Using semiotic resources to teach and assess scientific concepts in a bilingual Namibian primary school: A socio-cultural discourse analysis

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Plagiarism declaration

I, Set Beatha, declare that this thesis is my own work, undertaken with the normal Guidance of my supervisor. This work has not been previously submitted in whole, or in part, for the award of any degree at the University of Cape Town or elsewhere. Each significant contribution to, and quotation in, this dissertation from the work, or works, of other people has been attributed, and has been cited and referenced.

Signature: Signed by candidate Date: December 2020

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Dedication

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Abstract

The Namibian school system subscribes to a separatist language policy and ideology that advocates the use of monolingual English as Medium of instruction (MO1) as well as conducting all written assessments from Grade 4 and beyond in English. Despite Namibia being a multilingual country, the Namibian monolingualist Language in Education Policy (LiEP) makes no provision to accommodate multilingual practices and to fulfill the linguistic needs of learners from linguistically diverse backgrounds, who lack proficiency in English. The language separatist ideologies sanctioned in the Namibian LiEP as well as in science written assessments need further consideration in order to embrace language as an open system that is fluid, evolving, and hybrid. Given the complexities of the language policy and pedagogical challenges of language of instruction choices in the Namibian classrooms, I wanted to investigate how primary school Science teachers and learners meet the demand of the Namibian curriculum of Learner Centered Education (LCE) and the ideologies of monolingualism advocated in the Namibian Language in Education Policy. I undertook a small-scale, ethnographically informed case study approach to examine the nature of discourse employed by a Grade 4 teacher and his learners (aged 10- 12) in a bilingual Namibian classroom as they engaged in science classroom discourse, exploring how these specific discourses support or constrain learners' opportunities to construct scientific meaning. I combined various theoretical resources from a sociocultural approach to language as social practice, Bakhtinian heteroglossia and dialogism, neo-Vygotskian ideas of what constitutes the learning of scientific concepts, together with the recent theorising of dynamic bi/multilingualism to understand this phenomenon in depth. The data include video and audio recordings of lessons, field notes, learning materials, policy document, photographs , interviews, written work (drawing and writing) as well learners' written science assessments. The data was analysed through sociocultural discourse and multimodal analytical methods.

This study's findings suggest that in contrast with dialogic practices, monologic practices were dominant, as evidenced by the constrained Initiation Response Feedback (IRF) discourse structure. This suggests that English monolingual policy places constraints on bilingual learners to use their multiple linguistic recourses flexibly and thereby silenced their voices in the classroom. This implies that the struggle to break away from rote leaning towards conceptual understanding through exploratory talk remains elusive for the Namibian bilingual learners. Therefore, I suggest that one cannot argue for dialogism or for conceptually rigorous instruction in scientific concepts

if the learners cannot understand the language of instruction. The discussion of dialogism and multimodality as a sole vehicle for raising the quality of science teaching should be further complimented with a consideration of deliberate use of multilingual and multimodal meaning-making which enables teachers to value their learners' linguistic resources that they brought to school to enable effective science teaching and learning. The findings of this study revealed how the affordances of multiple linguistic resources and modes have positive effects for emergent bilingual learners to gain nuanced understanding of the scientific knowledge, regardless of their limited proficiency in English. I will therefore argue that the prevailing monoglossic orientations to the current Namibian education system is a major contributing factor preventing Namibia to realise its' educational goals of access, quality, equity, and social justice. There is a need to support learners from linguistically diverse backgrounds through a deliberate inclusive language policy that harnesses their multilingualism and their cultural identity to enhance equal education access to all Namibian children. Clear direction is warranted on how teachers can publicly acknowledge and sustain their learners' linguistic and cultural resources in science written assessments.

Contents

Abbreviations

CDA- Critical Discourse Analysis

CQ- Closed Question

DA- Discourse Analysis

ESL- English as a Second language

IRE – Initiation, Response, Evaluation: triadic discourse structure

IRF- Initiation, Response, Feedback

LCE- Learner-Centered Education

LE- Linguistic Ethnography

LiEP– Language in Education Policy

MMDA- Multimodal Discourse Analysis

MOI – Medium of Instruction

MT- Mother Tongue

MBE- Ministry of Basic Education and Culture

MBESC- Ministry of Basic Education, Sport and Culture

NIED- National Curriculum for Basic Education

SDA- Sociocultural Discourse Analysis

SLA – Second Language Acquisition

SCT- socio-cultural theory

SWAPO – South West African Political Organisation

TL- Translanguaging in Writing

TSC- Translanguaging in Science Classroom

ZPD- Zone of Proximal Development

List of Figures

List of Tables

CHAPTER 1: Introduction

Namibia is a multilingual country. However, its language in education policy is largely monolingual, enforcing teaching in a colonial language, English, as the medium of instruction (MOI). This is common to many other post-colonial African multilingual contexts particularly where learners are transitioning abruptly from mother tongue instruction to English-only medium of instruction (Probyn, 2015; McKinney & Tyler, 2019). Research in Africa and elsewhere in the world has established the clear links between the English only policy and the multilingual students' challenges to engage in their learning and negatively affecting their academic performances (Msimanga & Lelliott, 2014; Probyn, 2015; Tyler 2016). In addition, teacher education programs, including science teacher education, do not address how best teachers could organize and adapt their science instruction to address the linguistic diversity of all students in multilingual contexts (Cummins, 2017a). There is an urgent need to adapt the science subject content to the linguistic abilities of students and their cognitive abilities to enhance effective learning (Cummins, 2017 b). However, in Namibia, there is no clear direction at policy level or in curriculum development as to how multiple languages and modes can be used deliberately and strategically in the bilingual science classroom to enhance learners' scientific conceptual understandings. Given the complexities of the language policy and pedagogical challenges of language of instruction choices in the Namibian classrooms, it is fundamental for this study to fathom this situation in-depth.

One contributory factor to learners' underperformance, despite starting their education in their mother tongue, is the type of bilingual education model being practised in schools: the early-exit transition model where learners are instructed in their mother tongue from Grade 0-3 while learning English as a First Additional Language subject from Grade 1 (Wolfaardt, 2005; Harris, 2011; Kisting, 2012). For the school under investigation in this study, this early-transition language policy model implies that from Grade 0-3 learners acquire their initial literacy skills in Standard Written Oshiwambo (Ministry of Basic Education (MBE):1993) and while receiving all the curriculum materials in English as from Grade 4 onwards. These learners are subsequently put at an even greater disadvantage, as, from Grade 4, they are forced to learn science concepts in an unfamiliar language. My study focuses on grade 4 where the transition from mother tongue education to English medium happens. LaDousa (2007) argues that Namibian learners are exposed to a 'sink or swim' situation because they are instructed in English, whether they like it or not.

Cantoni (2007) claims that the early transition to the English medium results in learners failing to cope both with the English language and with subject content and constrains their participation in the lessons. According to her, this is more complex as it also affects the act of reading for understanding, and this situation imposes a considerable burden on teachers to deriver the curriculum effectively. Additionally, many educators in Namibia complain that most students resort to memorizing the subject matter, which they merely repeat in examinations without fully understanding it (Murray, 2007). Therefore, the current language policy reform together with the introduction of the new curriculum of learner-centered education seems to not be an answer to transform the education system in Namibia. This calls for a review of the current language in education policy, to ensure equitable education for all as enshrined by the Namibian constitution.

To redress the inequality resulting from Apartheid, the Namibian education system underwent comprehensive reforms that include the Language in Education Policy (LiEP), curriculum revision, as well as the assessments methods. The Namibian education reforms were underpinned by goals such as accessibility, equity, democracy, and quality (Ministry of Education and Culture, 1993). When Namibia gained independence in 1990, the new Ministry of Education and Culture proposed a pedagogical transformation through the introduction of the new curriculum known as Learner-Centered approach (LCE) (Ministry of Basic Education, Sport and Culture (MBESC), 2008). The main ideology that underpinned the LCE curriculum is that "the starting point at each stage of a learning process is each learners' existing knowledge, skills, interests and understanding, derived from previous experience in and out of school" (MBESC, 2003:25). This new curriculum aimed to replace the Bantu education of a teacher-fronted teaching approach and to move away from the subject-centered curriculum that was inherited from the colonial' legacy (Tabachnick, 1998). The same curriculum endorses the notion of going "beyond relying on what they have read or been told" and "to think independently and critically" (MBESC, 1993:119). Therefore , the introduction of the LCE curriculum was regarded as a remedy to curb the educational inequalities of the colonial legacy while at the same time ensuring a quality and democratic educational system that would offer equitable education to all Namibian learners (MBESC, 1993). It is worth arguing that the Namibian education system suffers from the separation of curriculum and language policy development when in fact language of instruction is the key to curriculum development and implementations.

Despite the aforementioned goals of the post-colonial Namibian education reforms, the government's efforts of achieving the quality and accessible education to all Namibian children has not been realised, particularly for children who attend schools in the rural areas and townships. (Kasanda, 2015). The progress toward successful implementation of LCE in the Namibian schools has been challenging, despite efforts made to ease the implementation of the new teaching approach. Numerous studies (see Adejoke, 2007: Cantoni, 2007; Kapenda, 2008; Nyambe, 2015) observed that most Namibian teachers resort to traditional teacher-fronted instructional practices for knowledge transmission with minimal or no learner participation. Cantoni (2007) identified teachers' authority and their instructional practices, together with the levels of teachers' and learners' English proficiency, as major stumbling blocks for Namibian learners to participate fully in their learning process.

International studies (Lemke 1990; Gibbons 2008; Webb and Treagust 2006) argue for teachers to establish opportunities for students to participate in conversations where they are encouraged to argue, discuss, explain, and generalize in order to develop a deeper understanding of science Contrary to that, Namibian classrooms lack these kinds of conversations. The international and post- colonial African studies have argued against the reported Namibian teacher's teaching approach of teacher-fronted instructional practices claiming that these type of teaching practices have a negative impact on science knowledge construction as well as on learners' language development in general (see Lemke, 1990; Gibbons 2003, 1999; Probyn, 2015; Tyler, 2016). At the same time, little is known about the communicative interaction in the Namibian bilingual science classrooms where learners shift from mother tongue medium to English medium of instruction (MOI). The transition from teaching in mother tongue to teaching in English in Grade 4 is one of the key areas of interest to this study.

Given this situation, my interest is to investigate how a teacher navigates the difficulty entailed in teaching children in a language that is not their own and simultaneously developing academic language proficiency and science- specific disciplinary content knowledge. Studies reveal that learning Science through an unfamiliar language in the bi/multilingual contexts impacts negatively on African bilinguals' access to the science content, and that this negatively impacts on their performance in science subjects (Chick 1996; Chimbutane 2005; Probyn, 2009; 2015.) This is especially challenging in light of the Namibian LCE that envisages learners' active participation

in their own learning as well as the "promotion of learning through understanding" (Ministry of Education and Culture, 1993:60). One might question how the curriculum' goals can be achieved while at the same time meeting the demand of the monolingual approach of the Namibian's Language in Education Policy (LiEP). However, in Namibia and globally, it is more common to be bilingual than monolingual and, thus multilingualism is no longer regarded as a barrier to teaching and learning (García, 2009a). The question that arise thus, is how best primary school Science teachers can capitalize on the multiple language resources and modes as legitimate resources for science teaching and learning in the bi/multilingual primary school contexts.

There is a general concern that learners in a bilingual context are incapable of meaningful engagement with science concepts in a language they are not proficient in (Lee 2005; Lee and Luykx, 2007). To accentuate the problem, the gap that exists between scientific and everyday language might present some complications for emergent bilingual learners to comprehend the scientific concepts , establishing the bridges between the discourses and registers and engaging in the science classroom discourse (Jakobson and Axelsson, 2012; Probyn, 2015). This gap might widen when learners are expected to simultaneously master the basic competencies in the English language and the unique structure of the scientific language through a language not yet mastered by them (Gibbons, 2003; Lemke, 1990). In most instances, students are often left on their own to decipher and discover science meanings they encounter during the Science discourse without provided sufficient learning support from the teachers (Lemke, 1990; Lee 2005; Lee and Luyckx, 2007). However, science in itself is a specific specialized language that embodies "a specific grammar (e.g., passive voice), certain rhetorical structures or figures of speech, and certain models for activity (for example, the question-and-answer structure)" (Lemke, 1990: 21). These language patterns present enormous challenges even for English native language speakers. Thus, the emergent bilingual learners are at higher risk to conceptualize and appropriate the scientific concepts without proper mediation (Probyn, 2015). Yet, science teachers often display a lack of experience and professional knowledge about how science instruction could be organized to support multilingual students' needs when it comes to developing their language and conceptual knowledge (Lee, 2005).

In spite of ample evidence that demonstrates children's ability to comprehend scientific concepts and think abstractly at a young age (see Fleer, 2010; Haynes and Murris, 2012), scientific concepts

teaching in Natural science subject is not taken seriously by the Namibian ministry of basic education . Often untrained teachers are used to teach science in primary schools (MBESC, 2010) because of the idea that young children are unable to learn complex concepts. Teachers have a critical role in establishing a classroom discourse that enable opportunities for joint knowledge constructions and the appropriation of the academic 'ways with words' (Heath, 1983). However, poor performance in science persist, despite the efforts made by the Namibian government, such as increasing the budget allocation to the Ministry of Basic Education's. It is worth arguing that the most important issue lies in what kind of meaning making is enabled when learners are encouraged to use their full linguistic repertoires, and through which teachers can establish intertextuality connections and shifting between the discourses to influence students' scientific literacy development.

Research problem

The Namibia linguistic situation: The Language in Education Policy and it's implementations in the Namibian Schooling

According to Tollefson (1995:2), "language policies are both an outcome of power struggles and an arena for those struggles". This is not distinct from the Namibian linguistic landscape, where tensions around the language policy are rooted within the legacy of German colonisation from 1985 till 1915. During this period, "German was introduced as the official language and hence the MOI" (Cluver, 1992:118). This period was followed by the South African regime that took over the administration of Namibia in 1918, According to Cluver (1992:119) "Dutch was replaced by Afrikaans as one of the official languages of Namibia". English was never a Namibian colonial language and thus, English did not have the status of an official language in Namibia (Frydman 2011: 182). In fact, there were other Namibian indigenous languages (see Oshikwanyama, Oshindonga, Rukwangali, Otjiherero, Rugciriku, Thimbukushu, Silozi, and Setswana, all belonging to the Bantu language group, and Khoekhoegowab and Ju/'hoan which belong to the Khoesan language group) that were used by local people in the country. Ironically, despite the small percentage of Namibians who are English first-language speakers, after independence English was chosen as the sole official language of the country, used in all its formal domains.

Prior to Namibian independence, only 0.8% of the Namibian population were English native speakers and merely 4% of people used English as a second language (Frydman, 2011).

It is imperative for this study to discern the reasoning behind the South West African Political Organisation (SWAPO's) decision to choose English as Namibia's official language and how these policy decisions impacted on teaching and learning in Namibia's multilingual context. The impetus to choose English as the sole official language over other local Namibian languages was informed chiefly by the country's sociopolitical situation and the linguistic diversity at a time of the drafting of the constitution and during the formulation of the Language Policy (Frydman, 2011). Afrikaans and German were perceived as the languages of oppression, thus, English was considered 'a neutral language' to play a decisive role for unifying all Namibians. Part of what contributes to the complexities of current Namibian language in education policy (MBEC, 2003), is the large variety of languages and dialects found in the country. The data collected from Central Intelligence (2011) shows Namibia to have 13 recognized national languages and over 50 varieties of those languages spoken by 87.8% of the population and 3 Indo-European languages: Afrikaans that is spoken by 9.5% of the population, German by 0.9%, and English by a mere 0.8% (Frydman, 2011). It was perceived that the choice of a Namibian local language might to cause ethnic conflicts and divisions, thus preventing social cohesion among Namibian' ethnicities and polity groups (Frydman, 2011; Brock-Utne and Hopson, 2005). In addition, English was chosen because of its global positions in trade and its suitability to harness science and technology in the new Namibian dispensation. On the other hand, the Namibian local languages were considered as underdeveloped in scientific and technological terminologies (Frydman, 2011). To date, the status of English as the sole official language does not reflect the diversity of the Namibian population, which is primarily multilingual (Buschfeld & Kautzsch 2014).

In 2003, the Ministry of Basic Education & Culture (MBEC) adopted a LiEP for the Namibian schools that would guide implementation of language issues in Namibian schooling. The Namibian LiEP stipulates that the MOI as from Grade 1-3 should be the mother tongue or the dominant language, advocating that learners should get access to additional languages through additive bi/multilingualism. From Grade 4 the shift is made from mother tongue instruction to English medium and the mother tongue becomes a subject, and that in this process of language substitution, as the mother tongue loses its language status and power, when it becomes a mere subject (MBEC,

2003). The rationale for the mother tongue instruction in grades 1-3 is that "it is ideal for learners to study through their mother tongue, particularly in the early years of schooling when basic skills of reading, writing and concept formation are acquired" (MBEC, 2003:1). The same policy states that all National examinations, excluding mother tongue as a subject, must be written in English medium (MBEC, 2003). It is clear that the Namibian Ministry of Education's monolingual language policy fails to recognise the dynamic nature of languages, and imposes this monolingual identity on learners, and that this act is one of silencing their bi/multilingual voices (McKinney & Makoe, 2014; McKinney & Tyler, 2019; Creese and Blackledge, 2010). Thus, the English monolingual official policy continues to have substantial negative consequences for the Namibian education system and the bi / multilingual learners' academic performances (Chavez, 2015; Wolfaardt, 2005; Harris. 2011; Harlech-Jones, 1990; Brock-Utne and Holmarsdottir 2001; Cantoni, 2007; Frydman, 2011). This is because of teachers' and learners' poor competencies in the English language as well as the lack of training to teachers for to implement the use of English MoI and inadequate teaching and learning resources to support this (Harlech-Jones, 1990; Brock-Utne and Holmarsdottir 2001; Cantoni, 2007).

A significant amount of existing evidence shows that most Namibian learners, before they progress to the grade 4, do not speak English, or have low levels of fluency in English, due to lack of out of school English exposure (LaDousa, 2007; Cantoni , 2007). Wolfaardt (2005) investigated the language policy of Namibian schools and purported that students' limited proficiency in English is not appropriate to their grade level. Wolfaardt revealed that 22.4% of students in Grade 8 were not functionally literate in English, and that 49.2% of the students had numeracy skills below a Grade 7 level. All the students that tested below the required level came from primary schools that opted for English medium of instruction straight from Grade 1 rather than mother tongue instruction. So it appears that although the LiEP stipulates that the MOI should be the learners' home language/mother tongue in Grades 1-3, some schools are not complying and introduce English MoI from Grade 1. This implies that the neglect of mother tongue (MT) instruction during the first years of formal education could partly be the cause for poor reading and numeracy results in Namibian schooling (Van Wyk & Mostert, 2016). Moreover, Kisting (2010) reported that Namibian teachers, particularly in the Northern part of Namibia where this study was conducted, have poor proficiencies in English grammar and reading comprehension. A test performed country wide from 2011 to August 2015 by the Ministry of Education showed that

98% of Namibian primary school teachers do not have Basic English competencies. According to Kisting (2012) over 70% of the Namibian teachers in senior secondary schools cannot read and write Basic English. Most teachers went through the schooling system before English became the official language of instruction. For these teachers, their home language served as the language of instruction in primary schools, while Afrikaans was used as medium of instruction at both secondary school and during their teacher education training. It is evident that the adoption of English MOI from grade 4-12 was not properly thought through as it was adopted without proper teachers' training to teach through the medium English MOI (Totemeyer, 2018). Therefore, teachers' lack of proficiency in English and the lack of training to improve this, greatly influenced the underperformance of their learners, increased frustration among learners and teachers, and can also be linked to a high learner dropout rate (Murray, 2007). In 2010, 50% of Grade 10 learners across the country failed the Namibian national junior secondary school examination (Kisting, 2012).

Even if the Namibia language policy encourages the teaching of learners through the medium of their mother tongue in the early years of schooling, the implementation of the policy has not been evenly, equitably, or properly applied throughout the country (Wolfaardt, 2005). This is partly due to the lack of clarity contained in the language policy recommendations as to how national languages (or mother tongues) should be used in schools (Wolfaardt, 2005). However, in practice, the policy spells out that "in a school where there are a substantial number of learners (20 or more) from different language groups, the school must make arrangements to provide instruction in the different languages" (MBEC, 2003: 5). The fact that the choice of the medium of instruction is decentralized, means that many schools in urban areas have opted to use English as a medium of instruction from Grade 1 for various reasons. Some education planners and parents believe that the earlier the children are instructed in English the better they will master the language, thus providing access to tertiary education and to the job market (Wolfaardt, 2005). As a result, there were discrepancies in the implementation of LiEP from region to region due to the misinterpretations of the policy, and the fact that majorities of the parents and school principals preferred English over the mother tongue (Tötemeyer, 2010).

Moreover, Totemeyer (2010:10) reported that:

> *Some principals still believe that they have the right to decide which African/ indigenous/local languages shall be taught or not taught in their schools, or even to decide that no African language shall be taught. This assumed freedom to discriminate against some or all African languages, even when they are being spoken in the immediate vicinity, is not stipulated anywhere.*

Various scholars, however, stress that the use of English as the sole language for instruction impedes not only quality curriculum delivery, but also learners' ability to comprehend subject content knowledge in an unfamiliar language. (Frydman, 2011; Harris, 2011; Chavez, 2015; Van Wyk & Mostert, 2016). Frydman (2011:1542) argues that, if the current Namibian language policy is not revisited and revised, it can significantly impede the government's 2030 vision for "a prosperous and industrialized Namibia, developed by her human resources, enjoying peace, harmony and political stability". Until recently, there has been a concern over the smooth implementation of the Namibian LiEP raised by numbers of scholars (see Frydman, 2011; Harris, 2011; Chavez, 2015; Menshah, 2015; Totemeyer, 2018). Sadly, to date (2020), the current Namibian LiEP, formulated prior to Namibian independence in 1990, continues to be the sole official policy for the Namibian schools. In addition, the English monolingual policy has prevented the majority of Namibian learners from learning in their native language, thus marginalising not only Namibian local languages as a medium of instruction, but also indigenous knowledge and cultures contained within these languages, in schools (Frydman, 2011). This occurs, despite the fact that the Namibia language policy recognizes all the Namibian local languages to be treated equally in national schooling and calls for the embracing of cultural diversity and indigenous knowledge (MBEC, 2003). In principle, the same policy dictates that English should be used as sole MOI as from Grade 4 and beyond (Menshah, 2015). In this respect, Frydman (2011) posits that the Namibia school system is in dire need of an explicit multilingual policy that could guide the appropriate roles of local languages, including English within Namibian schoolings.

The monoglossic approach that underpins various states' official LiEPs, has come under scrutiny from scholars who view it as instrumental in silencing the voices of learners in the classroom (see Blommaert, 2005(a)) while promoting 'epistemic injustice' (see Fricker, 2007) in which learners are positioned as monolingual beings, often labelled as deficient "English monolinguals" (Fricker 2007, 2012; Tyler & McKinney, 2019). This very same positioning is also evident in the case of

neighbouring South Africa, and is reflected in the "curricula, textbooks and assessments that are available in English only, and through official education department communications to schools that ask teachers to refrain from 'code-switching' in classrooms" (McKinney & Tyler, 2019:6). Thus, Namibia has an official monolingual language policy that continues to promote the notion of the 'single standard language' at the same time ignoring the multiple varieties of linguistic resources as well as the varieties of modes during the classroom discourse and also in materials development (McKinney & Tyler, 2019). Therefore, the Namibian education system can be said to be failing to meet the needs and demands of learners who are not learning through their mother tongue in early grades and beyond. Despite the expectations of the MBEC (2005b) that by Grade 4 learners will have acquired adequate proficiency to read texts in English for concept comprehension, in fact very few are able to do so (Leech, 2010). This could be the reason why the majority of Namibian learners from rural and township schools have difficulty comprehending and processing reading material, decoding meaning, show less participation in learning, and often resort to rote learning (Murray, 2007). Therefore, it is imperative for this study to explore the language ideologies and language ecology that shapes the classroom practices in Namibia, as well as how ideologies were being "embodied in communicative practice" (Kroskrity, 2006: 496), that is, how the language ideologies could be observed and interpreted from language practices in this data.

