enable thematic analysis. This is a process called qualitative content analysis. Qualitative content analysis is a research method for the subjective interpretation of the content of text data through the systematic classification process of coding and identifying themes or patterns. In the present study, the collected data from interviews and observations was transcribed and coded. Common themes were extracted from the coded data and these were supported by verbatim quotations from the participants.

4.7. RIGOUR

When investigating a certain phenomenon, it is crucial to ensure that the methods used for data collection and analysis ensure valid and reliable outcomes. For this study, reliability and validity were checked by using strategies for trustworthiness, which included strategies such as credibility, dependability, confirmability, and verisimilitude (Lincoln & Guba, 1985).

4.7.1. Credibility (internal validity)

Credibility is a method of ensuring that the research findings tally with reality and make sure that the reader can trust the findings of the research process (Flanagin

& Metzger, 2007). In this study, credibility was enhanced by ensuring that the findings for this study were derived only from the collected data (Maxwell, 1992).

4.7.2. Dependability

Dependability is referred to by Maree (2010) as the degree to which the reader can be convinced that the findings did indeed occur as the researcher says they did. Dependability of qualitative collected data was established by the researcher through member checking (Creswell, 2007).

4.7.3. Confirmability

Confirmability is referred to by Lincoln and Guba (1985) as the extent to which the findings of the study are shaped by participants, and not by the researchers' interest or motivation. It also ensures that the findings are derived solely from the data collected and are a true reflection of what occurred during data collection, confirming that the study was properly conducted. Triangulation was employed to ensure confirmability in this study. The researcher checked the information she got from interviews with what she saw in the classrooms.

4.7.4. Verisimilitude

In this study, the researcher used direct quotes from the participants when analysing and presenting the findings from the data collected. This was done to avoid the presented data being questioned or deemed unreliable. To ensure verisimilitude, the researcher wrote the participants' direct responses in italics to indicate that these are the participants' voices, not the researchers.

4.7.5. Triangulation

According to Nancy Carter et al. (2014) triangulation is the use of different methods or multiple techniques (usually three) to confirm findings. This method is used to determine the credibility of the study (Schumacher & McMillan, 1993). To ensure credibility and data accuracy in this study, the researcher used interviews, observations and diaries. Research methods must be corroborated in order to achieve findings in a qualitative study since multiple research methods

are used in this approach. To establish this, the researcher corroborated the participant's responses from the interviews and observations, which is called "methodology triangulation" because multiple methods of data collection techniques were used.

4.7.6 Pilot Study

A pilot study is defined by Babbie (1990) as an overview of the entire study design. A pilot study is a very central part of any research project as it gives an overview beforehand of what to expect when conducting a research study, and it further serves to investigate the feasibility of the study and bring possible insufficiencies that may arise to the fore. In this study, the reason for piloting the instruments was to assist the researcher in determining whether the instruments were clear and appropriate to the needs of the study in order to make some modifications or keep them as they were.

The instruments for this study together with the Data Analysis Scheme (DAS) were submitted to the supervisor for comments. Thereafter, they were refined with one participant who was not from the same school and was not part of the main study but was like the participants from whom the data for this study will be collected. Furthermore, the participant met the criteria of the study, which were:

- All teachers must be teaching Natural Sciences in senior phase schools, particularly in the Siyabuswa 2 circuit.
- Both teachers and learners must be competent in isiNdebele.
- Participants were willing to participate in the study.
- Parents or guardians of a learner at a selected school

The following was learned during the pilot study:

- After the researcher presented the consent form for learners to the principal, He suggested that parents' contact details be added to the consent form. Hence, that was done.
- When the researcher was interviewing the learners, she realised that learners were more comfortable answering the questions in isiNdebele than

in English. The researcher has learned that she must also explain the questions in isiNdebele and allow learners to answer in isiNdebele.

- The participant did not understand some of the questions, so the researcher had to do a lot of explanations in both English and isiNdebele.
- The participant was not audible enough. Hence, the researcher has learned that she must put the recording device closer to the participants and ask the participants to speak aloud.
- There were more delays when the pilot was conducted, because of urgent meetings that had to be held, and learners had to be released early. In some cases, the participant had to attend to urgent private matters, which caused further delays. The researcher has learned that she must have a more flexible schedule to allow for such circumstances.
- There were more learners who participated in the study than the estimated number, so more material had to be printed.

In conclusion, the pilot study was eye-opening for the researcher and further prepared them to handle the main study.

4.8. ETHICAL CONSIDERATIONS

The researcher attended to important ethical considerations such as informed consent, voluntary participation and withdrawal, confidentiality and anonymity, as well as protection from harm. Since this study involved learners as participants, the researcher requested that parents of learners who were willing to participate in the study sign a consent form on behalf of their children before they could participate in the study as an indication of approval. The choice of withdrawal from the study was made known to learners even when their parents had signed their consent forms.

4.9. SUMMARY

This chapter outlines the research methodology that was used to collect data from the participants. It further outlined the following aspects, which were imperative for this chapter, namely: qualitative approach; case study approach;

nature of research; research context; rigour; and data management. Furthermore, it examined the issues of validity and trustworthiness. The qualitative data collection techniques that were used were also discussed in detail, namely interviews, observations and diaries.

CHAPTER 5:
DYNAMICS ABOUT THE SCIENTIFIC LANGUAGE REGISTER FOR NATURAL SCIENCES IN ISINDEBELE.

5.1. INTRODUCTION

This chapter presents the data collected for the purposes of this study. In addition, the data is discussed, and findings are reported. This study was guided by the following research questions:

- What are the opportunities and challenges in the development of the scientific language register for Natural Sciences in isiNdebele and its application?
- What are the stakeholder's perceptions about the use of isiNdebele as the language of learning and teaching Natural Science?
- How did the developed scientific language register for Natural Sciences in isiNdebele shape classroom interactions and discourses?

However, this chapter will present the data collected and the findings of this study, focusing on two research questions. Which are:

- What are the opportunities and challenges in the development of the scientific language register for Natural Sciences in isiNdebele and its application?
- What are the stakeholder's perceptions about the use of isiNdebele as the language of learning and teaching Natural Science?

The researcher wanted to note the opportunities and challenges in the development of the scientific language register for Natural Sciences in isiNdebele and its application, as well as understand stakeholder perceptions about using isiNdebele as the language of learning and teaching Natural Sciences.

5.2. DYNAMICS OF THE SCIENTIFIC LANGUAGE REGISTER FOR NATURAL SCIENCES IN ISINDEBELE

This section will focus on the first research question of this study. What are the opportunities and challenges in the development of the scientific language register for Natural Sciences in isiNdebele and its application?

The below table indicates the theme and categories used to manage the data.

Themes	Categories
Theme 1	
Development of scientific language register for Natural Sciences in isiNdebele: Opportunities and chlallenges	Opportunities
	Challenges

5.2.1. Data Presentation and Discussion

With isiNdebele being the indigenous language recognised as one of the official languages in South African schools in the year 1985, it has painted a blueprint for the steady development of this language. This language was introduced in schools even though they lacked the resources at that time.

As indicated in chapter 4 while researcher was developing this register, she encountered many challenges regarding some of the natural sciences terminologies in isiNdebele. She then contacted the isiNdebele PANSALB chairperson regarding the matter, as indicated below:

> *"Before the researcher started developing a register, she had a meeting with isiNdebele Pan South African Language Board (PANSALB) chairperson. During our discussion the chairperson alluded that the biggest challenge with isiNdebele there are limited terminologies let alone the scientific terms. He further made the researcher aware of the challenges that they have as a board. Amongst others he noted that most of the isiNdebele terms are borrowed from Afrikaans and they are still in the process of changing them"*

From the above description, it paints a clear picture that isiNdebele is still way behind in terms of development, as alluded to by (Abongdia, 2013; Skhosana, 2002). Mr Mahlangu also made another assertion as he mentioned one of the challenges they encounter when developing isiNdebele scientific terms. His assertion is captured below:

> *"It is still difficult to do that for a fact that it is a still struggle because there are no one word terms. Hence, that means they must join two or more terms to come up with the equivalent word. such as "weather" is derived from two terms which is "ubujamo" and "bezulu" = "Ubujamobezulu"*

The researcher was also provided with isiNdebele dictonary and Multilingual Natural Sciences & Terminology term list, written in English, Afrikaans, isiNdebele, isiZulu, IsiXhosa, and Siswati to use as a reference as she developed her register. However, the provided dictionary and Multilingual Natural Sciences & Terminology term list did not assist the researcher in any way, as there were no terms relevant to the researcher. See the captured transcript below:

> *"Beyond the conversation with the chairperson, he sent the researcher the isiNdebele dictonary and Multilingual Natural Sciences & Terminology term list, written in English, Afrikaans, isiNdebele, isiZulu, isiXhosa and Siswati. The researcher went through the documents and she discovered that Mr Mahlangu's assertion are true, that the language has limited terms, and most are borrowed from Afrikaans. Terms such as: "Aluminium" which is " I-aluminiyamu" the word is directly translated from English and written in isiNdebele."*

As the researcher developed the register, experiencing the lack of isiNdebele scientific terms, she contacted isiNdebele teachers she knew. See the description below.

> *While the researcher was developing the register there were terms that she could not explain in isiNdebele or find a better explanation for them, she made calls to ask isiNdebele teachers she knew. Their response was similar to that of Mr Mahlangu to say there are no such terms in isiNdebele, their advice was to use an equivalent term or*

derive terms using my understanding based on how the term should be used in the context

Since the researcher resides in one of the villages of KwaNdebele, there are few older citizens in her area. She also consulted these older citizens regarding the definitions of these scientific terms and equivalent terms she could use in her register. See the description below.

"*I consulted some of the isiNdebele speaking senior citizens in the village asking them the word they would use to explain terms such as filtration amongst others. They made it clear that they don't understand the term in English, I then explained the process of filtration to them using isiNdebele. some said the equivalent word to that could me ukuhlunga/ukuhlukanisa and some said ukusefa. I then engaged with Mr Nsizwa Mahlangu to assist in choosing the term that best fit filtration which we decided to use ukusefa taking considering of the context of this term which supported Mr Mahlangus's assertion in the above transcript".*

The above description attests to the assertions made by Skhosana (2002) and Mahlangu (2014) that there are limited scientific terms in isiNdebele. The researcher was successful in developing equivalent terms while keeping in mind how the developed terms would be used in a scientific context.

Irrespective of the challenges encountered by the researcher when developing the register, there were also opportunities identified by the researcher. The researchers being provided by the dictonary and Multilingual Natural Sciences & Terminology term list, written in English, Afrikaans, isiNdebele, IsiZulu, IsiXhosa, and Siswati, showed the progress made in terms of developing scientific terms in indigenous languages. However, there were minimum terms in isiNdebele. Furthermore, most of the developed terms in isiNdebele were direct translations and borrowings from Afrikaans, as (Mahlangu, 2014; Skhosana, 1988) alluded to.

The researcher also contacted Mr. Nsizwa Mahlangu, who assisted in developing scientific terms for this register; see the description below.

I saw my friend's WhatsApp status posted about Mr Nsizwa Mahlangu who is an IsiNdebele teacher and a writer of some of isiNdebele textbooks and poems. He was going to talk about months of the year and their meaning in isiNdebele on iKwekwezi Fm. I then asked for his numbers. I contacted Mr Nsizwa Mahlangu explaining the purpose of my study and the challenges I have with lack of scientific terms written in isiNdebele. terms such as: chromatography, pure-substances, and materials. He noted that there are no such terms in isiNdebele hence they need to be developed. I also made it clear to him that the terms should not be directly translated from English. He further said he will develop them and revert to me. He sent the terms to me with definitions.

From the above, there are limited scientific terms in isiNdebele. However, that does not overrule the fact that these terms can gradually be developed until this language has all the scientific terms, whether by using direct translation or by using borrowed terms, just like Afrikaans, which was developed through borrowed terms from Dutch. To this date, Afrikaans is considered as an official language and a medium of instruction in some South African schools, and it has developed gradually. This shows that all the native languages can get to this point if they work hard and keep going.

5.2.2. Findings

The findings of this study reveal that IsiNdebele is still a developing language as there are still limited scientific terms in IsiNdebele. Furthermore, the existing scientific terms in isiNdebele are mostly borrowed terms from Afrikaans and English, and some are directly translated from English and Afrikaans. This poses a hurdle for linguists and scientists in terms of the work that needs to be done to develop such terms so that this language will enjoy the same status as English and Afrikaans as not being recognised as an official language but as a medium of instruction across the grades up to higher institution level.

The gradual development of this language is, however, promising, such as having a bible and dictonary written in isiNdebele and having terms in the

Multilingual Natural Sciences & Terminology term list shows progress, though it is still minimal. Looking at how Afrikaans was developed, it gives hope that one day even isiNdebele will reach its milepost and enjoy a national status just like English and Afrikaans.

5.3. STAKE HOLDERS' PERCEPTIONS

This section focused on the second research question.

The below table indicates the theme and categories used to manage data.

Themes	Categories
Theme 2	
Perceptions of stake holders about the use of isiNdebele as the language of learning and teaching Natural Sciences	Teachers perception
	Learner perceptions
	Parents perceptions

5.3.1 Case one: John from Funda combined school

5.3.1.1 Data presentation and discussion

The South African School Act (SASA) (84 of 1996) stipulates that beyond the third grade, it is within the choice of parents and the school governing body (SGB) to choose the medium of instruction. However, this is still a paper policy in rural schools since learners are still subjected to learning all the subjects in English due to the lack of resources in indigenous languages (Abongdia, 2013). As the researcher was creating the isiNdebele scientific language register, she needed to know what stakeholders (teachers, learners, and parents) perceptions about using isiNdebele to teach natural sciences. John the teacher indicated that:

> *"I think it would be good… Most of the learners when you are explaining to them like I said in certain topics they understand their language easier than English. And you find out most of the learners they know the topic is just like they did not know the word in English. Like today I had a learner who came to school to ask about it was mostly planet earth and beyond the topic. So, I asked him about a supernova. So, he could not explain a supernova like in English but*

when I explained to the learner what is a supernova she said I know that thing(yikhwezi) is just I do not know how to explain it in English, but I could explain in my language in IsiNdebele"

According to the above, the teacher expresses and supports his views on the use of isiNdebele to teach natural sciences.This demonstrates that, while English is considered a medium of instruction for African learners, it can be a barrier to effective teaching and learning, as Roy-Campbell (2019) and Motala (2014) have noted.From the teacher's view, learners understand certain topics better when they are explained in their mother tongue, which attests to Motloung et al. (2021) and Adesemowo (2017), who made assertions that there are benefits to using indigenous language to teach African learners as they are able to understand better and relate to concepts in their own language and culture. Adesemowo's assertions are further supported by the below response from John:

"isiNdebele it is their home language, it is the language that they know better than any other language. It is easier for you to explain to them in isiNdebele. Some of the things that they learn in school. It is some of the things that they also do at home it is just that they are not familiar with the terminologies used in English and in their language you have to find a way maybe have like pictures and show them pictures then they tell you oh we know this thing is just that we do not know the exact word in English but we know it in our own language".

The teacher also made assertions on the impact the language has in terms of learners' performance in teaching Natural Sciences (see below transcript).

"Yes, I think it has an impact" … "English which is used to teach Natural Sciences itself it is difficult for the learners looking at their background, their environment they grow in, the language used most of the time, it is their home languages. And when… the only time they use English, it is when they are in class. So, most of the vocabulary they develop it from their own language. So when it comes to you explaining something in English, not every learner understands English, there are those who understand English you can teach them

and they will understand in English but most of the learners like the majority will find that you have to explain again in their languages. That is when the topic becomes easier. So you will have to explain with their languages. It is not that they do not know the topics or certain learning areas. It is just that the language in which the area is taught. It becomes difficult when it is taught in English"

Researchers such as (McKinney & Tyler, 2019; Mweli, 2018; Milligan & Tikly, 2016) have alluded to the difficulties that English presents to African children and the negative impact it has on their performance. The fact that learners find it difficult to understand concepts when taught only in English indicates the struggle that the medium of instruction poses to African learners. This struggle, as alluded to by (Sibanda & Baxen, 2016; Hugo & Lenyai, 2013), results in teachers devising other means to explain to learners in their mother tongue so they can have a better understanding. This practise is referred to as "code-switching" by (Maluleke, 2019).

Researchers such as Adesemowo (2017), political commentators such as Dr Somadoda Fikeni, traditionalists such as Zolani Mkiva, and Historian and Cultural Analyst Professor Pitika Ntuli affirm that learning in the mother tongue improves learner's performance. This is confirmed by learners' responses to their perceptions:

"Mina ma'am ngicabanga ukuthi nasingafunda iNatural science ngesiNdebele kungaba ncono (I think if we could learn in isiNdebele it would be better) and some of us could understand more, abanye sine (some of us we have) passion in learning but inkinga (the challenge) is the language which is English that they are using is difficult for us to understand. So, in other words, if we could learn ngesiNdebele it would be better singa performer kuhle (we could do our best) most of us"

"Yes, nami ngivumelana naye (I also agree with her) cause if singafunda ngesiNdebele singaphasa ngobuningi cause I English le asiyiunderstand'i if we can be taught in isiNdebele majority of us could

pass, because when we are taught in English we fail due to the fact that we do not understand English)"

They also alluded to the impact that the medium of instruction has on their performance:

" Not really good Ma'am, because we do not understand more in English. Asizwisisi kuhle" L1
"Because like i-English i-difficult, abanye abantwana abanengi aba-understand so nabahlathulula ngesiNdebele (some learners do not understand it, but when concepts are explained in isiNdebele it becomes much better and ne-performance ingaba different (can be different)" L2.

The foregoing supports the claims made by McKinney and Tyler (2019); Mweli (2018) & Milligan and Tikly (2016) about the difficulties that English presents to African children and the negative impact it has on their performance (Adesemowo, 2017). The learners further noted the language they would prefer to learn Natural Sciences. Their responses are captured below.

"I-language engingayi-prefer yisiNdebele (the language I would prefer) because mostly ama-learners la esikolweni (most learners here at school) they understand isiNdebele better than i-English because not everyone perfectly know i-English. It is better if they could use isiNdebele." L1

"Nami I prefer isiNdebele because isiNdebele vele is my home language and I understand it better ukudlula isiNgisi (than English)." L2

From the above, these learners are more comfortable with isiNdebele being used to teach Natural Sciences based on the fact that it is their mother tongue and they understand it better than English.

Despite the difficulties that the medium of instruction poses for African learners, it remains the preferred language of teaching and learning, not only for parents

but also for some learners (Tshotsho, 2013; Tembe & Norton, 2011; Kishindo, 2010). See the below:

> ***"****Angeke kube kuhle ngoba abanye emakhaya abazali babajwayeze i-English. Mina ngicabanga ukuthi kuyoba nzima kibo nasekufanele bafunde ngesiNdebele. Ngeke besakgona ukuphasa kuhle. (I do not think it will be good because most of the learners their parents want them to speak and get used to English, it would be difficult for them to understand natural sciences in isiNdebele and that will affect their performance)." L1*
>
> *"Ma'am, na u-transfer ama-Science to isiNdebele, ngathi kuzoba nobudisa nyana ngoba isiNdebele si-deep nyana ukudlula thina asisazi isiNdebele, so angiboni ukuthi isiNdebele singaba-easy ukuthi sifunde ngaso i-Natural Science. (ma'am transferring science concepts to isiNdebele It will be way difficult for me, since I am not fluent in isiNdebele because, I prefer English)". L2*

The above supports (Ball, 2010; Kishindo, 2010) assertions on parents' perceptions of the use of indigenous languages to teach their kids. Furthermore, it outlines the influence these parents have on their kids in terms of why they should prefer English as a medium of instruction. The learner's response to the difficulty of transferring science concepts to isiNdebele confirms Cummins's assertion that skills which are learned in a first language, which is the mother tongue, can be transferred to a second language, which is English, but the skills learned in English cannot be transferred to the mother tongue (2001).

See the continuation of the questions from the above and refer to Pre-interview group 2: Funda combined school from lines 26-63 (p 1-2). The teacher indicated that she is not sure why they are being taught in English. The conversation shows how the learner values English, irrespective of how little she understands being taught in it, yet she still prefers it because she does not understand her own language. This confirms Tshotsho's (2013) and Heugh's (2008) assertions on how African learners and parents devalue indigenous languages while placing a value on English and Afrikaans. Cummins (2001) further alluded that favouring of the dominant language could bear unfavourable results as it could be a barrier

between kids and their identity because they may fail to communicate in their mother tongue while they are fluent in English, which is a foreign language to them. This is the case with some of the learners who prefer English as the medium of instruction.

According to (McKinney & Tyler, 2019; Nomlomo, 2017; Milligan & Tikly, 2016; Heugh, 2013), the transition from learning all content subjects in the mother tongue from grades 1-3 to learning all content subjects in English from grades 4-12 has a greater negative impact on African learners' performance. Regardless of the impact, African parents still promote the use of English as a medium of instruction in schools. See below:

> *"Madam, 1, vocabulary. Ok, let me start by indicating that it is fine teaching using isiNdebele as a medium of instruction in teaching. it is orderly, the only challenge would be concepts. That I personally perceive that it will disadvantage our learners. One, there may be concepts that are not yet known to them. Remember when we talk teaching, we are integrating the prior knowledge with the new knowledge. Now, learners will be disadvantaged by the fact that their prior knowledge does not know the concepts that they will be bringing into class. That's basically my perception".*

From the above, parents do not promote the use of indigenous languages to teach natural sciences because English has an advanced vocabulary and that there are limited resources in indigenous languages, which is true. However, I do not see that as a reason enough to deprive African learners of the privilege of learning in their mother tongue just like their counterparts, as resources could be developed with time.

This is how the parent responded when asked which language they would like their children to learn:

> *"Ma'am let them use the same English language though there should be a room to accommodate, as I spoke about prior knowledge. The interaction, the combination must always be there. Hence, I spoke about code switching to say where need be, that is why it is always*

good that teachers need to code switch so to ensure that they do not leave these kids behind".

The parent indicated that he would prefer his child to learn Natural Sciences in English. He also recommends the necessity of code-switching to ensure that "learners are not left behind." Which makes his statement contradictory to his preferred choice of language, as code-switching is the use of two or more languages, which could be English and an indigenous language. This practise is done to clarify concepts in the mother-tongue where English fails (Uys, 2010; Abad, 2010). The above statement indicates that the participant is aware of the shortfall of using English as the medium of instruction for African learners. However, he is still blinded by the status engendered by English (Tembe & Norton, 2011). This practise was highly discouraged by Chief Justice of the Constitutional Court of South Africa, Mogoeng Mogoeng, when he was delivering a speech at an event to celebrate indigenous languages at the University of Johannesburg's Soweto Campus on the 22nd of February 2019. He totally dispelled such a perception held by African parents, as he argued that the notion that English will help one progress in the corporate world is wrong because the Chinese, Koreans, and many others are surviving using their mother tongue.

Irrespective of the status and benefits that come with using English as a medium of instruction, some parents still feel it is not the preferred medium of instruction. See the below:

"*Okay, you see using any African language for a start to teach natural science it is a good idea, it assists learners to get more understanding of the subject one, two assist learners to get a clear and exactly what this subject is all about. And lastly, it makes easier for even parents at home to assist learners with their schoolwork if they have got a little bit of home language which you are referring to as IsiNdebele, as most of the parents never got that chance to go further with their studies."P1*

"isiNdebele yi-language esiyiberegisako sibabantu sihlala KwaNdebele nathi simaNdebele ngoba kukhona abanye abantu abangasi maNdebele. Bese ke, okwenzakalako nasisebenzisa ilimi

lethu, kwezinye imfundo zesikolo lesi, abantwana bazokgona ukuthi bezwisise masinyana ngoba bahlala bakhuluma isiNdebele nemakhaya, bahlala baphila ngaso yoke into abayikhulumako baberegisa isiNdebele. Manje na singaberekisa isiNdebele ema-subjectini akhona la, Kungabamnandi khulu ngoba bazojwayela indlela then ngicabanga ukuthi kunamathuba wokuthi babenama-marks amanengi, bazo-excella esikolweni.(If they use isiNdebele, learners will perform better because it is the language that they are used to and it is their home language they are used to the language. They talk using this language at home and both at school. So, they will be excelling in their subjects).”P2

“It is good to teach Natural Science ngesiNdebele just because some learners would not understand English properly. And when we teach with isiNdebele, some of them are going to understand clearly, rather than to teach in English. Then I think isiNdebele is a home language, every person is going to understand everything that is teaching in isiNdebele” P3

“My perception of teaching Natural Sciences in IsiNdebele, I think it is a good initiative because obviously we could switch when we normally teach our children so i think it will be a good news for us as educators to make use of IsiNdebele as our language in Natural science”. P4

They further alluded to the impact that English has as compared to IsiNdebele in the teaching of Natural Sciences.

“*Yes they have got an impact. My reason to that is If they are going to be teaching in their language, some children particularly do not understand the language, the English, the national language. But they do not understand it. But if they are taught in their home language, they will get higher marks and excel in the subject”. P1*

“Yes. I think it is English, but it is not very good just because like I say from question 1, to teach natural Sciences in isiNdebele is going to teach all the learners to understand very well what Natural Science is.

What they are meaning when they say Natural Science and it is going to understand everything about Natural Science because some of the learners they do not understand English clearly. And then if we teach Natural Science with isiNdebele, they going to be clear".P2

"Yes it does have an impact because normally we code switch, we clarify many forms in IsiNdebele to help learners understand."P3

Parents were also asked in which language they would like their children to be taught Natural Sciences; one parent stated:

***"**preferable one it can be isiNdebele. Because of all the children that are living here, most of them are the Ndebele's. They understand isiNdebele because it is the home language. Everything that they speak, they speak in Ndebele language. English, I know that is a communication language but the best language is going to be isiNdebele".*

The above responses shed light that they do acknowledge the benefits that come with English as a medium of instruction. But the use of indigenous language as a medium of instruction could bear much success as these learners will be learning in the language which they understand better and they could perform better, as alluded to by researchers such as (Adedemowo, 2017). These parents share the same sentiment with political commentators such as Dr Somadoda Fikeni, traditionalists such as Zolani Mkiva, and Historian and Cultural Analyst Professor Pitika Ntuli, who affirms that learning in the mother tongue improves a learner's performance. Traditionalist Zolani Mkiva, the general secretary of the Congress of Traditional Leaders of South Africa (CONTRALESA), is also in support of the use of indigenous languages as a medium of instruction. He believes that indigenous wisdom should be incorporated into the curriculum so that it is not lost over time (Ngobeni, 2020).He also believes that the intellect of people is better tested when they use their mother tongue because it takes longer for one to learn a foreign language, and he noted that better results will be achieved across the board if learners are taught in their home languages.

5.3.1.2 Findings

Teacher's perceptions

This study reveals that John has a positive perception of the use of indigenous languages, which in this case is isiNdebele, to teach Natural Sciences. He noted the benefits of using the isiNdebele to teach Natural Sciences. John commented on the negative impact the medium of instruction, which is English, has on the teaching and learning. He also noted how easily learners can understand and relate to concepts if they are explained in their mother tongue compared to when they are explained only in English. The practise John refers to is called code-switching, which is dominantly used to explain concepts to learners so they can better understand when English fails.

Learners perceptions

This study also reveals different perceptions held by learners. Learners in this case shared different perceptions about the use of isiNdebele to teach Natural Sciences. Some learners reveal that using isiNdebele will disadvantage them as they are not fluent in their mother tongue and, further to that, it is their parents' wishes for them to be fluent English speakers. These learners also highlighted that they do not clearly understand when they are being taught in English, but still prefer it. This reflected the influence and pressure they got from their parents regarding the use of indigenous languages as a medium of instruction. Contrary to what they claimed, some saw the use of IsiNdebele to teach Natural Sciences as a greater opportunity for them to excel in the subject, citing their difficulties understanding concepts in English.They further highlighted the negative impact English has on their performance and how code-switching practise helps them understand the concepts.

Parents perceptions

Parents' perceptions on the use of isiNdebele to teach natural sciences differed from those of learners. This study reveals that some parents still prefer English as a medium of instruction for the fact that it has a developed vocabulary and that isiNdebele has limited scientific terms. Irrespective of their choice of the medium, they still promote the use of code-switching to assist learners to have a better understanding of the concepts. Their responses are contradictory and paint a clear picture that they know the struggles their kids are facing being taught in English, but the benefits and status that come with using English as a medium of instruction over-shadow their perception. This was evident during the interviews. Some parents endorsed the use of isiNdebele to teach natural sciences. Their perceptions were strongly based on the fact that their kids were very fluent in isiNdebele as it is their home language, and hence they will do better in the subject as there will be a limited language barrier as it is the language that they understand best. These parents further noted how using isiNdebele will make them actively involved in their kids' schoolwork as they will be able to assist them with their homework. Because as the status quo stands now, they are limited because they are not fluent in English.