The prominent role of English as a sole language for medium of instruction has given rise to intense interrogating of how teachers in a bi/ multilingual context can make use of all available language resources and modes for science meaning-making situations (Karlsson, Larsson, & Jakobsson, 2020). While there is an urgent call for bilingual teachers to embrace multilingualism in the context of science teaching and learning (see Karlsson, Larsson, & Jakobsson, 2018, 2020), various studies have reported that contrary to this call, science subjects are frequently taught monolingually (Lemke, 1990; Lee, Luyckx, Buxton and Shaver, 2007). Therefore, students are not always encouraged to draw from their entire set of linguistic repertoires in the context of science teaching and learning (Lee, 2005). To successfully implement the science curriculum, it requires teachers to adjust the support provided to bilingual learners to learn the science discourse despites their level of English proficiency (see González-Howard et al, 2017).

Background of science and literacy learning in Namibian schooling

Many countries aspire to having a scientifically literate citizen body to accelerate the 4th industrial revolution. Namibia is no exception to this. The 2016 Namibian National Curriculum for Basic Education, (NIED) aimed to offer "good early childhood development and pre-primary programmes to provide a stimulating environment for the all-round development of the child and lay a foundation for formal schooling, especially for children with learning disadvantages" (2016:2). However, this goal remains elusive as many Namibian learners, particularly in the contexts of this study, continued to perform poorly in science subjects. Scholars have raised concerns over the current Namibian education system due to the overwhelmingly poor performance in Literacy, Mathematics and Natural Science and high drop out rates at both primary and secondary education level (see Mutorwa, 2004; Makuwa, 2004; Wolfaardt, 2005; Hartley, 2011; Nyambe 2015).

Extremely worrisome data has emerged from systemic studies regarding the low level of scientific literacy in Namibian schooling. For instance, both the 2004 and 2005 Namibian Survey Report by the Southern and Eastern Africa Consortium for Monitoring Educational Quality (SACMEQ), showed that Namibian learners' scores in Math and science were lower compared to that of other African countries. In addition, in 2004, Namibia's education system was criticised by the World Bank: "only one child out of fourteen children can read before they reach Grade six" (UNICEF Report, 2004:22). Wolfaardt's (2005) qualitative study conducted in Namibian primary schools country wide reported that 22.4% of Grade 6 learners were not functionally literate in English while 77.6 % learners were functioning at Grade 3 level; 49, 2% of Grade 7 learners' numeracy skills were lower than the Grade 7 level in one of the Namibian township schools. According to Wolfaardt, learners who fail to perform well in literacy and numeracy in Grade 8, are mostly from primary schools where English is chosen or mandated to be used as a medium of instruction as from Grade 1. Therefore, Namibian underperformance in numeracy, science and literacy is a source of great concern for this study, particularly when learners are transitioning abruptly from Grade 3 mother tongue medium to English medium in Grade 4. Notably, learners' lack of competence in their mother tongue (MT) can greatly affect their academic progress since these learners would fail to acquire prerequisite cognitive skills in their first language, which is key for

learning in other content-based subjects like Science in the second language (see Cummins, 1998; Heugh, 2006; Heugh, Diedericks, Prinsloo, Herbst, & Winnaar, 2007).

It can be argued that learners' limited exposure to effective scientific concepts learning in their early years of schooling may create a barrier to the later learning of scientific concepts (Blatchford & Taggart, 2004). Yet in Namibia, the struggle to break away from rule-based , rote-leaning towards more conceptually-oriented exploratory engagement is more acute due to teachers' lack of subject knowledge, limited resources, lack of competencies in the English medium of instructions, cultural factors, and learner background (NIED, 2003; O'Sullivan, 2004; Kasanda, 2015). Achieving the Namibian goal of education for all poses considerable challenges because of the dilemma of English-only policy which place more teaching and learning demands on students and their teachers. At the same time little is known on how semiotic resources are used in the joint construction of science knowledge in Namibian bilingual science classrooms where learners shift suddenly from mother tongue medium to English MOI.

The aim and the significance of the study

My study takes direction from the argument posed by Cooper and McIntyre (1996:1) that: "Any serious attempt to improve the quality and effectiveness of teaching and learning in schools must start from an understanding of what people in classrooms do at present". As such, within this study, an understanding of the role of multiple languages and modes in science learning is pivotal to develop classroom strategies that would assist emergent bilingual learners to acquire language, and to develop a conceptual understanding of science. Moreover, the provision of equitable educational opportunities for all Namibian children despite their socio-economic, cultural, or linguistic background is a goal of the Namibian school system. However, the concern regarding the under-performance of bilingual learners in Maths and Science subjects is very alarming in Namibia, as elsewhere in post-colonial African contexts. Specifically, the role of the language varieties for learning is not being recognised in the school language policies nor in the teachers' education training programs (Probyn, 2009). Therefore, I was motivated to investigate further how primary school Science teachers and learners meet the demand of the LCE on the one hand and the ideologies underpinning the monolingualism of the language policy on the other hand. This is

needed to serve as a basis for the development of theoretical and practical knowledge in the Namibian research community.

There is an urgent need for shifts in teachers' pedagogical practices that encourage the use of semiotic resources in the joint construction of science knowledge particularly in the context of bilingual primary schools. In the bilingual person, as García & Li Wei (2014) claim, separate languages do not exist in the brain, but rather they have a complete set of linguistic repertoires from which they can draw to execute their learning tasks in a given situation (García, 2015d). This study recruits the concept of semiotic resources, which include embodied "actions and artefacts we use to communicate" (Van Leeuwen, 2005:3). Employing a socio-cultural view of language learning or learning in general, this study sought to examine the types of semiotic resources used and their consequences for mediating meaningful engagement and understanding of science ideas in a Grade 4 bilingual classroom. The study takes place in a bilingual Township Primary school (Grades 0-7) that I will refer to as 'Grace Primary School' (pseudonym) where English is used officially as medium of instruction from Grade 4-7 while Oshiwambo is used as a medium of instruction from Grade 0-3. This school is in a 'disadvantaged' historically poor township community most of whom speak Oshiwambo, with a few other speakers of different Namibian languages. The disadvantaged schools in the Namibian context refer to formerly Black schools that were severely under-funded during the colonial era. The school is situated in the Northern part of Namibia, in the Oshana Region, about 750km away from the capital city of Windhoek, and teachers and learners in this school share a common home language of Oshiwambo. The school was selected as a subject of this study because it has been extensively reported by previous scholars(see Hardman, 2005; Fleisch, 2008) that schools that are located in impoverished disadvantaged areas, are prone to poor performance in maths and science subjects As reflected in regional standardized test scores, the school under investigation was ranked as 31 out of 35 schools in the 'regional schools performance report, compared to other local schools in 04 December 2014 and yet it didn't improve in 2017 (Oshana Directorate reports, 2014-2017).

Figure 1: 1 Namibian map

The aim of this study is to understand problems around teaching science in grade 4 more generally and also to explore how various embodied semiotic resources such as speech, gestures, body movements, images, drawing and material objects are used to construct scientific knowledge and understandings in Science oral and written discourses, including assessments. In addition, this study sought to better understand the nature of discourse employed by the teacher and learners as they engaged in various classroom activities and, to see how these specific discourses supports or constrains opportunities to construct science meaning. This study did not focus only on the use of semiotic resources for meaning making but also the sociocultural significance of these communicative practices. It can be argued that the implementation of the school language policy and curriculum policy alone will not resolve the educational crises in Namibian schooling.

Educational planners and educators alike need understandings of the dynamics of bi/multilingualism and a multimodal approach to Science teaching, so as to address the linguistic and educational needs of the bilingual learners.

Identified gaps

Previous studies of learning in Science classrooms within the African context were mostly conducted in secondary schools (see August & Shanahan, 2008; Jaipal - Jamanif , 2010; Rubinstein-Avila et al., 2014; Tyler 2016 ; Tyler and McKinney, 2019 ; Williams , Tang & Won, 2019) and focus on the linguistic mode (e.g., Nomlomo on isiXhosa in primary science) , and tertiary levels (see Mazak & Herbas-Donoso, 2014). Currently there is no single study that has been conducted on the role of multimodality in science discourse at the primary school level in bi/multilingual contexts that are linguistically constrained, particularly in the African post-colonial context. Besides the studies of Probyn (2015) and Tyler (2016), whose studies investigated the use of multiple modes for meaning making in bilingual secondary school science contexts, no studies could be found that have directly investigated the role of multimodality in science meaning making within bilingual Science primary school contexts.

Moreover, there is not a single study that has interrogated the use of semiotic resources in Science teaching and learning in Namibia. The available literature in Namibia focuses solely on the consequences of using an English monolingual language policy on learners' performance (see Cantoni, 2007; Frydman, 2011; Menshah, 2015), the aspects of language use and attitudes (see Buschfeld & Kautzsch 2014); the function and occurrences of codeswitching between L1 and L2 (see Zähres, 2017; Kamati, 2011); the contradictions of the implementation of the language policy and the learner centered curriculum (see Wolfaardt, 2005; Kapenda, 2008; Tötemeyer, 2010; Kisting, 2012) . To my knowledge, there have been no published studies in Namibia that looked at how semiotic resources are used in oral and written assessments and their effects on science knowledge construction, despite the fact Namibia itself is a multilingual country. Again, there is a scarcity of studies that interrogate the use of semiotic resources for science knowledge construction in science written *assessments* in both international and national research studies, particularly at primary school level. Very few studies have reported on *written* texts in multilingual classroom

settings (but see Garcia, & Menken, 2006; Canagarajah, 2011b, 2013; Velasco & Garcia, 2014, Kiramba, 2016 for exceptions), particularly in African settings where multilingualism is a reality.

The aims of the study

This study thus aims to close this gap, through employing a case study approach. It is against this background that the present study aimed to close this gap, by focusing on one Grade 4 bilingual Natural Science class, and employing a case study approach, to achieve the following five major goals:

1. The first and central aim of the thesis is to make a theoretical contribution of developing the analytical framework of integration and combining theoretical resources in classroom discourse as well as in science assessment within a framework of sociocultural and multilingualism perspectives. This is achieved chiefly by employing different conceptual frameworks of Vygotsky, Bakhtin and Translanguaging theory complimentarily, and developing an analytical framework that is informed by these set of theories.
2. The second goal is to contribute to the paradigm shift from the current debates on what single named language, or which language, should be used as a medium of instruction in post-colonial contexts and to move towards heteroglossic practices which consider the multiple linguistic resources that the learners brought to the classroom as valuable resources for science teaching and learning.
3. On a practical level, the insights from the current study sought to make a meaningful contribution to the enduring problem in the Namibian schoolingof positioning linguistically-diverse students through the deficit lenses of monolingual beings, while ignoring the semiotic resources, language variety, culture and spontaneous knowledge that learners bring to school. This study embraces the development of multimodal theory and the conceptualization of multilingualism through applications of these theories to Science teaching and learning as well as in Science assessment discourse.
4. This study hopes to contribute to a better understanding of the linguistic challenges for emergent bilingual learners who are learning Science in an unfamiliar language and how this problem might be mitigated by moving towards flexible innovate pedagogies that would enable them to access Science learning. This will be done by providing new insights

to the policy makers ,on teaching practices and the assessment method in post-colonial schooling to move towards multilingual and multimodal practices .

5. Lastly this study would make some suggestions to help educators teaching in multilingual contexts to be cognizant and sensitive to the linguistic demands of their learners and to establish learning opportunities that positioned learners as co-constructor of Science knowledge rather that remaining passive and ultimately to address under performances in math and Science subjects in primary bilingual contexts.

Research problem

Against the background of the challenges highlighted by the literature consulted and cited earlier in the first section, I have argued that there is a need for exploratory studies in Namibian context to interrogate the nature of meaning-making in science classroom discourse. Given the multilingual character of the Namibian society, a sensitive, sustainable approach to the linguistic situation in Namibian schooling is the highest priority for this study. Building on previous research, and the wide gap in research in the Namibian context on meaning-making in science classroom discourse at the primary school level, this study seeks to explore further how classroom discourses are used through language and other modes of communication. Communicating scientific concepts is quite a formidable task in the context where learners are "in the process of actively acquiring English, and whose primary language is one other than English" (Bardack, 2010:7). These children must accommodate a double load: that is to learn a foreign language and to acquire conceptual knowledge in it. It can be argued that the degree to which learners develop systematically organized concepts of a high degree of generality depends on well-organised systematic instruction in which they transition to a higher level of thinking (Vygotsky, 1987).

Research questions

This in-depth single case study, which recruited various methodological approaches to data collection, seeks to understand the relationship between classroom communicative practices in a science classroom, the pedagogic practices in the multilingual context, language ecology and language ideologies and the dominant discourses from the wider social and cultural perspectives within a linguistically and culturally diverse primary school context. To attain the main objective

of this study, the main research question was formulated as: How does the teacher navigate the difficulty entailed in teaching children in a language that is not their own and simultaneously developing academic language proficiency and science-specific disciplinary content knowledge?

To attain the main objectives of this study, the following sub-questions were generated:

1. What is the language ecology that shapes science classroom discourse in the Namibian primary school in this study?
2. How do the teacher and the learners attempt to make science meanings in a context where English is used as the official medium of instruction?
3. How are science meanings constructed using multiple modes?
4. How do the teacher's practices influence or constrain the learners' appropriation of science meanings during classroom discourse?

Outline of chapters

To assist readers in their navigation of this thesis, an overview of subsequent chapters follows. The present thesis is divided into nine chapters. In the first chapter, I presented an introduction to the research problem, research questions and conceptual and contextual background to this study.

In Chapter 2, I set out the theoretical framework for my study. I intended to provide a clear and more concise identification of the key issues in existing and established theory that are pertinent to my study.

In Chapter 3, I situate my study within previous literature by reviewing studies in the fields of multilingualism, multimodal research in science education as well as language and science classroom discourse. I also reviewed relevant empirical studies to locate my present investigation into the previous conversations that are already established in each body of literature.

In Chapter 4, I reflect upon my methodological approach. I specify the criteria guiding my data collection and I also provide contextual detail and explain each step I undertake for my data analysis.

In Chapter 5, I investigate the language ideologies, drawn from the Namibian Language in Education policy as well as from the interviews responses with the participants of this study.

In Chapter 6, I investigate the language ecology in "Grace Primary School" (pseudonym) that shapes the classroom practices, as well as how language ideologies could be observed and interpreted from their actual usage in participants' communicative practices.

In Chapter 7, I provide a detailed analysis of how the teacher attempted to support the construction of science knowledge through classroom discourse, paying particular attention to how science meanings were made in the course of teaching and learning through the use of multiple linguistic resource and modes.

In Chapter 8, I provide an in-depth analysis, on how science meaning that were constructed by the teacher during the classroom discourse enabled or constrained the learners with opportunities to appropriate the science discourse during classroom discourse. In addition, I offer an analysis of learners' formal written science assessments to ascertain how they have managed to appropriate the science meaning that were conveyed to them during science classroom discourse.

In the final chapter 9 , I provide a summary of my research study, the answers to my research questions, the limitations for my study, the recommendations for policy makers, educators as well as for the advocates of multilingual education and science learning and the potential avenues for future research.

CHAPTER 2: Theoretical framework underpinning this study

Introduction

In this chapter, I present the theoretical framework that informs this thesis. I will discuss what a sociocultural perspective means for researching science learning in a bi/multilingual context. I will also explicate the notion of multilingualism and multimodality. In addition, I will discuss some important aspects of language ideology and the multilingual practices that are relevant to learning and assessments in general. For this study, I recruited Vygotsky's socio-cultural theory (SCT), and used his key concepts such as semiotic mediation, Zone of Proximal Development (ZPD) ; and his well-known discussion of how concepts develop, that being every day concepts and scientific concepts (which are dialectically entailed) as the primary lenses for examination of some salient issues in this study . To support my analysis, I rely on an extensive and diverse range of literature, reflecting on what has been variously referred to as socio-cultural or cultural-historical research. I also draw from Bakhtin's concepts of dialogism, appropriation and heteroglossia, and the theorising of bi/multilingualism from a social perspective as conceptual resources and tools for this study. These theories provide me with a range of perspectives on the ways in which teachers and learners use semiotic resources (including language) to construct science meaning in Science classroom discourse.

The sociocultural theory of learning

In this study, I employed the sociocultural (SCT) perspective to investigate how science meaning, through the use of semiotic resources, was constructed during the classroom discourse in a bilingual primary school setting. Central to this study, is a sociocultural perspective of science education, in which language is considered as a cornerstone of mediational means during social interaction as well as at the level of individual's thought (see Leach & Scott, 2003). The sociocultural perspective highlights that all human actions are socially, culturally, and historically situated. Pioneers of the socio-cultural perspective, Lev Vygotsky, Mikhail Bakhtin, and their followers, considered the notion of meaning-making, arguing that meaning is constructed dialogically between speakers. This view is in contrast to the mentalist perspectives of meaning-

making which premised that meaning-making takes place within the individual's mind (Lemke, 1990). From a sociocultural perspective, language is viewed as a mediator of the knowledge and skills that a learner appropriates (i.e., the science content of learning). From this approach, learning is not regarded as substituting old knowledge with new, but, is viewed as negotiating the new meanings in the joint space of social interaction in which various cultural perspectives coalescence with others in a process of joint knowledge construction (Edwards & Mercer, 1989; Mercer, 1995).

The classroom discourse, which is the core interest of this study, has the following basic attributes: it takes place in the social and institutional setting of a bilingual primary school science classroom: it comprises the voices of speakers and other semiotic modes; it is controlled chiefly by the teacher; it is geared towards science meaning making at the social plane of the classroom; it is also directed towards the processes of appropriation of the scientific concept/ discourse at intramental plane over the period of time. Therefore, I located my study within a socio-cultural framework which posits the significance of the social interaction in the course of science knowledge construction in relation to one's self, with others, as well as to the world. This is because knowledge from the socio-cultural perspectives is constructed in a dialogic space and talk is regarded as "an integral part of how understanding is developed" (Maybin, 1994:133). The classroom is perceived as a social space within which mutual understanding and knowledge constructions are conjointly constructed, and where teachers support learners to acquire the common understandings and language by which to express themselves (Edwards & Mercer, 1995; Mercer, 1995). Therefore, without well-developed language skills, learners might face challenges to comprehend the science language. This is because language is fundamental in the process of thought internalization which enables true learning to take place (Vygotsky, 1986) and learners employ the linguistic resources at their disposal for meaning making. This implies that in this study, the teacher, together with emergent bilingual learners, can make science meaning through the use of multiple semiotic resources. It is therefore crucial for this study, to recruit Vygotskian theory together with Bakhtin's ideas in order to analyse and understand how semiotic resources are used as a tool for thinking as well as for the development of science knowledge and understanding in a bilingual science classroom discourse using a sociocultural and dialogic approach (see Bakhtin, 1981& 1986; Vygotsky, 1962 & 1978) together with the theorising of bi/multilingualism.

A further critical element of this study is that the analysis is based on investigating the appropriation or internalisation of the scientific meanings during the classroom discourse. The key issue to be addressed is how the teacher's instructional practices supported or constrained the learners in developing their understandings of the scientific concepts. Therefore, in this study, I introduced a framework for analysing the language used in the classrooms discourse, by taking the aspects of the Vygotskian & Bakhtin's' theoretical perspective together with the bi/multilingualism theory and applying these theoretical tools to science bilingual classroom teaching and learning situations. However, SCT does not address how language itself is a heteroglossic practice and Vygotsky did not specifically write about or research the issue of bi/multilingualism. Vygotsky's theory was developed in relation to the monolingual learner. Therefore, the Translanguaging theory which draws on a social approach to bilingualism, and Bakhtin's notions of language as fundamentally heteroglossic, needs to be investigated in addition to Vygotsky's, in conceptualizing dialogism in classroom interaction, and language as multi-voiced, multi-registered, and as having multiple varieties and codes (heteroglossia).

Vygotsky and Bakhtin's theories complement each other, and together they give a broader view of language as central to knowledge construction. The major issue that connects their philosophy is the acknowledgment of the social and historical/cultural nature of language, and the formation of meaning through discourse. Bakhtinian concepts, such as 'dialogicality', 'social language', and 'speech genre' provide a clear path for extending Vygotsky's claims about the social origins and social nature of human mental functioning (Wertsch & Smolka, 1993). For these scholars, the dialogue is the main factor in the formation of self- consciousness. Again, learning is considered to be a semiotic process, that is, a process of meaning making, in which language is regarded as a primary semiotic tool (Vygotsky, 1981; Halliday, 1993). Both Vygotsky (1978 a) and Bakhtin (1986) argue for the need to go beyond the isolated individual when trying to understand human development and functioning. Both Vygotsky (1962, 1987) and Bakhtin (1981 & 1986) highlight that meaning does not reside in the language itself, nor do individuals construct meaning by themselves. However, it is through joint dialogue, intersubjectivity and joint construction of meaning where knowledge is co-constructed. Although Vygotsky and Bakhtin agree in viewing language as a cultural tool that is developed through social action and interaction, the ways in which they have interrogated this position have led them in different directions.

While Vygotsky and Bakhtin have a common understanding regarding the part that language plays in understanding the individual as a member of a particular culture; the significant difference is that Vygotsky's socio-cultural historical theory (SCT) focuses on children's' cognitive development that originated from the social interactions through guided learning within the zone of proximal development (ZPD). It is in the ZPD where children and their more knowledgeable others co-construct knowledge. Although both scholars defined the individual through consciousness, Vygotsky's cultural-historical approach is instrumental in defining how self-consciousness is achieved through the activity of mediation. In contrast, Bakhtin's dialogic approach was essentially ontological, defining consciousness through bodily experience, responsibility, addressivity, responsivity, respect, human dignity, and relationship with the other (Creswell & Teucher, 2008). In this context, Bakhtin's ideas are important, as it provides insight to the heteroglossic nature of language and attentiveness to the aspects of dialogue, multiple forms of language, modes and discourse. In his comparative analysis of both theorists, Wertsch sees them as providing a foundation for a sociocultural approach to mediated action. He argues however that Vygotsky did not adequately explain or sufficiently account for context: how specific historical, cultural, and institutional settings are tied to various forms of mediated action. Wertsch (1991) perceives Bakhtin as extending Vygotsky's ideas on linguistic mediation to consider the institutional structures such as government and education systems. Thus, Wertsch recommended that the sociocultural approach can be further extended by supplementing Vygotsky's theories with Bakhtin's ideas.

While these set of theories gives us insight into dialogue as a key factor in the creation of individual consciousness; the literature review has revealed that there are relatively few studies that made a detailed attempt to use Vygotsky and Bakhtin's theoretical approaches to understanding language use in Science meaning-making complementary to the field of multilingualism. In addition, none of the studies of this nature was done in the Namibian context where this study is situated. So far most of the studies that used Vygotsky and Bakhtin complementarily were conducted in the monolingual native English-speaking literacy classroom context (see Sime, 2008; Unger & Walter, 2010). Thus, this study aimed to introduce this type of research in a science bilingual classroom. It is hoped that this current study will make an important theoretical contribution to our understanding of meaning-making in linguistically constrained primary science classrooms: Where previous research in Namibia has viewed linguistic diversity as an impediment to teaching

and learning, my study is intended to take a radically different approach, acknowledging cultural and language diversity as the norm in teaching and learning.

Vygotsky's theory of language as semiotic mediation

For this study, I recruited Vygotsky's sociocultural theory for my analytical framework, because his theory of learning emphasises the importance of semiotic mediation between the teacher and the learners in the classroom context. The process of semiotic mediation leads to learners' internalisation of scientific concepts that are acquired through systemic instruction. Vygotsky (1987) draws attention to the distinction between spontaneous and scientific concepts in his discussion of how children's thinking moves from concrete (in spontaneous concepts) to abstract (in scientific concepts). It should be noted that according to Vygotsky's usage, the term 'scientific' relates to any formalised and specialized knowledge system, of which the natural sciences would be just one example. Scientific and spontaneous or everyday concepts are dialectically entailed; one cannot have one without the other. While spontaneous concepts link to the child's development of everyday concepts, scientific concepts are so general and abstract that they need to be actively taught to a child.

Vygotsky (1987) examined the role of signs in mediating action, and in the development of the infant into a mature, social being. He also explained the processes through which signs and utterances come to regulate people's behavior, and how they become internalized in the mind. As has been mentioned, Vygotsky (1978a) saw human learning and development as occurring in socially and historical culturally shaped contexts. The development of people into adults thus depends on what they have experienced in the social contexts they participated in, particularly during childhood. Thus, mediation in these social contexts is an important theme running through Vygotsky's work and later developed by Wertsch (2007). The concept of mediation is defined as "the idea that higher psychological functions are accomplished indirectly through the use of auxiliary stimuli" (van Compernolle, 2015:197). This concept suggests that, instead of acting directly on the social and physical worlds, our contact with the world is indirect, or is mediated by signs, symbol systems, and tools in which people develop the higher mental functioning (Wertsch, 2007). A key tenet of Vygotsky's ideas is that cognitive development happens first between a novice and a 'more knowledgeable other' in the social sphere (1978a). This shared knowledge is

gradually internalised and transformed by the novice until it eventually becomes hers/his for problem solving.

Vygotsky (1987) argued that the attainment of verbal mediation is demonstrated in how children use self-directed language (known as inner speech), not only to communicate their needs, but to come to regulate their behaviour. According to him, it is through children's mastery of speech and other signs and symbol systems (such as writing, sign language, scientific and mathematical formulae, diagrams, mnemonic aids) that they come to know and negotiate their world. Signs perform an important role in meaning-making, in directing attention, shaping memory, developing active control over one's own thinking and acting, and in gradually establishing other higher forms of mental functioning and problem solving. For Vygotsky (1987; 1999), it is speech (talk) generated during social interaction between a more knowledgeable other and a novice that plays the most significant role in an individual's cognitive and social development. Thus, it is through social activity, the use of cultural tools, and structured, guided practice, that people establish their internal thoughts and develop both cognitively and socially. Cultural tools, including dialogue, result in language development and enable individuals to organize their thoughts for problem solving and for negotiating their world. From a Vygotskian perspective, science equipment that are used while learning are technical tools that can mediate meaning making of both the teacher and learners.

In his seminal work *Thought and Language* (1986) Vygotsky emphasises that the formation of the child's intrapsychological plane is mediated by what he calls "tools." Tools are either of a technical nature or of a psychological origin; they are objects used to accomplish an activity. However, he placed great value on language as an enabler for development because it is the most important psychological and material tool that humans use to develop higher mental functions **(**Kozulin and Presseisen (1995). In essence, science meaning making can originate from the use of technical tools such as microscopes, thermometers, magnifying glasses, real objects, as well as other human beings (agents) that are used to aid learners to internalise the scientific concepts from the different perspectives.

However, in the classroom learning situations, the symbolic tools can function if they are mediated to enhance learners' cognitive development, which can eventually result in psychological tools (Kozulin & Presseisen, 1995; Kozulin, 2003). Karpov (2005: 23) found that "children use the

newly acquired psychological tools to restructure the information to be memorized, to search for links between new information and the current knowledge". The development of *self-regulation* is an example of the product of *mediation*. Self-regulation means that children have mastered the necessary psychological tools in the course of interpersonal communications. In the initial stages of language acquisition, children focus on the meaning of words; later they focus on the language forms. It is the understanding of meaning in the speech of interlocutors that makes linguistic development possible. The cognitive developmental process from a Vygotskian perspective always occurs between people (the intermental plane), and progressively moves into the individual's psychological plane (the intramental plane). Thus, as has been noted, development takes place through social interactions with others. During this process children internalize the forms of behaviour, and language used between individuals. This internalization is guided by the process of linguistic mediation. Primarily, the development of a child's word meaning arises in the familiar mode of speech activity that Vygotsky (1987) termed "interpersonal," or "external" speech. This is speech that occurs socially during conversation with others.

Vygotsky (1987) clearly states that word meanings used as tools in interpersonal communication alter all individual psychological operations when they are used as signs during self-directed dialogue. He posits that word meaning is a critical form of association between thoughts and words. For this study, the notion of construction of knowledge through languaging is the key issue, in which the classroom discourse was analysed to understand how the language was used to construct the science meaning and to regulate learners' behaviour during the science classroom discourse. It is believed that through the discourse analysis of interactions, the learners' negotiated Science meaning-making and their cognitive or communicative difficulties will be revealed since "discourse is often referred to as thinking made visible" (Rudnitsky, 2013:2). In order to improve the quality of mediation of the scientific concepts and to facilitate effective scientific concepts learning, Vygotsky's notion of zone of proximal development (ZPD) is regarded as a critical space in which the "social forms of mediation develop" (Lantolf, 2000: 16). From the classroom's perspective, it suggests the supporting role of more capable others in aiding the learners to execute their tasks that would be otherwise impossible to complete on their own. In the context of science teaching, the teacher's role is to mediate the scientific concepts and processes within the parameter of ZPD, while using the scientific language. Vygotsky (1978) described the ZPD as "the distance

between the actual developmental level, as determined by independent problem solving, and the level of potential development, as determined through problem solving under adult guidance or in collaboration with more capable peers" (1978a:86).

The mediation that takes place within the ZPD, is geared towards the acquisition of scientific concepts that a child is able to gain if adequate guidance and teaching is provided in the classroom by knowledgeable others, such as a teacher or a more able peer. This suggests the notion of assisted learning where Science meanings are constructed via the shared discourse between a learner and the teacher. The ZPD could be considered as a dynamic framework within which inter-psychological (socio-cultural) processes transform into intra-psychological (individual) ones (Wertsch, 1985). In other words, while individual points of view are present on the social plane, individual people shape these views on the personal plane during the process of internalization. What happens in the ZPD, thus, resulted in the learners' cognitive development and this has some implications of how learners should be instructed in formal schooling. In particular, the notion of ZPD has an impact on how tests and assessments should be conducted, and it also has some pedagogical implications. The key issues for instruction from the ZPD perspective, is for the teachers to be sensitive to the individual learner's developmental level by not focusing only on what they already know but to embrace learners' abilities to move forward. In Vygotsky's view, what a child can do today with the help of more knowledgeable others can be done tomorrow without any assistance.

In the current study, it can be argued that the use of symbolic tools and artefacts as a means of mediation of higher mental functioning (scientific concepts) is important for classroom observation of the interaction process between teachers and learners, and the use of semiotic resources to mediate learning. The reason for employing the concept of mediation as a theoretical lens in this study, is because the classroom interactions are crucial social mediators geared towards the development of higher mental functioning, or learning (Wertsch, 1991; Simona, 2002). It is through these classroom interactions that the teacher mediates science learning, through using symbolic tools such as concrete objects, textbook, gestures, oral talks, and others; and learners are expected to internalize the scientific concepts being mediated to them. It can be argued that language for teaching and learning is crucial in informing issues that concern the learning of scientific concepts. A focus on language development also enabled me to understand the learners'

developmental consequences that resulted from the teachers' strategies of mediating the science knowledge. Thus, Vygotsky's theory provided me with a valuable lens through which to explore how the classroom discourse is structured by looking at these aspects of teacher-student interactions.

Learning Science from classroom discourse: Learning every day and scientific concepts

The analysis in this thesis problematised well-known binaries of how concepts develop in Science learning: that being, everyday concepts versus scientific concepts. It is imperative to review the studies that investigated how teacher-student talk in science lessons contribute to the construction of scientific knowledge and language development (see Lemke, 1990; Gibbons 2003, 2006b; 2008; Probyn, 2015 and Tyler, 2016). According to Gibbons (2008) when teachers and learners engage with different texts such as spoken and written discourses, they construct a science classroom discourse in which learners can eventually develop their own disciplinary-specific knowledge and language, i.e., scientific concepts. However, it is worth elucidating first the meaning of the term Science d/Discourse that is constantly used in this study. In his volume on Social linguistics and literacies: Ideologies in discourses, Gee (1990) makes a distinction between small'd' discourses and big'd' Discourses. He uses the notion of small'd' discourse for "connected stretches of language that make sense, like conversations, stories, reports, arguments, essays" (1990: 142). He uses the notion of big 'D' Discourses for "ways of being in the world, or forms of life which integrate words, acts, values, beliefs, attitudes, social identities" (Ibid.). The relationship between these two types of discourses is indexed in the use of just one word to refer to them, but with the distinctive small'd' and big 'D' tags. In commenting on this relationship, Gee argues that: "discourse is part of Discourse", but that "Discourse, with a big 'D' is always more than just language" (Ibid.) This distinction has implications for how we study language in social life. In this study I used the term Science Discourse (upper-case D) to include the multiple linguistic mode (discourse), gazes, gestures, artifacts, beliefs, actions, signs and images that are allied to the science discipline.

Furthermore, research studies have emphasized that pivotal to science learning, is the students' ability to recognise the relationships between everyday knowledge as well as the specific Science discipline-related concepts (see Lemke, 1990; Gibbons, 2006, 2008) interrelated with Vygotsky's

(1987) notion of ‘spontaneous’/every day and ‘scientific’(schooled) concepts. Vygotsky (1978a:86) acknowledged that education plays a critical role in the development of ways of thinking that do not occur in everyday contexts, in particular the development of scientific thinking. Vygotsky viewed these as two opposing but complementary knowledge structures. In “Thinking and Speech”, Vygotsky (1987) provides an explanation of how children’s thinking moves from concrete (in spontaneous concepts) to abstract (in scientific concepts). Vygotsky (1987:168) made a clear distinction between spontaneous concepts and scientific concepts in terms of how these concepts develop. Unlike scientific concepts, Vygotsky suggests that spontaneous (everyday) concepts emerge spontaneously from children's thinking about their daily experiences. That is, these concepts are acquired by the child outside of the context of explicit instruction. Ideally, the spontaneous/ everyday concepts develop from everyday life experiences and they are entrenched within a definite kind of contexts, and they are therefore unsystematic. On the other hand, the scientific concepts embodied the specific specialised discourse of the subject discipline, they are systematically connected, and they are logically and hierarchical structured (Kozulin, 1998). However, in the specific context of children developing and acquiring scientific concepts as commonly understood in the Natural sciences, Miller (2011:100) notes that this process is not strictly applicable in Vygotsky’s theoretical framework. Accordingly, Vygotsky using the term “scientific concepts” does not refer to concepts from the natural sciences but to social scientific concepts, such as ‘class struggle’ and ‘exploitation’, concepts that children learn at school as part of the social studies curriculum.” According to Vygotsky “the birth of the scientific concept begins not with an immediate encounter with things but with a mediated relationship to the object” (1987: 219) which means scientific concepts work from the abstract to the concrete. This implies that the scientific concepts do not exist to be 'discovered' by individual learner themselves in their immediate environment. Therefore, the process of learning scientific concepts entails the enculturation of learners through the language, concepts and modes of inquiry which are validated by the scientific community (Lemke, 1990).

[1]Vygotsky's ideas of the acquisition of scientific and everyday concepts was extended further by his followers through them pointing out the fact that Vygotsky did not elaborate adequately as to how these concepts develop at the specific stage of an individual development. From a neo-Vygotskians perspective, younger children have the capacity to learn new scientific concepts as long as the concepts are appropriately mediated to them (Freer, 2009; Hedegard, 2002). According to Morris et al, (2016:140) "everyday knowledge comprises randomly organised isolated ideas that are easily perceived through the senses". On the other hand, scientific concepts are units of scientific knowledge which can be distinguished from the everyday because of distinctive features. In the school context, young childrens' learning of concepts progress from that of simple scientific concepts into more complex concepts. Thus, simple scientific concepts are critical as a bridge from children's everyday world understanding into science understanding (Morris et al, 2016).

Moreover, the neo-Vygotskians highlighted that the process of scientific concepts learning that results in the students' ability to solve problems of the subject matter can only be possible when they are introduced to the use of pertinent procedures that are part of the particular concepts under investigation (see Davydov, 1990; Galperin, 1985 cited in Stetsenko & Vianna, 2006). According to these scholars, the procedures that are peculiar to the specific concepts of the 'subject-domains' are the approaches for analysing the scientific phenomenon of the subject domains. Davydov (1990) argues that most schools do not teach children to see internal connections between things and to differentiate between their superficial attributes versus their essential properties, suggesting that these schools fail to recognize that there are two basic groups of phenomena to which the term generalization applies: empirical and theoretical generalization. Karpov (2003) argues against the traditional transmission approach to instruction on the grounds that it teaches meaningless non-transferable procedures to learners. According to him, learners are often taught scientific concepts by verbal definition, and they are not provided with 'knowledge

[1] In his analysis of conceptual development, Vygotsky (1987) explains that children's development of everyday concepts lays the foundations for learning scientific concepts as follows:

"The scientific concept grows downwards into the domain of the concrete, into the domain of personal experience. The spontaneous concept follows a reverse course. Initially this type of understanding is very context dependent; over time however, 'it moves toward the higher characteristics of concepts, toward conscious awareness and volition" (Vygotsky, 1987: 220).

procedures'. The notion of a traditional approach to instruction has become the foundation for the development by the neo-Vygotskians of the theoretical learning approach to teaching. The main impetus of this approach is to discover a way of teaching school children scientific concept knowledge (that is, subject-domain concepts) and procedures that enable them to master, internalize and apply this knowledge (see Davydov, 1990; Galperin, 1985 cited in Stetsenko & Vianna, 2006).

Certainly, the distinction that neo-Vygotskians have made between empirical and theoretical learning, points to the value of some form of direct teacher instruction that incorporates both content and process in the teaching of scientific knowledge. This idea informed this study when I investigated the ways in which the teacher mediates the scientific concepts to the emergent bilingual learners. In particular, I examined how a teacher introduced the scientific concepts to the learners with regard to their essential attributes. That is, the teaching process was analysed in terms of how the learners were taught the most important features of concepts in order for these learners to be able to go on to classify the specific concepts, based on their several important attributes, in their science written assessments (see chapter 8). The notion of everyday concepts that are also dialectically entailed and scientific concepts is similar to the notion of academic registers versus everyday registers. I will argue that the notion of academic register can be likened to scientific concepts that are the content area in science whereas everyday concepts are the same as that of the register of everyday knowledge (see Lemke, 1990; Gee; 1990; Gibbons, 2003, 2006). Within the context of the science classroom discourse, the academic registers signify the varieties of the linguistic features of the various language of the discipline (i.e., the textbook science language); (i.e., academic register of the science content) that is distinct from the everyday language used (i.e., everyday register) (see Gee; 1990). The language of the Natural Sciences, for example, has a distinct feature in terms of its 'lexicogrammar and semantics' that embodied specialized language with complex vocabularies, and the use of nominalisation as well as the passive voice (Gee, 2004a). These features are part of Science written language that qualifies the science discourse to be referred as the as 'scientific register'. In a course of Science learning, learners need to appropriate this specific science register.

From a science perspective, Lemke (1990) claims that discourse should be regarded as "differentiated speech" which people bring to texts. According to him, science teachers are faced

with dual challenges on how to support learners to make connections between differentiated speech forms, such as from their everyday language to subject specific discourse. He made a distinction between features of everyday register versus academic register which might help the researcher to see how these registers are used in both spoken and written language in the observed lesson. In this thesis, when I refer to "the academic register of content area in science ", I use the terms such as *scientific concepts/ language or Science language / Discourse* while when I'm referring to "the register of everyday knowledge and everyday life" I refer to it as *everyday concepts / knowledge / language* (see Chapters 4, 5, 6, 7 and 8). In this study, science concepts are scientific concepts if they have within them the essential characteristics of the concept as highlighted by Davidov, (1981) and Gee, (2004a). The interrogation of how language was used in these two registers was necessary for this study, since learners bring to classroom a great variety of their common sense and their own linguistic resources that they acquired socially from their everyday encounters with the world. Conversely, learners' earlier experiences shape the social context of the classroom (Lemke, 1990).

Similar to Vygotsky's notion of everyday and scientific concepts, Lemke introduced an idea of intertextuality in the science classroom discourse. In Lemke's (1989) views; "the principle of intertextuality tells us that what any written or spoken words say to us depend on what we bring to reading or hearing them" (1989:138). Lemke highlights that equivalent scientific ideas or concepts can be communicated in multiple ways. For instance, the teachers can employ the strategy of what Lemke termed 'glossing', meaning that "an expression is immediately followed by a close synonym, or a formal or informal definition" (1990:226). This approach required the use of alternative word of the specific term or definitions to be expressed while using the features of the same language or of the different language. In the classroom, the teachers and learners could make use of different languages , terminologies, and phrases when referring to similar scientific concepts or ideas and they can also construct the equivalent 'thematic pattern' in the course of the classroom science discourse (Lemke, 1990). In his longitudinal study undertaken in English monolingual secondary school science classrooms in the USA 'contexts with the grades 9-12 students in the biology, chemistry, physics, and earth science lessons, Lemke (1990) observed teachers attempting to explicate the new scientific concepts while progressively trying to establish the pertinent thematic connections of the specific technical terminologies as well as between the

spoken-like science language and the written-like science textbook language. From intertextuality point of view, Lemke (1990) emphasises that.

> *Students will begin to grasp semantic and conceptual relationships in colloquial language first. Then they will substitute scientific, technical terms for colloquial words. Only much later will they be able to speak "pure science". Along the way their version of scientific language will be an "interlanguage", a sort of hybrid of colloquial and technical registers (Ibid.,:173).*

This suggests that the goal of mastering the scientific language is not to replace an everyday language but rather, to offer learners various tools to build their linguistic awareness for different communication purposes (Fang & Schleppegrell, 2008). When the discourse shifts between the science texts and the everyday knowledge and language, this kind of shift will eventually enhance the construction of the intertextual connections from unfamiliar science concepts and terminologies that are part of the science texts and thereby, enable the learners to develop the discipline-specific science language (Lemke, 1990). Lemke's ideas have been valuable theory that enabled the researcher to explicate how the various linguistic resources can be employed in a bilingual science context can also to do the similar conceptual understanding as those of the 'monolingual' strategies. Gibbons (2006, 2008) used Lemke's notion of intertextuality to explain how a science teacher in an Australian upper elementary English monolingual school classroom, facilitated the smooth progression from the students' everyday knowledge of science meaning making into more Science - discipline – specific knowledge and understandings. In Gibbons' (2008) study with Australian Grade 7 English as a Second language (ESL) contexts in science lessons on the units of energy and forces, the construction of science meaning clarified and expanded further by the teacher through modelling the subject-specific scientific language to the learners in multiple ways. These strategies increased students' opportunities to comprehend the dense science language and abstract concepts (Gibbons, 2008). Gibbons introduced this process in her previous studies (2003, 2006) as "message abundancy" while encouraging the educators to establish such contexts in their classroom discourse.

In another study by Gibbons (2009), she emphasises the significance of "bridging between discourse', register-switching 'meshes every day and subject-specific ways of meaning making, thus building on students' prior knowledge and current language as a way of introducing them to

new language" (2009:62). This teaching approach is considered to be critical in science learning since it can transform students' everyday knowledge into a more specialist science school knowledge and thereby learning to use scientific register correctly. For this study, an exploration of the process of shifting between the discourse and register as Gibbons (2003, 2006, 2008) put as well as Lemke's ideas of intertextuality (1989, 1990) offered a valuable lens to explore the role of bridging between the learners' everyday language and knowledge and the targeted science discourse in a quest to construct the new science knowledge. Specifically, the literature review above has revealed two main points which impact on the present study. The first is that with science discourse (e.g., science textbooks) that is learnt in the school contexts consists of high lexical density, abstraction, and technicality (Martin & Veel, 1998, (Halliday, 1993) which are not known by learners in their daily life. Secondly, Lemke's and Gibbons' studies have made a significant contribution on how Science discipline-specific language can be supported in the classroom discourse through the multiple avenues and to enhance students to develop a certain linguistic awareness of the differences between everyday language and the science language of science textbooks. These scholars have emphasised the supporting role of teachers in bridging between discourses and register, arguing that without teacher's support, students might only rely on their commonsense everyday knowledge reasoning and preventing them to make the thematic connections and thereby, limiting them from appropriating the correct science content (Varelas & Pappas, 2013).

As discussed above, research on discourse and social practice in the science classroom has given us an insight on how learning the discipline-specific Science language can be supported as discussed above. However, this body of research has not highlighted the linguistic challenges and language resources that bilingual learners bring to the science classroom to support the development of discipline-specific Science language. These studies were mainly conducted in English monolingual contexts. Learners in the contexts of this study face a marked increase in the challenges presented by dense and complex scientific language together with learning the science language through an unfamiliar language. However, little is known about how teachers engage their learners in science classroom discourse in a linguistically constrained context, where the learners have transitioned from their mother tongue to English instruction. There is no single study in this area, conducted in Namibia, and the gap in the study has prompted me to focus on this aspect to close this gap. I intend to build on the work of the previous scholars to investigate how

the teacher and learners linguistically establish the use of thematic patterns, construct bridging discourses and register, and the use intertextuality as a useful resource for science meaning making. Specifically, the analysis for this study showed how the teacher attempted to support science learning through bridging between the discourses (i.e., Mode and registers shifting between every day and Science language) to construct science meanings in primary school science lessons with emergent bilingual learners (see Chapter 6, 7 & 8 for more detail).

Bakhtin's theory of dialogism

Bakhtin is best known in the field of literary theory. His theory of dialogue has an important contribution to make to both language learning and conceptual development of learners when understood and applied in a multilingual context. His concepts of heteroglossia and dialogism in particular focus on the cultural and interpersonal dimensions of language and provide a useful lens through which to examine discourses formed by multiple voices. This study tried to show how Bakhtin's theoretical stance is valuable in the new trends in Second Language Acquisition (SLA) where the focus is to move away from the "monologic" linguistic approach and to embrace the heteroglossic paradigm in the context of teaching and learning (May 2014).

In his book *The Dialogic Imagination* (1981), Bakhtin's theory of dialogism explicated how a person's utterances are continuously shaped by others' speech through direct appropriation of others' voices in the course of social interactions. According to him "all our utterances are filled with others' words, varying degrees of 'our-own-ness'…which we assimilate, rework, and reaccentuate" (1986:89). For Bakhtin (1981), language and speech do not reside in an abstract system of linguistic forms. They occur socially through verbal interactions from which knowledge is constructed. His primary concern is how meaning making occurs through social interaction. Thus, dialogue in Bakhtin's work, is not merely concerned with language exchange between people, but includes the 'ideology of communication' (Bakhtin, 1981:1986). The starting point of his concept of dialogism is to regard language as essentially heteroglossic (Bakhtin, 1981:1986). For Bakhtin, the *nature* of language is *dialogic*. Dialogue is understood from the perspective of the discourse, which Bakhtin (1984) defines as "language in its concrete living totality, and not language as the specific object of linguistics" (Bakhtin, 1984:181). He was not concerned with individual named languages and their structures, but rather with how language as a means of communication works. Bakhtin's theories advanced the idea that dialogue is a way to know and

create the self in relation to another person, in which active listening for feedback purposes and for action play integral parts. According to him, social awareness of meaning in language is shaped by our experiences and interactions in a heteroglossic world. Thus Bakhtin (1986) is concerned with voices that interact, and that together create meaning and understanding. Meaning and understanding cannot be transferred from one person to the next; rather, they are created when voices engage simultaneously in dialogue with each other, and thus, language cannot be an abstract mental object existing in a single person's head.