5.3.2 Case two: Mandla from Khanya combined school

5.3.2.1 Data presentation and discussion

The use of English as a medium of instruction in South African schools is not only supported by African parents but by African teachers as well (Jankie, 2010)**.** See the below:

> ***"****Preferably, I prefer English because I think, number 1 it is because of the terminology that is used in Natural Sciences, it is not English per se, but it is Science. Then it is better off taught to them in English so that they can also be able to interpret whatever it is that the textbooks are saying to them so that it is not a strange thing that they are starting to see Natural Sciences in English."*

From the above, the teacher's choice of language is based on the learner's interpretation of Natural Science concepts and on being familiar with these concepts written in English. The teacher was further asked about his perception of the use of isiNdebele to teach Natural Sciences. His responses were:

> ***"****I do not think it is going to help because if you have, the learners are being taught in isiNdebele. So they might expect the next person to use isiNdebele as well. While the next person cannot be a Ndebele speaker or a Pedi speaker. So that is that about the use of their home languages in teaching Natural Sciences."*

The participant criticised the use of isiNdebele to teach Natural Sciences because not all teachers are able to teach in isiNdebele. Further questions were posed to him based on his language choice and perceptions, such as whether he encountered any difficulties when teaching Natural Sciences in English.

> ***"****Yes, because, mostly it is learners who do not speak English at home as their first language. So the content becomes a challenge and they have a problem with interpretation of the terminologies used in Natural Science for it to make sense to them so you have to code switch."*

From the above extract, learners have difficulty understanding not only the science concepts but the language as well. The participants' responses attest to Schaffer's (2007) assertion that African learners do not only struggle with the language but the science concepts as well. The participant was further asked about the code-switching practise he mentioned:

> ***"****I do code switch, so that the content makes sense to my learners so that they can remember it, because I think it is easier for them to remember their own language other than remembering foreign language to them."*

The teacher's response to the use of code switching to make learners remember the concepts confirms Adesemowo's (2017) assertion that learners understand and relate to concepts better in their mother tongue. Furthermore, his above response relates to the need and benefits of code switching, which is to clarify

concepts in indigenous languages to ensure effective teaching and learning, as alluded to by (Yusob et al., 2018).

The participant was also asked about the general performance and the impact language has on the learner's performance:

> *"It is moderate…Because as Natural Science is a content subject and the textbooks and whatever notes that they might use, they are printed in English and I think they spend most of their time speaking their home language inside the classroom with their friends, outside the classroom with their schoolmates. And when they get back home in the community, they also speak isiNdebele and Sepedi some of them. And so I think the language that is used there might hinder them because some of them they might have language anxiety whereby they are afraid to ask questions in English or to proper answer the questions that they are asked during examinations and tests"*

The teacher's response attests to the fact that English can be a barrier to effective teaching and learning, which could result in a learner's poor performance on the subject, as noted by (van Pinxteren, 2022; Mokiwa & Msila, 2013). His comments on the use of English as a medium of instruction, that it makes learners "anxious and afraid to ask questions", alludes to the fact that teaching African learners in English is more like "torturing" them, as noted by (Malekela, 2003).

Based on the teacher's responses, I asked in what language he would prefer his learners to learn Natural Sciences.

> ***"***On that one I think obviously, since my learners are Ndebele, they speak isiNdebele, so they would prefer the Natural Sciences also to be taught in isiNdebele. I think, number 1, it is because they would be free to ask questions as much as they wish. And they will better understand it because now they would easily relate the content with their day-to-day activities, and they would answer the questions better. And they would understand the questions better since they would be, or rather if it may be their home language."

From the teacher's response It was clear that, irrespective of his choice of medium of instruction, he was aware of the benefits that come with using an indigenous language to teach African learners. This was confirmed by his responses to "learners being afraid to answer questions when being taught in English" as opposed to "learners being free to ask questions when using their mother tongue". His statements attest to the fact that he is aware of the struggle and torture these learners are experiencing when being taught in English. But they choose to ignore it due to the status and benefits that come with English being used as a medium of instruction. His responses attest to Bloch's (2009) assertions that Africans depress the use of indigenous languages, uplifting the dominant language at the expense of indigenous languages. This practise is further referred to by Tshotsho (2013) and Heugh (2008) as "self-hate".

When collecting the data for this study, It was pertinent that I investigate not only teachers' and parents' perceptions but also learners' perceptions of the use of IsiNdebele to teach Natural Sciences. Their responses are captured below.

> ***"****Singa-understand because yi-home language yethu, siyayikhuluma emakhaya. Singayi-understand more. (we can understand more because it is our home language)" L1*
>
> *"Nge-language esiyijwayele vele sizoyi-understand yonke. (Learning in the language we familiar with, will make us understand)" L2*

Learners made it clear that the initiative of using IsiNdebele to teach Natural Sciences can improve their understanding because they will be learning in their home language. They were then interviewed about their performance on the subject and how the language they used affected their performance. Below are their responses:

> *"I-normal…Well, it is because of, sometimes we understand and sometimes we do not understand" L1*
> *"Ngoba asizwisisi kuhle nge English (we do not understand clearly in English)" L2 "Nasifunda nge-English, amagama amanye ayasihlula.* ***(****English have difficult terms, that we do not understand)" L3*

These learners made it clear that the language used to teach Natural Science has a negative impact on the performance, as alluded to by (McKinney & Tyler, 2019; Mweli, 2018; Milligan & Tikly, 2016). They have further noted that "sometimes they do understand and sometimes they do not understand." That shows a gap between the content taught to them and their level of understanding of the content.

Irrespective of how the medium (English) of instructions is criticised by researchers, such as by (McKinney & Tyler, 2019; Mweli, 2018; Milligan & Tikly, 2016), To some learners, it is still the most preferred medium of instruction. See the below:

> *“Kungaba bad (it would be bad). Because sesijwayele i- English and abazali bethu bafuna sazi i-English (we are used to English and our to parents want us be fluent in English)”*

The information presented above reveals learners' perceptions on the use of isiNdebele to teach natural sciences. Their responses are totally against the initiative because they are used to English. Furthermore, they noted the fact that their parents want them to be fluent in English. However, these learners are still not fluent and do not understand English, as they have noted that they understand it "sometimes." Bloch (2009) observes that their perceptions on the use of indigenous languages are solely influenced by their parents.

According to Tembe and Norton (2011), fluency in English is highly valued by black African parents as they regard it as essential for success in the corporate world. It was pertinent for me to understand the parent’s perceptions if they share the same sentiment as the above-cited researchers on the use of isiNdebele to teach natural sciences. Their responses are captured below.

> *“Bangayi-understand more than lokha bayifunda nge-English angitjho isiNdebele it is our mother language then bazoyi-understand more then ne-rate yabo ye-pass rate izokhuphuka because everything, bayikhuluma nge-language abayi understandayo. (They will understand better compared to when they are being taught in English*

because they will be learning in their mother tongue. That will also improve their pass rate rapidly)" P1

"I think if as a school IsiNdebele, is one of the languages for medium of instructions, first additional language, so it will be in advantage of learners because they will know exactly what they are talking about and they will hear the teacher very well because it is their mother tongue." P2

"I think, IsiNdebele especially because we have the Ndebele kids, my take would be I think it would make them achieve more because basically they will be using their own language and which of course they will be able to understand whatever question, whatever you know, whatever they want to say. I think to me that will make them to be more proficient in terms of you know the outcome" P3

From the above responses, these parents are in support of the use of isiNdebele to teach Natural Sciences. Furthermore, they noted that teaching these learners in their home language will benefit them as they will have a better understanding of the subject. Hence, that will improve their performance, as noted by traditionalist Zolani Mkiva, the general-secretary of the Congress of Traditional Leaders of South Africa (CONTRALESA), that the intellect of people is better tested when they use their mother-tongue because it takes longer for one to learn a foreign language. He further alluded that better results will be achieved across the board if learners are taught in their home languages.

The parents were interviewed to determine whether language influenced their child's performance. Their responses are captured below.

*"I think it is around 50 to 60 %, which mean we are not reaching the target, because our district is 80% and above, so generally we are not there**…** "Yes I think so, because most of the time our learner, they are talking their mother tongue so when we are doing teaching and learning we are using English so language can be a barrier. I think it is having a negative impact but if they are using the language that they understand, they even talk that language at home. The performance will be much better." P1*

"Definitely, definitely you know English cuts across basically but what I could say is amongst other things some of our learners are not proficient in terms of English language, so they might be knowing answers, but the problem would be they do not understand the question. If they are taught in their language they will be clued up and they will be able to you know, perform very well" P2

These parents were further interviewed about the preferred language for their kids to learn Natural Sciences. See their responses below.

"*Nakukgonala ngesiNdebele, ngingavuma ukuthi alifunde ngoba uzokuzwisisa ngcono nama-term la ukuthi nasikhuluma ngento enje, sikhuluma ngani ngoba lilimi alizwayo lelo.(If it is possible I would prefer my child to learn Natural Sciences in isiNdebele because they will able to understand all the terms and all the contents in their mother-tongue which they speak every day and they are used to)." P1*

"It depends on circumstance but here at our school we are offering two languages which is Sepedi and IsiNdebele our African languages so it depends but most of our learners are using IsiNdebele I think IsiNdebele can be much better because the learners who are learning in Sepedi, when they are playing outside they are using IsiNdebele I think it will be common to use IsiNdebele and they will definitely excel when using isiNdebele." P2

From the above parents' responses, these parents prefer indigenous languages for the fact that their kids will have a better understanding of the subject and they will perform better. They are in support of the University of South Africa's (UNISA) Acting Vice-Principal of Teaching, Learning, Community Engagement, and Student Support (2020), Prof Veronica McKay, who alluded that learning in one's mother-tongue could help learners understand better and improve performance (Liam, 2020).

5.3.2.2 Findings

Teachers perceptions

This study reveals that Mandla has negative perception about the use of isiNdebele to teach Natural Sciences. His perceptions are based on the fact that natural sciences is a language in and of itself, and textbooks are written in English; thus, he suggests that using English as a medium of instruction is preferable. He further noted that using isiNdebele will disadvantage learners as they will expect to learn using this language even in higher grades, which might not be possible as not all teachers are Ndebele speakers. Mandla also made a compelling case for how code-switching can help to ensure effective teaching and learning. His comment on the use and benefits of code-switching bears reference to the dire need for the use of indigenous languages as a medium of instructions.

Learners perceptions

The findings of this study reveal different perceptions held by learners. In this case, learners shared different perceptions about the use of isiNdebele to teach Natural Sciences. Some learners are in favour of using isiNdebele to teach Natural Sciences. They see this as their best chance to succeed in the subject. They further indicated that learning in isiNdebele will improve their performance in the subject as they will understand every concept taught to them because they will be using their mother tongue, which they understand better. On the same note, some students shared different perceptions as they indicated that they prefer to learn in English even though they do not understand it all the time. Their perception is strongly because they are used to being taught in English and their parents demand that they be fluent in English.

Parents perceptions

Parents in this case shared the same sentiments and embraced the use of isiNdebele to teach Natural Sciences. Their perceptions were strongly because isiNdebele is their mother tongue, which they speak on a daily basis and are fluent in. Hence, being taught in it will be an advantage to these learners. Furthermore, this will improve their performance in the subject as their pass rate

is moderate due to the language they use, which is foreign to them and they do not even understand it properly.

5.3.3. Case three: May from Khanya combined school

5.3.3.1 Data presentation and discussion

According to Guvercin (2011), the use of indigenous languages is highly discouraged by black African parents while, on the other hand, uplifting the use of the dominant language, which is English, due to the status it holds. For this study, it was pertinent for the researcher to evaluate the stakeholder's perceptions of the use of isiNdebele to teach natural sciences. See below from a teacher:

> *"It is bad. I think we should use English which is the medium of instruction and try to make it simpler for them to understand in English than using isiNdebele."*

From the above, the participant is not in support of the use of indigenous languages to teach African learners as alluded by (Guvercin, 2011). Based on her response she was further interviewed on the challenges she experiences when using English to teach Natural Sciences. Her response is captured below:

> *"In most cases, our learners they do not understand English basically and English is barrier to them"*

Regardless of how it may devaluethe use of indigenous languages to teach Natural Sciences. She is quite aware of how the use of English can be a barrier and further hinder meaningful learning, as alluded to by (Sibanda & Baxen, 2016). May further alluded to the challenges experienced by her learners using English as a medium of instruction. See the extract below.

> *"They do not understand. Sometimes you must explain more. Even in their home language and when they write, they forgot the English part, they write in their home language. Of which the subject is taught in English and is assessed in English"*

From the above, these learners are struggling using English as a medium of instruction to learn Natural Sciences as alluded to by (Sibanda & Baxen, 2016). From the teacher's responses, the researcher further asked her about the programmes they have in place to assist these learners. See the below:

> *"Usually sometimes if learners do not understand we switch to their home language because in most cases they do not understand English. We use the home language because they understand it better than the medium of instruction which is English."*

The participant mentioned that they use code-switching practice as an intervention strategy to assist learners to understand the concepts better, as noted by (Maluleke, 2019). This kind of practice is encouraged by researchers such as Yusob et al. (2018) as the best practice to explain the concepts better when English proficiency fails. This practice is used not only to help learners understand the concepts better but also to create an environment where teaching and learning occur at ease. May was also asked about the performance of learners in Natural Sciences. See the below:

> *"It is, for now, it is good. We have tried a lot to improve the problem of the barrier. We have made some notes to make the learners understand most of the words, hence I have said that we have used the dictionary and the vocabulary book and sometimes we have the debates. Sometimes we give them a chance to teach each other in the classroom."*

In her response, may emphasised the issue of the language barrier. Which confirms Historian and Cultural Analyst Professor Pitika Ntuli and Kwenda and Robinson's (2010) assertions on English being a barrier to meaningful learning and a detrimental factor to learners' poor performance.

Of the challenges she mentions, the language barrier experienced by her and the learners was She was further asked about her preferred language to teach Natural Sciences. Her response is captured below:

> *"I prefer English because most of the words in our home language are not there that are in Natural Sciences"*

From the above transcript, may chose English as a preferred language due to the fact that indigenous languages still lack scientific terms, which is true and has also been alluded to by Phiri et al. (2013) and Heugh (2013), that African parents and teachers still prefer English as a medium of instruction because it is well developed. Based on her response to the lack of scientific terms in isiNdebele, a follow-up question was asked about what she would prefer if the isiNdebele language was developed. See the below:

> *"I would prefer the home language because it is my home language. When you use the language that you are more comfortable with, the language that you understand the most, it is easy to respond even in more difficult questions."*

Her above response shows that she is in support of the use of indigenous languages as a medium of instruction. But currently, her choice is hindered by the fact that there is a lack of scientific terms in isiNdebele. Her choice of isiNdebele is strongly because it is easier to understand concepts when being taught in your home-language. This is further supported by traditionalist Zolani Mkiva, the general-secretary of the Congress of Traditional Leaders of South Africa (CONTRALESA), who opines that the intellect of people is better tested when they use their mother tongue because it takes longer for one to learn in a foreign language, and he noted that better results will be achieved across the board if learners are taught in their home languages.

Learners were also interviewed in this study. This was done to investigate their perceptions on the use of isiNdebele to teach Natural Sciences. See their responses below.

> *"Kungaba right (it would right) ngoba si-understand'a IsiNdebele kuhle than English (because we understand isiNdebele more than English)" L1*

> *"ngoba amagama weEnglish amanye abudisi manje ngesiNdebele siyawa zwisisa (some English terms are difficult to understand, but*

learning Natural Sciences in isiNdebele will make us understand those terms)" L2

"Ngoba IsiNdebele sisijwayele iEnglish asiyikhulumi ngamalanga nasifunda ngesiNdebele kuzoba ncono (We used to isiNdebele because it is our home language, and as for English we donot use it everyday. So if we can use isiNdebele to learn Natural Sciences things can be much better." L3

"Because some words are easier to understand in isiNdebele." L4

From the above responses from learners, they are in support of the use of indigenous languages to teach Natural Sciences based on the fact that they are comfortable and confident in their mother tongue. And that will lessen their frustration of being taught in a language that they are not fluent in (Malekela, 2003). They further made a very crucial assertion on why they perceive the use of isiNdebele to teach Natural Sciences as a good initiative. See the below:

"Because I usually use it. Nasekhaya singabuza ngoba abanye abayazi i-English so singakgona ukubabuza ba-understand bakgone ukusisiza ngama-homework nama-assignment and singaphasa kuhle khulu. (Even at home they will be able to assist us with homework and assignments and we can perform better)"

The above response paints a blueprint that these learners do not have the full support of their parents. In particular, the ones whose parents are illiterate. This shows that English can be a hindrance to parents' active participation in their children's schoolwork. They were then interviewed about their performance on the subject based on their responses. Their responses are captured below.

"Siphakathi nendawo…(Moderate) Because le English kusho ukuthi asiyazi. Sometime asi-understand bese na ama-test afika i-question thina siphendula i-opposite. (because we do not know English. And when we write assessments, we do not answer questions appropriately)"

From the responses they provided on their performance on the subject, they were further asked as to whether the language used to teach Natural Sciences has an impact or not. This is how one responded:

> *"Linomthelela Ma'am. Cause abanye abantwana aba-understand i-English so it's hard ukuthi abanye abantwana bayi-understand. Njengoba uMa'am akhuluma ngamagama a-difficult, and noma abhala ebhodini akusilula ukuthi abanye abantwana bawabambe and nakubhalwa ama-test abantwana bafeyili cause aba-understand i-English. (language has an impact Ma'am. Because some learners do not understand English, so it is hard for them to understand the concepts when the teacher is teaching particularly difficult terms. Even when the teacher writes on the board it is difficult for them to grasp these terms and when tests are written they also fail because they don't understand English."*

The above assertions clearly demonstrate how difficult English is for African learners. that is not only a barrier to effective learning; it is also a detrimental factor in learner's poor performance. Kwenda & Robinson (2010) argue that it hinders meaningful learning.

According to Phiri et al. (2013), a lack of teaching and learning resources in languages is one of the contributing factors to parents' negative attitude towards the use of indigenous languages as LoLT. These parents also do not want their kids to be taught in indigenous languages, as they prefer them to be taught in English (Jankie, 2010). For this study, parents' perceptions were also investigated regarding the use of isiNdebele to teach Natural Sciences. See their response below.

> "*Thank you for asking me that question. My perception on teaching in isiNdebele it is positive. And being positive in which way? In this way because most of our learners are staying or living with illiterate parents. So what they know better it is isiNdebele. So if it is in*

isiNdebele, it is their mother tongue, it is their home language, they will be able to relate what is being taught at school towards the home. Now the clash of teaching and learning will be far much easier and I think the performance of the learners is going to be far much better than now." P1

"Mina ngingakuthokozela khulu lokho ngoba kokuthoma kuzothuthukisa ulimi lethu lesiNdebele. Ngoba simaNdebele ilimi lethu lufundwa kanye, lufundwa ne kuyi-subject yesiNdebele kuphela. Amanye ama-subject awafundwa ngesiNdebele. Manje lokho kungangithokozisa khulu ngoba ilimi lethu lizabonakala ukuthi nalo liyathuthuka kancani kancani. (That would be great, and I am in support of that initiative, as that will make our language to progress and no longer be learned as a subject but be used as a medium of instructions as well)" P2

"Hie, my perception would be, I believe if the learners are being taught in their home language, it would be much better or they might understand in a better way compared to the other language, of which it is English or any other language. Home language normally is because daily they are using isiNdebele at home after school and during weekends. So most of these things which are science based normally, they are coming from this traditional background and everything. So, they normally do them at home. So, coming to school, it would have been much better if those things they are taught in home language because normally most of the words, the terms, the definitions or explanations normally they are there at home. So when it comes to school, they must understand much better. You have to think in English but you know the thing in isiNdebele now the learners they think the scientific words while he knows them much better in their home language." P3

From the above, parents are in total support of the use of isiNdebele to teach Natural Sciences. Their perceptions were strongly because learners are fluent in

their mother tongue, which will make it easier for them to comprehend and relate to the scientific concepts. Further to that, they noted that they will perform better as their intellect will be tested using their mother tongue, as alluded to by (Kembo-Sure & Webb, 2002), who indicated that the development and cognitive skills of learners befall more effectively in a language that the learner understands better, which provides a strong foundation for all learning and further improves their performance.

These parents were further asked about the learner's performance and if the language that is used to teach Natural Sciences has an impact on the learner's performance. See their responses below.

"it is moderate." P1

"It can. It can have a negative impact, because most of our learners do not understand English that much." P2

"Iye linomthelela. IsiNgisi omunye uyezwa mara akasizwisisi kusho ukuthini. Sometimes i-question naye bayambuza uthole ukuthi i-answer uyayazi ngoba bayibuza ngesiNgisi, akakgoni ukuyiphendula. Mara nakafundiswa ngesiNdebele, ilimi lekhaya and alikhuluma ekhaya, ngicabanga ukuthi kungaba yi-100% i-pass rate ngoba kuzobe kulilimi alaziko nalizwisisako. Awukho umbuzo wokuthi ngabhalelwa khona ukuwuphendula. (it has an impact because in English these learners do not understand. Sometimes they know the answers to questions being asked but due to the fact they use English they fail to respond to it). But if they were using isiNdebele which is their mother tongue it was going to be different and they will obtain a 100% pass rate because they will be using the language they are fluent in and understand better. Hence there would be no question that they will fail to answer."P3

"Yes, it does because most of these learners they only use English when they come to school. At home they speak isiNdebele or whatever language they speak. So when they come to school, we use

English. So it becomes a bit difficult to understand certain terms and also to understand teachers." P4

From the above transcript, parents highlight that English has a negative impact on learner performance as they struggle to understand the science concepts in English because they are not fluent in the language and it is not their mother tongue (Kwenda & Robinson, 2010). These parents were also interviewed about the preferred language for their children to use to learn Natural Sciences. This is how one of them responded:

"Mina ngingakhetha ukuthi afunde isiNdebele njengelimi alikhulumako ekhaya kuyi-home language yakhe. And angeke abe nekinga ngokuzwisisa begodu uzokuphasa khulu kunanje begodu ngizokukgona nokumrhelebha ngomberego wesikolo. (I prefer isiNdebele because it's their home language and they will have less challenges and they will pass with flying colors compared to now and I will also be able to assist them with their schoolwork)."

From the above response, the participant prefers isiNdebele because learners will understand it better and they will have fewer challenges in understanding the concepts as they will be using their mother tongue, which they are fluent in. She further made a very crucial point that she will also be able to assist her kids because they will be learning in a language she also understands better, hence that will further improve their performance in the subject (Adesemowo, 2017).

Regardless of the challenges the use of English as the medium of instruction poses to African children, there are still African parents who prefer the learners to be taught in English. See the transcripts below.

"*At the present moment we are still developing until we are fully developed, I think we are sticking to English. But when time goes on, everyone is on the board, then I would switch to isiNdebele" P1*

“Because it is easy to understand and most books in English, even the books that are not in their curriculum but for extensive research are written in English” P2

“I would prefer my child to use English because most of the resources we use in South Africa is in English. He can use isiNdebele for now but in future he will not benefit much out of it. I am telling you because in most parts of our world they use English. So using isiNdebele only benefits now but in future it will not benefit anything. So just for the benefit of my child, I would prefer that they use English” P3

“If it is Science, then I understand that most of the terms, of late, they are being taught in English. So they are learning in English, everything, the study guides, all the study material is in English. I will prefer my child to learn in English” P4

From the above transcripts, it is clear that this parents' choice of language is influenced by the fact that isiNdebele is still developing and it only holds the status of being an official language in South Africa due to the fact that it still has no registers for other subjects (Ball, 2010; Kishindo, 2010). Their choice is further influenced by the benefits that come with English being a medium of instruction, as alluded to by Tembe and Norton (2011), who noted that fluency in English is highly valued by black African parents as they regard it as essential for success in the corporate world. Their choice of preferred language determines the survival of the indigenous language and it is further defined by (Tshotsho, 2013; Heugh, 2008) as "self-hate" as they value the foreign language at the expense of their own language. As a researcher, I also find their choice of preferred language to be inadequate, as language can be developed with time. If Afrikaans was developed until it qualified to enjoy the status of being LoLT, from borrowing terms from Dutch, amongst other languages, It means any language can be developed gradually until it reaches such a status. However, that will take time and will need commitment from different stakeholders and fraternities.

5.3.3.2 Findings

Teachers perceptions

The findings of this study reveal that May has a negative perception of the use of isiNdebele to teach Natural Sciences. However, she acknowledges that learners do not understand English, but she still supports the use of it as a LoLT irrespective of the challenges it poses to African learners. May also highlighted that English is a barrier to African learners, which is contrary to her perceptions. She also made a very decisive point as she noted that the only way to assist these learners to comprehend the concepts or break a barrier is using code-switching. Her comments serve as a blueprint for the benefits of using indigenous languages as a medium of instruction and the dire need to develop indigenous languages to the point that they become the medium of instruction.

Learners perceptions

Learners perceived the use of isiNdebele to teach Natural Sciences as a great initiative. Their perceptions were strongly because they find it very difficult to comprehend science concepts in English as it is not their mother tongue. Furthermore, they mentioned the difficulties they face when answering assessments using English as a medium of instruction. From the struggles they faced being taught in English, they then supported being taught in isiNdebele. They based their perceptions on the fact that isiNdebele is their home language, which they understand better and fluently. Hence, they strongly believed that using it as a medium of instruction would limit their frustrations and improve their performance in the subject.

Parents perceptions

The findings of this study reveal that parents are totally in support of using isiNdebele to teach Natural Sciences. This is so because they strongly believe that if learners are taught in their home language, they will have a better understanding of the content as it is offered in the language they use every day both at school and at home. other than English, which they use at school and during specified periods. Hence, using their home language will be a great

advantage, which will give them opportunities to perform to the best of their abilities in Natural Sciences.

5.4. REFLECTION FROM THE CHAPTER

Drawing from the experiences the researcher had while developing the isiNdebele scientific language register, it is of no doubt that isiNdebele is still a developing language as far as science terms are concerned (Skhosana, 2002). This was further confirmed by the chairperson of PANSALB, who alluded that the biggest challenge with isiNdebele is that there are limited terminologies, let alone scientific terms. He further made the researcher aware of the challenges that they have as a board. Amongst others, he noted that most of the isiNdebele terms are borrowed from Afrikaans and they are still in the process of changing them. From Mr. Mahlangu's assertions, it was clear that the development of this language was steady. This is so because this language was officially recognised as an official language and introduced in schools in the year 1985 (Jiyane & Onyancha, 2010; Mnguni, 2004). After 37 years of this language being recognised as an official language and being introduced in schools, it has only launched its dictionary in 2006. which is 16 years after the recognition of this language. This paints the blueprint as to why we do not have scientific terms and register thus far. The pace of developing this language is too steady. That results in some parents, teachers, and learners having no confidence in the use of this language as a medium of instruction.

The teacher's perceptions about the use of isiNdebele as the language of learning and teaching natural sciences were different. One teacher was in total support of the use of isiNdebele to teach natural sciences. His perceptions were so because isiNdebele is the learner's home language, which they understand better and are fluent in. He further noted that it is easier for learners to understand and relate to concepts if they are explained in their mother tongue compared to when they are explained only in English (Maluleke, 2019). He also commented on the negative impact the medium of instruction, which is English, has on teaching and learning. And further highlighted the practise he always uses to

explain concepts to learners so they can better understand when English fails, which is code-switching (Yusob et al., 2018).

Two teachers acknowledged and accepted the challenges of using English as the medium of instruction, as they have indicated that English is a barrier to effective teaching and learning since it is not their home language, hence they do not understand it. Despite the difficulties that the medium of instruction presents for African learners, they prefer it as LoLT (Tshotsho, 2013; Tembe & Norton, 2011; Kishindo, 2010). Their choice of preference was based on the fact that isiNdebele has limited scientific resources and terms (Skhosana, 2002). Furthermore, they noted that using isiNdebele will disadvantage learners as they will expect to learn using this language even in higher grades, which might not be possible as not all teachers are Ndebele speakers. However, they made a very convincing point about how code-switching can be beneficial to ensure effective teaching and learning. Their comment on the use and benefits of code-switching bears reference to the dire need for the use of indigenous languages as a medium of instructions.

Learners in three different cases had different perspectives on the use of isiNdebele to teach Natural Sciences.Most learners were in support of this initiative, as they see this as the best opportunity for them to do well in the subject. They further indicated that learning in isiNdebele will improve their performance in the subject as they will understand every concept taught to them because they will be using their mother tongue, which they understand better (Motloung et al., 2021; Adesemowo, 2017). Furthermore, they highlighted the negative impact English has on their performance and how code-switching practise helps them understand the concepts.

From the above-mentioned facts, they strongly believed that using it as a medium of instruction would limit their frustrations and improve their performance in the subject. On the same note, some learners were against this initiative as they indicated that they preferred to learn in English as their parents demanded that they be fluent in this language. They also highlighted that they do not understand English but still prefer it. This reflected the influence and pressure they got from

their parents regarding the use of indigenous languages as a medium of instruction.

Like learners, parents also shared different perceptions across the cases. Most parents endorsed the use of isiNdebele to teach Natural Sciences. Their perceptions were strongly based on the fact that their kids were very fluent in isiNdebele as it is their home language, and hence they would perform better in the subject as there would be a limited language barrier as it is the language that they understand best (Adesemowo, 2017). Furthermore, it is their language of communication, which they use daily at home and at school. Unlike English, which they use at school and during specified periods, these parents further noted how using isiNdebele will make them actively involved in their kids' schoolwork as they will be able to assist them with their homework. Because as the status quo stands now, they are limited because they are not fluent in English. However, some parents discouraged the use of isiNdebele to teach Natural Sciences as they noted that isiNdebele is not well developed and English has a developed vocabulary and it is the language of supremacy and socio-economic development, and they want their kids to be fluent in it irrespective of the struggle they face using this language.

From the stakeholder’s responses on the status that comes with using English as a medium of instructions and the lack of resources in isiNdebele, one can infer that these two factors hinder their choice and make them hesitant about the use of isiNdebele as a medium of instructions.

5.5. SUMMARY

In this chapter, opportunities and challenges in the development of the scientific language register for Natural Sceinces in isiNdebele and the stakeholders' perceptions of the use of isiNdebele as the language of learning and teaching Natural Science were analysed, and the findings of this study were presented and discussed for each case. Furthermore, reflections were made from the findings of the two research questions outlined in this chapter. The next chapter will present and analyse the findings of the next research question of this study.

CHAPTER 6:
USING THE SCIENTIFIC LANGUAGE REGISTER FOR NATURAL SCIENCES IN ISINDEBELE

6.1. INTRODUCTION

This chapter presents the data collected for the purposes of this study. In addition, the data is discussed, and findings are reported. This study was guided by the following research questions:

- What are the opportunities and challenges in the development of the scientific language register for Natural Sciences in isiNdebele and its application?
- What are the stakeholder's perceptions about the use of isiNdebele as the language of learning and teaching Natural Science?
- How did the developed scientific language register for Natural Sciences in isiNdebele shape classroom interactions and discourses?

However, this chapter presents the data collected per case and the findings of this study, focusing on one of the research questions. Which is:

- How did the developed scientific language register for Natural Scineces in isiNdebele shape classroom interactions and discourses?

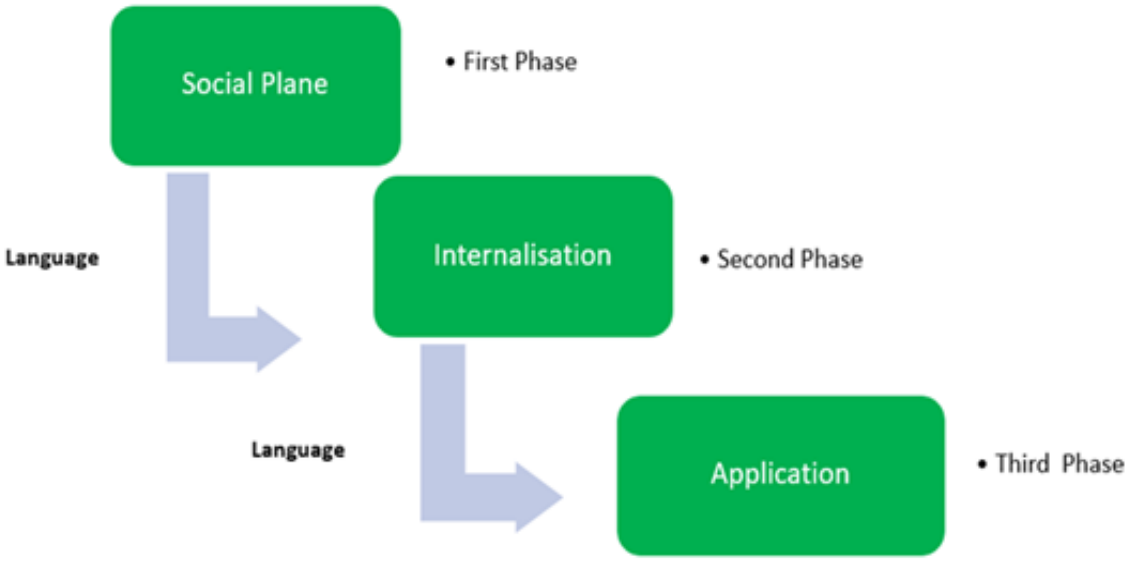
Here, the researcher wanted to know how the developed scientific language register for Natural Scineces in isiNdebele shape classroom interactions and discourses?

Below is the table indicating the theme that this chapter focused on and its categories.

Themes	Categories
Theme 3	
The influence of the developed register on classroom interactions and discourses	Types of discourses
	Patterns of discourse
	Teacher questioning
	Communicative approach

Classroom discourses are defined by Smart and Marshall (2012) as a diverse engagement between a teacher and a learner that could be best practiced orally in the form of discussions and debates. While Mudau (2013) defines classroom interactions as the involvement of teachers and learners closely working together to attain meaningful learning, Meaningful learning is a dialogic process wherein various ideas are brought together and reflected upon. Furthermore, the importance of interactions and discourses is highlighted by Mortimer and Scott (2003) as a fundamental to meaningful learning, which positively influences a learner's performance. They further alluded that meaningful learning occurs in three phases: the social plane, where the new content is presented to learners, the internalisation process, where learners are assisted to comprehend and make sense of the new content, and the application of the new content presented to them. These phases are facilitated by language, as it serves as a tool for interactions and discourses (Reis & Ng-A-Fook, 2010).

Figure: 6.1. Schematic diagram indicating the three phases of meaningful learning



From Mortimer and Scott's (2003) assertions on the importance of interactions and discourses, together with Reis and Ng-A-Fook (2010) assertions on the importance of language to enhance meaningful learning, It was plausible to develop and apply the scientific language register for Natural Sciences in

isiNdebele as it is a significant tool for learners to apply meaningfully what they have internalised, which is also through language, through which it happened in a social plane where again language is paramount.

6.2. CASE ONE: JOHN FROM FUNDA COMBINED SCHOOL

6.2.1 Data presentation and discussion

In the application of the register, I also wanted to understand the views of stakeholders on how the developed scientific language register for Natural Sciences in isiNdebele shape classroom interactions and discourses. John indicated that

> *"Yes, I think it does influence, because the register is written in their home-language making it easier for learners to interact when they understand the language rather than when using English register where their participation is minimal"*

His response above corresponds to how he responded during the interviews, as he noted that using isiNdebele to teach Natural Sciences can be a good initiative as these learners understand the concepts better when they are taught in their mother tongue compared to when they are taught in English. His assertions are further confirmed by Adesemowo (2017), who noted that the benefits of using an indigenous language to teach African learners is that learners can understand and relate to concepts in their own language and culture better. Learners were also asked the same question after an explanation of what a scientific register in isiNdebele entails. Some leaners responded as follows:

> *"Inomthelela omuhle ma'am ngobanyana sizokukgona ukuphendula imibuzo lula ngombana sizobe siyizwisisa ngoba ingelimu lekhethu neehlathululo zingelimi lekhethu". (yes, it has a good influence because we can interact since the register is written in our mother-tongue) L1.*

“Ma’am nasifunda nge register le siyakgona uku participator ngaphandle kokusaba ukuthi bazosihleka ngoba siberegisa sifunda ngelimilethu sikgona nokuqabanga msinya ngoba siyazwisisa”. (when we learn using this register, we can participate without fear because we learn using the language, we familiar with and we able to think quickly because we understand better) L2.

“Ah ma’am I think ine influence ehle cause ngoba sifunda nge siNdebele and singa understand’a” (the register has a good influence because we are learning in isiNdebele and we have a better understanding of science concepts in our own language) L3.

Some of these responses from learners correspond positively to the encouraging perceptions they have regarding the use of isiNdebele to teach Natural Sciences. However, some are contrary to how they responded during the interviews on their perceptions of the use of isiNdebele to teach Natural Sciences. Their perception was that they preferred English because their parents wanted them to be fluent in it. But when they were asked how the developed scientific language register for Natural Sceinces in isiNdebele shape their classroom interactions and discourses, they responded positively and supported the use of this register. The contradictory responses they gave could be the result of the negative perception they get from their parents on the use of indigenous languages as a medium of instructions, which shadows their views (Tshotsho, 2013; Tembe & Norton, 2011; Kishindo, 2010).

Parents are also an important stakeholder in the scientific language register for Natural Sciences in isiNdebele. Some parents indicated that

“Yes, it can influence because I think if they can teach Natural Science with IsiNdebele, because all learners are going to understand very well. If the teacher is talking about the head, body, leg, anything or an animal or what, they are going to explain to the learners with isiNdebele. And I think all learners in the class they are going to understand everything, and they are going to participate. Like maybe they are doing group studies, they are doing maybe assignments or

anything that is going to influence learners with the group, they are going to get total marks. Just because they got to do it with his home languages." P1

"Well, Yes Madam. Our learners may be reserved. Reserved in the sense that they may not be able to present well. Though we've got good learners that will always interact with their teachers. But there will always be those that are feeling like to be reserved not wanting to interact because of not being certain of the language." P2

Like learners' responses, some parents' responses on how the developed scientific language register for Natural Sciences in isiNdebele shape classroom interactions and discourses correspond to the responses they gave on their perceptions on using isiNdebele to teach Natural Sciences, which were positive. Their responses are consistent because learners will learn better as they will be using the language that they understand and are fluent in (Msila, 2013). However, some of the responses above contradict the parent's perception of the use of isiNdebele to teach Natural Sciences. Their contradictory responses may be a result of their failure to understand the relationship between using isiNdebele to teach Natural Sciences and the developed scientific language register for Natural Sciences in isiNdebele.

From the above responses, stakeholders agreed that the developed scientific language register for Natural sciences in isiNdebele may shape classroom interactions and discourses. Their responses were strongly based on the benefits and advantages of using the mother tongue, which results in meaningful learning and further yields to better performance, as alluded to by Adesemowo (2017). Political commentators such as Dr Somadoda Fikeni, traditionalists such as Zolani Mkiva, and Historian and Cultural Analyst Professor Pitika Ntuli, also affirm that learning in the mother tongue improves the learner's performance. These stakeholders' responses are further supported by Reis and Ng-A-Fook (2010), who also highlighted how the use of indigenous language can enhance meaningful learning and better results.

The researcher then observed teachers and learners in the classroom. This was done to corroborate and triangulate data collected from the interviews with what was being observed in the classroom (Nancy Carter et al., 2014). As It would not have been possible to capture classroom interactions and discourse using methods other than the observation technique.

During the interviews, John indicated that the developed scientific language register for Natural Sciences in isiNdebele does shape classroom interactions and discourses. Therefore, he was observed using the isiNdebele scientific register to teach Natural Sciences in the classroom. John started his lesson by checking the learner's prior knowledge of the topic, which is important for meaningful learning as alluded to by Keeley (2012). He indicated that

> *"Ama metha neensentjenziswa! uqabanga ukuthi ama metha yini. Yini igama elifika'kothoma qhaza nje ngendlela obonangayo Noma ngiwuphi umbono wamukelekile, (what comes to your mind when you hear the word "Matter" Any view is acceptable?*

During his lesson, John used dialogic discourse, as alluded to by Mudau (2013), as learners were given a chance to engage and discuss the content presented to them. This is supported by the extract below, where they were explaining what they think "matter" is:

> *"Mina Sir, I think amametha ziinsentjenziswa ukwenza okuthileko (I think matter is used to do something)" L1*

> *"Amametha zizinto eziphathekako (matter is something that can take up space)" L2*

When John was asked what the matter was, he told his learners, "Noma ngiwuphi umbono wamukelekile," which means that any point of view is acceptable.That made his approach interactive and dialogic, as noted by Mudau (2013) and Chin (2006), as learners were encouraged to give any responses they had, as the focus was not on correct answers but their participation and interaction, with the ultimate focus being meaningful learning.

John was also observed further using dialogic discourse during his lesson, as alluded by Mudau (2013) and by Chin (2006), as learners were debating and engaging if it was possible to get salt from saltwater and if so, what is that process called in isiNdebele? The learners' responses below support the above statement.

> *"Hayi, (no) Kuyakhoneka! (it is possible)" L1*
>
> *"Iye Mr, Kubilisa/Dhlabhazisa"(boiling) L2*
>
> *"Ngokutsenga"(filtering) L3*
>
> *"Siyokubilisa amanzi anetswayi bese amanzi azokutjha aphele bese kusale itswayi (we going to boil salt and water will evaporate and we will be left with salt)" L4*
>
> *"Mr nelangeni singawabeka amanzi anetswayi, amanzi azokutjha kusale itswayi lodwa, mara lokho kungathatha isikhatho eside. (we can also put the mixture in the sunlight water will evaporate, though that will take time)" L5*
>
> *"Indela yokuhlukanisa umvango loyo kukuwubilisa" (we can only separate the mixture by boiling)John*

From the above assertions, John did not only use dialogic-discourse but an interactive-dialogic approach as well. As his learners were observed, suggesting different ways to separate the mixture of salt and water, Even though some responses were incorrect, John did not dismiss them; he noted their responses and gave them the correct response. The statement above is further supported by the below statement, where John was teaching about pure substances and mixtures. He instructed his learners to write the key terms he was writing on the board as he said:

> *"Alright. Isahluko sok'thoma lapho. bhala amagama aqakathekile lapho (write these key-terms), (writes on the chalkboard the topic for the day, Imivango nezinto ezimsulwa)"*
> *"Nasikhuluma ngento emsulwa sikhuluma ngento ene sithago esizinzileko engeke sahlukanisa ngokwezakhi zazo. Njengamanzi*

wepompo. amanzi angeke sawahlukanisa. amanzi nawu waqalileko uyabona ukuthi akakahlanganiswa nalutho angitjho. Into emsulwa ayikahlanganiswa nezinye izinto.siyazwisisa soke?" (explaining what pure substance is and why is tap water a pure substance)

That made his learners be active during the lesson rather than information recipients. John's lesson was interactive as he employed both an interactive-dialogic approach and dialogic discourse. While he was teaching pure substances and mixtures. He further brought in materials to demonstrate and enhance his teaching. See the below picture below:

Learners were given an opportunity to take materials and make a mixture out of them, and then explain how to separate the mixture and why they chose that method of separation. They were also requested to report their responses in groups. See the below statements, supported by the pictures of the learners. All these happened using the isiNdebele scientific register for Natural Sciences (See Appendix O).

“(Group 2 uses a sieve to separate mixture of flour and rice) Sithathe umvango obukade uhleli ne-rice ne-flowurasawufaka esefeni sasefa i-flowura” (we used the mixture of flour and rice and sieved it)

“Ngoba sibone kuyiyo indlela esingahlukanisa ngayo i-rayisi ne-flowuru. Ukubumbeka kwakhona kukhulu kungakhona ukusala la ngaphezulu. I-flowuru ifeni ingakgona ukuya ngaphasi.” (Flour can pass through the sieve while rice cannot) G2

Throughout his lesson, John posed questions that sparked discussions or triggered learners' level of thinking. Which means that he asked questions to develop thinking skills. This was observed as he asked learners to identify and mention mixtures and pure substances. This is supported by the extract below:

“Amadribe awomi siweko-amsulwa” (raisons are pure-substances) L1

“Irama-imsulwa” (Rama is a pure substance) L2

“Nami anginako elinye igama engigayibiza” (I do not know any other name that best describes Rama in isiNdebele) John

“Yibhodoro” L3

The teacher and learners debate that margarine is English, and finally agreed that ‘yibhodoro’

From the above assertions, John did not ask questions to buy time. But he posed questions that made learners develop thinking skills. This was observed as learners debated on what "rama" means in isiNdebele, which John did not know, as he confirmed. However, his learners came up with a better name in isiNdebele, which is "yibhodoro," which is also borrowed from the Afrikaans "boter". From the above statements, isiNdebele can be developed to a standard where it will be considered not only as a language but as a medium of instruction as well, just like Afrikaans, which was developed from borrowed terms from Dutch.

Graesser et al. (2003) noted two patterns of discourse in the classroom. The initiation, learners’ response, and teachers’ feedback (IRF) is a three-fold figure wherein, firstly, the teacher initiates communication by posing a

question to learners, the learner will then respond to the question, and then the teacher will finally respond, giving feedback in the process (Molinari et al., 2013). The second one is (IRFRF), wherein the teacher initiates the lesson by probing questions followed by a response from learners. Then the teacher will respond in a way that will probe questions to learners' responses, and finally the teacher will give a final response to learners (IRFRF) (Scott et al., 2006). During his lesson when teaching methods of physical separation, John was observed employing an IRFRF pattern of discourse as he probed questions that were open-ended and learner-centered (Graesser et al., 2003). This is supported by the below extract:

> *"Lapha ninomvango onjani"? (what mixture do you have here) John*
>
> *"Sinomvango wenamanedi" (mixture of sweet aid and water) L1*
>
> *"Uyahlukaniseka neh, Ke sibone niyihlukanisa kanjani ke". That can be separated, right? (how to separate your mixture) John*
>
> *"Ukutsenga i-distillation. Angisho uba nempoto ezimbili, bese uthatha i-pipe ufake ngapha kumvango. Bese amanzi lawa, angithi na kubilayo amanzi la, ayobuya ngapha bese lawa angapha besekusala iswigiri le esiyithele lapha kunamnede. (a learner explaining the process of distillation)" L2*
>
> *"Irerhe khulu ipendulo yakho siyathokoza". (That is very correct, thank you) John*

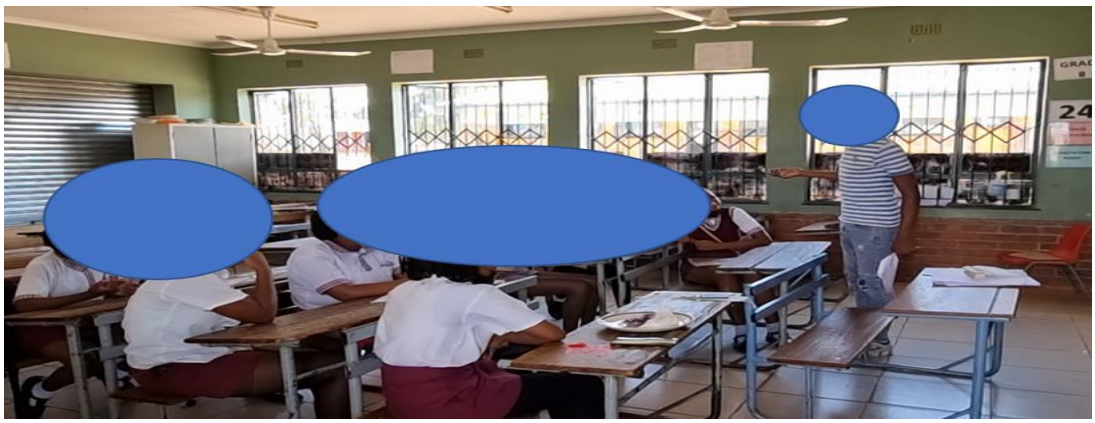
From the above extract, John employed IRFRF as his questions triggered learners to provide more responses to the questions. He asked them and then gave feedback at a later stage.

During the interviews, John mentioned that the developed scientific language register for Natural Sciences in isiNdebele positively shapes classroom interactions and discourses. He also noted that using the isiNdebele scientific register to teach Natural Sciences can make learners interact better compared to when they are taught in the English scientific register. Based on his

insinuations about English and isiNdebele registers for Natural Science, I decided to also observe him teaching the same topic using the English scientific register for natural sciences. (See Appendix P).

According to Chin (2006) and Mudau (2013), John used authoritative discourses from the start. This is so because learners were not given a chance to debate or discuss the concepts. All that he did was transmit information to learners using a question-and-answer method of teaching, which is highly discouraged by researchers who believe that it makes learners passive and shallow thinkers. During the observations, John used the question and answer method for the better part of the lesson, as he was asking the learners' questions about mixtures and pure substances. His questions were structured in a way that gave learners answers to the posed questions. After he gave learners the answer, he then posed the question "angitjho," which means "right." This question did not sound like a genuine question that learners could respond negatively to, but rather one that imposed learners to agree with him, so in all the instances when this question was asked, learners chorused "yes". John was observed using the question to proceed to the next aspect, as he said:

> *“Why are you saying Tap water is a mixture? Because they use a chemical angitjho? John*
>
> *“Yes” L’s*
>
> *“So, we all are agreeing that tap water is a mixture” John*
>
> *“Yes” L’s*



During his lesson, learners were not given a chance to engage or discuss, not even to ask questions or present their thoughts on the content being presented. John only conveyed the information, and learners were the passive acceptors of that information, which caused his discourse to be authoritative (Chin, 2006).

The pattern of discourse that John used in his class was Initiation Response Feedback (IRF) (Graesser et al., 2003). John was observed initiating questions about mixtures and pure substances, then giving feedback. This is supported by the extract below:

"Milk is a what? Is a pure substance angitjho?" John
"Yes" L's
"Another one" John
"Salt" L's
"Salt, it is a pure substance, right?"
"Yes" L's

In all instances, John did not initiate the questions that would allow discussions or trigger learners' levels of thinking; all the questions asked were straight-forward and had a defined answer, and in some instances, he gave learners' answers. Although there was a lot of questioning used by John during his lesson, it was pertinent to examine the motivation behind the questions posed. John was observed asking questions to evaluate and not to construct an understanding.

John used an interactive-authoritative approach during his teaching. This is so because, even though there was interaction between the teacher and learners, there was minimal interaction amongst the learners themselves. The authoritative nature of John is observed several times in the lesson as he dominated the lesson with lectures and question-and-answer methods of teaching, and learners were not given an opportunity to interrogate or ask questions about the content being taught to them. Even though he invited responses from learners, he gave them answers to questions that they could not give answers to. The above statement is supported by the captured observation below:

"Let us go to picture B. Picture B, what do you think of Picture B"? John

"(Mumbling)" L's

"You are not sure neh? But you can see different components there neh? There are some that is dark some that is white neh"?

"Yes." L's

"So, what you see there it is a mixture" John

The above extracts serve as evidence of the authoritative nature of John's communicative approach. Had John given learners a chance to interact amongst themselves and the content being taught to them instead of giving them answers, he could have granted the learners an opportunity to exercise different skills such as raising questions and communicating skills, as the NS CAPS document grades 7-9 stipulates. It follows then that learners were not interacting with the teacher in a meaningful way because the register that was being used for Natural Science was English.

6.2.2. Summary of John's Interactions and discourses when using isiNdebele scientific register for Natural Sciences.

Theme	**Category**	**Characteristics**
Classroom interactions And discourses	Types of discourses	Dialogic discourses
	Patterns of discourses	IRFRF
	Teacher questioning	Develop thinking skills
	Communicative approach	Interactive-dialogic

When using the isiNdebele scientific language register for Natural Sciences, John applied dialogic discourse as he was observed granting his learners several opportunities to engage and discuss the concepts being presented to them. Furthermore, John created an environment where his learners found it easier to interact with him and amongst themselves, as they were observed responding to questions at ease, even though their responses were not correct. That resulted in his approach being interactive-dialogic. John presented his lesson using the

question and answer method of teaching, wherein he posed questions to develop thinking skills. He further employed the IRFRF pattern of discourse as he was observed giving feedback that triggered his learners' thinking skills, resulting in them further discussing and giving better feedback.

6.2.3 Summary of John's Interactions and discourses when using English scientific register for Natural Sciences.

Theme	**Category**	**Characteristics**
Classroom interactions And discourses	Types of discourses	Authoritative discourses
	Patterns of discourses	IRF
	Teacher questioning	Evaluate
	Communicative approaches	Interactive-authoritative

Contrary to when he was using the English scientific register for Natural Sciences, the researcher found no attempted discussion between John and the learners or amongst the learners themselves. John was observed being a transmitter of information and his learners being information recipients. This resulted in his discourse being authoritative. Furthermore, the patterns of discourse he applied, which is IRF, deprived learners an opportunity to utilise some of the skills such as raising questions and scientific process skills as stipulated in the CAPS NS policy document. John asked questions during his lesson only to evaluate and not to develop learners' thinking skills or to further buy time and move to the next question. The researcher noticed that at the end of the lesson, learners were not given a chance to comment or reflect on the topic learned or seek clarity on what they were taught that called his communicative approach "interactive and authoritative."

Drawing from the two observations, one can infer that the developed scientific language register for Natural Sciences in isiNdebele does positively shape classroom interactions and discourses, which can lead to meaningful learning of Natural Sciences and further result in better performance in the subject, as alluded to by (Mortimer & Scott, 2003).

6.3. CASE TWO: MANDLA FROM KHANYA COMBINED SCHOOL

6.3.1. Data Presentation and discussion

Classroom interactions and discourse is the language that learners and teachers use in the classroom. This language is further highlighted by Mortimer and Scott (2003) as discourses, which is the fundamental key to meaningful learning. Based on their claims about the significance of language and classroom interactions and discourses, Then the researcher deemed it fit to understand stakeholder's views on how the developed scientific language register for Natural Sciences in isiNdebele shape classroom interactions and discourses. Mandla responded as follows:

> *"It does because, as I said earlier on, if you are like in Natural Sciences, my learners are expected to talk, or rather to speak English. And then because of that, language that is used during Natural Sciences, it is not easy for them to just go out of control in a class. And make disrupt the classroom and so they prefer to remain quiet. Instead of them saying something that is grammatically wrong".*

His response above corresponds to his views on the use of isiNdebele to teach Natural Sciences. Mandla did not support the use of isiNdebele to teach Natural Sciences, as he based his perceptions on the fact that Natural Sciences is a language on its own and textbooks are written in English. Hence, he suggests that it is better when English is being used as a medium of instruction for the status it holds. From his response above, he regards English not only as a preferred medium of instruction but also as a way of disciplining African learners (Bloch, 2009).

The Learner's views were also taken into consideration as they were also asked the same question. Their responses are captured below:

> *"Ma'am, sizokukgona ukubeka imibono yethu ngendlela elula nesizwisisa ngayo okusiNdebele. Cause nje asikgoni ngoba most of the time, na ufuna ukukhuluma i-answer nge-English, uyasaba ukuthi maybe ungenza i-mistake bese beyakuhleka ngoba ungakajwayeli.*

Manje siqoqela ukuthula or sivume nanoma singazwisisi(we will be able to state our views at ease since we will be using our home language, as of now we are unable to because we are scared to make mistakes in English and be a laughing stock because we are not used to English, hence we prefer to keep quiet or agree to the teacher even though we do not understand.)" L1

I register yesiNdebele izoba lirhelebho khulu ngoba nanoma nsingazwisisi angekhe sisabe ukubuza ngoba zobe siberegisa ilimu lethu. (It will assist us a lot because even if we do not understand we will be able to ask questions at ease because we will be using our home language)" L2

"Singafunda ncono besi interactor ncono khulu nokuphasa nokuphasa singaphasa khulu ngoba ngeke sisasaba ukubuza imibuzo nokutjho ama answer esiwaqabangako njengalokha sisaba nje. Iregister leyo ingasirhelebha khulu and singa enjoya ne Natural Sciences njengoba si enjoya I subject yesiNdebele ma'am. (we can learn better and interact better and we will even perform better because we will not be scared to ask questions and give answers. The register will assist us a lot we will even enjoy the Natural Sciences.)" L3

Some of these above learners' responses confirm their positive perception of the use of isiNdebele to teach Natural Sciences. As they indicated, learning in isiNdebele will improve their performance in the subject as they will understand every concept taught to them because they will be using their mother tongue, which they understand better (Adesemowo, 2017). However, some of the above responses are contrary to the negative perceptions held by some of these learners. Their negative perception was because they are used to being taught in English and their parents wanted them to be confident in it (McKinney & Tyler, 2019). They further indicated they do not understand it but still prefer it as it is their parents' most preferred medium of instruction. This indicates that these learners' perceptions are greatly influenced by their parents' perceptions.

The South African Schools Act (SASA) (84 of 1996) stipulates that it is within the choice of parents and the school governing body (SGB) to choose the medium of instruction of the school beyond grade 3. Hence, the parents were also interviewed about the same question. This is how they responded:

> *"Okay, I think if we are using the IsiNdebele scientific language register they will be free because they will be learning in their mother tongue, they will be encouraged to participate definitely they will participate and interact". P1*

> *"Yes of course because some of the learners like I've indicated earlier that the language it could be a barrier if a learner cannot express himself or herself in the language that is used, especially its English for now that could also make the leaner to keep quiet though the learners knows other things that he or she has researched but most importantly the language its clear and the learners are given an opportunity to actually talk and learn in their language then I think the isiNdebele scientific language register that will make a great impact in terms of meaningful teaching and learning and learners interactions and discourses."P2*

Parents in this case shared the same sentiments and embraced the use of isiNdebele to teach Natural Sciences. Their perceptions were strong because IsiNdebele is their mother tongue, which they speak daily, and they are highly proficient in this language. Hence, being taught in it will be an advantage to these learners. Furthermore, this will improve their performance in the subject as their pass rate is moderate due to the language they use for teaching and learning, which is foreign to them and they do not even understand it properly (Mweli, 2018; Milligan & Tikly, 2016).

The above responses from stakeholders confirm that the developed scientific language register for Natural Sciences in isiNdebele may positively shape classroom interactions and discourses. Their assertions are further supported by Reis and Ng-A-Fook (2010), who highlight the significance of language for meaningful learning and better performance. From the stakeholder's responses,

it was then pertinent for the researcher to observe the teacher using both English and the isiNdebele scientific registers for Natural Sciences. This was done to confirm the assertions made by stakeholders during the interviews.