Bakhtin (1986) developed a theory of language which is concerned with dialogic utterances as opposed to the use of correct grammatical structure in the language [language in use rather than as a system]. He defined utterances on the basis of changes of speaking subjects, not on the basis of their formal structure. He maintains that any single word can have semantic content (i.e., dictionary meaning) and sentences can have fixed grammatical form. Conversely, all the meanings of words we utter are inherently social in nature. According to him, "an utterance has expressive intonation' and receives its meaning by virtue of its position in a chain of speech communication" (Bakhtin, 1986:90-91). Thus, investigations of language and learning in the classroom context necessitates the elucidation of meanings that are created in social discourse. Bakhtin (1981) posits that all utterances in any language not only embody the context of the person who produces the utterance, but they are always informed by the others' utterances. For him, the social word is embedded in multiple voices and perspectives. Bakhtin proposes that all utterances are part of a "living language" (1981:288) and that, through dialogic interaction between speakers, the meaning of language is shaped and reshaped for both speaker and listener(s). Eventually speakers construct knowledge through engaging in discourse with others.

Bakhtin compares and contrasts the monologic approach to language with his concept of dialogism. Dialogism recognizes the diversity of different views and voices and thus dialogism is also known as 'double-voiced or multi- voiced' (1981:279). Dialogism refers to "the constant interaction between meanings, all of which have the potential of conditioning others: "The word in language is half someone else's. It becomes one's own only when the speaker populates it with his own intentions, his own accent, when he appropriates the word" (Bakhtin, 1981:279). Thus, in principle, dialogism is informed by others' voices, and different perspectives. This means that people do not only use words within the language when they communicate; they contextualize

socially the meanings and contexts offered by other speakers, and appropriate them for their own communicative needs (Marchenkova, 2005). Bakhtin's notion of 'appropriation of other voices' can be relevant in the context of learning new scientific concepts, which is similar to the process of internalisation of scientific concepts in Vygotskian terms. Bakhtin applies the analogy of 'struggle' to explain the process of ("seizure', 'forcing it to submit', 'difficult and complicated") where the speakers many words might be stubbornly or resist to appropriate others' words' (Bakhtin, 1981: 294) or Discourses into their own contexts.

Bakhtin (1986) argues that we use language that we have heard from other voices, and these voices are in turn discursive products of their historical positions and their membership of various social groups. He notes that it is in the very act of speaking and listening that knowing occurs, and therefore, both knowledge and identity are created in the discourse between speakers. He emphasizes that meaning in language does not lie in a fixed linguistic form, but rather evolves through imaginative interplay, iteration and questioning through the process of dialogue. This means that language is situated within the essential meaning of the speaker's utterance that consist of a multiple, discursive view that is firmly located in a socio-cultural context of words, phrases, and utterances (Vice, 1997). From this perspective, people do not simply learn English, or reading and writing in general. Rather, they learn a specific social language related to particular social strata (e.g., professional groups, age cohort groups, socio-economic groups) to accomplish certain social purposes. Additionally, people do not use one unitary social language, but mix multiple languages for specific social interactions. His approach to dialogue and utterances brings about multiple theoretical engagements with language. Thus, Bakhtin's notion of dialogism offers us a theory of language that enables connections to be made between people's everyday discourses and their cultural historical contexts (Busch, 2010). McKinney (2017) argues that Bakhtin's notion of dialogism can be ideal for the purposes of interrogating the issue of language and learning in multilingual and multicultural contexts. Indeed, Bakhtin's ideas were crucial to this study, as it assisted an understanding of issues of language and learning, particularly in a bi/multilingual context.

Using the interpretive frame of dialogism, I examined the kinds of dialogues and dialogic exchanges performed by the teacher and learners in the lessons I have observed. In particular, Bakhtin's dialogic theory provided me with a significant lens for an exploration of how the teacher

does or does not create the spaces for multiple linguistic repertoires, whether and how he accepted learners' different point of views, and the ways in which learners are or are not afforded opportunities to develop their own voices in relationship to other voices. In addition, dialogism enabled me to see how the emergent bilingual learners utilized the language and production of science meaning in science written texts, and if/how they appropriate others' voices to construct the science knowledge in their science written assessments. It is important to note that, when one applies the conception of dialogism to interrogate the use of language and the science instructional practices one must be cognisant that Bakhtin did not address and specify the pedagogical issues in his theory and in his entire research career. The aspect of teaching and learning was not part of his theory legacy; however, his theory of language and literature can be resourceful to research the issues of language and learning and bi/multilingualism. Therefore, his theory required to be supplemented with Vygotsky's (1978a, 1986 & 1987) theory of cognitive development that emphasises pedagogical issues.

Heteroglossia

The idea that people draw from multiple linguistic features voices and registers for meaning making was developed from Bakhtin's concept of 'heteroglossia'. Bakhtin's theory focuses on the cultural dimensions of languages and discourses that are formed by multiple voices. His notions of 'heteroglossia' and 'multivoicedness' have more recently been associated with linguistic diversity (Busch, 2011b). Heteroglossia is a concept used to explain the coexistence of multiple discourses within a single linguistic code. According to the heteroglossic perspective, languages do not coexist peacefully, but in a constant state of competition. To address this dilemma and the tensions, and to unify the "verbal-ideological world", heteroglossia serves as a remedy to challenge the 'authoritarian word' and bring it back to dialogue (Bakhtin, 1981:270). Bakhtin defines heteroglossia in terms of the socio-ideological nature of language(s) and the variety of registers present in any social context or situation:

> *At any given moment of its evolution, language is stratified not only into linguistic dialects in the strict sense of the word…but also - and for us this is the essential point - into languages that are socio-ideological: Languages of social groups, 'professional' and 'generic' languages, languages of generations, and so forth. (1981: 271-272).*

For Bakhtin, the hybrid text, or utterances ("double-voicedness") challenge the tension that exists among the use of varieties of languages and/or registers. Bakhtin's view that "every utterance is half-ours and half- someone else's" describes language as heterogenous (1981:345). The dynamic of heteroglossia addresses the many-voicedness of language within the discourse and a variety of ways of speaking in a social environment (Cohen & Uhry, 2007). This includes the use of multiple registers, voices, and named languages or codes, and also deals with the possibility of conflict between the various registers and voices (Bailey, 2007). For instance, this tension and conflict can be found between the "national" languages and the "unofficial" language resources that can be from the different languages or within the same language ". In the education context, and using Bakhtin's heteroglossia concept, McKinney (2017) argues that the heterogeneity of the use of language is not confined to the use of named languages, for example, a language officially labelled, such as English or Afrikaans, or mixing resources from different codes, but embraces a variety of voices, or registers, that can be used in and out of school, can be urban/rural hybrids, as well as spoken and written languages. This means that the use of heteroglossic practices deals with the movement across different languages, and across different registers or voices in one named language. This movement is referred to in sociolinguistics as code switching, defined as 'the juxtaposition of elements from two or more languages or dialects" (McCormick, 2001:447), or the alternating use of two or more than one linguistic code in the same utterances (Myers-Scotton, 1995; Lin 2007).This is discussed in more detail later in this study.

Moreover, Bakhtin's (1981) notion of heteroglossia challenges the dominance of one language in the context of multilingualism. Bakhtin was skeptical of the Saussurean structuralist separation of language into a *langue* that is concerned with a system of rules and the specification of each individual utterance, and *parole*, referring to language in use. He posits that language should be envisioned in the messiness of social interaction. Bakhtin used the analogy of centrifugal and centripetal forces to illustrate how language functions, equating monologic language with the former in referring to any language that functions as a sole unified language, and the latter, as resonating with heteroglossia, when language pulls in different directions. In other words, there are multiple ways of speaking in a social context. Bakhtin argues that social and linguistic communities are the avenues that are obstructed by these centripetal and centrifugal forces. Centripetal forces try to unite and establish one common language, seeing the speaker attempting to put all the language varieties into one single form or utterance. Monologic language functions

according to the centripetal forces, where the emphasis is on one official and standardised language to be spoken by everyone. This suggests the "ways in which different resources are not equally valued or distributed, i.e., the stratification of linguistic resources as well as value in indexicality" (McKinney et al., 2015:110). On the other hand, centripetal forces are the product of social and linguistic diversity and serve as the unifier of two or more languages to establish common understanding between speaker(s) and listener(s). These are the social languages that we speak: heteroglossia in Bakhtin's terms. In other words, centripetal forces pull towards a unified standardised variety while centrifugal forces pull towards diversity and variation; however, both forces are at work in social language. In this study, the language ideologies manifested in the (LiEP) as well as in the actual language practices will be discussed through the lens of heteroglossia.

I employed the Bakhtinian concept of heteroglossia to examine the language practices in the context of Namibia bilingual schooling and also to find out how the language ideologies shaped the actual science classroom language usage. Ideally, Bakhtin's conception of heteroglossia is worth recruiting as it offers an appropriate lens through which to examine the classroom discourses and the relationship between languages, cultures, and people in the multilingual setting. In addition, heteroglossia enabled me to investigate the specific ways in which the participant teacher created spaces for multiple linguistic repertoires, how he accepted, or did not accept, learners' different views, and if/how learners were afforded opportunities to develop their own voices in relation to other voices. In the discussion that follows, I explicated on how the heteroglossic resources might be used to interrupt the monoglossic ideology that is embodied in the official LiEP that dictates on what language should be used for teaching and learning and the implications of the monoglossic ideologies on the teaching and learning as well on the overall classroom language practices .

Language ideologies: monolingualism and heteroglossic practices

This study embraced the notion of heteroglossic practices, which considers the multiple linguistic resources that learners bring to the classroom as valuable resources for teaching and learning science. Poststructuralist scholars do not view languages as bound entities and discrete set of

grammatical structures, but instead, questions the boundaries that exist between the languages within which specific standards exist for language varieties to comply with, in order to be recognised (see Makoni and Pennycook, 2005; Creese and Blackledge, 2010; Makoe, & McKinney 2014; McKinney, 2015; McKinney & Tyler, 2019). These recent scholars call for a paradigm shift from focusing on single named languages; or which language should be used as a medium of instruction, arguing that the shifts should rather be centered on the use of multiple linguistic resources for learning, or 'languaging-for-learning' (see Guzula, McKinney and Tyler, 2016). Busch (2010) argues against the idea of mastery of a single standard structure of a named language (s) arguing that "linguistic practice differing from the normalized standard, such as language crossing, or the appropriation of elements across language boundaries, is understood as resource rather than as deficiency" (2010:284) . Ideally, bilingual speakers have a full set of a single 'linguistic repertoire' at their disposal when engaging in given situations (García, 2015).

As multilingualism has become more visible across the globe, applied linguists are now challenging the efficiency of the language in education policies that stipulate that a single named language should be used as medium of instruction (MOI), citing that such policies play significant role in enforcing linguistic hierarchies and the relegation of the marginalised native languages in the education system (see for example, Probyn, 2009; Banda, 2010; Chimbutane, 2013; Heugh, 2013; Makoe, & McKinney, 2014; McKinney & Tyler, 2019; Kiramba , 2016 & 2018). These studies argue against the strong monoglossic ideologies that inform official schools language policies and classroom practices, in that they result in positioning learners as monolingual beings, effectively silencing their voices in the classroom and labelling them as 'linguistically deficient'. The same positioning is also reflected in the "curricula, textbooks and assessments that are available in English only, and through official education department communications to schools that ask teachers to refrain from 'code-switching' in classrooms" (McKinney and Tyler, 2019:6).

Monoglossic ideologies inform aspects of the 'linguistic rights paradigm' (Blommaert 2005b), which in itself underpinned the Namibian constitution and the post-colonial language in education policy. In the African schooling contexts, there is a narrative of the benefits of 'mother tongue instruction' versus the 'English medium of instruction'. This narrative continues to uphold the notion of the 'single standard language', while ignoring the multiple varieties of linguistic resources as well as the varieties of semiotic modes that are not being recognised in classroom

discourse, nor in materials development and assessment (Gogolin, 1994, cited in Busch, 2011a; Makoe & McKinney, 2014; McKinney & Tyler, 2019). This phenomenon of what language should be used as Medium of Instruction (MOI) were meant to exclude the African languages from the education discourse for political reasons (Chimbutane, 2013). However, in this study, I will be using labels of different languages, such as English & Oshiwambo, since such labels are deeply entrenched in how languages are discussed in the Namibian context of teaching and learning as well as in the in the Namibian LiEP.

The Namibian education system is found to be deeply rooted in a monolingual ideology that enforces a unitary language policy aimed at homogenizing a linguistically diverse population. The study of McKinney & Tyler (2019:5) points out that in the South African' post-apartheid Language in Education Policy (LiEP), prescribed, "named languages as unitary, stable objects, clearly differentiated from one another". Similarily as mentioned in chapter 1, the Namibian' MBESC (2003) adopted a language policy that specifies how language should be used and implemented in schools, while advocating the notion of 'additive bilingualism' (Namibian Ministry of Education, Arts and Culture, 2003: 1 – 4). The notion of additive bilingualism strives to uphold the use of mother tongue together with an "effective acquisition of additional language(s)" (De Klerk, 2002:43). This means that students are expected to learn an additional language while they are also developing the competencies in their first language simultaneously. Therefore, in the bi/multilingual classroom contexts, there is a visible tension between the monolingual ideologies verses the 'multilingual, and translingual ideologies' that "mandates to adhere to school MoI policies while facing the linguistic needs of multilingual students" (Kiramba, 2016:3). Kiramba points out that in Kenya, the flexible use of multilingual strategies might be the solution to address linguistically structured inequalities, a possibility echoed in multilingual South Africa (Makoni & Pennycook, 2007; Makalela, 2015) and elsewhere in the world (García 2009; Creese and Blackledge, 2010).

Critiquing the positioning of children from non-dominant groups as well as bilingual non-English native speakers as linguistically deficient, empirical studies call for the radical shift from the monolingual paradigm to that of heteroglossic practices (see Jørgensen, 2005; Garcia, 2009; Canagarajah, 2011a; 2015; Wei, 2011; McKinney, 2017; McKinney & Tyler, 2019) which is commonly referred to as the 'multilingual turn' (May 2013). The multilingual approach is

particularly relevant to post-Colonial Africa, where in the past native/indigenous languages were marginalised and oppressed, in favour of the European language of the minority (see Garcia, 2009). Multilingual studies employlanguage ecological perspectives, along with considering teachers' and students' beliefs about language, to highlight the challenges of reproducing linguistic inequality in post-colonial African schooling where multilingualism is highly visible. As an example, McKinney (2017) examined how languages are treated in white schools in the South African post-colonial context. McKinney concludes that, whilst political power has shifted within post-Apartheid South Africa, in principle white supremacy is still prevalent, specifically in how languages are being treated within South African schooling. McKinney's study provided an important insight on the complex issues surrounding language power and classroom practices as well as the significant implications for language curricula and policy in the bilingual contexts.

In a similar study Makoe & McKinney (2014), observed how monoglossic ideology remains prevalent within South African schooling. They argue that a monoglossic ideology will not afford learners with the opportunity to reposition themselves as knowers and to feel accepted in the classrooms. In their study, they illustrated the epistemic implications of monoglossic ideologies in the classroom in which a teacher ignored a learner's linguistic repertoires that he brought to the classroom, and by doing so, positioned the learner as a deficient speaker and meaning maker. Makoe & McKinney (2014) claim that learners' linguistic repertoires are continuously perceived by teachers and education departments as 'barriers' rather than catalysts for learning. To this end, the authors regard enforced monolingualism as an exclusionary practice that results in the relegation of both minoritised learners and hybridised languages, treating these learners as less important and deficient language users, and inhibiting them from meaningful and effective learning.

There are numerous other studies that employed Bakhtin's theory to describe situations where teachers neglected students' multilingual voices in the classroom as a result of the monolingual policy (see Jørgensen; 2005; Lin & Luk, 2005; García, 2009a; Canagarajah, 2011; Li, 2011). The study conducted by Lin & Luk (2005) investigated to what extent dialogue played a role in English as a foreign language learning classroom in Hong Kong. During the participatory lesson, students were required to learn English and standard Chinese concurrently before they mastered their basic mother tongue (Cantonese) competencies. According to Lin and Luk, this language ideology

influenced learners' perceptions of how they saw themselves and their own language, and their attitudes towards learning English; it essentially excluded their voices and identities from the learning process. This was mainly due to the minority cultural students not being able to participate in the dialogue and finding it difficult to derive meaning from the teacher's utterances, due to their cultural and linguistic differences. Lin and Luk (2005) advocate for inclusive curricular activities that encourage students, whatever their cultural or linguistic backgrounds, to contribute to the classroom dialogue. In a study conducted on immigrant minorities in Danish schools, Jørgensen (2005) observed the shifts Turkish adolescent boys and girls made between multiple languages in their attempts to resist a monolingual ideology and adult restriction on their language use. Similarly, Cekaite and Evaldsson (2010) carried out ethnographic research in a Swedish primary school with minority schoolchildren where the official language is Swedish. Their study investigated how these children appropriated and disrupted dominant language ideologies of the use of 'correct' Swedish during play. Their study observed that, although the Swedish curriculum prescribes the use of a single 'correct' or 'proper' language, these learners resisted this ideology by using their heteroglossic resources in peer play. According to Cekaite and Evaldsson (2010), when children use such heteroglossic practices, without sanction from school authorities who own the dominant hegemonic discourse, they resist institutional power that privileges the correct use of named language.

Despite the body of contemporary studies that advocate for recognition of the heteroglossic nature of language, the Namibian LiEP, assessments methods as well as teaching materials and textbook are purely monolingual, treating languages as bounded entities. This phenomenon of the monoglossic approach can have a profound effect on deterring learners from active classroom participation and eventually denying them access to the quality education (McKinney et al., 2015). In addition, the Namibian LiEP is silent on the possible language conflicts that might emerge from how the languages should be used simultaneously in the bi/multilingual classroom. Despite the reported challenges of the monoglossic ideology that shaped the African post-colonial LiEP and its effect for teaching and learning in the bi/multilingual contexts, there are no studies of this nature in the Namibian research community. Most of the research has looked at the effect of English as a medium of instruction without paying attention to the notion of the monoglossic ideology that shaped the Namibian LiEP as well as to the overall monolingual orientations to language practices in the school contexts (see chapter 1).

Given the fact that classrooms are sites where knowledge construction is contingent upon the language ideologies that shape the discourse and the language practices (Kiramba, 2018), it is imperative for this study to interrogate the actual articulated ideologies and the actual practices of these ideologies within the Namibian bilingual classroom. This investigation is warranted to gain an understanding of an ongoing debate of unequal positioning of local African languages, and the perception that they are not valuable and present a barrier to learning. The present study is underpinned by an ecological perspective since it emphasises "the relationships among languages, relations among social contexts of language, relationships among individual speakers and their languages, and inter-relationships among these three dimensions" (Hornberger & Hult, 2008:282) while considering the ideologies that "pervade language choice and language policy" (Creese & Martin, 2003:4). Makoe & McKinney (2014) define language ideologies as "the values, practices and beliefs associated with language use by speakers; the discourse which constructs values and beliefs at state, institutional, national, and global levels and that provides the link between social structures and power relations and language use at the micro level (2014:2)". Therefore, the present study is an extension of previous studies, local and international, that seeks to explore what counts as legitimate language resources for learning in order to overcome the assumptions behind the reproduction of inequality in bilingual classroom as suggested by Makoe & McKinney (2014). According to Makoe & McKinney "without an understanding of the language ideologies informing both policy and practices, we will not be able to shift practices in South African classrooms so that learners' full multilingual repertoires can be legitimately used as resources for learning" (2014:1). It is therefore imperative for the Namibian education system to embrace learners' multilingual repertoires rather than viewing them as a barrier to teaching and learning.

Translanguaging and Trans-semiotizing in bi/multilingual multimodal classroom discourse

The critique of a monolingual language policy for schooling, that entails the relegation of native languages in favour of a monolingual language policy, along with the negative effect it has on learners' perception of themselves as "knowers" due to being silenced, has given rise to recent studies that push for innovative multilingual approaches to learning (see Creese and Blackledge, 2010). These innovations are being pushed so as to question the strict separation of languages in

classrooms where learners and teachers are bilingual, instead calling for the practice of 'translanguaging' and to includes other semiotic modes (e.g. Setati, 2005; García and Wei, 2014; Canagarajah, 2015; Tyler, 2016; Blackledge and Creese, 2017; Li Wei, 2015; 2019; Setati-Phakeng, 2014). A common orientation within this innovative body of research is to embrace and use multiple languages and modes productively, and not view them as barriers to learning, and to challenge the deficit perspectives that regards bi/multilingual learners as less capable of learning the subject specific content. For this reason, the concept of translanguaging has become more prominent in the field of applied linguistics. The translanguaging concept has been taken up and extended further by many scholars to explain the use of language, not as discrete skills or system defined by boundaries or codes, but as a dynamic and fluid linguistic repertoires (see Canagarajah, 2011a; García and Wei, 2014; Otheguy et al., 2015 ; Blackledge and Creese, 2017; Li Wei, 2019).

The concept of translanguaging has diverse understandings among scholars, yet the common description thereof is that it refers to the use of a speaker's full set of linguistic repertoires to surpass the boundaries between the named language varieties, codes and other semiotic systems (Blackledge & Creese, 2010; Canagarajah , 2011; Garcia and Kano, 2014; Guzula et al., 2016; Wei, 2017; Lin, 2019). As Busch (2010: 284) states: "In this view, linguistic practice differing from the normalized standard, such as language crossing, or the appropriation of elements across language boundaries, is understood as resource rather than as deficiency". McKinney & Tyler (2019) view translangauaging as an ideology that disrupts the monoglossic and monomodal language ideology while acknowledging the "heteroglossic, multimodal and multisensory nature of the communicative practice" (2019:7). García et al. (2017), describe translanguiging as "both the complex language practices of multilingual individuals and communities, as well as the pedagogical approaches that draw on those complex practices to build those desired in formal school settings" (2017:2). In the similar vein, McKinney & Tyler (2019:7) claim that translanguaging can be transformative and productive in the course of learning when it is purposely planned to embrace the languaging practices and to free the multilinguals students from being oppressed by the 'monoglossic and monomodal language' forces .

These new insights within translanguaging theory resulted in the birth of new terminologies to describe what bi/multilinguals do when they draw from their multiple semiotic resources in the course of communication: 'languaging-for-learning'(Guzula et al., 2016); 'translanguaging space'

(Wei, 2011), transemiotising or 'translanguaging zone' (Lin, 2019; Blackledge, Creese, & Hu, 2016a). [2]The current trend of translanguaging is distinct from the notion of code-switching that focuses on the speaker switching between two named language codes or more. Instead, translanguaging focuses on the speaker's ability to draw from his/her complete semiotic repertoire in the course of communication (García and Wei, 2014). According to Canagarajah (2011), code-switching advocates the notion of language interchange whereby the bilingual speakers switch between the two language codes or various systems. On the other hand, Canagarajah (2007) sees code meshing as well as translanguaging embracing the languages as integrated into a single system while at the same time appreciating the global language diversity.