Mandla was observed teaching Natural Sciences using the IsiNdebele scientific register. He started off his lesson by checking the learner's prior knowledge, which is crucial for meaningful learning, Keeley (2012). See the statement below:

> *"Amaphepha esizowaberekisa for i-topic esizoyenza (handing out material). Ok, lapha sizofunda ngemetha nendlela imivango ehlukaniswa ngayo. So, kuze siqhubekele phambili kufanele sithome sazi ukuthi imetha yini. Kukhona okwaziyo ukuthi yini imetha? (today we will be learning about mattrs and ways of separating mixtures. Before we can continue, we need to know what matter is, anyone who can tell us what matter is)?" Mandla*

Mandla did not only check a learner's prior knowledge during his lesson but also applied an interactive-dialogic approach (Chin, 2006) as he encouraged the answers from learners. He also accepted learners' responses and further commended them for giving the answers, even if they were not exact. See the extract below:

> *"Yinto ethatha indawo ethize (something that takes up a space)" L1*
> *"Sithokoze ngependulo ehle. imetha ngenye nenye into enesisindo and ekhavara indawo ekhona. imetha sithi ngenye neyinye into enesisindo and ithatha indawo, kufana njegani? Iphepha, (writes on chalkboard), okunye? (good, Mandla explaining what matter is and giving a "paper" as an example of a matter, what else?" Mandla*
> *"Incwadi (a book)" L2*

From the above statements, Mandla was observed encouraging his learners to give examples of matters that they could think of. He was also observed using dialogic discourse as his learners were encouraged to interact with the lesson. See the extract below:

“Ungaberekisa izandla ukuthatha amadribe lawa. (You can use a hand)” L1

“Ungasikhombisa ukuthi uzohlukanisa njani? (asking the learner to come and demonstrate)” Mandla

“(Hand picking raisons to separate them from flour).” L2

He used dialogic discourse as he was observed asking questions about methods of separating mixtures, and after his learners responded, he would encourage them to come to the fourth and demonstrate how they would separate the mixture since he brought different samples of mixtures (Mudau, 2013) and (Chin, 2006). That made his lesson more interactive as learners were hands-on rather than reserved and bored. If none of the resources he brought to class can separate the mixture, Mandla would request his learners to explain in detail how the mixture can be separated. See the statements and picture below:

“(Tastes contents) mvango. Kuhlangene itswayi namanzi. Ungakgona ukuyihlukanisa, uyibeka estofini bese iyabila. Bese itswayi lizokuya ngaphasi, bese amanzi azokhuphuka njalo uyayihlukanisa. (it is a mixture of salt and water. Learner explaining how to use evaporation to separate the mixture).” L1

From the above extract, the learner was requested to taste the solution, then indicate if it was a mixture or a pure substance, then indicate the components of the mixture, and finally, ways of separating the mixture. In this case, the learner was not able to separate the mixture by hand. She explained the methods of separation, which in this case was through evaporation.

Mandla's dialogic discourse was further observed as he encouraged his learners to discuss the answers in groups. This is supported by the extract below:

> *"Nasikhuluma ngobujamo bezenziwa sikhuluma ngani lapho? Hlanganisani imibono yenu ngeencenyana zenu. (what are physical proporties, discuss in your groups and report back)" Mandla*
> *"Zizinto eziqhaza/zikhombisa bona into yenziwe ngani (learners trying to explain what they think a physical property is)" G1*
> *"Zizinto ezihlathulula isimo ubujamo obuthize bento (learners trying to explain what they think a physical property is)" G2*

From the above statements, Mandla gave his learners time to discuss what physical properties are and further report their answers in groups. Mandla applied lot of questions during his lesson. Based on the observations,

Mandla used questioning to develop the learners' thinking skills. This is confirmed by the statements below:

"Itswayi liyini? (asking if salt is a mixture or a pure substance)" Mandla

"Akusimvango. (it is a pure substance)" L1

"Kubayini utjho njalo? (why you are saying that)" Mandla

"Ngoba itswayi lilodwa alikavangwa nalitho (it is made up by one particle and it is not mixed with anything)" L2

From the above statements, Mandla did not accept correct responses from his learners without wanting to understand why they chose the answer. That assisted learners to support their responses, which developed their thinking skills. The patterns of discourse that Mandla employed are IRFRF. This is supported by the extract below:

"Ok, amanzi. Awela ngaphasi kwento emsulwa namkha ngaphasi komvango? (Is water a mixture or a pure substance)" Mandla

"Awela ngaphasi kwento emsulwa, ngoba amanzi anesakhi sinye begodu angeke ahlukaniswa ngezakhiwo zawo". (It is a pure substance because it is made up by one particle and it is not mixed with anything). L's

"Liqiniso lelo amanzi amsulwa. (that is true water is a pure substance)" Mandla

From the above assertions, Mandla used an Initiation Response Feedback Response Feedback (IRFRF) pattern of discourse, as he was observed using open-ended questions, which are learner-centred (Graesser et al., 2003). He was observed initiating a question, then allowing his learners to respond, then he gave a response that would further require his learners to respond, after which he would give final feedback (Scott et al., 2006).

During the interviews, Mandla indicated that during his lessons his learners are expected to speak English, and because they are not fluent in English, they always prefer to remain quiet. He also made a very alarming statement as he noted that since his learners are not fluent in English, it is not easy for them to

just go out of control in a class and disrupt the classroom. Hence, they prefer to remain quiet. Instead of them saying something that is grammatically incorrect, His learners further concur with his assertions as they noted that "we are scared to make mistakes in English and be a laughing stock because we are not used to English, hence we prefer to keep quiet or agree with the teacher even though we do not understand." From Mandla's assertions and his learners, English does not only negatively impact a learner's performance but also suppresses their emotions and views and further serves as a disciplinary major.

From the assertions above, Mandla was then observed teaching Natural Sciences using the English scientific register. This was done to corroborate what he said during the interviews with what was observed in the classroom. From the onset, Mandla employed an authoritative discourse as he asked his learners what a pure substance is and directed them to refer to the notes they had (Mudau, 2013) and (Chin, 2006). And he said:

> *"Okay, Firstly, what is a pure substance? You can refer from the notes."*

From the above assertion, Mandla did not give his learners a chance to engage with the content. He requested them to give answers they read from their notes, which they did not even understand. Mandla's authoritative discourse was further observed as he requested learners to suggest ways of separating mixtures they could use at home. Before they could even respond, he gave them responses. See the extract below:

> *"Suggest other tools that can we use in the kitchen to separate mixtures number one is a sieve neh" Mandla*
>
> *"Yes" L's*
>
> *"Two, by boiling neh" Mandla*
>
> *"Yes" L's*

After mentioning an answer, he will then say "neh," which means "right." This is a term which learners cannot say no to but must agree with him instead. This

made his lessons teacher-centred rather than learner-centered, as learners were compelled to agree with him even if they did not understand.

Mandla employed an interactive-authoritative approach, as he was observed giving learners answers when they failed to respond. This is supported by the statements below:

"Is gold a mixture or not?" Mandla

"mumbling" L's

"It is not a mixture, neh? It is a pure substance" Mandla

"Yes" L's

From the above statements, Mandla employed an interactive-authoritative as he gave his learners answers where they failed to respond (Scott et al., 2006). Furthermore, he did not explain to them why gold is a pure substance, but only told them it is a pure substance, and his learners agreed with him without further asking questions as to why it is a pure substance. Drawing from their mumbling, it is either they do not know the answer, or they are scared to say it. However, they remained ignorant as to why gold is a pure substance. This further confirms the assertions they made during the interviews that they prefer to be quiet or to agree with the teacher even when they do not understand. Mandla's interactive-authoritative approach was further observed during the lesson. See the below extract:

"What is the physical property of water? Something you can see with your eyes, what can you see with your eyes when it comes to water?" Mandla

"Silence" L's

"Water is what? It is colorless, it is shapeless, it is shapeless it takes the shape of the container neh" Mandla

"Yes" L's

From the above statements, Mandla was observed as being an information giver and his learners as passive acceptors of information. He was using the lecture

method to convey the information to his learners. During his lesson, his learners were not given an opportunity to engage or ask questions but remained information acceptors and agreed with him (Tytler & Aranda, 2015). Even when they failed to respond to questions, Mandla continued giving them answers without giving them a chance to discuss the answers, and that made the communication one-sided.

Mandla used the question and answer method during his lessons. But he was observed using questions to evaluate rather than to construct understanding or develop thinking skills. See the extract below:

> *"One type of particle so this is what we call a pure substance Do we know any examples?" Mandla*
>
> *"Flour" L1*
>
> *"Correct, baking flour is a pure substance" Mandla*

From the above extract, Mandla used questions to evaluate if learners knew examples of pure substances but did not ask a follow-up question as to why they think flour is a pure substance. Furthermore, he was observed asking questions to move to the next aspect of the lesson. See the below extract:

> *"Okay, another example." Mandla*
>
> *"Pure water" L1*
>
> *What else"? Mandla*
>
> *"Sugar" L2*

Mandla allowed his learners to mention pure substances without supporting their answers. The patterns of discourse employed by Mandla during his lesson are called Initiation Response Feedback (IRF) (Molinari et al., 2013). See the statements below.

> *"Let us look at the examples of mixture. what are examples of mixtures that you know?". Mandla*
>
> *"Sea water". L1*
>
> *"Correct, Sea water, is a mixture" Mandla*

According to the assertions above, Mandla was observed asking questions, waiting for learners' responses, and finally providing feedback by agreeing to the given response (Molinari et al., 2013).

6.3.2. Summary of Mandla's Interactions and discourses when using isiNdebele scientific register for Natural Sciences.

Theme	Category	Characteristics
Classroom interactions And discourses	Types of discourses	Dialogic discourses
	Patterns of discourses	IRFRF
	Teacher questioning	Develop thinking skills
	Communicative approach	Interactive-dialogic

Mandla was observed teaching Natural Sciences using both isiNdebele and English scientific registers for Natural Sciences. When using the isiNdebele register, Mandla started off his lesson by checking the learner's prior knowledge of "matter". He also gave his learners an opportunity to engage and discuss the concepts, and further encouraged them to give answers from their discussion, even if they were not exact answers. That made his communicative approach interactive-dialogic. He further applied dialogic discourse as he was observed giving his learners an opportunity to demonstrate in front of the class how to separate mixtures using hand sorting. In cases where hand sorting was not possible, he asked them to explain alternative separation methods. Mandla used a lot of question and answer methods wherein his questions focused on developing the learner's thinking skills. He also used IRFRF patterns of discourse as he asked questions that triggered learners' thinking skills, giving them an opportunity to further engage and give better feedback.

6.3.3. Summary of Mandla's Interactions and discourses when using English scientific register for Natural Sciences.

Theme	Category	characteristics
Classroom interactions	Types of discourses	Authoritative discourses
	Patterns of discourses	IRF

And discourses	Teacher questioning	Evaluate
	Communicative approaches	Interactive-authoritative

Different classroom interactions and discourses were observed when Mandla was teaching Natural Sciences using the English scientific register for Natural Sciences. Mandla started off his lesson by checking the learner's prior knowledge. However, he did not give learners an opportunity to engage and discuss. He directed them to read from the book. That made his discourse authoritative as he did not create an environment where his leaners could discuss the concepts with ease. Mandla was further observed using an interactive-authoritative approach as he asked his learners questions and when they did not respond, he would give them responses without further explanation. In most cases, after responding, he would say "neh," which means "right," and his learners would respond with a chorus of "yes" without asking questions or requesting clarification. His lessons were teacher-centered and he used the lecture method of teaching as his learners were passive information acceptors, and Mandla was an information giver. Mandla asked questions during his lesson only to evaluate and move on to the next aspect of his lesson. The patterns of discourse he employed were IRF as he asked straight-forward questions which did not trigger learners' thinking abilities.

Drawing from the two observations, one can attest that the developed scientific language register for Natural Sciences in isiNdebele does shape classroom interactions and discourses, which confirms the stakeholder's assertions made during the interviews.

6.4. CASE THREE: MAY FROM ZITHA COMBINED SCHOOL

6.4.1 Data presentation and discussions

According to Mortimer and Scott (2003), interactions between teachers and learnes in class are very important because learners gain a thorough understanding through questioning, discussions, and debate. For the purpose of this study, stakeholders were interviewed to find out whether the developed

scientific language register for Natural Sciences in isiNdebele shape classroom interactions and discourses**.** May respond as follows:

> *"Yes, sometimes when they have the language barrier, they do not really ask the questions that need to be asked. Sometimes they keep quiet because they do not want to speak in the language that we are using for teaching. They decide to keep quiet and stay with the questions that they need to ask, of which the questions will assist them when they are having a test or agree with you without understanding. But using the isiNdebele register will make them interact better because they will be using their home language"*

The above assertion made by May is contrary to her negative perception of the use of isiNdebele to teach Natural Sciences. Irrespective of her perception, she also acknowledged that learners experience challenges in being taught in English, as she highlighted that this medium of instruction is a barrier to effective teaching and learning (Sibanda & Baxen, 2016; Hugo & Lenyai, 2013). Hence, to make these learners understand and interact, they use code-switching (Maluleke, 2019). The above response and the assertions she made on the use of code-switching show a dire need for using indigenous languages as a medium of instruction.

Since the developed scientific language register for Natural Sciences in isiNdebele will be used to teach learners, they were also asked the same question. This is how they responded.:

> *''Iye ngoba singafunda ncono. Ngoba sometimes angikgoni because amagama amanye tholukuthi uyazi ianswer mara igama leli ulikhuluma ngesiNdebele angikhoni ukulibiza nge English" (Yes, because we can learn better. Because English is a barrier to us) L1*
> *"Like uMa'am nakabuza i-question, uthole ukuthi uyayazi I answer mara, uyasaba and ubona engathi bazakuhleka nawubhedako nge English basthi angiyazi i-English" (sometimes we know the answers but we are afraid to say them because if you say it incorrectly you will be a laughing stock) L2*

“Ingasirhelebha khulu, singafunda ncono sikhululekile ngoba siberegisa ilimi lethu. Ngoba nge English umuntu angaphendula igama kumbi bayakuhleka” (we will learn better and freely because we will be using our home language, unlike now when we are laughed for saying answers incorrectly due to not knowing English).

The above learner’s responses correlate to the positive perception they have onthe use of isiNdebele to teach natural sciences. Their perceptions were because they find it very difficult to comprehend science concepts in English as it is not their mother tongue (Sibanda & Baxen, 2016). Furthermore, they mentioned the difficulties they face when answering assessments using English as a medium of instruction. As a result, they saw this as a fantastic initiative that would improve their performance and interaction in the subject. Their assertions are further supported by the SADTU general secretary, Mugwena Maluleka, who argued that teachers need to be instructed to teach learners using their mother-tongue, as doing so will yield better results (Jordaan, 2018).

Since parents are the fundamental component of the school and decide on the medium of instruction, they were also asked the same question. See their responses below.

“Yah, it does. The interaction of the teaching Natural Sciences in isiNdebele. If the teacher can interact with these learners, using the very same language, that is isiNdebele, I think that the understanding will be far much better and the performance will also be better. And looking at now, the teacher can just code switch using one word. But if the teacher is teaching in full isiNdebele, I think it’s going to be superb”. P1

“It has a great impact. I think, as you said, if more material was developed in isiNdebele they would participate more and we would not have to do a lot of explaining, in terms of what does this word mean, the Natural Science with all the scientific words. So if there were materials in isiNdebele, I think they would have been great improvement” P2.

"Yes. Ok, so it does because sometimes they cannot express themselves fully. For example, if you ask a question in English, a learner can have an answer but answering you in English is a bit difficult because isiNdebele is the only language which they use in most cases and it is the only language they are perfect in. So sometimes it becomes difficult". P3

"Of course, it does. Sometimes most of the terms are terms in English now the learner must think and try to think in English and then also write in English while the learner understands these things much better in their home language. So, it becomes a barrier when it comes to interaction. Now the teacher must ask in English, the learner does not know some of the terms, but he knows what the teacher is talking about. So, when it comes to communication, replying, responding to the teacher, the interaction becomes in a way poor, compared to the language that they normally use at home". P4

The above parents' responses support their positive perception of the use of isiNdebele to teach Natural Sciences. This is so because they believe learners learn best in their mother tongue, which they are confident and fluent in, unlike English, which is foreign to them. They also believed that if learners were to learn in their mother tongue, their performance and interactions would improve for the better.

The above assertions' stakeholders believe that the developed scientific language register for Natural Sciences in isiNdebele may positively shape classroom interactions and discourses. Their assertions were because the language that will be used will be familiar to learners, in whichcase they are comfortable. They also stated that the learners' performance and interaction will improve further. Their claims are further confirmed by Prof Veronica McKay, who alluded that learning in one's mother tongue could help learners understand better and improve performance (Liam, 2020).

May started off her lesson by checking the learner's prior knowledge on ways of separating mixtures. May relate the concept to the learner's everyday life. This is supported by the extract below:

“Niyakhumbula abogogo baberegisa imincamo eyahlukahlukeneko ukwenza izinto emakhaya? Bayihlukanisa njani imincamo le” May (Our grandmothers use different beads at home to make jewelery, how do they separate these kinds of beads?)

From the above statement, may created an environment where her learners were comfortable engaging with the lesson, which made her type of discourse dialogic (Mudau, 2013). Her example further made learners respond at ease because they are used to seeing their grandmothers using beads at home and they could easily relate the concept to their daily life experiences.

May’s dialogic discourse was further observed as she asked learners to discuss and report their answers in groups. See the extract below:

“Yini into emsulwa yinto enjani? Hlanganisa iinhloko ngeenqhema nisitjele iimpedulo zenu”. (asking learners to discuss in groups on what is a pure substance) May

(learners discussing and reporting in groups)

“Into emsulwa yinto engakahlanganiswa noma imvelo” (is something that is not mixed with anything, it is natural) G1

“Into emsulwa yinto engeze wakgona ukuyehlukanisa”. (it is something that you cannot separate) G2

The communicative approach that was used by May was interactive-dialogic. This is so because she accepted all the responses from learners, even the incorrect ones (Mudau, 2013) and (Chin, 2006). This was observed as she asked her learners how to separate a mixture of oil and water. This is how they responded:

“Sibilisa ukuhlanganisweko lokho bese amanzi azokuphuma kusale amafutha”.

(learner explaining the process of evaporation) L1

“Sithokoze, abanye bangathini?” (thank you for the response, can we have another response) May

“Singaberegisa iphepha lokutsenga, amanzi azokudlula bese amafutha azokusala ephepheni lokutsenga” (Using a filter paper, Explaining the process and outcomes) L2

From the above assertions, May was observed accepting the incorrect answer from the learner who suggested that water can be separated by boiling the mixture. Instead of discouraging the learner, May applaud the learner for giving the answer and further request other learners' opinions as the focus of the lesson was learners' engagement rather than giving correct answers.

May used a question and answer method wherein she was observed asking questions for the better part of the lesson. May ask questions to construct understanding and develop learners thinking skills. See the below extract:

“Amanzi amvango namkha awa”? (is pure water a mixture or not) May
“Awa”. (no) L’s
“Akusimvango, kubayani nitjhonjalo?” (why you are saying that) May
“Amsulwa, akakavangwa nalutho.” (they are pure and not mixed with anything) L’s

From the above statements, after her learners gave their responses to the question, she then asked them to support their responses. That assisted learners to construct a better understanding of the concept. The pattern of discourse that was used by May was the Initiation Response Feedback Response Feedback (IRFRF) pattern of discourse, as she was observed using open-ended questions that are learner-centred (Graesser et al., 2003). This is supported by the extract below:

“Nihlanganiseni lapho”? (what did you mix) May
“Sihlanganise itjhukela namanzi”. (water and sugar) L’s
“Itjhukela namanzi. Sekumvango”? (water and sugar, is it now a mixture or not) May
“A mixture” L’s

“Itjhukela konje sithe injani”i? (is a sugar a pure substance or a mixture) May
“Imsulwa”. (it is a pure substance) L’s
“Imsulwa liqiniso” (That is correct it is a pure substance) May

May was observed asking questions, then learners responded. She then gave the feedback that triggered her learners to respond to the question, and finally she gave a final response.

When she was interviewed about whether the developed scientific language register for Natural Sciences in isiNdebele shape classroom interactions and discourses? May indicate that the language of teaching and learning, which is English, is a barrier to learners. Hence, most of the time, they do not ask questions during the lesson because they are not confident in the language. Therefore, they remain quiet or agree to what the teacher says without understanding. From her assertions, she was then observed teaching Natural Sciences using the English Register.

May was observed asking questions during her lessons. But she used questioning to evaluate rather than to develop a learner’s skills: See the below extract:

“suggest tools that are used in the kitchen to separate mixtures”. May
“Sieve”. L1
“A sieve, next”? May
“A filter paper”. L2
“You can use a filter paper. Next”?
“Hands”. L3

From the extract above, may used questioning to move to the next aspect of the content rather than to construct understanding or develop learners' thinking skills. This is so because she accepted the learner’s responses without asking them how to use the tool or why they chose that tool. Which could have developed their thinking skills?

May used an authoritative discourse. This is so because she used the lecture method of teaching, as her teaching reflected one-way communication. See the extract below:

“Inside the gas box its hydrogen neh” May

“Yes” L’s

“We use that one when we cook and the hydrogen inside the gas is a pure substance.” May

“Yes”

From the above extract, May was observed making an example of pure substances wherein she used hydrogen gas. However, the method she used was lecture, as learners were not given a chance to engage and ask questions. Furthermore, she used the word "neh" after each of her statements, which means "right," which does not sound like a term to which a learner can say no, but rather will chorus "yes."This confirmed her assertions that learnerss would rather be quiet or agree with the teacher even if they did not understand. This reflects how many challenges English poses to African learners (Sibanda & Baxen, 2016).

During observations, may used an interactive, authoritative approach. This is so because she was observed asking learner’s questions. Where they were not sure of their responses, she gave them responses instead. See the extract below:

“Can you see the salt hen it is mixed with water?” May

“Yes/No” L’s

“No, you cannot see it because It melts, neh?” L’s

“Yes” L’s

From the above extract, may gave learners a response to the question and, furthermore, a reason why they cannot see the salt when mixed with water. Instead, she could have given learners an opportunity to support their responses

and that could have made her lesson interactive and dialogic. The pattern of discourse used by May is called Initial Response Feedback (IRF) (Molinari et al., 2013). This is so because she was observed initiating questions and learners responded, then she gave them feedback. This is supported by the statements below:

"Identify which of the following show mixtures and which do not." May

"Diagram C. It is a pure substance." L's

"Yes. It is a pure substance" May

From the above statements, May was observed giving learners final feedback without explaining why diagram C shows a pure substance.

6.4.2. Summary of May's Interactions and discourses when using isiNdebele scientific register in Natural Sciences.

Theme	**Category**	**Characteristics**
Classroom interactions And discourses	Types of discourses	Dialogic discourses
	Patterns of discourses	IRFRF
	Teacher questioning	Develop thinking skills
	Communicative approach	Interactive-dialogic

May was observed teaching Natural Sciences using both isiNdebele and English scientific registers for Natural Sciences. When she used the isiNdebele register, she was observed using dialogic discourse as she created an environment where her learners could easily engage, and she made examples that her learners could easily relate to their everyday life. Hence, that made her leaners interact at ease. She further used an interactive dialogic approach as she accepted all learners' responses, even the incorrect ones. She also used a lot of questioning during her lessons, which she used as a strategy to develop her learner's thinking skills. This is so because her learners were always requested to support their responses. The pattern of discourse applied by May is IRFRF, as she was observed initiating a question, giving her learners a chance to respond, then

giving them a response that would trigger their thinking skills, which they would give a response, and finally she would give a final response.

6.4.3. Summary of May's Interactions and discourses when using English scientific register in Natural Sciences.

Theme	Category	Characteristics
Classroom interactions And discourses	Types of discourses	Authoritative discourses
	Patterns of discourses	IRF
	Teacher questioning	Evaluate
	Communicative approaches	Interactive-authoritative

When she was using the English scientific register for natural sciences, she was opposed. May did not start her lesson by checking the learner's prior knowledge. Instead, she was observed using a teacher-centered method as her learners were not given a chance to engage with the content, but instead, they were acceptors of information that made her discourse authoritative. Further to that, May was observed using an interactive authoritative approach as she gave learners answers where they were not sure of their responses, instead of asking them the reason why they chose that particular response. She asked questions during her lesson to move on to the next aspects, as learners were not given a chance to support their responses. She also employed the IRF pattern of discourse as she was observed asking questions after the learners' responses. She then gave them the final feedback.

6.5. FINDINGS FROM THE CASES

Drawing from the stakeholder's responses, does the developed scientific language register for Natural Sciences in isiNdebele shape classroom interactions and discourses? The stakeholders shared the same sentiment, indicating that the register should positively shape classroom interactions and discourses. They strongly based their assertions on the fact that learners will be learning Natural Sciences in their mother tongue, in which they are highly proficient and further understand it better. As a result, the language barrier will

be reduced, and their performance and interaction in the subject will improve. Because they will only learn natural science concepts and not the language. Their assertions are further supported by Motloung et al. (2021) and political commentators such as Dr Somadoda Fikeni, traditionalists such as Zolani Mkiva, and historian and cultural analyst Professor Pitika Ntuli, who affirms that learning in the mother tongue improves learners performance.

Even though these stakeholders agreed that the developed scientific language register for Natural Sciences in isiNdebele will positively shape classroom interactions and discourses. Some of their responses were contradictory to the negative perceptions of the use of isiNdebele to teach Natural Sciences. Their negative perceptions were because IsiNdebele does not have scientific terms, which is true (Skhosana, 2002). But that cannot be the reason not to give indigenous languages a chance as language can be developed with time. Furthermore, they noted that they understand the challenges English brings to African learners. However, they still prefer it because it is deemed a language of power and better opportunities (Phindane, 2015; Heugh, 2010; Buthelezi, 2003). Their negative perception towards the use of indigenous languages is like what the apartheid government did by devaluing the indigenous languages and placing more value on English and Afrikaans (Tshotsho, 2013; Heugh, 2008). Their practise could be referred to as "self-hate". This practise is highly criticised by Chief Justice Mogoeng Mogoeng and (Becham & Visser, 2005), who noted that the notion that English will help one progress in the corporate world is wrong because the Chinese, Koreans, and many others are surviving using their mother-tongue.

The negative impact caused by using scientific registers written in foreign languages in African schools is a long-debated issue not only in South Africa but also in other African countries (Mutasa, 2015; Seti et al., 2015; Nel, 2014; Mpofu, 2012). Countries such as Angola, South Sudan, Ethiopia, and Mozambique were colonised and hence do not use scientific registers written in their home language. The impact of using scientific registers written in foreign languages is reflected in the learner’s performance and steady economic growth in these countries (Getahun & Jibat, 2018). Unlike other countries like Portugal, England, Cuba, and China, these countries use scientific registers written in their mother

tongue. In other words, they learn scientific concepts using their home language. The benefits of using scientific registers written in their mother tongue are reflected in their learners' performance and economic growth. Further to that, these countries are doing exceptionally well in Maths, Sciences and Technology. Their technological innovations serve as evidence and blueprint for the benefits of using scientific registers written in their mother tongue (Coughlin, 2019).

Reflecting on these countries, stakeholders can refer to and see these countries as exemplary, and they will understand the dire need for the use of scientific registers written in indigenous languages in South African schools.

6.6. SUMMARY

In this chapter, the data on how the developed scientific language register for Natural Sciences in isiNdebele shape classroom interactions and discourses was analysed. The findings of this study are presented and discussed for each case. The next chapter will present the answers to the research questions and the recommendations from the study.

CHAPTER SEVEN:
SUMMARY OF FINDINGS AND RECOMMENDATIONS

7.1. INTRODUCTION

This chapter presents the answers to research questions, summaries of findings, research contributions, and recommendations.

7.2. RESEARCH QUESTIONS

This study was aimed at developing isiNdebele scientific language register for Natural Sciences and applying it to some of the classes of the Siyabuswa 2 circuit, South Africa. This study was guided by three research questions:

- What are the opportunities and challenges in the development of the scientific language register for Natural Sciences in isiNdebele and its application?
- What are the stakeholder's perceptions about the use of isiNdebele as the language of learning and teaching Natural Science?
- How did the developed scientific language register for Natural Scineces in isiNdebele shape classroom interactions and discourses?

Below are the answers for each research question.

7.2.1. What are the opportunities and challenges in the development of the scientific language register for Natural Sciences in isiNdebele and its application?

The study discovered that IsiNdebele is one of the languages that is still underdeveloped as it still lacks some terms, particularly scientific terms. Furthermore, the development of this language is way too steady, which makes the chances of this language being recognised not only as an official language but also as a medium of instruction limited. Even though the development of this language is steady, some efforts are being made as some of the terms for this language are being featured in the Multilingual Natural Sciences & Terminology

term list, though they are limited. The slow development of this language places a burden on linguists and scientists in terms of the amount of work that needs to be done to develop this language until it is suitable for use as a medium of instruction. Studies reveal that language can be developed until it qualifies to be recognised not only as a language but as a medium of instructions just like Afrikaans, which was developed from borrowed terms from Dutch. This attest to the researcher's anecdotal evidence because as she developed the scientific language register for Natural Sciences in isiNdebele.She consulted different stakeholders such as the PANSALB chairperson, isiNdebele curriculum implementor, isiNdebele teachers and writers and senior citizens in the village who assisted in developing scientific terms which were relavant to the register. This paints a blueprint that with concerted effort from different stakeholder's indigenous languages can be developed to a level where can they be considered not only as official languages but as medium of instructions as well.

7.2.2. What are the stake holders' perceptions about the use of isiNdebele as the language of learning and teaching Natural Sciences?

CASE ONE: JOHN FROM FUNDA COMBINED SCHOOL

The study reveals that John has a positive perception of the use of isiNdebele to teach Natural Sciences. His perception is because isiNdebele is the learner's home language, which they understand better and are fluent in. As a result, learning in it will reduce the language barriers and challenges that these learners face when they are taught in English, which is foreign to them.Learners in this study had varying pecerptions, with some supporting the initiative and seeing it as a great opportunity for them to excel in Natural Sciences because they would be using a language they are familiar with.Contrary to some learners who had a negative perception of this, Their perceptions were based on the fact that their parents wanted them to be fluent in English. They also highlighted that they do not understand English but still prefer it because it is their parents' preferred medium of instruction.

Like learners' parents, they shared different perceptions. Some parents embraced the use of isiNdebele as the language of teaching and learning Natural Sciences. Their perceptions were because learners would be using their mother tongue, which they understand best. Hence, this initiative will give them a better chance to be actively involved in their kids' schoolwork, which will also improve their performance in the subject. Some parents were totally against this initiative, as they argue that isiNdebele is still underdeveloped, and they want their kids to be fluent in English because of the status it holds. Furthermore, these parents acknowledged the challenges faced by their kids in using English as a medium of instruction and recommended code switching.

CASE TWO: MANDLA FROM KHANYA COMBINED SCHOOL

The study reveals that Mandla has a negative perception on the use of isiNdebele to teach Natural Sciences. His perceptions are based on the fact that natural sciences is a language in and of itself, and textbooks are written in English; thus, he suggests that using English as a medium of instruction is preferable. He further noted that using isiNdebele will disadvantage learners as they will expect to learn using this language even in higher grades, which might not be possible as not all teachers are Ndebele speakers. Mandla also acknowledges the fact that using English as a medium of instruction for African learners poses many challenges. Hence, they use code-switching to try and eliminate these challenges. His assertions reveal a dire need for indigenous languages as a medium of instruction.

Learners shared different perceptions about the use of isiNdebele to teach Natural Sciences. Some learners are in favour of using isiNdebele to teach Natural Sciences. They see this as their best chance to succeed in the subject. They further indicated that learning in isiNdebele will improve their performance in the subject as they will understand every concept taught to them because they will be using their mother tongue, which they understand better. On the same note, some learners shared different perceptions as they indicated that they prefer to learn in English even though they do not understand it all the time. Their

perception is strongly because they are used to being taught in English and their parents demand that they be fluent in English.

Differently from learners, parents shared the same sentiments and embraced the use of isiNdebele to teach Natural Sciences. Their perceptions were strongly because isiNdebele is their mother tongue, which they speak on a daily basis and are fluent in. Hence, being taught in it will be an advantage to these learners. Furthermore, this will improve their performance in the subject as their pass rate is moderate due to the language they use, which is foreign to them and they do not even understand it properly.

CASE THREE: MAY FROM ZITHA COMBINED SCHOOL

The study reveals that May has a negative perception of the use of isiNdebele to teach Natural Sciences. However, she acknowledges that learners do not understand English, as she noted that it causes language barriers. Hence, they use code-switching practise to break the language barrier. Irrespective of the challenges it poses to African learners, some may still prefer it as a medium of instruction. Learners shared the same sentiment as they perceived the use of isiNdebele to teach Natural Sciences as a great initiative. Their perceptions were strongly because they find it very difficult to comprehend science concepts in English as it is not their mother tongue. Furthermore, they mentioned the difficulties they face when answering assessments using English as a medium of instruction. From the struggles they faced being taught in English, they then supported being taught in isiNdebele. They based their perceptions on the fact that isiNdebele is their home language, which they understand better and fluently. Hence, they strongly believed that using it as a medium of instruction would limit their frustrations and improve their performance in the subject.

Like learners, parents also shared the same sentiment as they supported the use of isiNdebele to teach Natural Sciences. Their positive perceptions were based on the fact that they strongly believe that if learners are taught in their home language, they will have a better understanding of the content as it is offered in the language they use every day both at school and at home. other than English, which they use at school and during specified periods. Hence, using their home

language will be a great advantage, which will give them opportunities to perform to the best of their abilities in Natural Sciences.

7.3. HOW DID THE DEVELOPED SCIENTIFIC LANGUAGE REGISTER FOR NATURAL SCIENCES IN ISINDEBELE SHAPE CLASSROOM INTERACTIONS AND DISCOURSES?

CASE ONE: JOHN

The study reveals that stakeholders believe that the developed scientific language register for Natural Sciences will positively shape classroom interactions and discourses. Their beliefs were because isiNdebele is the learners' home language, which they understand best. As a result, speaking in their native language will improve their interactions and performance in the subject. The different classroom interactions and discourses were observed when John was teaching Natural Sciences using different scientific registers. When he was using isiNdebele register, learners were interacting and engaging with the lesson as they were observed asking questions and giving responses. Contrary to when he used English register, the learner's interactions were limited to none.

CASE TWO: MANDLA

Stakeholders agreed, as in case one, that the developed scientific language register for Natural Sciences in isiNdebele will positively shape classroom interactions and discourses. Their belief is because learning in their mother tongue yields meaningful learning, which results in better performance. They further noted that learners will learn at ease without worrying about the language use as they will be using the language they are used to and highly proficient in. From the stakeholder’s responses, Mandla was observed teaching Natural Sciences using both scientific registers. When he was using isiNdebele register, learners were interacting to the maximum and asking questions at ease. Compared to when he was using English register, wherein there were limited interactions as they were observed being silent or agreeing with what the teacher was saying without interrogating the lesson.

CASE THREE: MAY

Like the two above cases, stakeholders also confirmed that the developed scientific language register for Natural Sciences in isiNdebelewill positively shape classroom interactions and discourses. They based their assertions on the benefits that come with using indigenous languages as a medium of instruction and how they positively influence meaningful learning and yield positive learning outcomes. Like the other two teachers, May was also observed teaching Natural Sciences using both English and IsiNdebele scientific registers. When using the isiNdebele register, learners were interacting and engaging with the lesson as they were observed asking questions and giving responses. Unlike when she was using the English register. Learners were observed to be passive acceptors of information as there was limited interaction.

From contrasting the different classroom interactions and discourses observed when participants were using different registers. One can infer that the developed scientific language register for Natural Sciences in isiNdebele does positively shape classroom interactions and discourses.

7.4. CONTRIBUTION TO THE FIELD

In this study, the purpose was to develop and implement the scientific language register for Natural Sciences in isiNdebele. Even though it was an instantaneous development and implementation, the findings show that the effort going forward should produce desirable results. During the application, I also focused on how it shape classroom interactions and discourse so that it will not just be its development but also check how it influences meaningful learning and performance. This is so because positive classroom discourse yields meaningful learning and better performance. Many studies have been conducted on the use of indigenous languages as a medium of instruction in South African schools. But none has looked at using scientific registers to teach in South African schools. The findings of this study reveal that the IsiNdebele language is still underdeveloped as it lacks terms, particularly scientific terms. Nonetheless, efforts are being made to develop this language, even though the progress is slow. But with concerted effort from different stakeholdersthe language can be

developed to the same status as English and Afrikaans.Some stakeholders still do not believe in the use of this language to teach natural sciences. However, some stakeholders believe that theuse of this language can assist in resolving challenges that come with using English as the medium of instruction in African schools. Regardless of the different perceptions these stakeholders have they share the same sentiment that the developed scientific language register for Natural Sciences in isiNdebele would positively shape classroom interactions and discourses. Their assertions are strongly based on the benefits of using indigenous languages and how they positively influence meaningful learning and better performance.

The South African government is moving towards making an enormous change to the education system in the form of introducing the use of indigenous languages as a medium of instructions. This is a long-awaited and debated change. However, it will not be plausible to advance this change without having resources written in indigenous languages. As a result, this initiative will remain "paper-paper."This study adds a resource, which is the scientific language register for Natural Sciences in isiNdebele, which will assist in achieving the goal of the South African government.

This study also paves the way for further research and development of scientific language registers in indigenous languages as it only focuses on one strand, which is matter and materials. And only 3 units were developed from this strand.

7.5. RECOMMENDATIONS OF THE STUDY

This study recommends that:

- The development of scientific languages registers for Natural Sciences focusing on other science topics besides Matter and Material.
- There must be a concerted effort to develop Indigenous languages to the point where they are recognised not only as a language but also as a medium of instruction.

- Qualified Natural Science and fluent in isiNdebele teachers develop an isiNdebele scientific language register for Natural Sciences focusing on other strands at school and circuit level.

7.6. LIMITATIONS OF THE STUDY

- The study focused only on three teachers, one class of learners, and five parents from three senior phase schools, which are in the Siyabuswa 2 circuit. Hence, the findings of this study cannot be generalised because it was based on a sample and not the entire population of the Siyabuswa 2 circuit. This was done as it allowed the study to be feasible and cost-effective.
- The study was done only on participants who fulfilled the requirements of the study design and criteria to avoid generalisation as it was a case study. Hence, the sampled participants were deemed to be information-rich individuals who would assist in answering the research questions of this study. The study design and criteria were explained in chapter four.

7.7. CONCLUSION

From the findings of this study, it is of no doubt that isiNdebele still lack scientific terms due to the fact that this language is still underdeveloped. However, that does not overrule its chances of being developed to have such terms as language is not stagnant. Thus far this language has a bilingual dictionary and it has terms listed in the Multilingual Natural Sciences & Terminology term list although most of them are directly translated from English and Afrikaans. This shows that there is progress in this language though it is minimal. With adequate investment of time and resources the development of this language can be plausible. Furthermore, some stakeholders believe that using scientific language register written in isiNdebele to teach natural sciences will give learners an opportunity to perform well in this subject as they will be learning in their mother which they understand best. Moreover, the findings of this study has revealed that using indigenous languages as a language of teaching and learning

positively shapes classroom interactions and discourses which yield to meaningful learning and better performance.These findings shows a dire need of introducing African indigenous languages as language of teaching and learning in schools.It is therefore, recommended that isiNdebele be developed to such a state that is enjoys both the status of being recognised as official and medium of instruction. As this has appeared to be negatively influencing some stakeholder's perceptions on the use of this language to teach Natural Sciences. Further to that more scientific language registers be developed in indigenous languages. This therefore poses a hurdle for linguists and scientists in terms of the work that needs to be done to develop such terms so that this language will enjoy the same status as English and Afrikaans as not being recognised as an official language but as a medium of instruction across the grades up to higher institution level.

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APPENDICES
APPENDIX A: PROOF OF REGISTRATION

UNISA university of south africa

0840

MTULI T G MISS
P O BOX 1112
SIYABUSWA
0472

STUDENT NUMBER : 51923585

ENQUIRIES TEL : 0861670411
FAX : (012)429-4150
ePAIL : mandd@unisa.ac.za

2022-04-12

Dear Student

I hereby confirm that you have been registered for the current academic year as follows:

Proposed Qualification: PHD (EDUCATION) (00019)

CODE	PAPER	S	NAME OF STUDY UNIT	NQF crdts	LANG.	PROVISIONAL EXAMINATION EXAM.DATE	CENTRE(PLACE)
Study units registered without formal exams:							
@ TFNSE01			PhD - Education (Natural Science Education)	**	E		
TFNSE01			PhD - Education (Natural Science Education)	**	E		

@ Exam transferred from previous academic year

You are referred to the "MyRegistration" brochure regarding fees that are forfeited on cancellation of any study units.

To avoid cancellation of your registration or examination entry and forfeiting your minimum initial payment, you must submit the following to the Registrar (Academic) by return of mail:
204 A copy of the transcript of your complete academic record(s), issued by the Registrar of the university/s previously attended by you.

Your attention is drawn to University rules and regulations (www.unisa.ac.za/register).
Please note the new requirements for reregistration and the number of credits per year which state that students registered for the first time from 2013, must complete 36 NQF credits in the first year of study, and thereafter must complete 48 NQF credits per year.
Students registered for the MBA, MBL and DBL degrees must visit the SBL's ESOnLine for study material and other important information.
Readmission rules for Honours: Note that in terms of the Unisa Admission Policy academic activity must be demonstrated to the satisfaction of the University during each year of study. If you fail to meet this requirement in the first year of study, you will be admitted to another year of study. After a second year of not demonstrating academic activity to the satisfaction of the University, you will not be re-admitted, except with the express approval of the Executive Dean of the College in which you are registered. Note too, that this study programme must be completed within three years. Non-compliance will result in your academic exclusion, and you will therefore not be allowed to re-register for a qualification at the same level on the National Qualifications Framework in the same College for a period of five years after such exclusion, after which you will have to re-apply for admission to any such qualification.
Readmission rules for M&D: Note that in terms of the Unisa Admission Policy, a candidate must complete a Master's qualification within three years. Under exceptional circumstances and on recommendation of the Executive Dean, a candidate may be allowed an extra (fourth) year to complete the qualification. For a Doctoral degree, a candidate must complete the study programme within six years. Under exceptional circumstances, and on recommendation by the Executive Dean, a candidate may be allowed an extra (seventh) year to complete the qualification.

RECEIPT NUMBER:	CASH:	CHEQUE:	CARD:	POSTAL ORDER:	MONEY ORDER:	FOREIGN:
20220413-1837-005			18795.00 (Straight)			

STUDY FEES: 18795.00

BALANCE ON STUDY ACCOUNT: 0.00

Yours faithfully,

UNIVERSITEIT VAN SUID-AFRIKA PRETORIA UNIVERSITY OF SOUTH AFRICA

Prof M S Mothata
Registrar

0108 0 00 0

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APPENDIX B: TEACHER INTERVIEW PROTOCOL

THE TEACHER INTERVIEW PROTOCOL

Semi-structured interview questions for Natural Science teachers

Section A. (biographical information)

1. What is your home language?
2. How long have you been teaching Natural Sciences in the senior phase?
3. What teaching qualification do you have?
4. What are your major subjects?

Section B

Part A (Challenges and Opportunities)

1. Do you experience any challenges using English to teach Natural Sciences? If yes, elaborate those challenges.
2. Are your learners experiencing problems being taught in English?
3. If yes, what kind of problems? Please elaborate
4. What programmes do you have in place to assist learners with difficulties in learning with English?
5. What is the Language spoken outside the classroom by your learners?
6. What is the language spoken you and your learners inside the classroom?
7. Do you apply code-switching in your classroom? If yes, why?
8. What language do you normally code switch to and why?
9. What are the challenges did you experience in using the scientific language register?
10. And what are the opportunities did you identify in using the scientific language register?
11. How was your experience in using the scientific language register? And Why?

Part B (Perceptions)

1. What is your perception on the use of isiNdebele to teach Natural Sciences?
2. Why is your perception like that?

3. How is the general performance of Natural Sciences in your school? (Good or Bad)
4. Do you think the language used to teach Natural Sciences has an impact to that performance? And Why?
5. What language do you prefer to use to teach Natural Sciences? And why?
6. What language do you think your learners would prefer to learn Natural Sciences? And why?

Part C (Interaction and discourses)

1. Does the developed isiNdebele scientific register used to teach Natural sciences influences the learner's interaction and discourses in the classroom? If yes, please elaborate.

APPENDIX C: LEARNERS INTERVIEW PROTOCOL

THE LEARNERS INTERVIEW PROTOCOL

Semi-structured interview questions for learners

Section B

Part A (Challenges and Opportunities)

1. Do you experience any challenges in learning Natural Sciences in English? If yes, elaborate those challenges.
2. What language would you prefer to learn Natural Sciences? And why?
3. What is the language do you speak inside the classroom? And why?
4. What language to speak outside the classroom? And why?
5. What are the challenges did you experience when learning Natural Sciences in isiNdebele?
6. What are the opportunities identified in learning Natural sciences in isiNdebele?

Part B (Perceptions)

1. What is your perception on the use of isiNdebele to teach Natural Sciences?
2. Why is your perception like that?
3. How is the general performance of Natural Sciences in your school? (Good or Bad)
4. Do you think the language used to teach Natural Sciences has an impact to the performance? If yes, Why?

Part C (Interaction and discourses)

1. How does the developed isiNdebele scientific register used to teach Natural Sciences influences your classroom interactions and discourses?

APPENDIX D: PARENTS INTERVIEW PROTOCOL

THE SGB (PARENTS) INTERVIEW PROTOCOL

Semi-structured interview questions for SGB (parents)

Section B

Part B (Perceptions)

1. What is your perception on the use of isiNdebele to teach Natural Sciences?
2. Why is your perception like that?
3. How is the general performance of Natural Sciences in your school?
4. Do you think the language used to teach Natural Sciences has an impact to the performance? And Why?
5. What language do you prefer your child to use to learn Natural Sciences? And why?

Part C (Interaction and discourses)

1. Do you think the developed isiNdebele scientific register used to teach Natural sciences influences the learner's interaction and discourses in the classroom? If yes, please elaborate.

APPENDIX E: OBSERVATIONAL TOOL

THE TEACHER OBSERVATIONAL TOOL

Lesson observation schedule for Natural Science teachers on the use of scientific language register.

School:

_____

Date:

_____

Grade:

_____

Number of learners in natural sciences classroom:

Boys: _____ Girls: _____ Total: _____

Teacher:

_____

Researcher:

_____

Role of Researcher:

_____

Time of observation:

_____

Length of observation:

_____

A. Challenges and opportunities

1. Did the teacher had any challenge in using the scientific language register

---

---

2. Did the teacher used isiNdebele though-out the lesson?

_____

_____

3. Lesson properly planed and presented

_____

_____

4. Teachers understanding of concepts and presentation

_____

_____

B. Interaction and discourses

a) Learners' participation

_____

b) Learners interactions and discourses

_____

APPENDIX F: PERMISSION LETTER TO THE DISTRICT MANAGER
LETTER TO THE DISTRICT MANAGER

College of education

Department of science and technology education

Request for permission to conduct research at schools

Title: "**Developing isiNdebele scientific language register for Natural Sciences and its classroom application in Siyabuswa 2 circuit, South Africa"**

22 June 2021

The District Manager
Nkangala Region Department of Education

Dear Sir/ Madam

I, Ntuli Thuli Gladys, am doing research under the supervision of A. V. Mudau, a professor in the Department of Science and Technology Education. I am working towards my Doctoral Degree in education with specialisation in Natural Sciences at the University of South Africa. There is no funding involved in this study. I am requesting a written permission to use the schools that will be interested to participate in ta study entitled: "Developing isiNdebele scientific language register for Natural Sciences and its classroom applications in Siyabuswa 2 circuit, South Africa"

The aim of the study is to develop isiNdebele scientific language register for Natural Sciences and its classroom applications in Siyabuswa 2 circuit, South Africa. The study will also explore perceptions, challenges and opportunities of developing this register and how it shapes the interactions and discourses in the classroom. Your department has been selected because the main objective of the study is to explore perceptions, challenges and opportunities of developing this register and how it

shapes the interactions and discourses in the classroom this objective can only be realised within your department. The study will request consent from Natural Sciences teachers, learners and parents of the Siyabuswa 2 circuit to participate in this study, prior to interviews and observations, participants permission will be requested, a recording device will be used. Up on the granted permission from the participants to take park in the study, I will then work with them through-out the research process. In this study three schools will be selected to participate, one teacher from each school will be observed and interviewed, one class from each selected school will be interviewed and 5 parents from each selected school will be interviewed.

The benefits of this study will be for all schools situated in Siyabuswa 2 circuit even the neighbouring ones. There are no known risks associated with this study. Confidentiality will be maintained by not disclosing the names of schools and participants. The data that will be collected form the participants will be kept confidential and will be strictly used for research purpose. Participants will not be reimbursed or receive any incentives for participating in this study. Up on request participants will receive the summary of the research findings.

For more information regarding the study, please contact me on: 078 209 1017 or email: entulit@unisa.ac.za and my supervisor professor A.V. Mudau can be reached at: 012 429 6353 or email: mudauav@unisa.ac.za

Yours sincerely

Ntuli T.G (Researcher)

APPENDIX G: PERMISSION LETTER TO THE CIRCUIT MANAGER
LETTER TO THE CIRCUIT MANAGER

College of education

Department of science and technology education

Request for permission to conduct research at schools

22 June 2021

The Circuit Manager
Nkangala Region Department of Education

Dear Sir/ Madam

I, Ntuli Thuli Gladys, am doing research under the supervision of A. V. Mudau, a professor in the Department of Science and Technology Education. I am working towards my Doctoral Degree in education with specialisation in Natural Sciences at the University of South Africa. There is no funding involved in this study. I am requesting a written permission to use the schools that will be interested to participate in ta study entitled: “Developing isiNdebele scientific language register for Natural Sciences and its classroom applications in Siyabuswa 2 circuit, South Africa”

The aim of the study is to develop isiNdebele scientific language register for Natural Sciences and its classroom applications in Siyabuswa 2 circuit, South Africa. The study will also explore perceptions, challenges and opportunities of developing this register and how it shapes the interactions and discourses in the classroom. Your circuit has been selected because the main objective of the study is to explore perceptions, challenges and opportunities of developing this register and how it shapes the interactions and discourses in the classroom this objective can only be realised within your circuit. The study will request consent from Natural Sciences teachers, learners and parents of the Siyabuswa 2 circuit to participate in this study,

prior to interviews and observations, participants permission will be requested, a recording device will be used. Up on the granted permission from the participants to take park in the study, I will then work with them through-out the research process. In this study three schools will be selected to participate, one teacher from each school will be observed and interviewed, one class from each selected school will be interviewed and 5 parents from each selected school will be interviewed.

The benefits of this study will be for all schools situated in Siyabuswa 2 circuit even the neighbouring ones. There are no known risks associated with this study. Confidentiality will be maintained by not disclosing the names of schools and participants. The data that will be collected form the participants will be kept confidential and will be strictly used for research purpose. Participants will not be reimbursed or receive any incentives for participating in this study. Up on request participants will receive the summary of the research findings.

For more information regarding the study, please contact me on: 078 209 1017 or email: entulit@unisa.ac.za and my supervisor professor A.V. Mudau can be reached at: 012 429 6353 or email: mudauav@unisa.ac.za

Yours sincerely

Ntuli T.G (Researcher)

APPENDIX H: PERMISSION LETTER TO THE PRINCIPALS

LETTER TO THE PRINCIPALS

College of education

Department of science and technology education

Request for permission to conduct research at schools

22 June 2021

The School Principal
Nkangala Region Department of Education

Dear Sir/ Madam

I, Ntuli Thuli Gladys, am doing research under the supervision of A. V. Mudau, a professor in the Department of Science and Technology Education. I am working towards my Doctoral Degree in education with specialisation in Natural Sciences at the University of South Africa. There is no funding involved in this study. I am requesting a written permission to use the schools that will be interested to participate in ta study entitled: “Developing isiNdebele scientific language register for Natural Sciences and its classroom applications in Siyabuswa 2 circuit, South Africa”

The aim of the study is to develop isiNdebele scientific language register for Natural Sciences and its classroom applications in Siyabuswa 2 circuit, South Africa. The study will also explore perceptions, challenges and opportunities of developing this register and how it shapes the interactions and discourses in the classroom. Your department has been selected because the main objective of the study is to explore perceptions, challenges and opportunities of developing this register and how it shapes the interactions and discourses in the classroom this objective can only be realised within your department. The study will request consent from Natural Sciences teachers, learners and parents of the Siyabuswa 2 circuit to participate in this study,

prior to interviews and observations, participants permission will be requested, a recording device will be used. Up on the granted permission from the participants to take park in the study, I will then work with them through-out the research process. In this study three schools will be selected to participate, one teacher from each school will be observed and interviewed, one class from each selected school will be interviewed and 5 parents from each selected school will be interviewed.

The benefits of this study will be for all schools situated in Siyabuswa 2 circuit even the neighbouring ones. There are no known risks associated with this study. Confidentiality will be maintained by not disclosing the names of schools and participants. The data that will be collected form the participants will be kept confidential and will be strictly used for research purpose. Participants will not be reimbursed or receive any incentives for participating in this study. Up on request participants will receive the summary of the research findings.

For more information regarding the study, please contact me on: 078 209 1017 or email: entulit@unisa.ac.za and my supervisor professor A.V. Mudau can be reached at: 012 429 6353 or email: mudauav@unisa.ac.za

Yours sincerely

Ntuli T.G (Researcher

APPENDIX I: LETTER TO NATURAL SCIENCES TEACHER
LETTER TO NATURAL SCIENCES TEACHER

College of Education

Department of Science and Technology Education

Title: “Developing isiNdebele scientific language register for Natural Sciences and its classroom applications in Siyabuswa 2 circuit, South Africa”

DEAR PROSPECTIVE PARTICIPANT

I, Ntuli Thuli Gladys, am doing research under the supervision of A. V. Mudau, a professor in the Department of Science and Technology Education. I am working towards my Doctoral Degree in education with specialisation in Natural Sciences at the University of South Africa. There is no funding involved in this study. I am inviting you to participate in ta study entitled: “Developing isiNdebele scientific language register for Natural Sciences and its classroom applications in Siyabuswa 2 circuit, South Africa”. The main objective of this study is to explore perceptions, challenges and opportunities of developing this register and how it shapes the interactions and discourses in the classroom. You are requested to participate in this study because you are a suitable candidate as you are teaching Natural Sciences in one of the schools situated in Siyabuswa 2 circuit where the study will be undertaken. I do not have your details.

I hereby request your permission to observe you while teaching Natural Sciences using the isiNdebele scientific language register in your classroom and use of audio recording during interviews. The time allocation for every interview will be 40 minutes maximum and research will be conducted for a period of one month.

Participating in this study is voluntary and you are under no obligation to consent to participation. If you decide to take part, you will be given this information sheet to keep and be asked to sign a written consent form. You are free to withdraw at any time and without giving a reason. In this study there are no potential benefits for taking part.

There are no negative consequences for any participant if they participate in this study. The information that you provide will not be disclosed to your colleagues or seniors your identity will be kept confidential. Hard copies of your answers will be stored by the researcher for a period of five years in a locked cupboard/filling cabinet at the researcher's workplace for future research or academic purposes: electronic information will be stored on a password protected computer. Future use of the stored data will be subject to further research ethics review and proposal. The researcher will destroy the information two years after the completion of study by shredding the hard copies and by permanently deleting the soft copies using software applications. In this study there will be no incentives and no receipt of payment for participation. Up on request participants will be provided with the summary of the research findings.

For more information regarding the study, please contact me on: 078 209 1017 or email: entulit@unisa.ac.za and my supervisor professor A.V. Mudau can be reached at: 012 429 6353 or email: mudauav@unisa.ac.za

Thank you for taking the time reading this information sheet

Kind regards

NTULI THULI GLADYS

APPENDIX J: LETTER TO PARENTS
LETTER TO PARENTS (SGB)

College of Education

Department of Science and Technology Education

Title: “Developing isiNdebele scientific language register for Natural and its classroom applications in Siyabuswa 2 circuit, South Africa”

DEAR PROSPECTIVE PARTICIPANT

I, Ntuli Thuli Gladys, am doing research under the supervision of A. V. Mudau, a professor in the Department of Science and Technology Education. I am working towards my Doctoral Degree in education with specialisation in Natural Sciences at the University of South Africa. There is no funding involved in this study. I am inviting you to participate in ta study entitled: “Developing isiNdebele scientific language register for Natural Sciences and its classroom applications in Siyabuswa 2 circuit, South Africa”. The main objective of this study is to explore perceptions, challenges and opportunities of developing this register and how it shapes the interactions and discourses in the classroom. You are requested to participate in this study because you are a suitable candidate as you are teaching Natural Sciences in one of the schools situated in Siyabuswa 2 circuit where the study will be undertaken. I do not have your details.

I hereby request your permission to interview you. The time allocation for every interview will be 40 minutes maximum and research will be conducted for a period of one month.

Participating in this study is voluntary and you are under no obligation to consent to participation. If you decide to take part, you will be given this information sheet to keep and be asked to sign a written consent form. You are free to withdraw at any time and without giving a reason. In this study there are no potential benefits for taking part.

There are no negative consequences for any participant if they participate in this study. The information that you provide will not be disclosed to your colleagues or seniors your identity will be kept confidential. Hard copies of your answers will be stored by the researcher for a period of five years in a locked cupboard/filling cabinet at the researcher's workplace for future research or academic purposes: electronic information will be stored on a password protected computer. Future use of the stored data will be subject to further research ethics review and proposal. The researcher will destroy the information two years after the completion of study by shredding the hard copies and by permanently deleting the soft copies using software applications. In this study there will be no incentives and no receipt of payment for participation. Up on request participants will be provided with the summary of the research findings.

For more information regarding the study, please contact me on: 078 209 1017 or email: entulit@unisa.ac.za and my supervisor professor A.V. Mudau can be reached at: 012 429 6353 or email: mudauav@unisa.ac.za

Thank you for taking the time reading this information sheet

Kind regards

NTULI THULI GLADYS

APPENDIX K: LETTER TO LEARNERS PARENTS
LETTER TO LEARNERS PARENTS

College of Education

Department of Science and Technology Education

Title: “Developing isiNdebele scientific language register for Natural Sciences and its classroom applications in Siyabuswa 2 circuit, South Africa”

DEAR PROSPECTIVE PARTICIPANT

I, Ntuli Thuli Gladys, am doing research under the supervision of A. V. Mudau, a professor in the Department of Science and Technology Education. I am working towards my Doctoral Degree in education with specialisation in Natural Sciences at the University of South Africa. There is no funding involved in this study. I am inviting you to participate in ta study entitled: “Developing isiNdebele scientific language register for Natural Sciences and its applications in Siyabuswa 2 circuit, South Africa”. The main objective of this study is to explore perceptions, challenges and opportunities of developing this register and how it shapes the interactions and discourses in the classroom. You are requested to participate in this study because you are a suitable candidate as you are teaching Natural Sciences in one of the schools situated in Siyabuswa 2 circuit where the study will be undertaken. I do not have your details.