The monolingual language policies in the bi/multilingual contexts, have contributed hugely to further expanding the concept of translanguaging as response to embrace the multilingual turn. These expansions include the semiotic repertoires used for meaning making in the school contexts as well as in the social space - e.g., different named languages, different modes such spoken language, written language; gesture, body movement, eye gazes; head nodding (see Canagarajah, 2011; Creese & Blackledge, 2010; Guzula, McKinney and Tyler, 2016; McKinney & Tyler, 2019). García and Li (2014) call for a radical move to "signal a trans-semiotic system with many meaning-making signs, primarily linguistic ones that combine to make up a person's semiotic repertoire" (2014:42). In addition, analysis of semiotic repertoires also includes the gaps between the speech and silences and contextual responses (Blackledge, Creese, & Hu, 2015a). According to Lin (2019), these semiotic repertoires are important for meaning making in the course of communications. This is because in their everyday social interactions, speakers frequently shuttle between language varieties, styles, registers, and writing systems to fulfil their communicative needs (Lin, 2017). In Hong Kong, the work of Angel Lin (2015; 2017) has further broadened the concepts of translanguaging to incudes other semiotic modes that are used to convey meaning with her term 'trans-semiotiozing'. Trans-semiotising according to Lin (2019) transcended the focus on the analysis of the spoken *language* only while viewing the language practices as intertwined with the multiple semiotics repertoires such as (visuals, gestures, bodily movement) that are used

[2] Various scholars have also established new terminologies with regards to translanguaging in writing, and thus, the following terms were established: 'codemeshing' (Canagaragah, 2011; Young, 2004), 'transcultural literacy' (Lu, 2009); 'translingual writing' (Horner et al., 2001; Kiramba, 2018) 'translanguaging pedagogy for writing (García & Li Wei, 2014) 'multiliteracies' (Cope & Kalantzis, 2000) and others.

for meaning making. According to Lin (2012), the use of trans-semiotising between language varieties and system as well as other modes are key factors in effective communication and also for meaning-making particularlyin linguistically constrained contexts. These theoretical developments in the study of multilingualism is critical for understanding the importance of the semiotic repertoires that are used and distributed among speakers during classroom discourse (Lin, 2019; Canagarajah, 2011; Lemke, 2016; He et al, 2016).

Furthermore, the alternative translanguaging pedagogy approach in the multilingual context for language or subject teaching and learning was developed to explain the linguistic practices that are leveraged by bilingual speakers for different purposes in the education context (see Blackledge & Creese, 2010; Canagarajah, 2011; Garcia, 2011a; Makelela, 2015; Probyn, 2015; Kleyn & García, 2019). Classroom translanguaging has been widely studied as a new flexible pedagogical practice that can be restructured in bilingual classrooms for inclusivity of the emergent bilingual students' language practices, while at the same time supporting them to acquire competencies in the English language. For instance, Baker's term "trawsieithu" (translanguaging) (2011, cited in Makalela, 2013) in bilingual Welsh/English schools means a pedagogic practice where one receives input in one language and gives output through the medium of another language in order to maximise learning, and enhance subject comprehension, and help learners to acquire competencies in the weaker language. Probyn (2015) also writes about "pedagogical translanguaging" emphasizing how multiple language resources are deliberately used to mediate learning. According to Probyn pedagogic translanguaging is especially useful to researchers to examine how classrooms practices might be structured to afford learners with opportunities to learn effectively. Creating spaces for such translanguaging to support learning, is therefore an act of transformative education in which the teachers "challenge the operation of coercive relations of power in the wider society" (Garcia, 2009: 318) in order to effect more equitable education practices for all learners. Translanguaging pedagogy is therefore viewed as a right for learners to draw from their linguistic repertoires for meaning making in the process of learning, (Creese and Blackledge 2015). Velasco and García (2014) argue that if the practices of translanguaging are not taken into consideration in the classroom discourse, this can equally violate the learners' rights to learn.

While much research on translanguaging in education focuses on spoken discourse, there is now also a call for a paradigm shift to embrace the translanguaging in writing pedagogy as well as in

written assessments (see Canagarajah, 2011b, Kiramba, 2016; Kleyn & García, 2019; Krause & Prinsloo, 2016; Gee, 2003; Shohamy, 2011). This pedagogy strives to move away from the monolingual ideology that is strongly sanctioned by institutional policies where the languages variations from the standard language, hybrids and non-native varieties are perceived to be deficiencies (D'warte, 2014; García 2009; Krause and Prinsloo, 2016, 2019; Shohamy, 2011). Currently, multilingual writing is seen as an innovative way of shuttling between languages and discourses to achieve the communication goal of the writer (Canagarajah, 2011b). From this perspective, students are perceived as emergent bilinguals (García & Kleifgen, 2010) or multilingual speakers who already possess the oral and literacy language skills that they already use in their everyday life interactions. This implies that students are not positioned as "Limited English Proficient" (LEP), a term that focuses on "what students don't know as opposed to what they do" (Kleyn & García, 2019:70).

For educational purposes, García & Li Wei (2014) contend that meaning making in the writing process can be ensured when writers are afforded with the opportunities to utilise their entire linguistic repertoires. Cummins (2006) reported that when emergent bilinguals are permitted to share their past and present experiences by drawing on their cultural and linguistic resources, they produced more rich written texts. He claims that "identity texts" encourage children to draw on the multimodalities of 'spoken, written, musical, visual, and dramatic' to the message being conveyed. Kiramba (2017) views Translanguaging in writing as a transgressive form that departs from the monolingual habitus. According to her, Translanguaging in writing can create a foundation to exemplify what it means to be a multilingual by navigating away from the traditional ideology that treats languages as bound entities and instead embraces the fluidity of languages. On the other hand, she reported that schools continue to indoctrinate learners by enforcing the monolingual view of literacy, thus impeding them from tackling the daily problems they experience in the classroom.

Various scholars have also critiqued the transformative nature of translanguaging (Jaspers, 2018; Zhu, Li, and Lyons, 2017; Cenoz, 2017; McKinney & Tyler, 2019). The key argument from these scholars is that translanguaging is not intrinsically transformative. According to these scholars, translanguaging can only be transformative and function productively when it is intentionally planned to be used in the pedagogy as a means to promote and reinforce learning. As Ganuza &

Hedman (2017:3) wrote: “the concept pedagogical translanguaging should be reserved for contexts where teachers have made a deliberate decision to include students’ flexible language uses, and where the multilingual practices employed in pedagogy harmonize with the teachers’ ideologies of language”. From a linguistic ethnography perspective, this is correct because no language practices, whether it is code-switching or monolingual language use, is inherently oppressive or transformative, but it always depends on how it is used (Jaspers, 2018).

I draw on a translanguaging trans-semiotising perspective to examine teaching, learning, and assessment practices in contexts where heteroglossic languaging practices are not embedded in the educational policy as well as in the assessment language policy. From the translanguaging and trans-semiotisng perspective, within this study, the classroom is regarded as an avenue for the multiple semiotic resources within the individual person, as well as between the speakers, who are in the quest to accomplish the goal of communicating and appropriating scientific concepts. In addition, translanguaging theory enabled me to observe whether the participating teacher did or did not created the interactional spaces that cultivate and build on learners’ emergent bilingualism, so as to create multiple opportunities for both language learning and conceptual development. Given the lack of research on multilingual and multimodal practices of meaning making in the primary Science classroom in Namibia, and more broadly, this research aims to contribute to filling this gap.

Conclusion

This chapter presents the range of theoretical perspectives that are critical to this study. I draw from both Bakhtin (1981) and Vygotsky (1978) theory, as they both see language as a social practice and language and thought as being dialogic in nature. Therefore, both Bakhtin and Vygotsky’s theories form an analytical framework for analysing the nature of the classroom discourse enacted between classroom participants. In particular, I employed Vygotsky’ attendant key concepts such as: Semiotic Mediation, Zone of Proximal Development (ZPD) as well as his concepts of scientific and everyday concepts. I also reviewed the studies that have investigated how teacher can structure their science classroom discourse in which learners can eventually develop their own disciplinary specific knowledge and language, i.e., scientific concepts. Much of

the research in this area has highlighted the importance of the supporting role teachers play in bridging between every day and science language, through suggesting the need to promote classroom talk that build upon intertextual connections between the science texts and classroom talk.

While Sociocultural Theory (SCT) is useful for arguing the central role of language in learning, it does not sufficiently explain how language itself is a heteroglossic practice. In addition, Vygotsky did not specifically write about or research the issue of bi/multilingualism; his theory was confined to the monolingual learner. Therefore, I have recruited further the concepts of translanguaging and trans-semiotising concepts as well as multimodality which draws on a social approach to bilingualism, and Bakhtin's notions of language as fundamentally heteroglossic and well as his concept of dialogism which draw on a social approach to bilingualism, to complement Vygotsky's theory, in conceptualising dialogism in classroom interaction, and language as multi-voiced, multi-registered, and as having multiple varieties and mode to find the solution to establish rich science learning in the bilingual contexts. However, this study acknowledged that translanguaging has a transformative power if used intentionally to disrupt monoglossic practice, and this has epistemic value for learners in how they regard themselves as "knowers".

CHAPTER 3: Literature review and empirical research on bi/multilingualism and multimodality in the contexts of a Science classrooms.

Introduction

In this chapter, I firstly contextualise my theoretical position by providing an overview of multimodality perspectives on science meaning-making in the context of science teaching and learning. Secondly, I review the empirical research on bi/multilingualism and multimodality in the contexts of Science classrooms. In the final part of this chapter, I focus on literature about classroom discourse, by reviewing studies conducted at both international level as well as in the African post- colonial contexts. At each stage of my literature review, I give an account of how the reviewed literature informs my study and thus, contributes to the deeper understanding of the theoretical underpinning around the research problem.

Multimodal research in Science Education

Researchers of multimodality and multilingualism have problematized the 'monomodal' approach to meaning making that privileged only the verbal and written mode (Kusters et al, 2017; Blackledge & Creese, 2017). A number of researchers have argued that effective Science meaning making requires the use of multiple modes (Jewitt & Kress, 2003; Walsh, 2011; Tylor, 2015; Siry & Gorges, 2019). The use of the term "mode" in this study denotes the various means of communication that are "socially and culturally shaped resources or semiotic structure for making meaning" (Mills and Unsworth, 2017:1). There is an acknowledgment that in science, teaching and learning is realised through the deployment of combinations of multiple modalities and semiotic resources and consequently, for the development of the scientific knowledge (Lemke, 1998; Kress, 2003; Jewitt & Kress, 2003; Walsh, 2011; Siry & Gorges, 2019). Jaipal-Jamanif (2010) indeed posits that "science as a semiotic system constitutes a body of knowledge generated by a community of scientists using sets of codes." (2011:195). In my study, semiotic resources are understood as "the systems of meaning available to the user" (Mills and Unsworth, 2017:7). I also include the concept of semiotic resources so as to consider also "actions and artefacts we use to communicate" (Van Leeuwen, 2005:3), in this instance, the science classroom. According to Lemke, (1992 & 1998) when scientists communicate their research design, ideas, logic, and

findings, they do this not only through words, but through multiple modes (e.g., verbal text, graphs, tables, diagrams, illustrations, and photographs). From this perspective, "meaning-making is learning from another perspective" (Kress et al. 2014:24). Therefore, meaning making in science relies greatly on a) the abilities of both teachers and learners to construct scientific concepts and to realise them through the use of multiple modes (Prain and Tyler, 2012), and b) the ability to interpret the science ideas from one mode into a different mode (Russell & McGuigan, 2001).

Lately, various scholars have shown that multimodal literacy practices impacts positively in science teaching and learning. Examples of these practices include that of maximising learners' classroom participation and effective engagement during science lessons; developing real-life experience and authentic learning; creating the bridge between every day and scientific discourse; establishing the interest in learning, allowing students to grasp the subject matter; boosting learners' self-esteems and enabling learners' voices to be heard (see Kress &Van Leeuwen, 2001; Jewitt , 2008; Jaipal - Jamanif, 2010 ; Adamson, Santau, & Lee, 2013; Lee & Buxton, 2013; Bravo and Cervetti , 2014; Choi & Yi, 2016; Williams, Tang & Won, 2019; Siry & Gorges, 2019; Taylor, 2015). The study of Bravo and Cervetti (2014) in science lessons with elementary school English learners in the UK concluded that the multimodal approach to teaching and learning can "allow multiple entry points into understanding and processing" (2014:242).

Despite the enumerated cognitive benefits offered by multimodality in science learning and pedagogy practices, the literature shows that minimal occasions are created for multimodal literacy teaching and learning within classroom discourse (see Lemke, 1990; Walsh, 2009). Kauffman and Kahn (2000) argue that "it is only in schools that students are restricted to using one sign system to think" (2000:160). In the context of Science Education Discourse in the UK, Kress et al. (2001) reported that teachers communicated general epistemological meanings through particular configurations of modes. For example, teachers used empirical evidence and measurement, analogy, classification, and presentation of facts through a textbook to implicitly communicate the nature of knowledge as given fact. Multiple modes for classroom use must be selected with consideration to the modes that are accessible to learners. Tylor's' study (2015) in a Grade 5 UK Primary classroom science lesson, suggests that "education researchers examining classroom interaction need to be sensitive to the selection of modes made by the pupils and to the affordances of modalities available in any given circumstance" (2015:417).

Currently there exists a myriad of studies that focus on the benefits of using multimodality for science meaning making; however, most of these studies were not conducted in bi/ multilingual contexts. Furthermore, most of these studies on multimodality have dealt with classroom discourse interactions, while the studies that explore how multimodality works in written texts are scarce (Canagarajah, 2011b). Most of the previous studies that researched multimodality in Science education, were also conducted in secondary schools (see Jewitt et al. 200; August & Shanahan, 2008; Rubinstein-Avila et al., 2014; Tyler 2016 ; Tyler and McKinney, 2019 ; Williams, Tang & Won, 2019; Jaipal - Jamanif, 2010; Probyn, 2015), and tertiary levels (see Mazak & Herbas-Donoso, 2014; Archer, 2017). It is important to note that the key findings from the previous studies underscore my central argument regarding the value of semiotic resources in science education, especially within the multilingual contexts and the need to explore it at primary school level too.

Empirical studies on heteroglossic practices in bi/multilingual Science classrooms

In this section, I drew on a body of research studies on bilingual Science education that were conducted in the Northern, Western as well as the post-colonial African contexts. Although most of the learners in post-colonial African contexts are believed to be bilinguals, it was observed that the science education for bi/multilinguals'students is often taught monolingually (Lee, Luyckx, Buxton and Shaver, 2007). Globally, science education researchers agree that a major result of monolingual instruction for science teaching and learning is that it inhibits the bilingual students' chances to perform well in science compared to their monolingual counterparts (see Lee and Luyckx 2007; Msimanga & Lelliott, 2014; Ollerhead, 2019; Zavala, 2019; Charamba, 2019, 2020; McKinney & Tyler, 2019). This could be attributed to the fact that Science education and bilingualism are rarely incorporated into teacher training education or in educational curriculum development (Lee, 2005). Therefore, most teachers might not be aware of the importance of bilingual science education. In addition, the sanctioning of monolingual MOI by the language policies within certain countries, is also linked to the political context within which they are developed, for it is the political forces that cause teachers at times to stick exclusively to the monolingual MOI sanctioned by the language policies in some countries (García, 2009; Msimanga & Lelliott, 2014). This phenomenon poses a great threat to the bilingual students to express their

science meaning and thereby, hinder them from grasping the scientific language due to their limited proficiency in the MOI (Lee, 2005; Nygård Larsson , 2011; García & Kleifgen, 2010) and it is also very crucial in a post-colonial context. As a way forward, scholars, suggest a need to acknowledge and adopt the multilingual approach in the classrooms teaching and learning contexts and to enable students to become competent multilinguals without sacrificing English development (Charamba, 2020; Lin, 2019; Nygård Larsson, 2011).

At present, there are few studies in science education that focus on primary school multilingual learners in particular (Siry & Gorges, 2019). Several empirical studies in science secondary school education in the global North and– in Hong Kong provided concrete evidence on how heteroglossic practices benefit the process of science meaning-making for linguistically diverse students in multilingual science classrooms (see Roseberry et al., 2010; Karlsson et al. 2018; Buxton & Lee 2014; Zeynap Ünsal et al., 2017; Karlsson, Larsson1 & Jakobsson, 2019; Lin, 2019;). For example, Pozer's study (2018) with a fifth grade English language class in a US school reported that the use of bilingual linguistic repertoires , authentic learning experiences and access to targeted language varieties as positive factors in supporting science conceptual understandings. Karlsson, Larsson, and Jakobsson (2018) conducted a study at a multicultural primary school (grades 4–6) in Sweden, observing how Translanguaging in the Science Classroom (TSC) increases students' chances to comprehend the semantic relationships between scientific concepts and everyday concepts. This supported students in developing a deeper conceptual understanding while at the same time positioning them as the co-constructors of science knowledge. In a different study by Karlsson, Nygård Larsson, and Jakobsson (2016), they reported how students were able to shift between various discourses and languages during the process of learning the new scientific concepts. Students were deliberately using all the language resources to facilitate their understanding of the scientific concepts with ease and they were able to interact actively during the lessons. These findings corroborate the studies of Reyes (2009) with a class of 4th grade bilingual students during a science lesson in California, as well as the study of Stevenson's (2013) in a North American science classroom with bilingual Latino learners.

Rosebery, Ogonowski, DiSchino, and Warren (2010) conducted a study that focused on grade 1 and 3 learners and revealed that when teachers were conscious of, and sensitive to, learners'

multiple voices, their learners were able to both understand and apply scientific concepts. For example, they made meaning by using their language repertoires to describe science concepts (both as adjectives – "hot," "warm", and as verbs "getting hot," "heating up) and nominalized them ("the warmness," "the hotness"). To this end, Rosebery et al, (2010) stress that linguistic diversity in the classroom should not be regarded by teachers as a burden, but as a source for active participation and meaning making. In Lin's Hong Kong study of grade 9 science lessons, she reported the spontaneous use of 'translanguages and trans-semiotise' in which the teachers and students draw from their semiotic resources to co-construct the understanding of the topic 'blood clotting function of the platelets' despite the strong advocacy of the monolingual policy by the institution. Lin (2019) calls for the teachers to deliberately create spaces for 'translanguage and trans-semiotising' to facilitate and expand on the students' linguistic repertoires to accelerates their understanding of the science subject matter.

Indeed, several empirical studies in science education have revealed the importance of establishing hybrid language and discourses, which entail the process of linking everyday language with scientific language, so as to enable students to contextualise and relate the new scientific knowledge to their everyday life experiences (Kelly, 2011; Nygård Larsson & Jakobsson, 2017; Karlsson, Nygård Larsson and Jakobsson, 2018; 2020; Goldberg et al, 2009). For instance, Karlsson et al., (2018) who focused on a multicultural primary school science lesson in Southern Sweden, reported on how students clarified the scientific meaning of flower first in their everyday understanding in their language which eventually aided them to distinguish between their everyday understanding of the term 'flower' from the scientific meaning of flower. In a similar study by Goldberg, Enyedy, Welsh and Galiani, (2009) in a Spanish-speaking sixth-grade science classroom, they reported on how the teacher created a supportive environment for science learning while encouraging the students to use Spanish spontaneous /everyday concepts in order to interpret and make sense of the new English scientific concepts. Goldberg et al., (2009) found that these practices minimised students' anxiety to learn new scientific concepts in an unfamiliar language.

However, establishing the connection between the scientific knowledge with everyday knowledge is not always fruitful in the bi/multilingual contexts given the implicit language or words that are used in the different discourses that have different meanings (Serder & Jakobsson, 2016; Yore

&Treagust, 2006; Praina and Waldrip, 2006; Rincke, 2011). In a study by Ünsal and colleagues (2017) during science lessons with the 3rd grade (9–10 years old) and 7th grade (13–14 years old) emergent bilingual students from diverse Swedish linguistic background, it was found that students' everyday language repertoire obstructed them in constructing authentic science meanings . This study revealed that students' understandings of scientific concepts from Swedish to Turkish were erroneous, and thus their explanations of the scientific concepts were incorrect. In a similar study, Zhang (2016) reported on the findings with a 6th grade bilingual science class in which everyday language of science meaning making and the scientific language observed during the lessons were not often related to one another. The teacher failed to communicate the science content eloquently to her students despite the use of multimodal resources during the lessons. Praina and Waldrip's case study (2006) with the science teachers and students (Years 4–6) in Australia urged teachers to be vigilant about their students' linguistic needs and to be sensitive as to how they will react to the various modes during the course of learning science. When considering the data analysis of these scholars, the use of hybrid language and discourses in line with the recent trends within applied linguistics theory.

Post- colonial African bilingual classroom discourse studies and Science learning

African scholars are also researching the trend of translanguaging. These studies highlight how teachers and learners in a multilingual science classrooms often employed more than one language for various functions spontaneously, although these practices were not sanctioned by education authorities (see Setati et al, 2002; Probyn, 2009, 2015; Banda, 2010; Probyn, 2015, Guzula, Tyler & McKinney, 2016; Tyler 2016; McKinney and Tyler, 2019; Kiramba, 2016; Prinsloo and Krause, 2019:2016; Charamba, 2020). These scholars reported the cognitive benefits of using translanguaging deliberately for mediating the subject content while addressing the dilemma of the monoglossic ideology of LiEP; which is critiqued for the silencing of learners' voices and thereby denying them the right to learn in a language they feel comfortable in. These studies show that , translanguaging and multimodal strategies can offer possible pedagogical strategies for science meaning-making that challenge the dominant monolingual orientation to science teaching and learning (see Probyn, 2009, 2015; Guzula et al., 2016, Tyler 2016; Kiramba, 2016; McKinney and Tyler, 2019; Charamba, 2020).

Probyn's study (2015) of a Grade 8 science classroom in a rural school in the Eastern Cape, reported on one teacher who deliberately and strategically employed translanguaging practices, using isiXhosa and English in an integrated and coherent way to enhance his learners' meaningful understanding of science content. This teacher attempted thus to "bridge the gap between everyday discourse and academic discourses" so as to help learners acquire science concepts and draw the line between scientific knowledge versus everyday science language (Probyn, 2015:233). Regarding such pedagogical practices, Probyn (2015) sees this as ideal to achieving significant learning in a multilingual context, and as helping to curb the 'linguistically structured inequality' that continues to be perpetuated in South African schooling. She argues that it is critical to scrutinize teachers' language use in order to consider how teachers' pedagogical practices can be structured to afford learners with the opportunity to learn in meaningful ways, and to offer hope of attainment of access, equity, and redress for all learners.

Tyler (2016) also conducted research on the discursive practices of shifting between the discourses of the everyday, spoken home language to that of the discipline-specific written English discourses. Her study was conducted within the context of a bilingual secondary mathematics classroom at a rural South African school. Tyler found that the use of flexible multimodal, language variety, together with the register shifting in the bilingual context, enabled the learners to acquire new mathematical concepts and helped them to establish the link between different registers, whilst simultaneously positioning them as capable knowers. Tyler encouraged teachers in multilingual contexts to appreciate and embrace the use of diverse linguistic resources in the process of learning.

McKinney and Tyler (2019) further explored the pedagogical potential of translanguaging in a bilingual isiXhosa/English South African high school. In this study, the data from an after-school intervention reported on how bilingual students can draw from their full set of linguistic resources in a creative way to construct science knowledge. During the science tasks, it was not about speaking the right 'English' nor 'isiXhosa'; neither 'pure Science', nor 'pure everyday language' but they were encouraged to draw from their range of semiotic resources in their repertoires. McKinney and Tyler call for a dis-invention that goes beyond boundaried languages to include boundaried registers of Science' discourse and 'everyday' discourse in content-based learning

contexts. In McKinney and Tyler's view "the specialised scientific registers are not anybody's home language" (2019: 6) and thus need to be explicitly taught.

The studies of Nomlomo (2007, 2010), and Msimanga and Lelliott (2014) in the South African bilingual contexts explored the use of code switching in the context of science teaching and learning. These studies emphasised that bilingual teachers and students draw from their set of linguistic resources to construct science meaning making despite the authorised monolingual language of instruction. The study of Prinsloo & Krause (2019) in a bilingual primary school in South African Khayelitsha Cape Town, in Grade 4 to Grade 7 , highlights the need for " making language policies more flexible by legitimizing established translingual practices" (2019:170) in order to address the classroom realities and the linguistic dilemmas . This will enable learners to draw from their language resources freely when engaging in classroom discussions and to write translingually without restricting them over their language use (Prinsloo & Krause, 2019).