I hereby request your permission to interview your child. The time allocation for every interview will be 40 minutes maximum and research will be conducted for a period of one month.

Participating in this study is voluntary and you are under no obligation to consent to participation. If you decide to take part, you will be given this information sheet to keep and be asked to sign a written consent form. You are free to withdraw at any time and without giving a reason. In this study there are no potential benefits for taking part. There are no negative consequences for any participant if they participate in this study. The information that you provide will not be disclosed to your colleagues or seniors

your identity will be kept confidential. Hard copies of your answers will be stored by the researcher for a period of five years in a locked cupboard/filling cabinet at the researcher's workplace for future research or academic purposes: electronic information will be stored on a password protected computer. Future use of the stored data will be subject to further research ethics review and proposal. The researcher will destroy the information two years after the completion of study by shredding the hard copies and by permanently deleting the soft copies using software applications. In this study there will be no incentives and no receipt of payment for participation. Up on request participants will be provided with the summary of the research findings.

For more information regarding the study, please contact me on: 078 209 1017 or email: entulit@unisa.ac.za and my supervisor professor A.V. Mudau can be reached at: 012 429 6353 or email: mudauav@unisa.ac.za

Thank you for taking the time reading this information sheet

Kind regards

NTULI THULI GLADYS

APPENDIX L: CONSENT FORM FOR TEACHERS

CONSENT FORM FOR NATURAL SCIENCES TEACHERS

I,_____(participant name), confirm that the researcher asking for my consent to take part in this research has told me about the nature, procedure, potential benefits and anticipated inconveniences of participation.

I have read and (or had explained to me) and understand the study as explained in the information sheet.

I have had sufficient opportunities to ask questions and am prepared to participate in the study.

I understand that my participation is voluntary and that I am free to withdraw at any time without penalty.

I am aware that the findings of this study will be processed into research report, journal publications and/or conference proceedings, butt that my participation will be kept confidential unless otherwise specified.

I agree to be recorded in the interviews and observations

_____

I have received a signed copy of the informed consent agreement.

Participant Name & Surname (please print)_____

APPENDIX M: CONSENT FORM FOR PARENTS (SGB)

CONSENT FORM FOR PARENTS (SGB)

I, _____(participant name), confirm that the researcher asking for my consent to take part in this research has told me about the nature, procedure, potential benefits and anticipated inconveniences of participation.

I have read and (or had explained to me) and understand the study as explained in the information sheet.

I have had sufficient opportunities to ask questions and am prepared to participate in the study.

I understand that my participation is voluntary and that I am free to withdraw at any time without penalty.

I am aware that the findings of this study will be processed into research report, journal publications and/or conference proceedings, butt that my participation will be kept confidential unless otherwise specified.

I agree to be recorded in the interviews._____

I have received a signed copy of the informed consent agreement.

Participant Name & Surname (please print)_____

APPENDIX N: CONSENT FORM FOR LEARNERS (PARENTS)

CONSENT FORM FOR PARENTS OF LEARNERS PARTICIPATING IN THE RESEARCH PROJECT

I, _____ (full name of parent / guardian), the parent of_____ (name of a learner / participant) hereby confirm and give consent to the researcher (Ms Thuli Gladys Ntuli) for my child to take part in her study entitled : **"Developing isiNdebele scientific language register for Natural Sciences and its classroom applications in Siyabuswa 2 circuit, South Africa".**

Ms Ntuli Thuli Gladys has discussed or explained the purpose of research with the principal and understand the study she wishes to undertake as the researcher. She has also received consent for our circuit manager on behalf of the department.

I understand that my child will have sufficient opportunities to participate in the research and ask questions as he / she participates in the study.

I understand that my child's participation is voluntary and that he / she is free to withdraw at any time without penalty or negative repercussions.

I understand aware that the findings of this study will be processed into research report, journal publications and / or conference proceedings, but that his / her participation will be kept confidential unless otherwise specified.

I agree or give consent that my child be a participant in the research project and be recorded in the interviews and observations if need be and the recordings will solely be utilised for the purpose of research.

_____

_Surname and name of the parent/guardian Participant / learner name & surname

_____

Signature of the parent/guardian Signature of the participant/ learner

DATE : _____ DATE : _____

CELL NO : _____

APPENDIX O: NATURAL SCIENCE SCIENTIFIC LANGUAGE REGISTER FOR NATURAL SCIENCES IN ISINDEBELE

COMPILED BY Ms THULI GLADYS NTULI

ISIQUNTU SESIBILI

Amametha nensetjenziswa

Ukuhlukaniswa kwemivango

Ukuwurubaja

Esihlokweni sesihlanu nifunde bona imetha I setjenziselwa ukwenza okuthile. Ufunde bona asikhethi iinsetjenziswa ngemibandela yezinto ekgona ukuzenza. Ebangeni lesithandathu ufunde bona imetha neensetjenziswa ingaba ziingaba ezimbili into emsulwa kunye nomvango ahlukeneko njengomoya namkha amanzi welwandle.

Imivango ingahlukaniswa ngendlela ezinengi zokusebenzisa izandla. Isibonelo umvango wemifino namkha yemincamo ingahlukaniswa ngokusetjenziswa kwezandla.

Umsebenzi Wokuthoma
Dzubhula izindlela zokuhlukanisa

Isithombe:1

Isithombe: 2

Qala iiithombe ezingehla ezinomborwe no:1 kunye no 2 sikaMandisa olungiselela ukubhaga

1. uMandisa uvange \uhlanganise iflowuru kunye namadribe onyisiweko.

    a. Nakhisibe uhlanganise amadribe amanengi ngeflowurwini ungawakhetha njani emvangweni?sekela ipendulo yakho.
    b. uMandisa uthela amaqanda nebisi kumvango wakhe. Itjho bona angawahlukanisa njani amadribe omoleko kumvango wakhe. Sekela ipendulo yakho.

2. Qagela \ipha eminye imihlobo\iindlela zokuhlukanisa imivango ezisetjenziswa ngekhwitjhini.

Tlola bona mivango namkha awa enikelwe ngaphasi

    a. Amanzi
    b. Amanzi welwandle
    c. Itswayi
    b. d.Umvango wekhekhe

a. Umoya

b. Isaladi yemifino

IMIVANGO (Isahluko sokuthoma)

Amagama aqakathekileko

Into emsulwa

- Sithago esinzinzileko engeke sahlukaniswa ngokwezakhi sazo

Umvango

- Wenziwe ngezakhi ezimbili kuya kwezintathu ezinobujamo obuhlukileko ezihlanganiswe ndawonye

Ubujamo bezenziwa

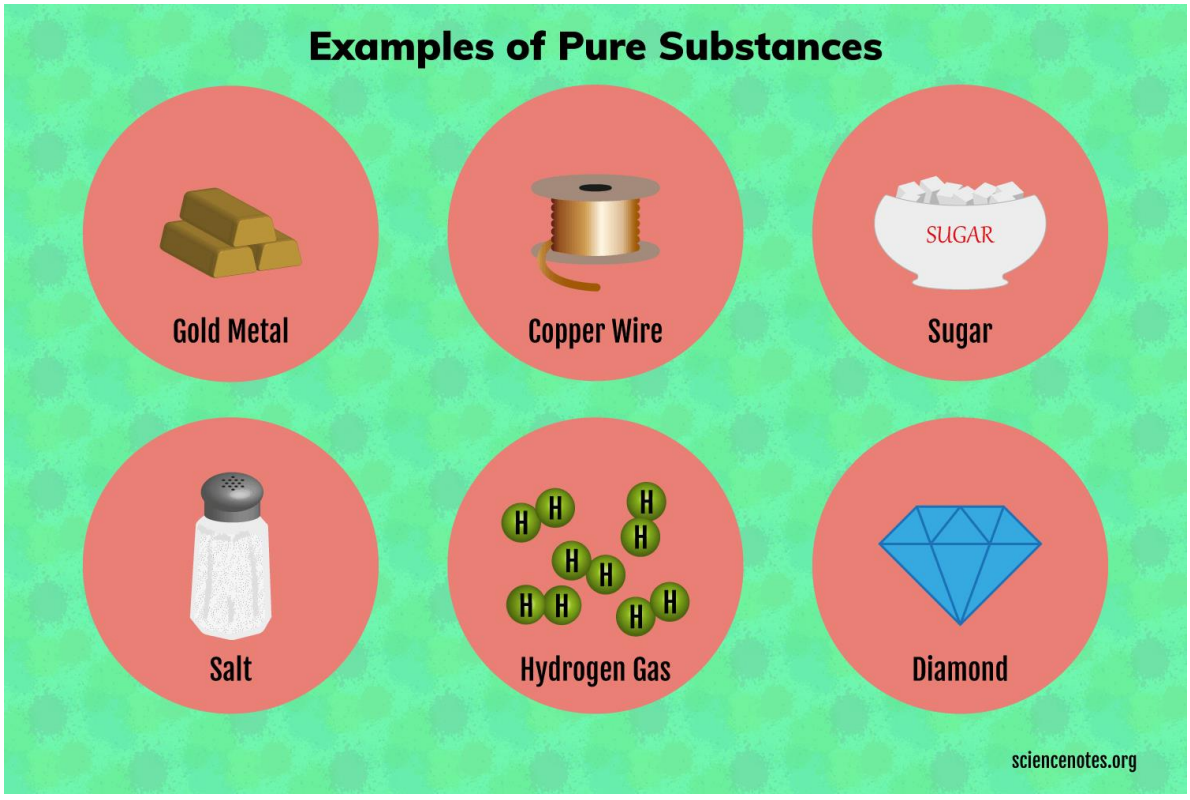
- Zizinto ezahlukileko ezenza\ezihlathulula isimo\ubujamo beenqeqwana

<u>INTO EMSULWA</u>

Sithago esinzinzileko engeke sahlukaniswa ngokwezakhi sazo

Qala iimbonelo ezingenzasi

Iimbonelo zezinto ezimsulwa



a) Izakhi zeqolide zoke ziyafana
b) Izakhi zentambo esamthofo
c) Izakhi zetjhukela
d) Izakhi wetswayi
e) Izakhi zerhasi yomoya
f) Izakhi zerhawuda

Imivango

Imivango ayifani nezinto ezimsulwa. Imivango yenziwa zizakhi ezimbili kuya kwezintathu nangaphezulu ezinobujamo obuhlukileko. Ubujamo bama bezakhi busetjenziselwa ukuhlukanisa isakhi esinye kwenye. Esigabeni esidlulileko ufundile ngalokhu: ubujamo bezakhi obufaka hlangana ukuncithikisa, ubujamo bokudlhlabhaza Kanye nokubalula.

Incenye yomvango inobujamo obuhlukileko. Imivango eminye nawuhlanganisa izakhi zayo ubujamo obubonakala bayo abutjhuguluki ihlala injalo

Qala iimbonelo eethombeni ezingenzasi

a. Kuhlanganiswa amantongomani kunye nemihlobo yeentanga. Ubujamo bamantongomani Kanye nebeentanga busese njalo abutjhuguluki(ngombana sisakgona ukubona amantongomani kanye nemihlobo yeentanga begodu singakgona ukuzi khetha sizihlukanise)

b. Umvango wamaswidi singakgona ukukhupha umhlobo wamswidi ngokudobha ngamunye siwuhlukanise. Lokho kutjho bona ubujamo obubonakalako bomvango abukatjhuguluki

*kweminye imivango akukgonakali ukubona izinto ezimsulwa emvangweni ngombana ngemva kobanyana kuhlanganisiwe kuphuma umvango ofanako kweze bona kubebudisi ukubona bona umvango wenziwe ngani.

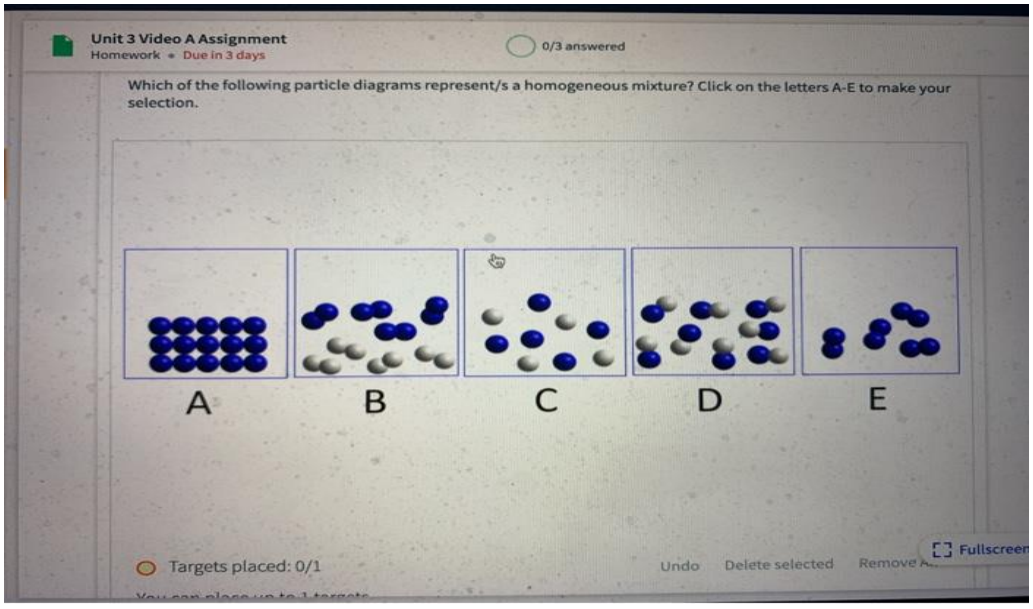
Isibonelo: Amanzi avangwe netswayi nawuqala umvango kubanzima ukubona bona kuthelwe ini\wenziwe ngani ngobanyana ufana namanzi. Yeke-ke indlela yokwazi kukuba kuzwelela umvamgo ngokusebenzisa ilimi.

Singasebenzisa indlela ezibonakalako ukuhlukanisa imivango eminye ngobanyana ingakahlanganiseki begodu ubujamobayo bungakatjhuguluki.

Isibonelo_ Ipuphu nerayisi singasebenzisa isefo ukusefa / ukukhetha irayisi kusale ipuphu

<u>Umsebenzi wesibili (Dzubhula okumivango eenthombeni ezingenzasi)</u>

1. Khetha bona ngiyiphi idayagramu ekhombisa umvango, sekela ipendulo yakho.



2. Hlunga iinthombe ezingenzasi bona ngisiphi esikhombisa umvango; ngisiphi esingakhombisa umvango.

Isahluko sesibili

Iindlela zokuhlukanisa ngendlela ebonakalako

Amagama agakathekileko

a. Ukusefa

- Yindlela esetjenziselwa ukuhlukanisa imivango enobujamo obuqinileko begodu engalinganiko

Isibonelo: Irayisi/ itswayi

b. **Ukusefa ngobujamo**

- Yindlela esetjenziswa ukuhlukanisa okuqinileko nokumamanzi

c. **Okungancibilikiko/ Okuncibilikako**

- Ngokuqinileko okungancibilikiko / okungancithikisa ngokumamanzi

Ukuhlukanisa ngokugopha ngesandla

Le-yindlela yokohlukanisa imivango eqinileko begodu nehluke ngamasayizi, ngemibala nangokubumbeka.

Isibonelo

Imincamo eyehlukileko ngemibala isilinganiso, nobujamo yehlukaniswa ngokudobha munye ngenalidi.

Iindlela yokuhlukanisa ngokudobha itjhiphile begodu iyindlela elula kodwana ithatha isikhathi eside ngombana udobha ngayinye.

Ukusefa

Iindlela yokusefa isetjenzisewla ukuhlukanisa umvango oqinileko kodwana ongalinganiko ngesilinganiso. Isefo ineentunjana ezincani ezilinganako. Iintunjanezo zivumela izakhiwo ze silinganiso zidlule kizo.

Isibonelo

Abakhi bendlela baberegisa isefo ukuhlukanisa isannda namatje.

Ukusefa ngobujamo

Singasebenzisa ukusefa ngobujamo ukuhlukanisa okungancithikiko ngemanzini. Singasefa amanzi siwahlukanise nokungancibilikiko.

Isibonelo

Singasefa amanzi siwahlukanise nehlabathi (singahlukanisa umvango wamanzi nehlabathi). Singasebenzisa iphepha lokusefa namkha ifanele ukwenza lokho. Iphepha lokusefa lineentunjana ezincancani ezidlulisa amanzi kuthi angadlula kusale eentunjaneni ngombana zizincancani khulu yeke lapho –ke sesihlukanisile umvango wamanzi ne sanda.

Umsebenzi wesithathu (ukuhlukanisa umvango wemanzi nepuphu)

Ukuhlukanisa umvango wamanzi nepuphu intlabagelo ozozidinga / ozokudinga. Iphepha lokusefa, umvango wepuphunamanzi zibengebhigiri / irhalasi.

Indlela elandelwako (method)

Kokuthoma

Sika ibhodlelo ehlokwanen ngesikero,

Kwesibili

Goqa iphepha lokusefa ulenze uncanthathu njengobanyana ufundisiwe ebangeni lesihlanu

Kwesithathu

Faka incenye esikweko ngaphakathi kwebhodlelo uyiqalise phasi (ufake iphepha lokusefa ngaphakathi)

Kwesine

Thela umvango ngaphakathi kwebhodlelo/ ifaneli oyenzileko.

Okubonileko/ nesiphetho

1. Tlola koke okubonileko/ okuyeleleko ngalokhu ebegade ukwenza
2. Hlathulula ngokunabileko bona uhlukanise njani umvango lo?
3. Siyini isiphetho somberego wesibonakaliso/ otjhatjhalazi ebegade uwenza lo wezandla.

4. Yipha iimbonele ezimbili bonyana singasebenzisa njani indlela yokuhlukanisa ngobujamo emakhaya.

Amagama aqakathekileko

Ncibilika / ncithika

- Sisakhi esiqinileko esikgona ukuncithikiswa ngokusamanzana

Isikhambeleni

- Mvango owenziwe ngokuncithikisa okuqinileko ngokusamanzaneni

Okuqinileko

- Ngokuncithika ngokusamamzaneni

Okusamanzana

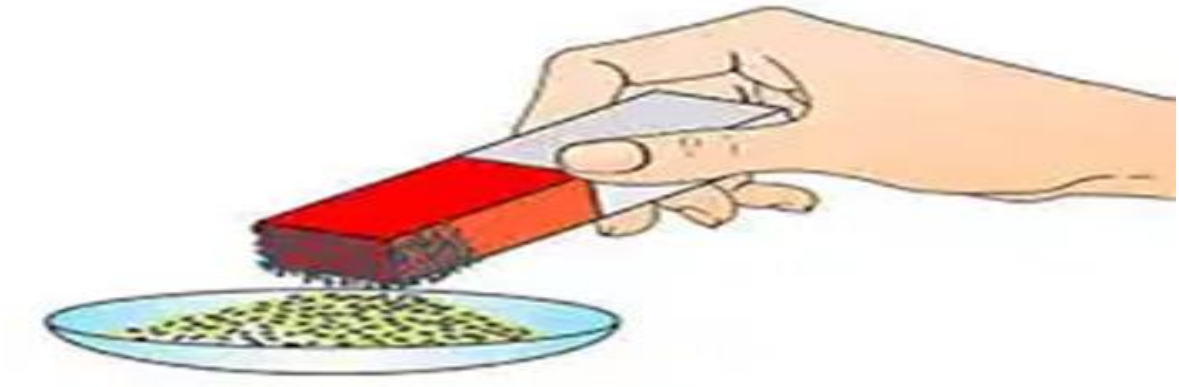
- Ngokuncithikisa okuqinileko

Umrhwamuko

- Yindlela yokutjhugulula ubujamo kusuka kokusamanzana ukuya kokusamoya

Ukusetjenjiswa kwetjhogo ukuhlukanisa umvango

Itjhogo inekgono lokudosa isimbi lokhu kungobanyana isimbi isthago setjhogo.



Umsebenzi wesine (Hlukanisa umvango usebenzise itjhogo)

Okudingekako

Isannda-ihlabathi evangene nensimbi
Umvango wehlabathi kunye neensinjana ezincani, Nesiqetjhana sephepha
Kokuthoma (imigomo) landela yenza-lokhu

1. Thela umvango ephepheni
2. Tjhideza itjhogo hlanu komvango. Idlulise hlanu komvango mahlandlana
3. Tlukutla iphepha kancani ubuyelele igadango lesibili
4. Tlola phasi okubonile
5. Hlathulula bona yini okwenze bona indlela yokuhlukanisa iberege

Urhwamuko
Ukutjhuguluka ubujamo kusuka kokusamanzana ukuya kokusamoya

Isikhambeleni
Esingabeni sesithandathu ufundile bona okuqinileko kungancithika ngokusamnzanene.

Isibonelo
Itjhukela iyancithika nge manzini ngesikhambelenini setjhukela namanzi kubudisi ukubona / ukuhlukanisa itjhukela emanzini. Kilokhuke **itjhukela** ngokuncithikela ngemanzini kuthi **amanzi** ngokuncithikisa itjhukela.

Ukusetjenziswa kokutjhugulula ubujamo kusuka kokusamanzana kuya kokusamoya ukuhlukanisa imivango / umvango

Kilokhu- ke angeze sasebenzisa ukuhlukanisa ngobujamo ngobanyana umvango sele ufana begodu kubudisi kubudisi ukuhlukanisa nokubona umehluko. Iindlela yokuhlukanisa amanzi netjhukela (isikhambeleni samanzi netjhukela kukobanyana sidhlabhazile isikhambeleni isikhathi eside okusamanzana kuzokuphenduka umoya kuthi okuqinileko okuyitjhukela kusale ngepotweni.

Umsebenzi wesihlanu (ukuhlukanisa iskhambeleni samanzi netswayi)
Okudingekako:

Litswayi, ilebhula, irhalasi, amanzi, ipiringhi, nendawo enelanga.

KOKUTHOMA

- Thela amalebhula amathathu wetswayi ngaphakathi kwerhalasi, thela amanzana amancani ururе uhlanganise.

KWESIBILI

- Raga ngokuthela itswayi nokuhlanganisa bekufike lapha itswayi lingasabonakali khona.

KWESITHATHU

- Thela isikhambelani ngaphakathi kwepiringhi.

KWESINE

- Beka ipiringhi endaweni enelanga
- Tlola phasi isikhathi nelanga

KWESIHLANU

- Hlola ipiringhi ngamalanga bese utlole okubonako

KWESITHANDATHU

- Mhlazana amanzi angasekho epiringhini kusele itswayi lodwa. Tlola phasi bona kuthethe amalanga amangaki ukuhlukanisa isikhambeleni setswayi namanzi

KWESIKHOMBA

- Tlola isiphetho somberego lo.

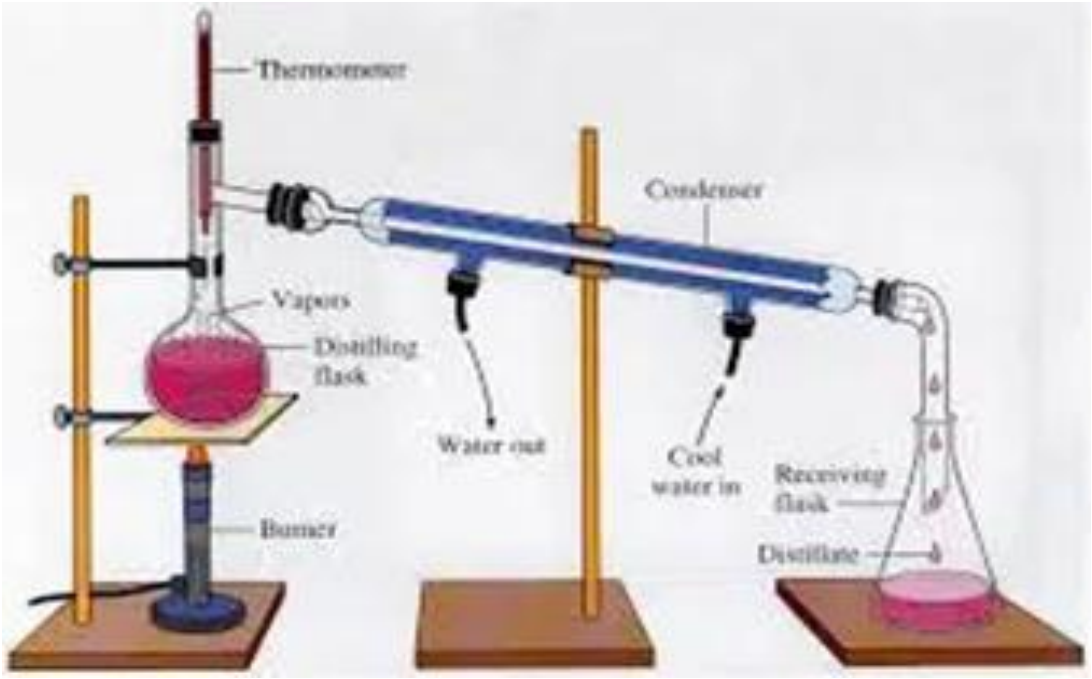
Amagama agakathekileko

Ukurhunyeza

- Yindlela yokuhlukanisa isikhambeleni ngokusidhlabhazisa ukuze okumanzana kuphephuke bese okuphephukileko kuya pholiswa kobanyana kujike kusuke kukusamoyana ukuya kokusamanzana.

Ukutsenga

- Yindlela yokujika / yokutjhugula okusamoyana kube samanzana
-



UKUHLUKANISA

Nasifuna ukubuyisa okuqinileko nokusamanzana singasebenzisa indlela yokudhlabhazisa isikhambeleni sivimbe okusamanzi bona kungaphephuki bese siyakupholisa bona kujike kube samanzana.

Amagama abalulekileko

Ukuhlukanisa

- Indlela yokuhlukanisa umvango ngokuberegisa indlela eyodwa kodwana ibelo elihlukileko.

Umbala

- Sithago esikhupha umbala kokuphilako.

Isibonelo: Apha igazi umbala obovu, imith namkha iintjalo umbala ohlaza, nemibala esetjenjiswa ukupenda izambatho.

Ukuhlukanisa

- Iindlela yokuhlukanisa umvango ngokusebenzisa indlela eyodwa kodwana ibelo elihlukileko. Isetjenjiswa ukuhlukanisa imivango epha imibala. Lokhu kwenziwa ngokuthela okusamanzana okufana namanzi namkha utjwala emvangweni wemibala, bese uthela ephepheni. Okhunye okupha imibala kuncithike masinya ukudlula eminye. Lokhu kubonakala ephepheni la kuba nemibala ehlukahlukeneko.
-

UMBEREGO WEZANDLA

OZUKUDINGA

Imincamo, Ihlabathi, Iinsimbi ezincani, Itswayi, Amanzi, Amarhalasi amabili, Itjhogo, Ifaneli, Iphepha lokusefa, Istofu esincani, Iderefudi.

1. Tlama umsebenzi wezandla ozowuberegisa ukuhlukanisa umvango womncamo, ihlabathi, iinsimbi ezincani, itswayi kanye namanzi.

YELELA LOKHU

- Kufanele uthome ukhiphe lokhu okuqinileko emvangweni.
- Uzokudinga ukuberegisa iindlela ezidlula yinye ukuhlukanisa umvango.
- Hlela urhubhululwakho kuhle ngokuqophela okuphezulu.

2. Tlola zoke iindlela ozozoberegisa ukuhlukanisa umvango, zitlole ngokulandelana.
3. Hlathulula bona kubayini udinga ukuberegisa indlela ngayinye ngayinye.(5)
4. Tlola ngokulandelana bona uzowenza njani umberego wakho wezandla. (12)
5. Hlaziya irhubhululo lakho: ngaphasi kwananzi iinhloko

a. Ibe yipumelelo engangani iindlela ozoberegisileko, sekela ipendulo yakho (3)

b. Kukhona ebegade ungakwenza bhedere emberegweni wakho wezandla nakhisibe unganikwelwa ithuba lokuyenza godu? Sekela ipendulo yakho (5)

[25]

Isahluko sesithathu

Ukuhlukanisa nokubuyekezwa kwezinto.

Omunye nomunye umuntu unokuziphendulela ngeenziibi ezisilaphaza ibhoduluko. Yeke kunendlela ezahlukileko zokunciphisa ukusilaphazeka kwebhoduluko nanzi ezinye:

1. a. Nciphisa nofana rhunyeza: **Isibonelo**: thenga izinto ezingasingama pakana.
   b. Buyelela uberegise: izinto ezinjengama phepha nofana iimphanagana.
   c. Buyekeza: buyekeza izinto ezifana namaphepha, iinsimbi ngokufaka ngephanaganeni.
2. Qinisekisa bona iinzibi zangekhaya ezifana nama bhodlelo, iingubhe zeplastiki ziyahlanzwa ngaphambi kobana zisiwe endaweni yokubuyekeza.
3. Butha iinzibi eziyingozi ezifana nama bhedriya, umtjhiningqondo kunye nokhunye okuberega ngegezi.

Iinzibi ezilungelwe ukubuyekezwa

Iinzibi ezilungele ukubuyekezwangezifana nama bhodlelo, amaphepha, amabhokisi, iingwagwa, iinsimbi ne plastiki / itjhwara tjhwara.

Ukubuyekezwa kwenzibi kungenye indlela yokwenza imali. Iinkolo ziyakhuthazwa bona zibe nalaphazplahlela khona iinzibi ukuze zizokwenza imali ngokuthengisa iinzibi emabubulweni abuyekeza iinzibi.

ISIBONELO

Amabhodlelo, iinsimbi kunye namaphepha.

- **Amabhodlelo** angabuyekezwa kanengi lokhu kwenziwa mabubulo amakhulu afana nabo ‘’Eclass Recycle Company’’. Amabubulo la akhuthaza abantu bona bahlukanise iinzibi ezimabhodlelo emakhaya.
- **Iinzibi zeensimbi** ezifana neenkoloyi ezidala, iinqandisi, amakotikoti/ amabhlege angabuyekezwa ngokukgadlwa.
- **Amaphepha** angabuyekezwa ubuncani kasikhombisa amaphepha afana nesiwaberegisa ngendlini encani awabuyekezeki.
- **Iimplastiki/ iitjhwaratjhwara** Iplastiki iberegiswa nofana siyiberegisa ngamalanga njengamabhodlelo, Iinkoloyi / amatoyisi/ neempahlazangekhaya. Inani lokusetjenjziswa kwemplastiki liyanda

ngamalanga. Lokho kwenza bona iinzibi ezinengi kube ngezeplastiki. Iplastiki ingabuyekezeka lokha songa amanzi kunye namandla. Iplastiki yenziwa nge oil, nofana amafutha, okusetjenziswa esingakandi. Lokhu kungenzinye zeenzathu ezenza bona iplastiki ibuyekezwe. Kunemihlobohlobo yemplastiki. Abenzi bemplastiki basebenzisa itswayo kunye neenomboro ukuhlukanisa iimplastiki ukuze kubelula ukuzihlukanisa.

Isibonelo

Iinzibi zebhoduluko

Iinzibi zebhoduluko, kuziinzibi ezivela embandaneni kanye neentjalweni. Iinzibi lezi zifakahlangana ukudla okubolileko, namakelo wemifino kunye nemikhwani kunye nobulongwe babantu. Leli ihlobo lenzibi libhidlizwa ziinlwana ezincani ezifana neenkuba bulongwe, iimbungu zenza isivande bona sinone. Ubulongwe babantu nabo buvundisa iimvande yeke bungasetjenziswa emakhaya .

isibonelo

- Buberegiswa njengomanyoro

Izinto ezingabuyekezwa

- Kunehlobo leenzibi ezingabuyekezwako ezifana namaphepha aphuthela amazambana ngombanyana lineplastiki mahlangana.

Iindlela yokuhlenga/ yokukhetha iinzibi

- Iinzibi zemakhaya nezemiberegweni efana nema ofisini ziyathuthwa, kanye ngeveke ngumasipala ayozigubhela.
- ESewula Africa asinayo indlela ebanzi yokubuyekeza iinzibi zemakhaya. Abanye bazisa lapha kubuyekezwa khona kani abanye bayayitjhisa. Lokho kutjho bona akusuye woke umuntu obuyekeza iinzibi. Ukuhlukanisa iinzibi

kwenza bona kubelula ukuzibuyekeza begodu kuvula namathuba wemisebenzi.

Umsebenzi wethoba (Rhubhulula ukubuyekeza esikolweni sakho).

1. Ngenqhenyana ezincani hlungana bona ukubuyekeza iinzibi kuzonisebenzela esikolweni senu namkha awa.
2. Thintani iinhlangano ezibuyekeza iinzibi ezifana ne “collect –a-can’’, the Glass Recycle Company namkha umasipala. Niqokelele ilwazi ngendlela ezincono zokubuyekeza iinzibi.
3. Thathani isiphetho bona ngiziphi iinzibi enizozibuyekeza. Qabangani bona nizozibuthelela njani begodu nizozibulunga njani.
4. Tlolani phasi iindlela enizoziberegisa yokubuyekeza iinzibi enizikhethileko. Nithule neentjhijilo eningahlangabezana nazo nokobana nizozihlula njani.
5. Thulani iplani yenu phambi kwetlasi kube ngilo elizonipha isiphetho bonyana I plani yenu izokuberega namkha awa.

Imiphumela emimbi yokungatlhogonyelwa kwenzibi

- Iinzibi nazingathlogonyelwako kunengi okuzokonakala ebhodulukweni. Kusemandleni kamasipala kunye norhulumende bona afundise nofana ayelelise abantu ngokuthlogonyelwa kwenziibi ngombana nakangenzi njalo kuzoba nemiphumela emimbi ebhodulukweni.

Nasi eminye yemiphumela

- Ukusilaphaza kwamanzi, ibhoduluko, nehlabathi. Iinzibi ezivela nezibuya emabubulweni amakhulu asilaphaza amanzi, nebhoduluko, lokho kubulala iintjalo kanye neembandana.
- Amagulo nezepilo: Iinzibi nazingathlogonyelwa zibanga amaphela, iimpukani, kanye namakhondlo, aletha ukugula okuhlukahlukeneko njengokuthulula okungapheliko. Nentuthu ephuma emabubulweni isilaphaza umoya begodu ibangela ukugula okufana nesifuba,nesifo samaphaphu.

- Ukuvaleka kwamaphayiphi akhambisa iinsila ukungathlogomeli amaphayiphu akhambisa iinsila kwenza bona aphuphume ngeensila kusilaphazeke ibhoduluko lokho kungabangela ukugula okufana ne Cholera.
- Ukuthlayela kweendawo zokugubhela iinzibi: ukungathlogonyelwa kweenzibi kwenza bona iinzibi zizale lokho kwenza bona kufuneke indawo enengi yokugubhela iinzibi, iindawo engasetjenjiselwa ukwakha namkha ukutjala.
- Iinzibi ezingabuyekezwa namkha ezingabhadekelwa: Iinzibi ezingabhadekelwa nofana ezingabuyekezwa ziyalahlwa ngokuthloga ilwazi ngokubuyekezwa kweenzibi.

Amabizelo emkhakheni wobuthago, wezokwenjiwa kunye nekuthlogomeleni kweenzibi

Manengi amabizelo emkhakheni wokuthlogonyelwa kweenzibi:

Isibonelo

- Abonjinyera bensiimbi bapheka isimbi bayenze into esikgona ukuyiberegisa. Nabomabhalani bayasetjenziswa kulomkhakha.\

a. **Ukubuyekezwa kwesifundo sethoba**

1. Hlathulula bona uyini umvango
2. Tlola zoke iindlela zokuhlukanisakwemivango ofunde ngazo kilesisihloko
3. Hlathulula umuhlobo ngamunye bonyana uberega njani

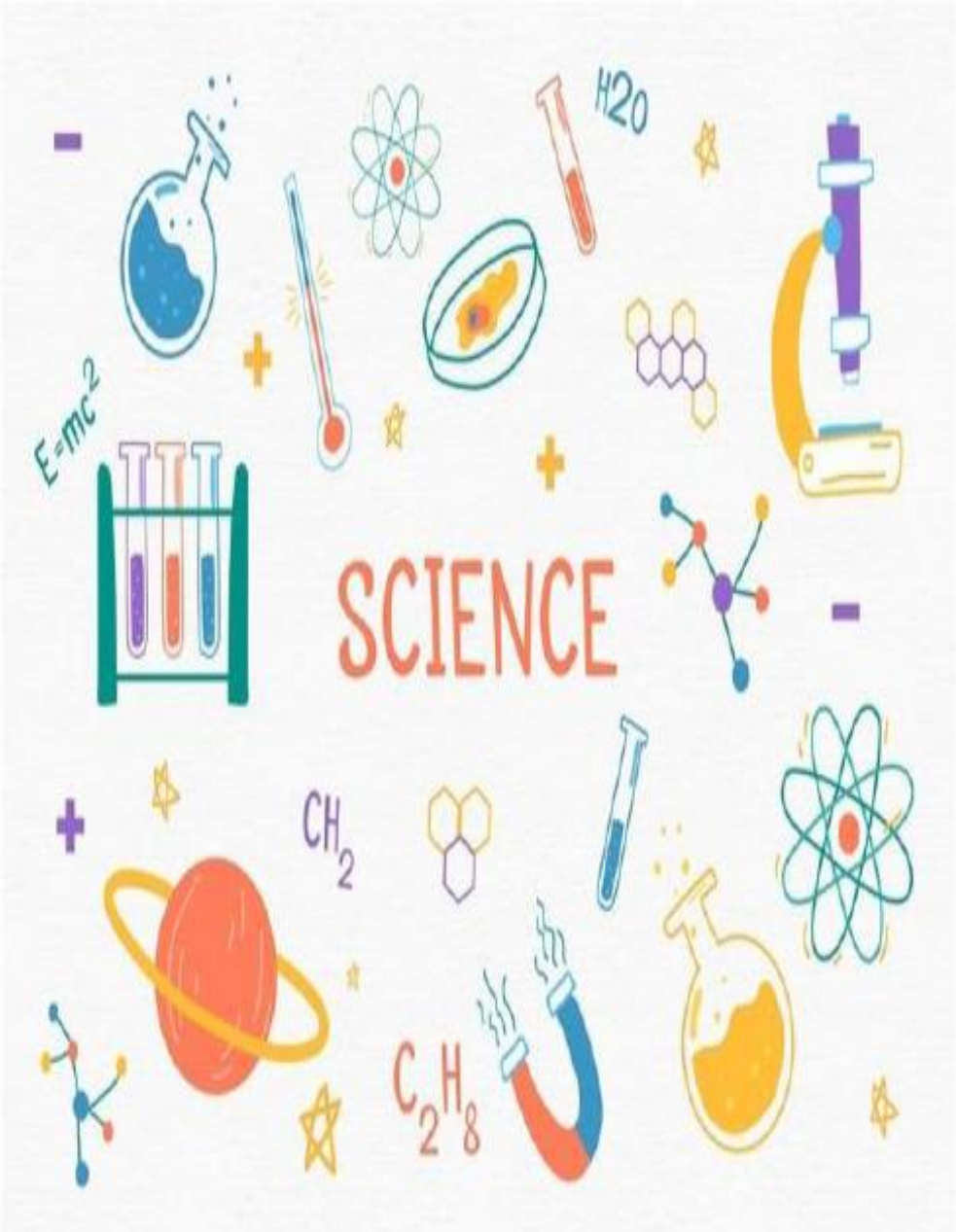
b. **Zivivinye**

Hlathulula bona ngimuphi umuhlobo wokuhlukaniswa kwemivango ongayisebenzisa ukuhlukanisa imivango elandelako

1. Umbala obovu emakarini abomvu
2. Iinsinjana ezincani ngemanzini
3. Utjwala namanzi
4. Amabhontjisi neenkunupe
5. Itswayi nebilibili
6. Hlathulula ukubaluleka kokuhlukaniswa kwenzibi

APPENDIX P: ENGLISH SCIENTIFIC REGISTER FOR NATURAL SCIENCES

ENGLISH NATURAL SCIENCE REGISTER



Topic 6

Separating mixtures

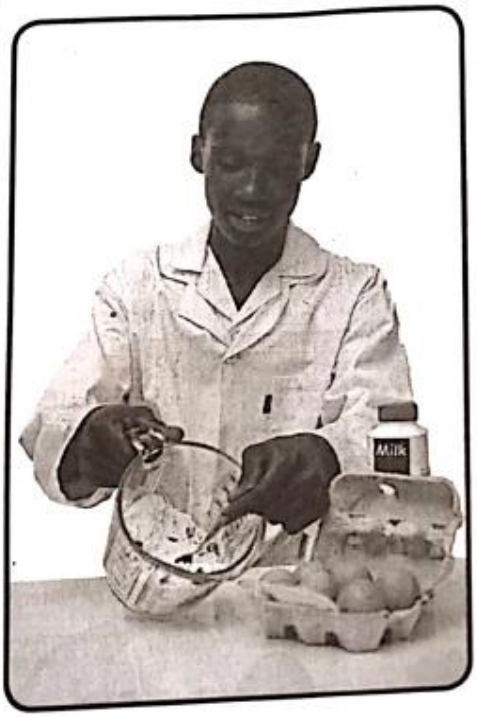


Figure 1 Mixtures in the kitchen

Starting off

In Topic 5, you learnt that a material is matter that we use to make something or do something. You learnt that we choose a material for a certain task because of the properties the material has.

In Grade 6, you learnt that matter and materials can be pure substances or mixtures of different substances. For example, air and sea water are examples of mixtures.

We can separate mixtures using different physical methods. You may use some of these in the kitchen. For example, if you make a fruit salad, you will probably hand-sort the fruit to select the best quality fruit for your salad. You will not use fruit that is underripe or overripe.

Activity 1 Identify methods of separation

Look at the photo in Figure 1 of Vusi preparing to bake.

1. Vusi mixed flour and raisins together.
   a) If he added too many raisins, how could he separate them from the mixture? Support your answer with a reason.
   b) Vusi then added eggs and milk to his mixture. How could he separate the raisins now? Give a reason for your chosen method.
2. Suggest other tools that are used in the kitchen to separate mixtures.
3. Decide whether each of the following are mixtures or not:
   a) pure water
   b) tap water
   c) salt water
   d) cake mixture
   e) air
   f) gold
   g) salt

Unit 1

Mixtures

Key words

- **pure substance** – substance that is of made up of one type of particle
- **mixture** – two or more substances with different physical properties that are mixed together
- **physical properties** – special characteristics used to describe the particles of a substance – the tiny parts that make up substances

All materials or substances are made up of matter. Matter is made of tiny particles. Air, water, gold and trees are matter, and so are made of tiny particles. The particles are so small that we cannot see them. We can use pictures of the particles to help us understand substances.

We classify matter as either a **pure substance** or a **mixture** of different substances.

Pure substances

A pure substance is made up of only one type of particle. A pure substance has the same properties all the way through. The following diagrams show some examples of pure substances.

(a) (b)

Figure 2 (a) Gold nugget and (b) gold particles

All the gold particles that make up the gold nugget are identical.

(a) (b)

Figure 3 (a) Water and (b) water particles

All the particles in a glass of water are identical.

(a) (b)

Figure 4 (a) Table salt and (b) table salt particles

The same particles are arranged in the same way in a spoon of table salt.

(a) (b)

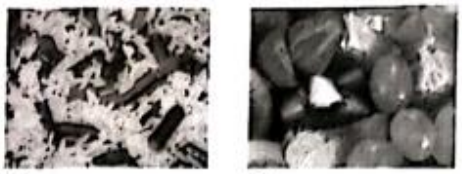
Figure 5 (a) Carbon dioxide blown into a balloon and (b) carbon dioxide particles

All the carbon dioxide particles are identical.

Mixtures

A mixture is not a pure substance. A mixture is made up of two or more substances or materials that have different **physical properties**. Physical properties are the special characteristics of a substance that we use to describe it. You learnt about physical properties, such as flexibility, melting point, boiling point and conductivity, in Topic 5.

When we mix two substances, the particles of one substance move in between the particles of the other substance. The different parts of the mixture do not join together. The different parts of a mixture can be combined in any amounts.



(a) (b)

Figure 6 Examples of mixtures: (a) beans and rice, and (b) fruit salad

The parts of a mixture have different physical properties

In some mixtures, the substances that are mixed together keep all of their own physical properties. Figure 6(a) shows a mixture of beans and rice. The properties of the beans and the properties of the rice remain the same. They are just mixed together.

Sometimes we cannot see the different parts of a mixture. Salt water is a mixture of salt and water. In this case, the properties of the mixture are a combination of the properties of the substances that were mixed. Salt water looks like water, but it tastes like salt.

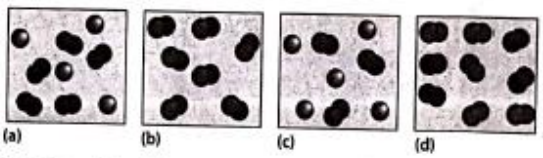
(a) (b)

Figure 7 (a) A glass containing salt water and (b) the particles in salt water

We can separate a mixture using physical methods. This means that we do not need a chemical reaction to separate a mixture. Because the different substances in a mixture are not joined together, we can use their different physical properties to separate them. For example, in a mixture of sand and rice, the sand and rice have different physical properties. The sand particles and the rice particles differ in size, colour and shape. The mixture can be separated by placing it in a sieve – the small sand particles pass through the sieve, but the rice grains do not.

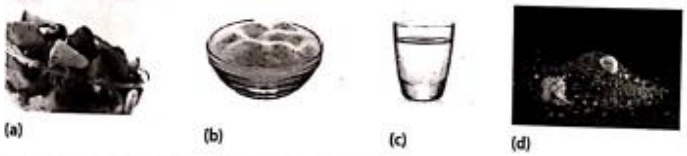
Activity 2 Identify mixtures in diagrams

1. Identify which of the diagrams below show mixtures and which do not. Provide reasons for your answers.



(a) (b) (c) (d)

2. Identify which of the photographs below show mixtures and which do not.



(a) (b) (c) (d)

Key concepts

- A mixture is made up of different substances that have different physical properties.
- We can use physical methods to separate a mixture.

Unit 2

Methods of physical separation

Key words

- **sieving** – method in which a sieve is used to separate a mixture of solids containing different-sized particles
- **filtration** – method in which a filter is used to separate a solid from a liquid
- **insoluble** – a solid that does not dissolve in a liquid

Hand-sorting

We can sort a mixture that is made up of solid particles with different sizes, colours, textures or shapes by hand. Hand-sorting is easy and cheap, but it can take quite a long time. Figure 8 shows examples where hand-sorting is used in practice. Once a sheep is sheared, the fleece is cleaned, and thorns and sticks are removed. Only then can the wool be spun into yarn or threads. Before fruit is packed and sent off to shops, it is hand-sorted according to size and quality.

(a)

(b)

Figure 8 Examples of hand sorting: (a) separating thorns from sheep wool and (b) sorting fruit

Sieving

We use **sieving** to separate a mixture of solids that have particles of different sizes. A sieve has holes in it that are all the same size. The holes catch large particles and allow smaller particles to pass through.

Builders sieve sand to separate stones and other impurities before they use the sand to make plaster (see Figure 9).

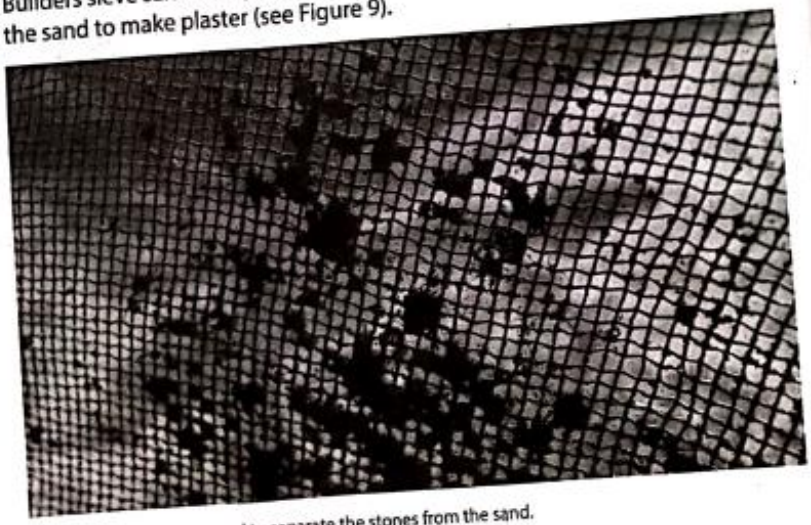


Figure 9 Builders sieve sand to separate the stones from the sand.

Filtration

We can use **filtration** to separate an **insoluble** solid from a liquid. We use a filter that lets the liquid particles through, but not the solid particles. In this way, filtration is similar to sieving.

Sand is insoluble in water. If we want to separate a mixture of sand and water, we can use a funnel and filter paper. Filter paper is a material that has very small spaces that let the water particles through, but not the sand particles.

Activity 3 Separate a mixture of sand and water

You will need: filter paper • plastic cooldrink bottle • mixture of sand and water in a beaker or jar • scissors

Safety
Be careful not to cut yourself with the scissors.

Method

Step 1: Cut through the bottle, about one-third of the way down from the top.

Step 2: Fold the filter paper and form a cone, as you learnt in Grade 5.

Step 3: Set up your filter funnel and insert the filter paper cone.

Step 4: Pour the mixture into the funnel. Be careful not to let it flow over the top of the filter paper.

Observations and conclusions

1. Record all your observations.
2. Explain in detail how you separated this mixture.
3. Draw a conclusion from this experiment.
4. Suggest some examples of how we use filtration in the home.

Case study: Wetlands filter water

Filtration is a natural way in which water is 'cleaned' in the environment. In Grade 6, you learnt that wetlands filter water. The plant roots in a wetland form a natural water filter. They trap the large particles of impurities and let the water particles through. Nylsvley in Limpopo, and Blesbokspruit in Gauteng, are examples of wetlands.

Activity 4 Write about wetlands as natural filters

1. Explain the meaning of the terms 'filtration' and 'insoluble'.
2. Explain how wetlands act as natural filters.
3. Suggest why wetlands are important to people.

Figure 10 The plant roots in the Nylsvley wetland form a natural filter.

Key words

- **dissolve** – when the particles of a solid spread between the particles of a liquid so that you can no longer tell the two substances apart
- **solution** – mixture that consists of a solid dissolved in a liquid
- **solute** – substance that dissolves when making a solution
- **solvent** – liquid in a solution in which the solute dissolves
- **evaporation** – process of changing from a liquid to a gas because particles on the surface of the liquid escape into the atmosphere

Using a magnet to separate mixtures

A magnet can attract iron. This is because iron, cobalt and nickel are magnetic elements. Steel is also magnetic because it contains iron.

A mixture of substances in which one of the substances is magnetic and the other not, can be separated using this difference in their properties.

Magnets are used in recycling to recover magnetic substances from domestic waste.

Activity 5 Separate a mixture using a magnet

You will need: a mixture of sand and iron filings • magnet • piece of paper

1. Put a small amount of the mixture in the middle of the piece of paper (see Figure 11).
2. Slowly bring the magnet close to the mixture. Move it back and forth just above the mixture.
3. Shake the paper a little and repeat Step 2.
4. Record your observations.
5. Explain why your separation method worked.
6. Suggest another way to separate a mixture of sand and iron filings. Explain whether you think this alternative method would be a better method than using magnetism.

Figure 11 Mixture of sand and iron filings

Evaporation

Solutions

In Grade 6, you learnt that certain solids can **dissolve** in certain liquids. Sugar, for example, dissolves in water. In a **solution** of sugar and water, you cannot distinguish the sugar from the water. The solid that is dissolved is called the **solute**. The liquid is called the **solvent**.

Using evaporation to separate solutions

We cannot use filtration to separate a solution. The solvent particles surround the solute particles. So, when we filter a sugar-water solution, the sugar particles move through the filter paper with the water particles. The water particles and the sugar particles are small enough to pass through the filter paper. However, we can use **evaporation** to recover the solute particles from the solution. When the solution is heated, the particles on the

Did you know?
Only iron, nickel and cobalt are magnetic.

surface of the liquid gain enough energy to escape into the atmosphere. If the process carries on long enough, all the liquid particles will change to gas particles. The solute particles will be left behind.

Case study: Using evaporation to produce salt

At Coega, near Port Elizabeth, and at Velddrif on the West Coast, people produce salt for commercial use. At these salt mines, the sun and the wind provide energy to evaporate water from the salt pans. The water is moved through a series of ponds and becomes more and more salty. Eventually, the salt can be collected.

Figure 12 At Coega, near Port Elizabeth in the Eastern Cape, salt is separated from water by evaporation.

Activity 6 Separate a solution of water and salt

You will need: salt • teaspoon • beaker or drinking glass • water • watch glass or small saucer • a sunny spot

1. Put three teaspoons of salt in the beaker. Add a small amount of water and stir well.
2. Carry on adding small amounts of water and keep on stirring. Stop as soon as all the salt has dissolved.
3. Pour some of your salt solution onto the watch glass.
4. Write down all the properties of:
   a) salt
   b) water
   c) salt water
5. Leave the watch glass in a sunny spot. Record the date and time.
6. Check on the watch glass every day. Record all your observations.
7. When all the water has evaporated, record the date and time again. How long did it take to separate the salt from the water?
8. Suggest what you could do to speed up the evaporation process.
9. Draw a conclusion from this experiment.
10. Explain how evaporation of salt could provide people with employment.
11. Suggest why no glass is allowed to be brought into a salt mine.

Figure 13 Salt can be recovered from salt water by evaporation.

Key words

- **distillation** – process of separating a solution by boiling it so that the solvent evaporates, and then cooling the vapourised solvent so that it condenses
- **condensation** – change of state from a gas to a liquid; normally caused by cooling

Distillation

If we want to collect both the solute and the solvent when we separate a solution, we can use **distillation**. Distillation involves evaporation followed by **condensation**.

Heat the solution so that the solvent evaporates. Instead of letting the solvent particles escape into the atmosphere, collect the vapour. Then cool the vapour so that it condenses to become a liquid again.

If you heat salt water in a pot, the water evaporates from the solution and condenses on the pot lid (see Figure 14). This is a very simple way to show how distillation works. In Activity 7, you will see how we perform distillation in a laboratory.

We can use distillation to collect pure water from sea water. However, this method is expensive because it needs a lot of heat energy.

Figure 14 Distillation can be used to recover pure water from salt water.

Activity 7 Observe distillation

You will need: Bunsen burner • two retort stands with clamps • distillation flask with stopper • thermometer • Liebig condenser with stopper • beaker or flask • salt water • rubber tubing • tap with running water

Your teacher will set up the distillation apparatus as shown in Figure 15.

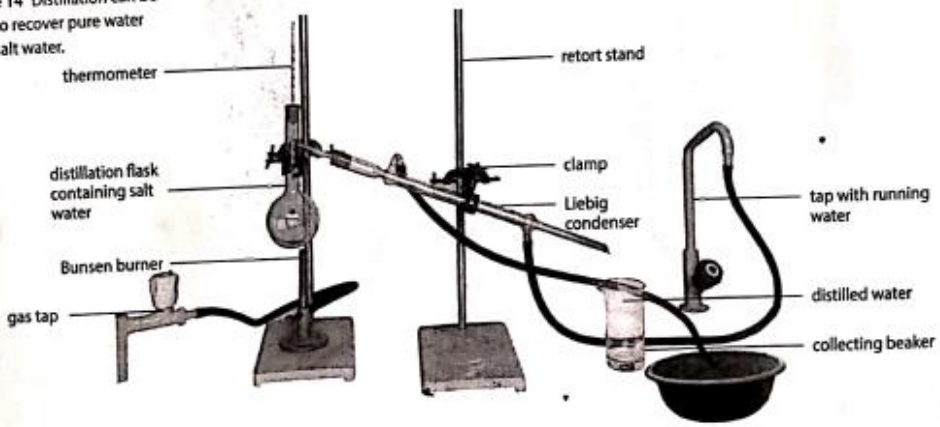


Figure 15 Example of how distillation is done in a laboratory

Safety
Your teacher will demonstrate this activity.

1. Write a step-by-step method to explain how your teacher set up the apparatus to separate salt water by distillation.
2. The Liebig condenser is attached to a tap with running cold water. Explain why this is necessary.

3. Fill the beaker about 2 cm from the bottom with methylated spirits.
4. Hang the paper from the pencil so that one end dips about 1 cm into the methylated spirits (see Figure 17). The paper should not touch the sides of the beaker. Secure the paper to the pencil with sticky tape.
5. Observe the paper and wait until the ink stops moving through the paper.
6. Dry the paper and paste it into your workbook. Use it to answer the following questions.
   a) State how many different coloured pigments were contained in the ink.
   b) Which pigment travelled the furthest through the paper?
   c) Arrange the colours of the pigments from most soluble to least soluble in methylated spirits.
7. Draw a conclusion from this experiment.
8. Suggest similar investigations that you can do.

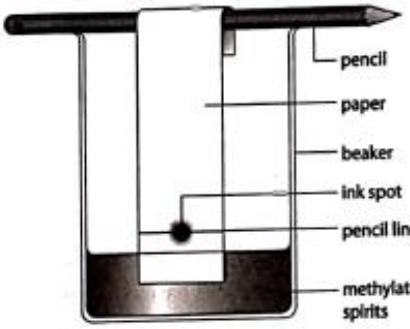


Figure 17 Chromatography can be used to separate different coloured pigments.

Did you know?
The word 'chromos' is Greek for 'colour'. Chromatography is used in medicine, industry and policework to identify substances. It can be used to test if a food product contains a harmful substance. The urine of sports stars is often tested for drugs using chromatography.

Key concepts

- The physical properties of the materials in a mixture determine the separating method used.
- Different physical methods are used to separate mixtures, for example, hand-sorting, sieving, filtration, using a magnet, evaporation, distillation and chromatography.