Outside of South Africa, the study of Chimbutane (2013) in a bilingual Changana/Portuguese Science class in a Mozambican bilingual primary school resonates with the South African and Namibian' linguistic ecology. Chimbutane reported on the strong advocacy of monolingual ideologies at play, despite the apparent uses of the translanguaging practices. Chimbutane observed that teachers explained and demonstrated science concepts in Changana during the Portuguese Science medium of instruction to enable science comprehension. This implies that the monolingual language policies do not consider the realities of the linguistic demands of the post-colonial African classrooms. A study by Kiramba (2016) in primary school contexts in Kenya observed the science teacher and the students drawing from their multiple semiotic resources flexibly to make sense of science meaning despite the official monolingual policy. However, such practices during the science written discourse collided with what is considered to be the 'correct' language in writing and the notion of treating languages as bounded entities. Kiramba argued for the educators to recognise the multilingual resources that learners bring to the classroom as a legitimate cognitive tool for communication and thereby helping the students to comprehend the science knowledge.

Furthermore, the policy of teaching through English only is regarded as a major cause of the discursive patterns commonly found in many of the classrooms in the developing world (Chick,

1996; Arthur, 2001). Scholars have reported that code switching and safe-talk are commonly used in contexts where learners have limited proficiency in the language of instruction (Chick, 1996; Setati et al., 2002; Kapp, 2004; Chimbutane, 2011). Chick (1996) calls the discourse of the "completion chorus phenomenon", "safe-talk". According to Chimbutane (2011:28) "the key pattern of safe talk is that of teacher prompt and pupils' choral responses, that is, teachers routinely provide cues to which pupils respond in chorus. The prompts or cues used by teachers to trigger such pupils' chorusing responses include yes/ no questions and oral gap-filling exercises". This kind of talk mitigates against learners producing their own meanings hence they are constrained with opportunities to participate meaningfully in learning and to access the curriculum (McKinney et al. 2015). Weber (2008) claims that safe talk is primarily the language used by teachers in the classroom when they do not want to take any linguistic risks but instead choose to follow prescribed ('safe') routines and patterns. In Kapp's (2004) words: "The discourse practices of the English classroom are incompatible with the need to use the language at cognitively demanding levels in other subjects, resulting in extensive code-switching and rote-learning in those classes" (2004:260). Dembele (2003) proposes for the educators to encourage the use of local languages and to embrace cultural and local knowledge.

Many post-colonial African studies have highlighted the teacher-dominated discourse of Initiation-Response-Feedback (IRF) in monolingual classrooms, where the learners have limited language proficiency, Within the IRF method, teacher-learner interaction comprise mainly of recitations constructed by the teacher, to explain concepts; and the use of closed questions (see Chick, 1996; Verspoor, 2006; Wedin, 2010; Pontefract & Hardman, 2005; Beccles and Ikeda, 2011; McKinney et al. 2015). It is widely reported that in South African township and rural classrooms where English MOI is rarely spoken outside of school, teachers tend to tightly control the curriculum agenda, where learners' participation in their learning is minimal; rote learning is encouraged (see; Chick, 1996 Verspoor, 2006; Wedin , 2010; McKinney et al. 2015); learners are trained to answer "questions relating to self-evident general knowledge issues" (Kapp, 2004:253) or responding briefly by using "acceptable linguistic chunks" (McKinney et al., 2015:116) in a chorus form that responds to a particular intonation cues or tag-questions from teachers (see also Beck, 2016; Chick, 1996) and the teacher's affirmation to learners' responses, mainly produced through repetition (McKinney et al., 2015). This type of classroom discourse impacts negatively on the multilingual learner's opportunity to acquire and construct meaning, resulting in underachievement due to their

limited proficiency in the MoI (see Charamba, 2019; 2020; Reddy et al., 2016; Fleisch, 2008; Msimanga & Lelliott, 2009; Verspoor, 2006; Probyn, 2015). While highlighting what constitutes quality of classroom interaction, the study by Setati, Adler, Reed, and Bapoo, (2002) in the multilingual South African context, described language complexities in South African rural schools where teachers and learners were under pressure to navigate from informal exploratory talk (in the learners' main and/or additional language) to formal, discourse-specific talk using the English language. This dilemma however, resulted in what Setati et al., (2002:146) termed "in-complete journey of moving from informal exploratory talk in the main language to formal discourse-specific writing in English".

In West Africa, Hardman, Abd-Kadir, and Smith, (2008) investigated the classroom interactions and discourse practices in Nigerian primary schools to ascertain the factors that affect effective teacher-learner interaction. Their study observed the apparent dominance of teacher explanation, recitation and rote in the classroom discourse and the teacher did not check whether the learners comprehended the lesson. They claim that the quality of classroom interaction is the cornerstone of ensuring quality teaching and learning; particularly in contexts where learning resources and teacher training are limited. In Ghana, a study by Beccles and Ikeda (2011) reported that science teachers ignored and rejected students' incorrect answers and ridiculed them during classroom discussion in a bilingual classroom setting. They suggested that science teachers should encourage their students to express themselves freely without fears during the lessons.

In Namibia where this study is conducted, studies have observed that although the curriculum advocates for teaching approaches that encourage learners' active participation in classroom discourse, this does not always translate into practice. This is a result of teachers resorting mostly to the traditional teacher-directed classroom discourse (Cantoni, 2007; Wolfaardt, 2005; Kapenda, 2008). Cantoni's study (2007) in the Namibian context , identified teachers' authority and their instructional practices, together with the levels of teachers' and learners' English proficiency, as major stumbling blocks to learners' ability to participate fully in their learning. It can be argued that over-reliance on the use of tightly controlled IRF exchanges in African classrooms negatively affects the negotiation of meaning in the classroom discourse, which is critical for co- construction of knowledge (Van Lier, 1996). This might be attributed to teachers' lack of awareness of how the posing of closed questions might greatly influence or constrain classroom discussions (Scott,

1998). In addition, tightly controlled IRF discourse structure is believed to be ineffective as it places learners in a passive role and encourages them to memorise facts without necessarily developing conceptual understanding (O'Sullivan, 2004).

A key finding from the empirical studies reviewed above, is that bilingual students have full sets of linguistic repertoires from which they select features strategically to convey their meaning. A common element drawn from the literature review, is the need for science educators to institute opportunities for bilingual students to make use of available linguistic repertoires at their disposal during science lessons. These studies have indicated that these opportunities might maximise students' abilities to understand the semantic relationships between scientific words and concepts, increases classroom participations and enables students to make significant associations between the new science content and their everyday knowledge. However, it is evident that the research gaps are palpable. Firstly, studies concerning the use of multimodality are predominantly conducted in monolingual settings as well as in classes where students and the teachers speak different native languages. The focus of these studies is on oral classroom discourse and not written assessments. Secondly, only a few studies have explored how bilingual students draw from their full range of linguistic resources to negotiate meaning in their written texts in classroom settings (Canagarajah, 2011, 2013; Velasco & García, 2014, Kiramba, 2017). However, these studies were not conducted in science subject-specific discipline. Again, there are no specific studies that looked at the deployment of multiple linguistic resources in science written assessments. Thirdly, the multimodal approach to understanding how science meanings are constructed in the classroom is still a new and evolving research area, particularly in the African context.

On the other hand, the multimodal approach e has been applied predominantly in research that explores how science meanings are communicated through different modes by teachers at both tertiary level and in the secondary school science classroom and how these students employ various modes to construct their science meaning. Currently, there are relatively few studies conducted at the primary school level. So far, I could only find the study of Siry & Gorges' (2019) that was conducted in the European country of Luxembourg with kindergarten children (ages 4–6) in multilingual contexts and Tylor's (2015) study that was carried out in a monolingual UK Primary school science classroom with Grade 5 English native speakers. These studies examine how children use multiple modes and language resources available to them to express their

scientific understandings whilst exploring science phenomena under investigation. However, both studies did not consider both the pedagogical and learning perspectives, and on how multiple modes are used in science written assessments since these studies have focused sorely on learners' perspectives. Yet, this approach has not been used in the research studies in bilingual primary school science classroom contexts that are linguistically constrained. Therefore, this study was motivated to close the wide gaps that exists in the literature and the calls from previous scholars to embrace multilingualism and multiple modes in the course of learning. In this study, I intended to elaborate and build upon on the different perspectives introduced above by previous scholars' perspectives through my data analysis of the role of multiple linguistic resources or multiple semiotic modalities in constructing of the scientific meanings in a bilingual science classroom.

The Socio-cultural turn in classroom discourse / monologic and dialogic practices in Science classrooms

One aim of this study was to interrogate types of classroom discourses used by the teacher and the learners in the quest to construct science meaning. Thus, it is relevant to locate my study within previous research studies that provide insight into how classroom discourse patterns and activities influence students' opportunities to engage in science talk and scientific argumentation (see Lemke, 1990; Mortimer, & Scott, 2003; Mercer & Littleton, 2007). Therefore, the literature review in this section entails various research studies on classroom discourse patterns.

Previous research established the associations between classroom talk and cognitive development arguing that classroom talk is fundamental to the meaning-making process and thereby, to the construction of science knowledge (Mercer, Wegerif, & Dawes, 1999; Mortimer & Scott, 2003; Mercer & Littleton, 2007). Despite the enumerated benefits of dialogic discourse, there is minimal evidence of dialogic interactions in science classrooms around the globe (see Wells, 1999; Mortimer & Scott, 2003; Alexander, 2008b). In response to concerns over learner silence in classrooms, research studies in the developed world have been promoting the concept of 'dialogic teaching' through studying Initiation Response Evaluation (IRE) interaction in what Wells (2001:231) terms a 'genre of classroom discourse' (see Alexander, 2004; Mercer, 2000; Wells, 1999). IRE routines consist of a three-part exchange structure, that is an initiation, usually in the

form of a teacher question, a response in which a pupil attempts to answer the question, and a follow-up move, in which the teacher provides some form of feedback (very often in the form of an evaluation) to the pupil's response (see Alexander, 2001; Wells, 1999). This communicative pattern is also referred as Initiation-Response-Feedback (IRF) (Sinclair & Coulthard, 1975) or 'triadic dialogue' (Lemke, 1990). According to Abd-Kadir & Hardman (2007) IRE structure can also take various forms and functions that can result in different stages of learners' engagements in the lesson especially when it incorporates the follow-up move which transcend the evaluation of the learners' answers in which the teacher can extend the learners' responses to foster full lesson participation (Nassaji & Wells, 2000). These types of practices resulted in teacher and learners taking turns in speaking and promotes more pupil-initiated opinions and answers, thus supporting higher order thinking (Abd-Kadir & Hardman, 2007).

The linguistic studies into classroom discourse have lamented the teachers' reliance on the use of IRE as the primary discourse in classrooms hence it prevents students from engaging in extended talk, comprehending the subject matters as well as to exploring the new ideas in depth (Barnes, 1992b; Wolfe and Alexander, 2008; Mercer and Littleton, 2007; Wells, 1991). Further, the IRE format can be the reason why some teachers tightly control the classroom floor as well as the subject content (Lemke, 1990). In this teaching scenario, a teacher follows predominantly the pre- planned lesson to ensure that the content is being 'covered' in a given time while using questioning techniques to gauge students' understandings while assessing the correctness of the learners' responses (Evaluation). However, the moment tightly controlled I-R-E (I-R-F) patterns of interactions dominate the classroom discourse, students will not have any chance to discuss their ideas freely , and the teachers will not be able to assess their students' knowledge (Lemke, 1990). This kind of learning encourages students to acquire fixed scientific knowledge through rote learning (Edwards & Mercer, 1987; Lemke, 1990). Alexander (2008) argues that teachers are not always successful at making the most of the affordances of talk. His extensive study in UK primary classrooms revealed an overreliance on brief IRF sequences, wich provide limited opportunity for students to engage in extended and content-orientated dialogue, and lacks useful corrective feedback.

Dialogic discourse embodies a genuine form of communication and exchanges that encourage multiple voices to be heard, joint construction of meaning making and proper engagement (Lyle,

2008; Fisher, 2007). In such instruction, the issue of power distribution and the assumed supremacy of the teacher's knowledge in whole class dialogue impacts on the efficacy or even the possibility of the implementation of dialogic teaching (Lyle, 2008). The study of Wolfe and Alexander (2008) as well as for Mercer and Littleton (2007) emphasises that when classroom dialogue and discussions are encouraged, students have a better chance to participate in critical discussions and ultimately increases their conceptual understandings. Various studies in North America, argue for a rhetorical move towards 'inquiry-based' science learning where students are expected to collaborate with one another through open-ended class activities while solving science problems (see, for example, Kelly and Brown, 2003). Moreover, various studies have proven that dialogic discourse is an efficient approach for science teaching with early-primary school children since it can reveal young children' misconceptions and non-canonical science phenomena (e.g., Max, Siry, & Kracheel, 2015; Siry, 2013 Kelly and Brown, 2003). Moreover, Barnes (1976/1992) has proposed a kind of classroom talk that allows the students to explore their ideas and justify their ideas to one another in what he termed 'exploratory talk'. Exploratory talk required students to be actively engaged in their own learning process via thoughtful classroom participations that facilitate their conceptual understanding (Barnes 2008). However, students' active participation is only possible when students take ownership of their own learning through asking questions and drawing inferences.

Conclusion

The literature reviewed in this chapter indicates that science education for multilingual students continues to be conducted monolingually in a language that students lack proficiency in (Lee 2005; Lee and Luykx 2007). This is because the classroom language practices in 'multilingual' or linguistically diverse classrooms is shaped and constrained by monolingual language ideologies (Tyler, 2016). This implies that students in these contexts are currently facing double loads of mastering simultaneously both the English language and learning a subject-specific content in this second language (Gibbons 1998; Probyn, 2015). The studies reviewed in this section show that this monolingual approach impacts negatively on students' ability to participate in the science lessons and impedes their ability to engage in deeper science discourse talk (Lemke 1990; Gibbons 2008). Instead, the classrooms talk was observed to be typically controlled by teachers within the framework of Initiation-Response-Feedback (IRF) or "initiation, response and evaluation" (IRE)

discourse pattern in which chorus and rote learning are prevalent with minimal students' contributions to the classroom discourse.

The review further highlighted the pedagogical value of translanguaging and trans-semiotising as an innovative pedagogical strategy to enhance productive and effective teaching and learning as well as to disrupt the nation-state imposed hierarchies around the named languages that reproduce inequalities within a constrained language environment (see Kleyn & García 2019; McKinney & Tyler, 2019, Probyn, 2015).

CHAPTER 4: Research design and methodology

Introduction

In this chapter, I give an overview of the research methodology employed to answer the research questions of this study. These questions are reiterated in a table (3.2) for reference. Through employing an interpretive qualitative research methodology, this study explores science meaning making practices within a science classroom, through the use of semiotic resources/modes, and in relation to the wider socio-cultural context within which this type of learning takes place. Within this chapter, I explain the overall research methodology and methods I employed, by firstly describing the underpinning epistemological paradigm. I then discuss how the use of interpretive qualitative data collection methods assisted the exploration of the research questions, including a discussion of the chosen research procedures, created data sets, the research site, participants, and the ethical issues considered for participation in this study. I then conclude by presenting and evaluation the data analytic methods employed within this study.

Epistemological starting point and research paradigm

Based on the exploratory nature of the main research question for this study: How science meanings were made using multiple semiotic resources in a context where English is used as the official medium of instruction as from Grade 4 onwards, I adopted a holistic qualitative case study methodology to get an understanding of the complex phenomena of science teaching and learning that occurs in the social realm that is the classroom. I situated this study within the interpretivist paradigm, because it pays particular attention to the social construction of knowledge (Lather, 1991). Therefore, I decided to do a single small-scale case study to understand the relationship between classroom communicative practices, language ecology and language ideologies and the dominant discourses from the wider social and cultural perspectives. According to Yin (1984), case study research is an "empirical inquiry that investigates a contemporary phenomenon within its real-life context, when the boundaries between phenomenon and context are not clearly evident, and in which multiple sources of evidence are used" (1984:23). Given the lack of research on meaning-making practices in primary school Science lessons in Namibia, I became convinced that it would be ideal for me to carry out a fine-grained study focusing on one school with one Grade

4 class, including the learners and one teacher. The phenomenon under study is the meaning making enacted during classroom discourse, including verbal , written and visual texts given the fact that science meanings are made through multiple modes (Lemke, 1990), in a year 4 bilingual setting.

I situate my study within sociocultural views of science and learning. Seen through a socio-cultural lens, schooling is a socially constructed process where meaning is negotiated through classroom interaction in which multiple voices, written texts and other modes of communication are apparent. Within this perspective, the classroom is understood as a social learning space in which the speakers draw unconsciously from the range of available linguistic resources for meaning making (Blommaert & Backus, 2011). For this study, I tried to understand the nature of communicative practices as well as the participants' ideology, beliefs, and their experiences (Hammersley, 2007) in a naturalistic bilingual setting. In this kind of naturalistic setting, I aimed to observe, describe, and interpret while trying to understand the naturally occurring participants' behaviours as opposed to testing pre-formulated hypotheses.

Linguistic Ethnography

Within this study I aimed to understand the relationship between the classroom communicative practices, language ecology and ideologies and the dominant discourses from the wider social and cultural perspectives. To assist me with this understanding, I integrated the Linguistic Ethnography (LE) perspective into the research design. Linguistic ethnography is considered to be fit well with the nature of my study which school as an institution might encounter multiple challenges such as tensions and contradictions that emerge from language and curriculum policies that are not always properly, internalized and implemented at the micro- level. In addition, the school might be confronted by curriculum expectations as well as the participants' voices and positioning. For this study, the communicative practices in schools are best understood when considering the Namibian colonial legacy which has impacted adversely on educational attainment, especially in rural and townships schools. The language practices at the micro level are being studied in relation to the speakers' linguistic repertoires that they produced and draw from while positioning themselves (Pérez-Milans, 2016). This suggests that a linguistic ethnographic perspective can be adopted to

get an understanding of the participants' multilingual repertoires and their language ideologies regarding which languages to use, when and how, as well as to how these practices and ideologies shape the participants' communicative practices.

For this study, the LE perspective enabled me to enter into my participants' "conceptual world" (Geertz, 1973) while immersing myself in their everyday life routines and language practices, to gain an understanding of how individuals constructed science meaning from their experiences. This requires a great deal of attention to be paid to both verbal and the nonverbal communications such as gaze, posture, gestures as well as body language (Copland & Creese, 2015). In a nutshell, I wanted to understand how science meanings are constructed in naturally occurring interactions and how the communicative practices in a social space are shaped by the language ecology and ideologies in the context that is linguistically constrained because of the sudden transition from Oshiwambo MOI to English.

The Research site: selection of and access to the school, and ethics considered

The choice of the school as a research site was originally motivated by the lack of qualitative studies in Namibia that looked at science teaching and learning in bi/multilingual primary schools, in a context that is linguistically severely constrained. For the site of my investigation, I purposely chose a school where Oshiwambo is used as a medium of instruction from Grade 0-3, and thereafter English is used as medium of instruction from Grade 4-7. A further criterion was that teachers should be fluent speakers of Oshiwambo as this matched the regional linguistic profile, where the majority of teachers and learners in this region share a common home language, Oshiwambo.

To gain access to a school as a site for my study proved to be an overwhelming experience to me. In the process of selecting the school that matches the research criteria (see chapter 1), I approached the directorate office of the Ministry of Basic Education & Culture (MBEC) for a recommendation. I made an appointment with the subject advisor to explain my research purpose and the intended processes. She showed an interest in my study and was incredibly supportive to recommend a school and a 'competent' teacher whom I could recruit as a research participant.

The ‘Grace Primary School’ is located in a disadvantaged area, with a high poverty rate. Past studies have shown that schools located in these socio-economic contexts are prone to poor performance in math and science (see Hardman, 2005; Fleisch, 2008). Indeed, regional standardized test scores reflected that in 2014, Grace Primary School comparatively ranked 31 out of the 35 schools in the regional schools’ performances report and showed no improvement until the date of the research study (Oshana Directorate performances report, 2014-2017). Labelled as a concern, the school management and teachers were under sizeable pressure to reverse this downward trend. Considering the poor performance in science and maths in this school, together with language policies used in school, and the learners’ limited English proficiencies level, I decided to choose Grace Primary school as my research site.

I specifically chose to investigate science in a primary school class, because one of the main goals for the Namibian Science curriculum is to provide quality and accessible science education for all learners. Research suggests that knowledge of science at a young age is predictive of long-term academic achievement and school performance (see Duncan et al., 2007; Turner & Ireson, 2010). Students from lower income families are less likely to have access to higher quality science teaching and curricula than students from affluent families (Darling-Hammond, 2010). As further motivation to explore this topic, I am well versed in the science content for the primary Grades, because I was primary school science teacher and science was part of my teacher training in teacher education.

I negotiated access to the school by getting written permission from the Permanent secretary of the Ministry of Basic Education, as well as from Department of Education at a regional level (see Appendix B). Central considerations for this study are the “*sensitivity to the rights of others”* (Bulmer, 2001:45). I first considered the ‘rights of others’ by obtaining informed consent, respecting privacy, safeguarding confidentiality of data, potentials of harm to subjects and the researchers (Bulmer, 2001). These issues were attended to during the process of my research planning. I also informed the school principal, the Grade 4 Natural science teacher, and parents/guardians for Grade 4 in writing about the main aim of my study and gave them copies of my research scope. Consent letters for parents, explaining the aims and methods used for my study

were translated in Oshiwambo. All parents gave their written consent for the planned research in their children's classroom and their children's participation therein.

As my study involves human participants, I followed the ethical requirements of ensuring low risk research and obtaining informed consent from participants, as well as guardians where participants were children in line with the UCT's ethical clearance requirements. I arranged to meet with Grade 4 Natural science teachers, although I planned to research one teacher, to discuss my study scope before I requested their voluntary participation. In addition, my research proposal received ethical clearance from the University of Cape Town.

The Research Participants

The participants for this study were the Natural Science teacher, Mr. Shilumba (pseudonym) and his fourth-grade learners. I also interviewed the school, principal. The school, teacher and the learners are given fictitious names so as to protect their identity. The pseudonyms chosen are ethnically and culturally distinctive. All other details or facts that could potentially jeopardize the anonymization process have also been changed or removed. This also applies to photographic images or recorded videos, where care was taken to ensure participant identities are not revealed. The participants were offered the right to withdraw their consent or participation if they did not want to be video recorded or share some of their materials with me. However, for this none of the participants have withdrawn from the study.

Mr. Shilumba was 49 years old at the time of data collection. He holds the degree of Bachelor of Education, specialising in math and science teaching. He also has 16 years' experience teaching science at primary school level, of which eight years are at Grace Primary School. He speaks four languages, of which Oshiwambo is his native tongue. Mr. Shilumba was recommended to me by the science subject advisor, who described him as a passionate and excellent teacher in the Junior Primary phase. During my preliminary classroom observations, I observed that Mr. Shilumba was versatile in using various modalities in his teaching approach in order to make science learning more exciting to his learners. Furthermore, Mr. Shilumba showed a willingness to participate in my study and he gave me his consent to taking videos and audio recording during his lessons.

At the time of the field work, Mr. Shilumba was studying part-time for an Honours degree in Education Management.

The Grade 4b class, the subject of this study, consisted of 38 emergent bilingual learners – 23 girls and 15 boys – all of whom were native Oshiwambo speakers. In this dissertation, I use the term "emergent bilinguals" to emphasize the linguistic repertoires and language practices of the young Grade 4 learners. Before I began my classroom observations, I spoke to the learners, to explain the research, and their participation in it. During this interaction, I encouraged the learners to use their language and semiotic resources freely, as they normally would, without feeling intimidated by my presence in the classroom.

Contextualizing the school site

Grace Primary School offers learning from Grade 1 – 7. The school is situated in the northerly Oshana Region, about 750km away from the capital city of Windhoek. The school is located in a historically disadvantaged, predominantly Oshiwambo speaking working class area, characterised by a high unemployment rates, rampant crime, and alcohol and drug abuse.

The school has a population of 1037 learners and 36 teachers. There are 4 classes per grade with approximately 38-40 learners in each class. Most of its' learners are from poor households, and many parents are unable to pay the minimal school fees charged by the school. The school fees are charged in an attempt by the school to compensate for additional resources not supplied by the Ministry of Basic Education. As a result, the school has limited resources for learning texts books, or science equipment, neither does the school own a simple science kit with which to conduct science experiments. Therefore, in this school, learners do not own any science textbooks and are barely able to conduct science experiments. The school building is in a general state of disrepair: classrooms have broken windows, and there is no library or science labs. Most of the teachers at this school have been teaching there since before Namibian independence in 1990. All the teachers and learners in this school are native Oshiwambo speakers. The Oshiwambo language consists of various regional dialects, with distinct urban and rural varieties thereof. However, the Oshiwambo spoken by learners at home, is not the same as the standard Oshiwambo language that is tested in

schools. These learners also have extremely limited English language proficienciys, and mostly use English in the classroom only.

I chose to observe a Grade 4 science class because it is a critical year linguistically. In Grade 4, learners switch from Oshiwambo as MOI to English as their MOI for the remainder of their primary schooling. In Namibia, like elsewhere in Africa, the Grade 4 is a critical phase in which learners are transitioned abruptly from more concrete thinking into a more abstract thinking. These learners are also transitioned from reading narrative genres in which language usage is more centered on the everyday language register of everyday social interactions, rather than reading of expository texts which embody dense language and vocabularies (Chall, Jacobs & Baldwin, 1990). The National Curriculum for Basic Education, NIED (2016) prescribed the time allocated to teach English as second language from Grade 1-2 is 6 hours per week while in Grade 3 is 9 hours per week with 40 minutes per period across all Grades . As a result of this, these learners had limited exposure to English by the time they reached Grade 4, and they face the challenges of learning science language, concepts and processes at the same time as learning English language.

My role as a researcher

My role as a researcher in a context where I was a stranger in the school community, was challenging at first: people took some time to get used to my presence at the school; also, as a PHD scholar, some teachers regarded me as more qualified than them. This concern of being evaluated by a researcher concerned some teachers, who displayed fears, concerns or even refusal to be observed while teaching. To address these concerns, I set out to build trust and strong interpersonal relationships between myself, the teachers, and the learners.

In order to build trust and rapport, I spent two weeks at the school having informal conversations with the teachers, learners and random staff members; I also used this time to make observations about language used in the school environment and the school daily routines before commencing with my actual classroom observations. I did this so as to familiarise myself with the school's everyday routines, getting to know the teachers and learners, and to get an overall impression of the language use in the school environment. In the initial phase of my observations, it was also

critical for the teachers and learners to get used to me and to build a strong rapport. This was important for the learners not to feel like they were being judged on their intellects or on their English language competencies during the lessons.

After I gained a fairly high degree of confidence and trust from the learners and the teachers, I began with my actual classroom observations. I decided to observe all 3 Natural science teachers during the first week to make a well informed decision on whose classroom I would focus on for my study, despite the recommendation of a specific teacher I got from the subject advisor . This was very important for me to have a plan B in the event that the selected teacher withdrew from my study or in the event of unforeseen circumstances. All teachers were glad of having me in their classes for the first day. Nevertheless, on the second day of my classroom observation, some teachers, excluding the teacher that was recommended by the subject advisor , showed uneasiness of having me in their classes and I could easily read their concern from their body language, On the part of the learners, they were all enthusiastic to have me in the classrooms, but it was a little disturbing for them on the first two days and some were very shy to participate during the lessons. This changed as they became more familiar with me. I decided to recruit the Grade 4b class, since they were more comfortable with my presence and they were also participating more during lessons compared to other classes.

The data collections methods and data collections tools used for the study

I conducted data collection in one Grade 4 class, with the help of a research assistant, as non-participant observer, from 04 February until 26 June 2017. I conducted my classroom observation over a period of 13 weeks in which I observed 26 lessons in total that comprises of 33 hours of the science recorded lessons . It is important to note that I focused on the classroom observation data of four units that is; plants as living organisms, animals, the system of the body, and communicable diseases. Among the four observed units, I only utilised three in this study (see table 3. 3) due to the incompleteness of the unit on communicable diseases. All data sets collected during the fieldwork are summarised in table 3. 1. I also presented and discussed the different data collections tools used in this study and their significance. The data collection methods for this study consist of multiple tools to produce rich ethnographic data (Wolcott, 2008). The main goal

was to get as much information as possible about "the type of participants involved, what they do, in which situated events, what they say and how they say it, for what purposes they perform in a specific way, and the potential implications of such social practices" (Copland and Creese, 2015:29).

During the data collection processes I employed an unstructured approach , in the sense that I did not have to follow a pre-determined plan; nor did I use categories for interpreting what the participants said or on their actions that taking place , but this does not mean that my study was unsystematic .

The data was collected at two time periods: the beginning of the year (classroom observation of 20 lessons) and in the middle of year, I observed 16 lessons, and collected written assessments to provide me with rich data on classroom interactions and to validate the data I intended to collect data of the authentic everyday classroom interaction and communication practices that was taking place between the speakers. Additionally, I was interested to see how science meanings were produced in the speakers' utterances or by means of their non-verbal language as well as in their written production.

I joined the Grade 4b Natural Science class as a non-participant observer taking field notes and video- and audio-recording, and I sought to avoid interfering directly with the learners' and teachers' actions. In what follows, I will present the different kind of data collection process used for this study (i.e., Interactional data, field notes, recordings, documents, photographs, learners' written work), and explain the significance of each method. Each method has contributed significantly to produce rich data and they all offered the insights to me in their own unique way (Maxwell, 2005).

Video and audio-recorded classroom observations

Classroom observation entails entering into the classroom to observe and listen to teacher-learner engagement Hatch, 2002). Classroom observation is the most suitable method for exploring how science meaning is made through the use of semiotic resources. For this study, the classroom observations were the main source of data collection. The data gathered through classroom observation consisted of field-notes, and video and audio recordings of whole class sessions during

the Natural Science lessons. The two audio-recorders were used during classroom observations to capture the voices that could not be captured by the video recordings.

The research assistant operated the video camera located at the back of the classroom to capture the classroom interaction, as well as all events that occurred in the classroom while following the teacher's and learners' movements. As this study takes a multi-modal approach to meaning making in science teaching and learning, the data collection methods required a focus to be paid on all modes used in the classroom. The video recording was chosen because it offered visual details of what is happening in the entire classroom, including all the modes that are used for science meaning making (i.e., talk, gesture, eye movement, images and mode manipulations (Roschelle, 2000). In addition , the video recorded data also enabled me to review and to confirm any arising matter that needed some clarifications during the data analysis process and also to retrieve all the modes for transcribing. The limitations of relying on the video recorded data was overcome by supplementing it with other sources of data. An important limitation of single static video camera is that it only captures what the lens is focused on and not everything that is going on in the room. It is important to acknowledge the fact that the presence of the researcher and the process of recording might also influence the participants to change their normal behaviour (Darlington & Scott, 2002). Prior to the classroom recordings, I brought the recording equipment to the class for the learners to get acquainted with its presence during lessons. I also informed the learners that the assistant researcher and I would be in their classroom to learn from them and to see how they engage in their daily classroom routines. This arrangement seems to have worked, and I observed that during the entire fieldwork process, learners were not distracted at any point by our presence, nor disturbed by the recording tools. The duration of the recorded videos of all the observed lessons ranged from 45 to 90 minutes. Any limitations arising from the recording process were overcome by gathering other forms of data.

Field notes

In ethnographic observation, the researcher observes and notes down as much as possible of the participants' actions in the social space, thus recording fresh information on what he/she sees and hears or feels (Copland & Creese, 2015). The field notes are an important source of data because

they include the voices of both the participants' and the researcher (Copland & Creese, 2015). Ethnographers are always open to witness and record everything they observe during the fieldwork phase and do not use pre-determined categories (Blommaert, 2006c). In my study , I took detailed field notes during each science lesson; I also used the right margin to record my personal impressions of recurring classroom events, questions that needed further clarification, and at times I tried to make connections between my analytical notes and theoretical framework (Bernard, 2006). In my field notes, I also recorded information about the number of learners present, the seating configuration, the language used, what the teacher said when giving instructions, the types of modes that were used, classwork, who responded to the teacher's questions and many other aspects. After each lesson observation, I also summarised my overall impressions of the classroom activities I observed, as a form of pre-analytical interpretation of the data.

I also conducted an open observation in the school taking notes of what I considered salient to my study, such as notes of language used in the school environment during play, assembly, staff informal meetings and when learners were walking around the school premises. I also generated questions while I wrote field notes, and these questions guided me to design interview questions

I also kept research diaries in which I summarised reflections, observations, and analyses of each lessons, whilst simultaneously relating it to my research questions and literature that I was reviewing at the time. I also took some notes during the interview process of all the participants and I wrote down some specific remarks that I thought worth further interrogations. I noticed that as the study progressed, my observational and field note taking skills improved. This assisted me in narrowing down my analytical focus of the classroom events and language practices in relation to the research question and my theoretical framework.

At the end of each day of my fieldwork, I would go through my rough hand-written notes and I converted them into a more coherent legible narrative with a more comprehensive description (Bogdan & Biklen, 2007). Thereafter, I typed them into word documents and saved my notes on my computer for later retrieval and easier access for further in-depth proof reading and amendments. At the same time, I typed my hand-written notes of the informal interviews and discussion and I stored them on my computer as well. During the process of typing my classroom observations and other field notes, I also attached methodological and theoretical notes (Bernard,

2006) to my data to ease the process of the data analysis. I saved the daily notes separately in a sub folder on my computer.

For this study, the field note data facilitated the smooth selection of extracts from the transcribed recorded lessons and they were further used for my data analysis in chapters 5, 6, 7 and 8. The field notes also enabled me to develop a description of the classroom context, the school environment as well as for generating summaries and the episodes of each lesson (see appendix H). Thus, during the process of data analysis, the field notes were used as a primary source of data set that complemented other sets of data. Furthermore, these field notes were influential in navigating and examining other sources of data.

Interview data

Ethnographically informed research requires of the researcher to create a dialogue in which the participants can give their viewpoints and their personal voices (Duranti, 1997). During their observations, ethnographers make use of formal and informal interviews or general conversations in which they deliberate and ask questions for clarifications about the emerging issues or infrequent events, participants' language beliefs and ideologies (Kvale & Brinkmann, 2009). For this study, I placed the focus on my interviews to understand the participants' language repertoires and their language ideologies regarding which languages should be used in the different situations, when, why and how. Firstly, I conducted an open-ended, semi-structured interview with the Principal of Grace Primary School (see Appendix F). I also interviewed the Grade 4b Natural Science teacher, Mr. Shilumba, and some selected Grade 4b learners both informally and formally throughout the field work period. I selected 15 learners for interviews; these learners were a combination of those who showed an interest during the lessons; those who actively participated and also those were not participating during the lessons. As the study focused on how language was used during the classroom discourse, I asked about the rationale behind the use of different languages and about their classroom practices in relation to how language practices are linked with their language ideology and beliefs (see Appendix G).

The interviews helped me to gain a better understanding of the school culture and the daily routines, the school environment, the language ecology, the use of language and the conflictual

issues of the language policy and the realities on the ground. I also had subsequent interviews with the teacher around issues related to science teaching that emanated from my classroom observations, such as his support for science learning and assessments , the classroom language policy , and his impressions on the learners' overall science performance (see Appendix E). The interviews with the teacher enlightened me on what informed his decisions to construct science meaning in the way he did, and as a result, I gained insight as to the particular supports he put in place to enable learner participation and learners' conceptual understandings. Semi-structured interview methods were used to address unforeseen circumstances, or in the event where unexpected points were raised by research participants.

The interviews were conducted mostly on one-on-one, and the interviews with the school principal and the teacher were about 10-15 minutes long. All the interviews were transcribed verbatim. Because the participant learners were young, I created a safe and non-threatening environment for the interviews. I was also cognisant of the learners' level of English language proficiencies. For example, learners were interviewed in the presence of others, they were asked age-appropriate questions in Oshiwambo (see Appendix E), and all their interviews took place in their classroom. My main priority during the interviews was to ensure that learners were speaking freely. In most cases I made use of introductory questions (e.g., can you tell us about what you like about learning in Oshiwambo) to get rich data on the learners' perspectives. All interviews were audio recorded, and subsequently transcribed and kept safe electronically on my computer. All the participants were informed prior to data collections that their participation in this study was voluntary. I made it clear to the participants that I was not looking for answers or results that would be correct or better than others. Most of the data from these interviews was used for my data analysis in Chapter 5& 6.

Artefacts

During the science lesson, the learners and the teacher might use and produce different science texts that can be salient for an understanding of how science meanings were made through different modes. I collected a variety of artefacts that were produced during, as well as outside of the classroom (i.e., drawings, writing, timetables, national curricula, policy documents, science

textbook, images, chalkboard writing, or a poster in the classroom). The use of classroom artefacts provides a researcher with rich descriptive information (Borko et al., 2005). For this study, these artefacts were treated just as important as the recordings since science meanings are made through multiple modes or by any specific mode. With the teacher's help, I managed to collect a number of the artefacts that were produced during the lessons as well as the learners' written scripts for a science assessment. The collected assessments included one class activity and also three tests that were set by Mr. Shilumba himself.

I made copies of all the materials I collected, and I returned it the next day so that the learners could get their resources without any delays. In some cases, however, some of the written texts were exceedingly difficult to be collected because some of the learners' assessments paper were glued in exercises books, and some artefacts were too large to be photocopied. In this instance, I used my cell phone camera to take photographs of these artefacts.

I also searched for the language policy document online and reviewed it so as to analyse how the language ecology and ideologies shape the language used in the school and also during the classroom communicative practices. The collection of artefacts helped me to see how the science meaning was presented to the learners, and at the same time I was able to see how learners have managed to appropriate the science meanings that were presented to them during the classroom discourse during their science written assessments.

Visual research methodologies

Visual methodologies in ethnography make use of photographs, film, and other digital media to understand more about people and their world (Pink, 2013). Pink (2013) stresses that during fieldwork, the researcher can make use of a range of media (e.g., audio, video, and photographs of the research site) to represent the phenomenon under study and to conduct research from different angles. According to Pink (2013), "each medium evokes different elements of [the] fieldwork work. Therefore, the photographs do not simply illustrate the field notes, and the video is not simply evidence of conversation, interviews, or actions". Instead, the use of photographs and the

written words are complimentary to the overall recording of the research site or the subject under the study (2013:120).

In this study, I located my understanding and the use of visual methods within a larger frame of multimodality. Thus, I recognized photographic and videotexts as not simply one of multiple modes but rather multimodal in themselves (Bearne, 2003). Drawing from the notion of literacies as a multiple phenomenon (Street, 1995) and multimodal (Kress, 2009c), in this study, I sought to understand how the multimodality was embedded during the science lessons to construct science meanings from different perspectives. To realise this, the use of visual methodologies was critical to capture all the modes used for science meaning making. For instance, I used the digital camera on my cell phone to capture images of the posters and any environmental print and extracts from the textbook, chalkboard writing and images as well as photographs of learners' written texts.

Extracts from the lesson descriptions of the classroom discourse

In linguistic ethnography and conversation analysis, the data analysis reports are usually exemplified by the use of selected extracts of the transcribed talk, in which the analyst make a further commentary on the specific extract (Mercer, 2005). The fact that I had collected a large amount of classroom observation data, meant that I had to make a well-informed decision on selecting the data I used during the data analysis processes. It is not necessary to work with all the data of the transcribed lessons to make a well-informed analysis because of time consuming and incompleteness of some lessons topics. Thus, I generated broader themes and used it to guide me in selecting the extracts that are relevant to the research questions. Broad themes included that of the use of metaphor and analogy directly related to everyday experiences; bridging discourses, the use of translanguaging and non-standard varieties, the use of multiple modes for science meaning making, the register-switching between science and everyday vocabularies and the discourse that is entirely based on everyday level of engagement. I also examined the use of IRF dominant discourse pattern and the teacher's use of the textbook content.

Table 4.1: Types of data used for the observed nine lessons

Type of data	Descriptions of what was collected	Analysis methods used
Classroom observations of 9 lessons	Recordings with 1 video camera whole/c Recordings with 2 audio recorders whole/c Written field notes	Sociocultural & multimodal discourse analysis Sociocultural & multimodal discourse analysis
Documents	Namibian School language policy Learners' summary books Learners' exercises books Learners' science written tests scripts Grade 4 NS textbook Namibian Natural science syllabus timetables	Sociocultural discourse analysis Sociocultural & multimodal discourse analysis Sociocultural & multimodal discourse analysis Sociocultural discourse analysis Sociocultural discourse analysis
Informal and formal interview	Principal, Mrs. Eva (1) Teacher Mr. Shilumba (2) 10 selected learners (2)	Thematic analysis & Content analysis
Photographs	Learners' written work (20) Environmental prints (10) Chalkboard writing (15)	Sociocultural & multimodal discourse analysis
Questionnaires	4B learners (oral) Mr. Shilumba (written)	Thematic analysis
Science written assessments collected and what they covered.	Class activity on plants as living organisms Test 1 : Plants as living organisms test 2: Animals Test 3 : Animals and the system of the body	Sociocultural & multimodal discourse analysis

Data analysis for this study

The data analysis in this study followed the tradition of 'socio-cultural discourse analysis' in an attempt to deepen the analysis of the language used for science meaning making through paying attention to what the speakers say, the kind of linguistic resources used in the moment, how, and why, and the outcomes of using the language in this way. Mercer (2010) introduced the term 'socio-cultural discourse analysis' which he refers to as analysis of the content and the function of the spoken language in which an understanding of the shared knowledge is developed in a social context. I used the various modes in both spoken and written texts to analyse how science meanings were constructed. I used different approaches to analyse different sets of data (e.g., I use Discourse Analysis (DA), Sociocultural Discourse Analysis (SDA) and Critical Discourse Analysis (CDA) for the language ideologies in chapter 5 & 6, and then I employed the socio-cultural and Multimodal Discourse Analysis (MMDA) as well as Discourse Analysis (DA) for classroom data. MMDA is a perspective that defines a diverse range of approaches to analyse how the social actors produce meaning through the use of different semiotic modes and different modal while recognising that each mode has a potential to contributes to meaning- making in the course of teaching and learning three dimensions (Meneses et al., 2018; Bezemer & Kress 2016).

I aimed to understand how the boundaries between language-varieties and modalities as well as the 'monolingual bias in the language in education policy and educational sciences (Gramling, 2016) influence the participants' performances of languaging, their identity and their positioning in the course of classroom interactions. To realise this, I tried to capture the relationship between the micro and macro-power relationship imbedded in the language policy discourses and the complexities of the language policy implementation at the micro level (see the details of the analysis in chapter 5& 6). Moreover CDA (Fairclough, 1992a, 1992b, 2010) helped me to analyse the Namibian Language in Education Policy document and other important extracts of the discourse through the use of textual-based discourse analysis, which focused on the socio-cultural , language ecology and the ideological context of the discourse (Fairclough, 1992a) . Particular attention was paid to the participants' language choices as well as to what influences their decisions on language use. This kind of analysis was important to address my research questions: how the language ecology and ideologies shaped the classroom language practices; the

affordances of the different modes for science meaning making, and the particular kinds of teacher's support used to enable learners' conceptual understandings.

I also employed other fine-grained methods such as thematic analysis (Lemke, 1990) to identify the semantic relationships between scientific concepts and everyday concepts that were utilised in the classroom as well as in the science written texts. Specifically, the analysis on the notion of 'languaging' in which the focus is on the "fluidity and a continuum across named language-varieties and modalities" (Bagga-Gupta & Dahlberg, 2018:403) used for science meaning-making. In this study, I also analysed the written texts to see the kind of communicative repertoires deployed in science writing texts or genres. The aim was not to compare the writing across the language codes or to explore the standard language for writing, but attention was given to how language was used for science meaning making in relation to heteroglossic practices and also through the lens of appropriation of other voices (Bakhtin, 1975; 1981). The use of the language in this study is premised on 'multilingual points of departure' (Bagga-Gupta, 2014: 92). Thus, the overall data analysis in this study itself takes an approach of heterogeneous language and identity-positioning.

In order to reduce the large amount of data I collected, I began with the process recommended by Spencer et al. (2014) of sorting out data through familiarizations, discovering the themes and categories, interpreting, and reporting on the data patterns and clustering them into the manageable data . I also reviewed the selected extracts for coherence and their relevance to the key issued that this study sought to address. Guided by my research questions, I systematically searched for the themes and I progressively combined the topics into a ranking order of the major themes (Braun & Clarke 2006). Moreover, in exploring and examining how science meaning were made through the use of multiple modes, the micro ethnographic discourse analysis approach was applied to yield 'thick descriptions' (Geertz, 1973) . The thick description produced through this approach facilitated my ability to theorise how science meaning was constructed or mis-constructed through the use of multiple modes in the course of classroom interactions. In particular, I analysed the participants' actions, the classroom activity they engaged in and their communicative practices and considering it in relation to the wider social and cultural context in which it occurred.

I also undertook two broader levels of the data transcriptions. The first level of the data transcriptions was extensive, and it covered all the interactional data of all lessons transcribed. I adapted the transcriptions conventions which was used during this stage of the data analysis. Most of the conventions used in the transcription key were informed by both Bloome and colleagues (2005). For a full understanding of the transcription conventions used in this study (see Appendix C).

Furthermore, I constantly referred to my written reflexive notes as well as the analytic memos (Emerson et al., 2011) to account for any thoughts or any issues that emerged from the field and throughout the process of writing this dissertation. In this study, CDA, Sociocultural Discourse Analysis (SDA) as well as MMDA were employed throughout various stages of the data analysis.

The analytic procedure that was used in this study comprises different separable stages, but they are interrelated. In what follows I will describe each data types and the data analysis stages undertaken in this study.

Table 4.2: Overview of research questions, data analysis approaches and types of data analysed

Research Question	**Approach to data analysis for each question**	**Data Analysed**
1. What is the language ecology that shapes the science classroom discourse in the Namibian primary school in this study?	Socio-cultural DA , MMDA and thematic analysis	Participant observation, learners' written work, field notes, semi-structured and unstructured interviews with all the participants, photograph , policy documents
2. How do the teacher and the learners attempt to make science meanings in a context where English is used as the official medium of instruction?	Socio-cultural DA , MMDA	Classroom observation transcriptions, learners' written works multimodal productions and other, textbook visual data (photos and video), field notes, semi-structured and unstructured interviews with all the participants

3. How are science meanings constructed using multiple modes?	Socio-cultural DA , MMDA and thematic analysis	Classroom observations transcriptions, learners' written works multimodal productions and other, textbook visual data (photos and video), field notes, semi-structured and unstructured interviews with all the participants
4. How do the teacher's practices influence or constrain the learners' appropriation of science meanings during classroom discourse?	Socio-cultural DA , MMDA and thematic analysis	Classroom observations transcriptions, learners' written works, learners'' assessments written scripts ; multimodal productions and other, textbook visual data (photos and video), field notes, semi-structured and unstructured interviews with the teacher

Stage 1: Data transcripts and multimodal transcription

From the total of 20 recorded lessons, a subset of 9 lessons were selected for further detailed transcription, in accordance with Conversation Analysis and MMA conventions. The selection criteria for the 9 lessons was that the recordings of the entire lesson is audible enough and captured the participants' body language and all nonverbal communications, the artefacts used during the lessons, chalkboard writing notes and content is fully completed. In accordance with Seedhouse (2004:87), a PhD dissertation focusing on classroom interaction should have at least 5 to 10 lessons. Thus, the 9 selected nine lessons are adequate for the detailed analysis to research the phenomenon under study.