Practical task

Design and explain the best ways to separate a mixture

You will need: a few small beads • sand • iron filings • salt • water • two beakers • magnet • filter funnel • filter paper • Bunsen burner • tripod with wire gauze mat

Figure 18 A mixture of water, salt, iron filings, beads and sand that must be separated.

1. Design an experiment that you can use to separate a mixture of beads, sand, iron filings, salt and water.
   - You must be able to collect all the solids in the mixture.
   - You will need to use more than one method to separate the mixture.
   - Plan your investigation carefully.
2. List all the methods of separation that you will use. Write them down in the correct order. (4)
3. Explain why you need to use each of the methods. (5)
4. Write a step-by-step method of how you will carry out your investigation. Include labelled diagrams. (12)
5. Carry out your method. Your teacher will check whether you were able to separate all the solids and collect them. (5)
6. Evaluate your investigation:
   a) How successful was your method? Give a reason for your answer. (2)
   b) Is there something you could have done differently in this experiment? Give a reason for your answer. (2)

$[30 \times \frac{2}{3} = 20]$

Total: 20

Unit 3

Sorting and recycling materials

- **recycle** – process in which waste materials are broken down into different parts and reused to make new products
- **organic waste** – waste that comes from plants or animals, and that can be broken down by other living things

Every person is responsible for waste disposal

It is every person's responsibility to dispose of or get rid of waste correctly. Here are some examples of how you can do this:

- Reduce waste, for example, by buying products with less packaging. Reuse materials such as paper or objects like containers. **Recycle** suitable materials such as paper, plastic, glass and metal by taking them to a recycling bin or depot.
- Ensure that household waste for recyling is sorted and rinsed properly. Some municipalities provide special bins or transparent bags for household waste that you can recycle.
- Dispose of harmful materials such as batteries, computers and electronic components, and materials that contain mercury, in a responsible way. Your municipality will have more information about this.

Materials suitable for recycling

Materials that can be recycled are glass, paper, cardboard, metal and plastic. People can make a living by collecting glass, metal, paper and plastic from people's homes and selling it to buy-back centres. Schools are encouraged to have 'banks' where people can deposit materials for recycling. Schools can earn money from selling these waste materials to recycling companies.

Figure 19 People find employment by collecting metal waste from households and selling it to scrap iron merchants.

Glass, metal and paper

Glass can be recycled over and over again. Companies such as the 'Glass Recycling Company' encourage people to separate their glass waste at home.

Scrap metal such as used cans, broken fridges and old cars can be sold to scrap iron merchants. The metal is processed and reused.

Paper can be recycled at least seven times. Paper coated in plastic and toilet paper cannot be recycled.

Plastic

Plastic is used in many everyday products such as toys, bottles, furniture, computers and cars. The amount of plastic people use is increasing all the time, and therefore plastic makes up more and more of the solid waste at municipal dump sites.

Plastic can be recycled, which saves water and energy. Plastic is made from oil, which is a limited resource. This is another reason why we should recycle plastic. There are different types of plastic. Manufacturers use special codes that they stamp on the plastic so that it can be sorted easily (see Figure 20).

Figure 20 Symbols are used to identify the type of plastic used to make an object.

Organic waste

Organic waste comes from plants and animals, and it can be broken down by other living things, such as bacteria and fungi. Organic waste includes household food waste, such as vegetable peelings, and garden waste. Other examples include agricultural waste such as mielie stalks left over after harvesting and human waste such as sewage.

Composting household waste involves collecting organic waste in an area in the garden. Organisms such as earthworms, beetles, millipedes, bacteria and fungi break down the waste. Dark humus is formed. We can add this to the soil to enrich it with nutrients and improve its condition.

We can use animal waste to enrich soil or burn it to release energy. We have to use human waste such as sewage carefully, because it contains organisms that can cause disease. Raw human waste should never be applied to crops eaten by people or animals. After human waste is treated, it is used to make fertilisers.

Figure 21 Organic household waste can be composted and then used as fertiliser.

Did you know?
One metric ton of recycled paper saves 17 trees. It takes 40% less energy and 50% less water to produce than new paper. Metal tins can be melted to make new steel. This reduces the need to mine iron ore and also saves the energy that would have been used to mine and process it.

Materials that cannot be recycled

Some materials cannot be recycled, for example, paper with a plastic lining such as dog food bags and potato bags. Not all plastics can be recycled. Some types of plastic degrade during the recycling process and therefore cannot be used again. We have to dispose of this waste at landfill sites.

Systems to sort and dispose of waste

Waste produced by homes and offices is collected once a week and taken to landfill sites by the local municipality. Not all the waste decays, and some of it seeps into the soil. Suitable areas for landfill sites are quickly running out.

In South Africa, we do not have the proper infrastructure for recycling household waste. Households have to separate their recyclable waste and store it. In most municipalities, households are expected to take their recyclable waste to a drop-off centre themselves. As a result, many people do not recycle their waste.

Separating waste at the source, for example, in the home or office, provides a better quality of material for recycling. It also has the potential to create jobs if municipalities are prepared to collect the sorted waste directly from households. It is a better alternative to salvaging waste at landfills, where there are health and safety risks for the people who separate the waste.

The amount of waste produced per person in South Africa is high. It is similar to developed countries (see Figure 22).

The amount of waste produced increases as the population increases. Figure 23 shows how good South Africans were at recycling in 2011.

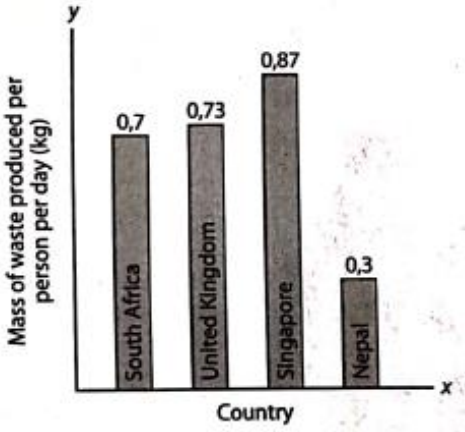


Figure 22 Average mass of waste produced per person per day in different countries

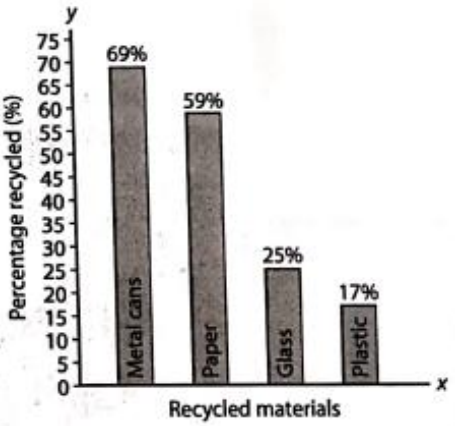


Figure 23 Approximate percentage of materials recovered from waste in South Africa in 2011

Activity 9 Investigate recycling at your school

1. In small groups, decide whether a recycling programme would work in your school.
2. Contact organisations such as Collect-a-can, The Glass Recycling Company or your local municipality to gather information about the best way to recycle waste materials.
3. Decide which materials you could recycle. Think about how you will collect and store them.
4. Write down a possible recycling plan for your class or school. Name any difficulties that you could have and suggest solutions.
5. Present your plans to the class. Your class should decide which plan is best and put it into action.

Negative consequences of poor waste management

Poor waste management means that people have not put much thought into how to deal with waste. Structures and processes to deal with waste effectively should be put in place by local authorities and government. If they do not do this, there are negative consequences. Here are some examples of these consequences:

- Pollution of water, soil and the environment: Chemical waste from factories and mines can enter the water system and pollute the water and soil. This harms the environment, because it pollutes the water, affects the structure of the soil, and kills plants and animals.
- Health hazards and diseases: Waste that is not disposed of properly increases the number of flies and vermin, such as rats, in the area. Flies and rats carry diseases that can lead to diarrhoea. Waste released into the air from factories, mines and power plants leads to air pollution. This can cause lung diseases and allergies in people living nearby.
- Blockage of sewage and water drainage systems: This occurs where sewage pipes are not maintained and, as a result of flooding, become blocked and overflow. Sewage can then enter drinking water sources and this can lead to an outbreak of diseases such as cholera.
- A shortage of landfill sites: Poor waste management causes more and more waste. This requires more land for landfill sites. Land that could have been used for housing or agriculture is wasted.
- Wastage of valuable materials: Materials that could have been reused or recycled are dumped instead.

Figure 24 A landfill site

Careers in chemistry, mining and waste management

There are many careers in fields related to separating substances. For example, a forensic chemist investigates chemicals collected from crime scenes. Metallurgical engineers process ores to produce products such as metals. A combination of processes, including physical processes, is used to separate metals or salts from their ores. There are also various careers in waste management, for example managers, administration clerks and controllers.

Activity 10 **Discuss careers in chemistry, mining and waste management**

1. Talk about all the careers in chemistry, mining and waste management that your group can think of.
2. Do some research on one career and write a paragraph on your findings.

Key concepts

- Some materials are suitable for recycling.
- Everyone should be involved in recycling.
- There are systems for sorting and disposing of waste.
- When waste is poorly managed, there are negative consequences.

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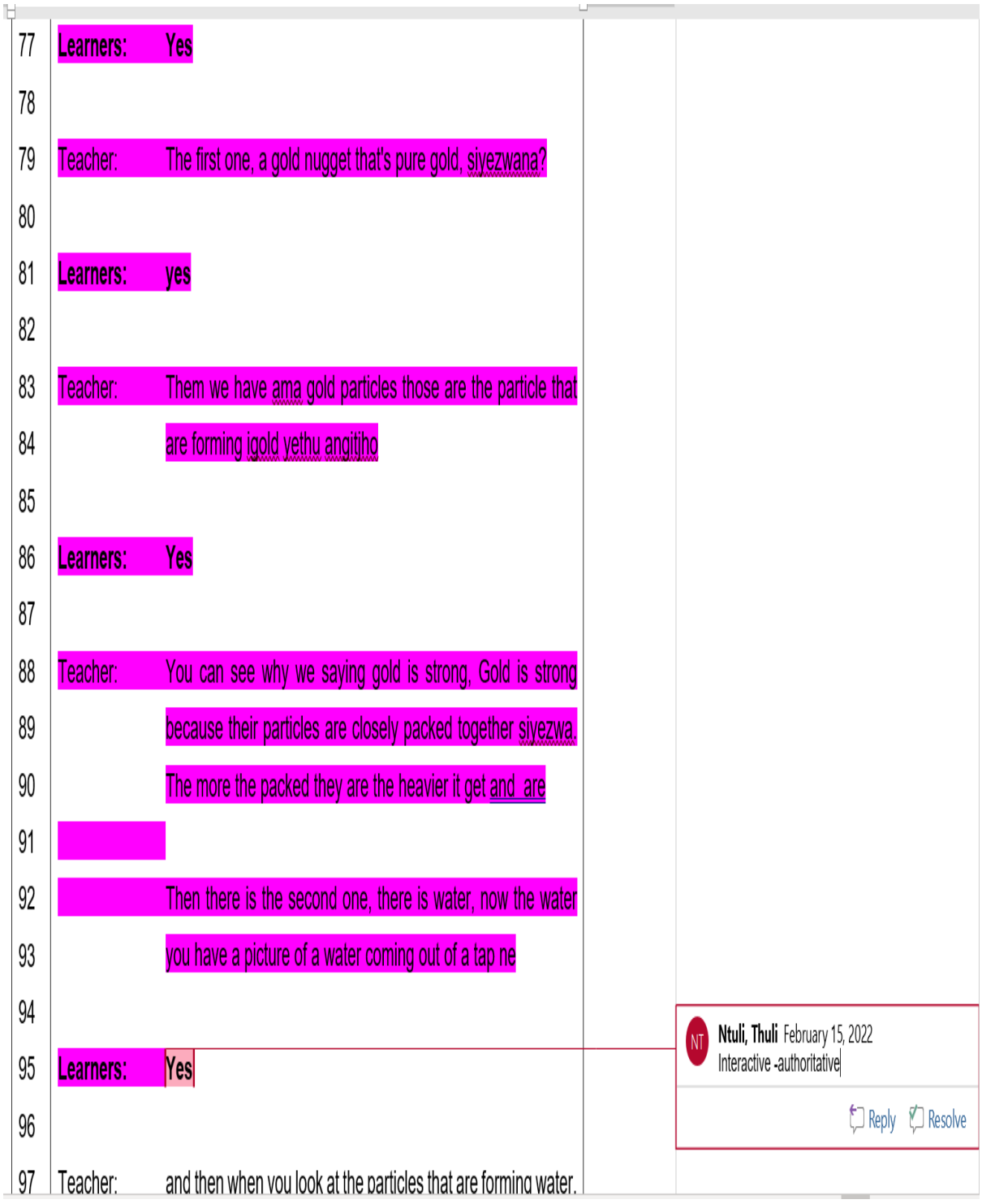
APPENDIX Q: DATA ANALYSIS SCHEME (DAS)

Themes	categories
Theme 1	
Opportunities and challenges in the development of the scientific language register for Natural Sciences in isiNdebele and its application	Opportunities
	Challenges
Theme 2	
Perceptions of stake holders about the use of isiNdebele as the language of learning and teaching Natural Science	Teachers perception
	Learner perceptions
	Parents perceptions
Theme 3	
The influence of the developed scientific language register for Natural Sciences in isiNdebele shape classroom interactions and discourses	Types of discourses
	Patterns of discourse
	Teacher questioning
	Communicative approach

APPENDIX R: CODED ENGLISH OBSERVATION TRANSCRIPT:

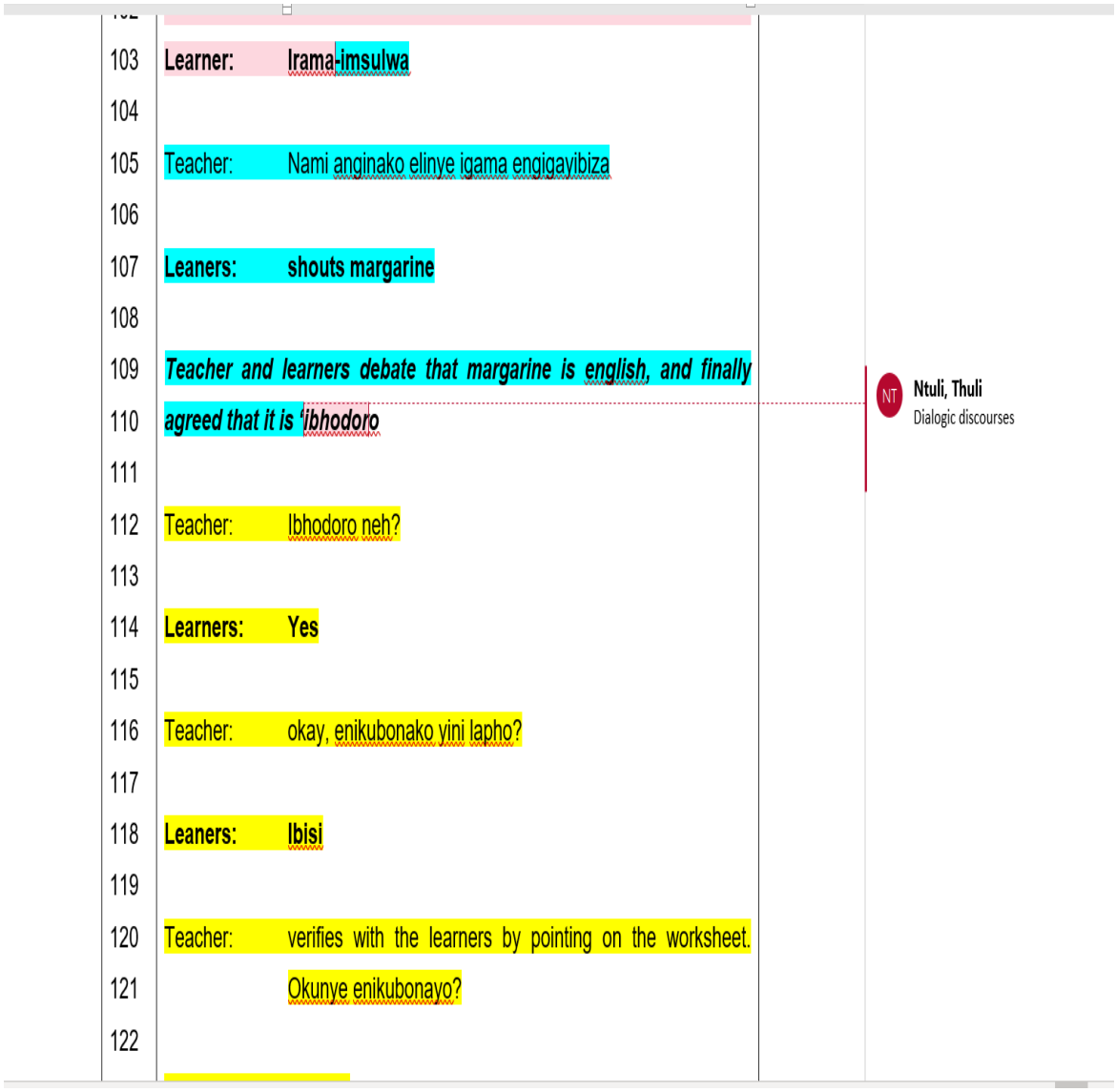


77	Learners:	Yes
78		
79	Teacher:	The first one, a gold nugget that's pure gold, siyezwana?
80		
81	Learners:	yes
82		
83	Teacher:	Them we have ama gold particles those are the particle that
84		are forming igold yethu angitjho
85		
86	Learners:	Yes
87		
88	Teacher:	You can see why we saying gold is strong, Gold is strong
89		because their particles are closely packed together siyezwa.
90		The more the packed they are the heavier it get and are
91		
92		Then there is the second one, there is water, now the water
93		you have a picture of a water coming out of a tap ne
94		
95	Learners:	Yes
96		
97	Teacher:	and then when you look at the particles that are forming water,

NT **Ntuli, Thuli** February 15, 2022
Interactive -authoritative

Reply Resolve

APPENDIX S: CODED ISINDEBELEN OBSERVATION TRANSCRIPT



103 **Learner:** Irama-imsulwa

104

105 Teacher: Nami anginako elinye igama engigayibiza

106

107 **Leaners: shouts margarine**

108

109 ***Teacher and learners debate that margarine is english, and finally***

110 ***agreed that it is 'ibhodoro***

111

112 Teacher: Ibhodoro neh?

113

114 **Learners: Yes**

115

116 Teacher: okay, enikubonako yini lapho?

117

118 **Leaners: Ibisi**

119

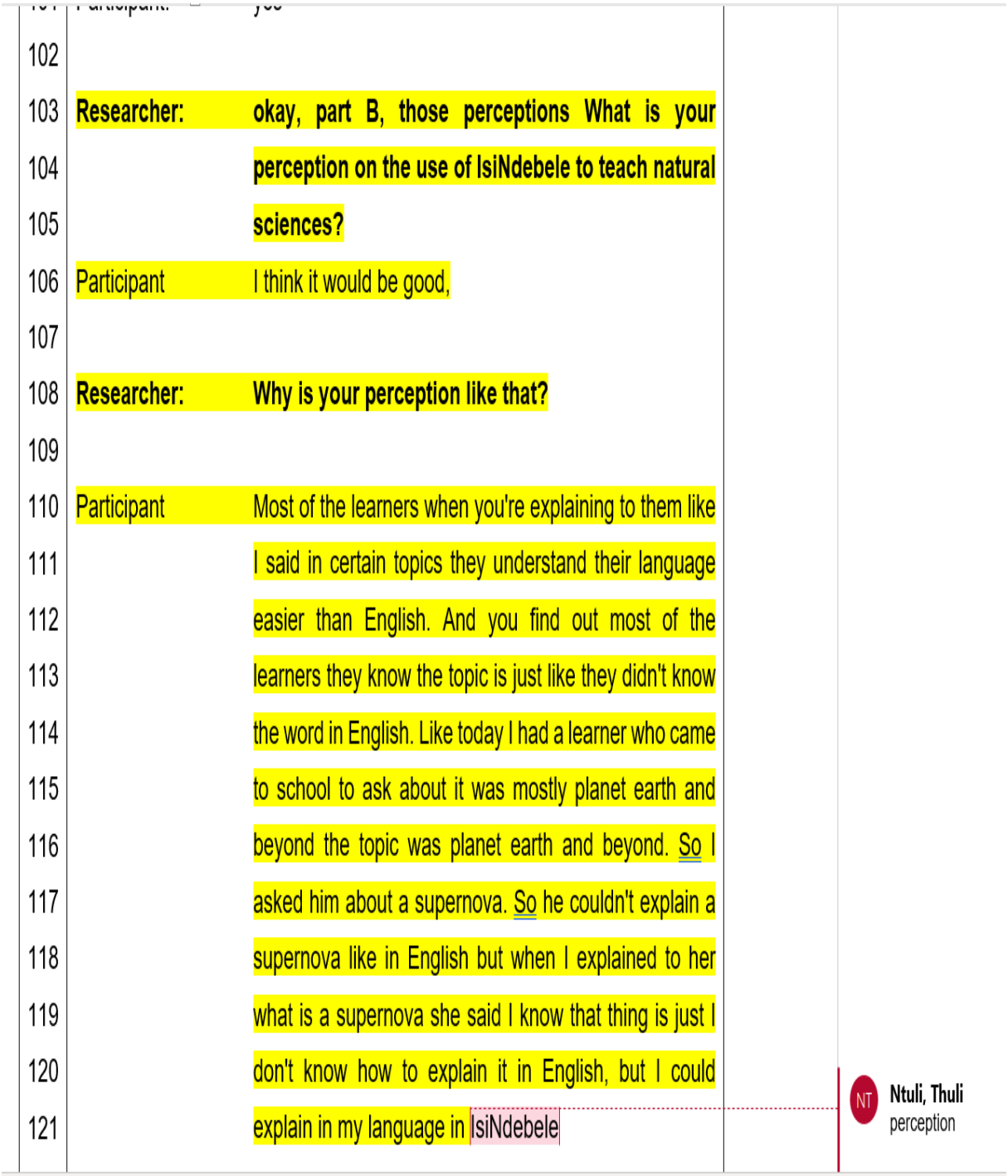
120 Teacher: verifies with the learners by pointing on the worksheet.

121 Okunye enikubonayo?

122

NT Ntuli, Thuli
Dialogic discourses

APPENDIX T: CODED INTERVIEW TRANSCRIPT



102		
103	**Researcher:**	**okay, part B, those perceptions What is your**
104		**perception on the use of IsiNdebele to teach natural**
105		**sciences?**
106	Participant	I think it would be good,
107		
108	**Researcher:**	**Why is your perception like that?**
109		
110	Participant	Most of the learners when you're explaining to them like
111		I said in certain topics they understand their language
112		easier than English. And you find out most of the
113		learners they know the topic is just like they didn't know
114		the word in English. Like today I had a learner who came
115		to school to ask about it was mostly planet earth and
116		beyond the topic was planet earth and beyond. So I
117		asked him about a supernova. So he couldn't explain a
118		supernova like in English but when I explained to her
119		what is a supernova she said I know that thing is just I
120		don't know how to explain it in English, but I could
121		explain in my language in IsiNdebele

NT Ntuli, Thuli
perception

APPENDIX U: CODED DIARY

Dates		Action
17 April 2020	1.	Before the researcher started developing a register, she had a
	2.	meeting with isiNdebele South African Language Board
	3.	(PANSLB) chairperson Mr Vincent Mahlangu. During our
	4.	discussion the chairperson alluded that the biggest challenge
	5.	with isiNdebele there are limited terminologies let alone the
	6.	scientific terms. He further made the researcher that of the
	7.	challenges that they have as a board. Amongst other he noted
	8.	that most of the isiNdebele terms are borrowed from Afrikaans
	9.	and they are still in the process of changing them, but it is still
	10.	difficult to do that for a fact that it is still struggle because there
	11.	are no one word terms. Hence, that means they must join two
	12.	or more terms to come up with the equivalent word. such as
	13.	"weather" is derived from two terms which is "ubujamo" and
	14.	"bezulu" = "Ubujamobezulu" The fact that isiNdebele is
	15.	divided into two which is: isiNdebele sakwaMabhoko and
	16.	isiNdebele sakwaManala was also discussed and how that
	17.	influences the terminologies considered to be formal in
	18.	isiNdebele.
	19.	The chairperson made the researcher that there are terms in
	20.	used in isiNdebele but according to isiNdebele language board

NT **Ntuli, Thuli**
Challenges

NT **Ntuli, Thuli**
challenge

APPENDIX V: ETHICAL CLEARANCE CERTIFICATE

UNISA university of south africa

UNISA COLLEGE OF EDUCATION ETHICS REVIEW COMMITTEE

Date: 2021/09/08

Ref: **2021/09/08/51923505/06/AM**
Name: Ms TG Ntuli
Student No.: 51923505

Dear Ms TG Ntuli

Decision: Ethics Approval from 2021/09/08 to 2026/09/08

Researcher(s): Name: Ms TG Ntuli
E-mail address: entulit@unisa.ac.za
Telephone: 078 209 1017

Supervisor(s): Name: Prof A.V. Mudau
E-mail address: mudauav@unisa.ac.za
Telephone: 012 429 6353

Title of research:

Developing the scientific language register for Natural Sciences in isiNdebele and its application in some of grade 7 classes in the Siyabuswa 2 circuit

Qualification: PhD Natural Science Education

Thank you for the application for research ethics clearance by the UNISA College of Education Ethics Review Committee for the above mentioned research. Ethics approval is granted for the period 2021/09/08 to 2026/09/08.

*The **medium risk** application was reviewed by the Ethics Review Committee on 2021/09/08 in compliance with the UNISA Policy on Research Ethics and the Standard Operating Procedure on Research Ethics Risk Assessment.*

The proposed research may now commence with the provisions that:

1. The researcher will ensure that the research project adheres to the relevant guidelines set out in the Unisa Covid-19 position statement on research ethics attached.
2. The researcher(s) will ensure that the research project adheres to the values and principles expressed in the UNISA Policy on Research Ethics.

Open Rubric

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PO Box 392 UNISA 0003 South Africa
Telephone: +27 12 429 3111 Facsimile: +27 12 429 4150
www.unisa.ac.za

3. Any adverse circumstance arising in the undertaking of the research project that is relevant to the ethicality of the study should be communicated in writing to the UNISA College of Education Ethics Review Committee.
4. The researcher(s) will conduct the study according to the methods and procedures set out in the approved application.
5. Any changes that can affect the study-related risks for the research participants, particularly in terms of assurances made with regards to the protection of participants' privacy and the confidentiality of the data, should be reported to the Committee in writing.
6. The researcher will ensure that the research project adheres to any applicable national legislation, professional codes of conduct, institutional guidelines and scientific standards relevant to the specific field of study. Adherence to the following South African legislation is important, if applicable: Protection of Personal Information Act, no 4 of 2013; Children's act no 38 of 2005 and the National Health Act, no 61 of 2003.
7. Only de-identified research data may be used for secondary research purposes in future on condition that the research objectives are similar to those of the original research. Secondary use of identifiable human research data requires additional ethics clearance.
8. No field work activities may continue after the expiry date **2026/09/08**. Submission of a completed research ethics progress report will constitute an application for renewal of Ethics Research Committee approval.

Note:

The reference number **2021/09/08/51923505/06/AM** *should be clearly indicated on all forms of communication with the intended research participants, as well as with the Committee.*

Kind regards,

Prof AT Motlhabane
CHAIRPERSON: CEDU RERC
motlhat@unisa.ac.za

Prof PM Sebate
EXECUTIVE DEAN
Sebatpm@unisa.ac.za

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APPENDIX W: TURNITIN

DEVELOPING ISINDEBELE SCIENTIFIC LANGUAGE REGISTER FOR NATURAL SCIENCES AND ITS CLASSROOM APPLICATIONS IN SIYABUSWA 2 CIRCUIT, SOUTH AFRICA

ORIGINALITY REPORT

10%	10%	1%	1%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	www.saarmste.org Internet Source	4%
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3	hdl.handle.net Internet Source	<1%
4	businesstech.co.za Internet Source	<1%
5	faubai.org.br Internet Source	<1%
6	www.iol.co.za Internet Source	<1%
7	"The dilemma of instructional language in education: The case of Ghana", Hungarian Educational Research Journal, 2021 Publication	<1%
8	journals.ukzn.ac.za Internet Source	

APPENDIX X: EDITORS CERTIFICATE

Academic consultancy
"Perfection is our DNA"

302 Aardal flat
219 Stead avenue, Queenswood
academicconsultancy3@gmail.com3
01 April 2022

To whom it may concern

This letter is to confirm that I, Keegan Bruce Schmidt, freelance copy-editor, have edited and proofread the research assignment entitled "***Developing the Scientific Language Register for Natural Sciences in IsiNdebele and its Application in Some Classes of the Siyabuswa 2 Circuit***" by ***Thuli Gladys Ntuli*** for grammar and spelling. I have not changed any of the ideas presented in this paper, only the grammar and spelling have been altered for the purposes of clarity. This is to confirm that I have edited the document to a level I deem satisfactory.

Keegan Schmidt
Qualifications:

- BIS (University of Pretoria)
- BIS Hons (University of Pretoria)