The data analysis began with the production of the lessons transcripts as well as the recorded interviews discourses. Given the fact of the vast recorded data, the important step that I took during the pre-analytical processes involved viewing and listening to all recordings. For the deliberations of 'what to transcribe', I focused mainly on the speakers' utterances and also on other semiotic resources they employed as part of their science meaning making processes that are found in the video recording . This was one important selection criteria considered in this study to sample the data. The utterances were analysed to find out the nature of science meaning making and how language was used for science meaning making. The notion of semiotic resources was useful to gauge the affordances of each specific mode for science meaning making.

I did the transcriptions, as I am native speaker of Oshiwambo, and also fluent in the English language. All recordings were transcribed using the actual language that was spoken (English and Oshiwambo and non-standard language varieties). I transcribed all the video recording and audio tapes of classroom observations and interviews discourse to reduce the spoken language to the written mode. All lessons were transcribed fully instead of transcribing some selected parts. The transcripts were produced through a process of "extensive listening" (Rampton, 2006:32) which entails numerous sequences of listening, transcribing, and re-transcribing. This involves the comprehensive representation of the verbatim data and other modes visible in the video recording to facilitate that all important information will form part of the analysis (Braun & Clarke, 2006). The whole process of transcribing was therefore, regarded as a step towards interpreting the data,

while at the same time trying to reduce the data from several modes into few manageable modes for further analysis.

Videotapes were viewed several times, and the content logged together with the observational field notes, produced a descriptive account of all selected nine lessons. The process of viewing the videos and listening to the audio recordings, logging, and organizing the data enabled me to sample the data with ease. I did this with an open and flexible mind to allow the numerous themes and ideas to surface from juxtaposing the different data emanated from other data sources.

During this stage, I employed the tradition of the DA system, combined with MMA which considers an account of all modes were used during the classroom discourse to ensure a fine-grained analysis (Tang, Delgado & Moje, 2014). This process entails transcribing the recordings of talk and breaking this down into a manageable discourse analytic unit. During this process, I was guided by the sociolinguistic theory which premised that human' communication practices take place in 'small chunks' of both spoken and non-verbal language in the course of the interactions (Gumperz, 1986, 1992) . This means that a close analysis was done on the words being uttered, the use of intonation, the pace of talk, gaze or a nod, gestures and all language signals that were used to communicate science meanings during the classroom discourse. I transcribed the recordings of the classroom discourse while attending to each specific mode used in the course of science meaning making in both spoken and written texts. The identifications of each specific mode in the transcript was useful to see the affordances of each mode for science meaning making. These transcripts were then subjected to micro ethnographic analysis in the later stages of the data analysis and some were selected to be used in this thesis.

Furthermore, all transcribed videotapes and hand-written data of field notes were further typed in a Microsoft program, and made available in a soft copy for further examinations. At the same time, I added the images that show gestures, gaze, body positions or longer descriptions to the portions of a transcript, thus challenging the mono-modal orientations of transcripts (Goodwin, 2007). This was done primarily through creating still images from the video recordings while on the pause mode, which in turn were embedded in the written transcripts. Thereafter, the lessons transcripts were analysed in detail in the different stages of the data analysis and the video recordings were kept safe as the backup of visual details for further examination of the physical movements of the teachers and learners, their body positions , chalkboard writing , practical demonstrations and

any classroom activity and actions that were not be able to be captured during the transcription processes . I referred to my field notes throughout the data analysis process, together with other sets of data to complement one another. All data gathered during the fieldwork have been kept strictly confidential to protect the participants' and the institution identities. In this study, confidentiality is maintained by not using identifiable images and obscuring faces of participants.

Stage 2: Immerse into the data and familiarizations

Data analysis consists of organizing the data based on what the researcher can sense and read in order to find out "what you have learned and make sense of what you have experienced" (Glesne, 2011:184). To study the fine-grained nature of the social interaction that occurs during the classroom discourse, I recorded science lessons, transcribed them, and then analysed the moment-to -moment of the classroom interactions (Erickson, 2006). This requires a rigorous look at how language was used, as well as the textual data to enable the researcher to immerse herself in the moment-to-moment aspect of the data, and to construct an understanding of what is happening in the course of science learning. At such moments of immersion, LE researchers explore with great focus the linguistic/communicative (verbal and non-verbal) conventions through which the participants sequentially coordinated their social actions in the course of the classroom interactions. These conventions embedded the features of turn-taking, linguistic choices, lexical choice, and the use of written texts in the course of interaction (Pérez-Milans, 2015). This process entails close reading all the transcripts of all the recordings of the classroom discourse and the field notes taken to search for the discourse patterns that represents the phenomenon under investigations (Schely-Newman, 2009).

As I had a huge selection of data, I applied the linguistic ethnographic procedures, to reduce; prioritise, organise and index the data before I began the actual analysis (see Erickson, 2012). I identified the key instances that had caught my eye during the preliminary data analysis phase, before I engaged in a deeper level of analysis and theorizing. This process began while I was viewing and listening to the audio- and video-recordings and also during the process of reading the textual data. I immersed myself into the data to acquaint myself with all transcripts, the field notes data, and all artifacts collected to get an overall impression how the science was taught and

to identify the patterns of the classroom discourse. This was an important step for guaranteeing that all emerging issues were dealt with in the data. During this stage, my goal was to have a broader picture on how the language varieties and modes were deployed to construct science meaning. I also wanted to understand how participants 'languaging' was influenced by the language ecology and ideological across the data sets. During this stage of the data analysis, I came up with the questioning mechanisms for developing a picture of what is happening during this stage. The following key questions guided me during the immersions stage: What is going on? What is the pattern of interactions, what language mode is used and for what? What is the context and structure for the language communications? How is science meaning constructed and their benefits for science learning?

Stage 3: Establishing the unit of analysis

Once I had identified the key events in stage 2, I conducted intensive discourse analyses of the events. This phase involved the analysis of the teacher and learners' actions and their turn-taking while concentrating on their verbal interactions as well as the contextualization cues that emerged in the course of the interactions (Gumperz, 1992) together with other semiotic resources that are visible in their interaction. During the science discourse, there were interactions between a learner and a teacher that involved a series of utterances as each speaker takes turns during the classroom discourse. These utterances can also be in the written mode (i.e., the chalkboard writing, or learners' produced texts). Thus, in my data, I make use of the critical elements of the conversation analysis where the analysis on the language used was done primarily by describing the kind of interactional patterns that occur through turn-taking sequencing.

The aims were to uncover how language was used during the process of the construction of the science meanings. This process entailed going through the transcripts and video and audio recordings slowly while analysing the classroom interaction that took place between the speakers turn by turn, while also considering the speakers' actions, and what influenced them to act, or not act. I reviewed the video while paying attention to the nonverbal language such as body language and facial expressions, body movements, gestures, the visual aids used during the lessons, body positions, seating configurations and gaze. I then employed the micro and multimodal analysis

during this stage to attend to the moment-to-moment interactions, the affordances of each mode for science meaning making, and also analysing on the unfolding issues (e.g., identity, who control the discourse and agency) in the course of learning. Thereafter, the transcribed key events were parsed into smaller units of analysis primarily based on the boundaries that the teacher and learners created in the course of interactions. Firstly , I examined one lesson in detail, while paying attention to how it was accomplished, the turn-taking patterns , the sequence development, and how a set of sequences were related to the lesson topic (hereafter referred to as episodes), and also how lesson beginnings, endings and transitions were accomplished. I went on to complete the transcripts for each lesson and then, I divided each lesson into the episodes in which they were categorised in terms of the different phases of the lesson activities.

To analyse how science meanings were constructed through the use of semiotic recourses, I used the nine selected science lessons presented by Mr. Shilumba. I also used this unit of analysis to get an overview of the lesson structure and to provide a background for the analysis of how science meaning are constructions through the use of semiotic resources. The individual lesson was broken down into the 'episodes' defined as "a unit of discourse with a unifying topic and the purpose" (Gibbons, 2006:95). The main purpose of developing the episodes was to provide appropriate chunks of data useful for further analysis and reporting. The discourse constituting each episode was handled systematically, utterance by utterance while paying attention to the features of each discourse. I noted down the behaviours, events, activities, routines, science meaning-producers, the modes used, classroom participation, authority and control of the floor and interaction, and conditions and constraints.

To capture the comprehensive data on the contexts of how science meanings were constructed during the lessons, I verified first all lessons transcripts with the observational field notes to construct the "Episode Summaries" of the individual lesson. All lessons transcripts were revised for the following : (1) the instructional practices (e.g., reviewing and question & answers session, reading textbook exposition, explanations, teacher-whole classquestion sessions and consolidation of the lesson (2) the content being presented (e.g., the type of science content being delivered) (3) the types of the modes used to construct science meaning (e.g., spoken, written, gestures), (4) time used in the specific episode (see appendix H).

For this study, the summary of lesson episodes was constructed to get a clear picture on how classroom discourse was structured in each lesson. Although all lessons are allocated equal time for 40 minutes except for the double period, it was observed that on many occasions the length of lessons varied considerably from 40-50 minutes. Appendix (H) exemplifies the lessons 'Episode Summaries' constructed from individual observed science lessons that are based on four science units (i.e., plants as living organism; animals, the system of the body and communicable diseases). In addition, each episode was analysed further in its sequential context to give the descriptions of each features. I continuously revised the descriptions of each episode. To facilitate the analysis and make sense of the classroom patterns, I kept my theoretical framework and research questions in mind in order to make sense of how science meanings were constructed, the mode used for science meaning making. The data analysis in this stage was essential to respond to my second & third research questions (see table 3.1), and they offered a holistic approach to investigate how science knowledge was constructed through the use of different modes in the course of teaching and learning.

Stage 4: From description to formulating broader analytical codes

During the initial reading of the lesson transcripts, I developed categories for coding the IRF moves (see Appendix I). In Stage 4, I used these codes to conduct a systematic analysis of the classroom interaction of IRF based on these defined categories. I made notes in the margins of the transcripts to look closely if patterns of exchange follow a pattern of IRF sequences. This was done to indicate who initiates the talks, who responds, who follows up and the kind of feedback given while coding all the lessons transcripts with the developed categories (see Appendix I). This entails the process of systemic coding and content analysis to arrive at the patterns in the data, in which I selected various extracts from different data sources to exemplify the claims I made. The aim was to identify the patterns of discourse that emerged during the classroom talk. I mapped the sequence of teacher-learner turns in the lessons transcripts to determine whether the classroom discourse pattern was 'authoritative discourse or persuasive discourse' (Bakhtin 1981:342).

In this stage, I also employed critical classroom discourse analyses (CDA) to analyse the authoritative roles (i.e., who initiates the classroom talks), the dominant patterns of the classroom

talks (i.e., who dominate the talks when and why). This analysis became focal to ascertain the patterns of talks that emerged from the classroom discourse (Kumaravadivelu, 1999). The coding system was developed to analyse the IRF classroom discourse moves according to their purpose, and this coding system was further used in the later stage of data analysis. The reason was to see the patterns of dialogue that were established and emerged during teacher- learners' interactions in order to establish their link to science knowledge constructions. Later, I coded the classroom talk for the different discourse interaction patterns within each episode; and a word count was done for each stretch of a particular discourse interaction pattern, to provide an indication of what forms of interaction predominated during the lessons. In this stage, I draw from Bakhtin's 'authoritative-dialogic discourse' (1981) to analyse the occurrences of an authoritative stance of transmitting knowledge with minimal learners'participation and also the incidences where dialogue and exploratory talk are visible in the data.

Stage 5: Selections of extracts

During this phase, in line with my research questions for the micro ethnographic analysis I selected numbers of extracts to exemplify the different types of discourse and the shifts that were observed during the transcriptions of the observed lessons and classroom talk. To make the process easier, I developed categories for the extracts that I marked as important to my research questions. The extracts included versions of the original language in which the communication took place, supplemented by the translated English text. For a full understanding of the transcription conventions, see Appendix C. Most of the extracts were taken from the interactional data, which illustrated the highly contingent nature of how science meanings were constructed through the varieties of language and modality during the classroom interaction. All extracts are presented sequentially to get an understanding of how, during lessons, science meaning was constructed through the use of the multiple modes.

I started by analysing the deployment of semiotic resources for meaning making that were relevant in each specific extract. The direct quotes from the lessons were used as the empirical evidence to support claims made throughout my study. I used the micro ethnographic approach in this phase of the analysis to look at the classroom interaction in detail while considering all the modes utilised

for science meaning-making and to learn more about the broader social context of the classroom (i.e., how its learning happened and to see what constrained science learning in relation to the language ecology and ideology). These prose interpretations of these data were then organised and re-arranged later into the data analysis chapters.

Constructing validity

The final analytic phase was to ensure validity to justify how credible my study was, in response to the formulated research questions. This study followed some procedures to ensure the validity in ethnographic studies (e.g., Heath & Street, 2008). Since my study is a small-scale case study, I aimed to ensure validity through collecting and analysing multiple sources of data from the classroom observation, making field notes, video- and audio- recording, interviews as well as from the collection of artefacts; thus, combining data from different sources to ensure valid findings. The lessons from which the extracts were taken are named and they are summarised into episodes to keep track of the extent to which the researcher draws on all parts of the entire data corpus. Moreover, the extracts were analysed, designated and discussed in detail. This might direct the reader to examine the empirical grounds upon which the conclusions and claims were drawn from or to check if the claims are justifiable. Another important element of attain the validity in the research, is the researcher's ability to reflect on their 'subjectivity' in the study (cf. Foley, 2002). For this study, I foregrounded my "decision rules" (Heath & Street, 2008: 45) as much as I could, which informed any decisions I make throughout my study.

Conclusion

This chapter provided a comprehensive discussion of the research approach and paradigm, research methodology, data collection tools and the analysis procedures employed to answer my research questions. In addition, questions relating to the validity of the research, and the measures taken to address the ethical issues in this study were discussed. I also included the justification for the selected data collection and analysis approaches. The process of transcription and data analysis was described in some detail including an overview of the different stages of the data analysis.

Lastly, linguistic ethnography was recognized as the key epistemological perspective employed within this study, so as to answer my research questions.

CHAPTER 5: School language ecology: ideologies and patterns of practices

Introduction

In this chapter I will provide an answer to my research question: What is the language ecology that shapes the science classroom discourse in the Namibian primary school in this study? I do so by discussing the results of my investigation into the language ecology in "Grace Primary School" (pseudonym) that shapes classroom practices, and how ideologies were being "embodied in communicative practice" (Kroskrity, 2006:496), that is, how the language ideologies could be observed and interpreted from participants' communicative practices. Teachers frequently "become the main agents through whom ideology is spread" (see Shohamy, 2006:79); therefore, it is necessary to examine how their personal beliefs and their language practices are shaped by "dominant language ideology" (Kroskrity, 1998). I will draw on classroom observations (field notes), interviews, the school's language policy document, photographs taken around the school grounds as well as extracts from classroom and study group interactional data which is revealing of how language ecology shapes classroom practices.

According to Haugen (1972), the language ecology refers to interactions between languages and the environment in which they are used. Once a language policy is passed and mandated, this policy will eventually be reinterpreted and renegotiated at the micro level by local actors (Hornberger & Johnson, 2007). There is a lack of understanding on how language ideologies that inform both policy and practices prevent shifts in classroom practices so that learners' full linguistic repertoires are considered as resourceful for learning, rather than being a barrier to learning (Makoe & McKinney, 2014). Therefore, it is critical for this study to build from a language ecology perspective in order to explore the participants' language ideologies, school language policy and the pattern of dominant language practices in the classroom.

Language ideologies in the Namibian Language in Education Policy

This section focuses on the current Namibian LiEP (LiEP) using language ideologies as the analytical framework. The impetus for this analysis was to establish an understanding of the language ideologies that inform the LiEP, and also, considering the diversity of Namibian 10

recognised school languages, to see what correct language (s) count in the education contexts. As established in chapter 2, language ideologies refers to the "values, practices and beliefs associated with language use by speakers, and the discourse which constructs values and beliefs at state, institutional, national, and global levels"(Blackledge and Pavlenko, 2002:123). From this perspective, language ideologies are socially constructed with the motive to legitimise and add status to some languages over others (Namyalo and Nakayiza, 2015). As stated earlier in Chapter 1, Namibia's current LiEP has been influenced by the country's history, linguistic diversity, and educational goals that is: access, equity, quality, and democracy (MEC, 1993). The policy is underpinned by a language rights which embraces all languages to flourish, and thereby recognising the cultural value of all indigenous Namibian languages. The goals of this policy are to enhance students' language and cultural identity and to embrace the "equality of all national languages regardless of the number of speakers or the level of development of a particular language" (MEC, 1993:1).

Following Namibian independence in 1990, Namibian' MBESC (2003) adopted a language policy that specifies how language should be used and implemented in schools. For instance, the Language Policy for schools in Namibia (2003: 1 – 4) stipulates:

> *"The use of mother tongue or a predominant local language as medium of instruction in Grades 1-3 throughout formal education and English should be a compulsory subject starting in 1 Grade up to Grade 12. The wish by a school, school board and parents to offer English as medium of instruction from Grade 1 must receive ministerial approval with well-grounded, convincing motivation. Grade 4 will be a transitional year when the change to English as medium of instruction must take place in which mother tongue should be taught as a subject. National examinations from Grades 4-12 will be taken through the medium of English only , except for the mother tongue that is taken as a subject"…"English will therefore be used in its official capacity as a medium of instruction and assessment throughout the education system in public schools as from Grade 4 onwards" (MBESC, 2003:3-4).*

As is evident from the extract above, the Namibian LiEP draws sharp distinctions between the named languages. The policy emphasises the use of one named official standardised language as

the sole MOI, officially labelled such as 'English or mother tongue instruction (Shohamy, 2006:77). Again, each language is assigned a specific time allocation on the school timetable with the impression that the target language should only be used and learnt at a given time during the lessons. The LiEP follows an 'Early exit model of bilingualism", which involves the switch from mother tongue instruction to English instruction in early years of schooling (Cummins, 1992). This promotion of a monolingual language ideology is exemplified by this separation of languages. This implies that learners are expected to replace their competence in first language with an additional language in the early years of schooling. This switch reduces their cultural identity and removes indigenous knowledge from their learning. This sudden switch is considered to inevitably lead to poor academic performances, since children will find it difficult to learn through a language, they lack competencies in (Cummins, 1992).

The LiEP continues its promotion of a monolingual language ideology, by stating that "only English should be used as medium of instruction from Grade 4 onwards, and examinations from Grades 4-12 will be taken solely in the medium of English" (MBESC, 2003:4). Thus it is clear that English is positioned at the top of the language hierarchy in the Namibian LiEP. Antia and Dyers (2016: 530) pointed out that "where language hierarchies exist, there is usually one dominant language, followed in order of decreasing importance by other languages or varieties". This is a clear reflection of how this English language monolingual ideology in the Namibian LiEP continue to marginalise other Namibian languages, as these languages are not used in assessments from Grade 4 upwards. This implies that imbedded in the LiEP, is the notion that other Namibian languages are considered as invalid for use by learners to master content knowledge. This binary narrative of the 'mother tongue instruction' versus the 'English medium of instruction' within the LiEP, continues to uphold the notion of the 'single standard language', and in doing so, ignores the multiple varieties of linguistic resources and semiotic modes that are not being recognised in classroom discourse, learning materials, or in assessment (McKinney & Tyler, 2019).

This monolingual ideology is not limited to Namibia only, but is evident in many other African post-colonial educational contexts. It has given rise to a number of studies that challenge the notion of a named language as MOI, instead, advocating for the use of multiple linguistic resources for learning (see Probyn, 2009; Banda 2010; Chimbutane, 2013; Guzula, McKinney and Tyler, 2016; Makoe & McKinney, 2014; McKinney & Tyler, 2019).

While Namibia's LiEP advocates for mother tongue instruction from Grades 1-3, the same policy states that; "in a school where there are a substantial number of learners (20 or more learners) from different language groups, the school must make arrangements to provide instruction in the different languages provided that the permission is granted from the Ministry" (MBESC, 2003:3). Thus, the policy gives schools' management and parents a choice to disregard the mother tongue instruction and begin with English MOI from Grade 1. As a result, 60% of Namibian schools implement the English MOI from Grade 1, thereby not opting for instruction in any other mother tongue or other dominant local language as MOI. Furthermore, by opting to use English as the only MOI, and this implies that learners are expected to learn all their subjects through the medium of English, and studies have shown that this has a detrimental effect on Namibian children' academic success (Tötemeyer, 2010).

There are discrepancies in the implementation of the Namibian language policy from region to region. Schools have put forward various reasons to justify their inability to adhere to and implement the LiEP guideline of mother tongue instruction during Grade 1 – 3:

1. The multilingual nature of most of the schools, implies that diverse learners from different linguistic background would require instruction in various languages (Murray, 2007).
2. Namibian people believe that instruction in English as MOI will provide their children with fluency in English as it is key to ensuring a livelihood in the economy: English proficiency, in their view, will enable their children to succeed throughout their school careers and secure prestigious positions in the job market (Frydman, 2011).
3. Many Namibian primary schools have adopted an English-only policy, because of pressure placed upon them by parents, who threaten to, or actually move their children from schools offering mother tongue instructions to that of English MoI schools (Tötemeyer, 2010).
4. The ambiguity and lack of clear guidelines of the Namibian LiEP and misinterpretations of the policy from the implementers. Most schools do not have knowledge of the policy and they do not explicitly understand the policy's expectations (Chavez, 2016; Murray, 2007).

According to Murray (2007:69) the learning through the English MOI in early years of schooling shows that "there is a strong and positive correlation between literacy in the native language and learning English, and that the degree of children's native language proficiency is a strong predictor

of their English language development". However, this has not always has been the case in Namibia given the fact that as many as 60% of Namibian schools do not provide learners with mother tongue instruction at all (see Tötemeyer, 2010). Therefore, the promotion of the Namibian children's cultural identities and traditional values has not been achieved or realised as per Namibian LiEP' intentions. This is another clear disparity between the Namibian LiEP' goals and its implementations manifested in the Namibian schooling system. A Namibian primary school teacher from a context where the majority of the learners' mother tongue is Khoekhoegowab but where this is rarely learned in school claims that:

> *"The young ones don't want to speak their own language; they all want to be Americans. They watch TV and get all this American stuff. They want to be like Michael Jackson and look down on their own culture" (Chavez, 2016: 190).*

This quote is indicative of how the dominant status given to English language over the other Namibian local languages in current Namibian LiEP instills in young learners a disregard of their own language in preference of English. Chavez (2016) emphasised the need for young Namibian children to be taught in their native languages as well as to encourage them to love and not to feel ashamed of their languages because this is part of their heritage. Therefore, educational language reform should focus on bi/multilingualism since multilingualism is not regarded as a burden to learning (Pütz, 2004). On the other hand, Namibian schools' language policies proceed from an ideology of viewing linguistic diversity as a barrier to learning as opposed to seeing it as advantageous for learning.

There is an ambiguity within the same LiEP policy which demands that:

> *"The indigenous languages should be strengthened by linguistic development through, amongst others, standardisation, harmonisation and the coining of new words" (MBESC, 2003:2).*

This is indicative of the policy's intention to treat and protect all national Namibian languages equally, and thus, challenging the stranglehold of monolingualism. From this policy perspective, multilingualism is recognized as a valuable resource in the Namibian schooling as the LiEP document emphatically guaranteed that:

> *For the purpose of timetabling, learning and instructional process in schools, all National Languages (home languages and mother tongues) are regarded as*

> *equal and at par with each other. Thus, all National Languages will receive equal treatment in the official school programme in State or State subsidised schools. Learners should be sensitised to appreciate the multicultural and multilingual character of Namibia (MBESC, 2003:2).*

Conversely, the policy's declarations over the use of English as sole MOI from Grade 4 and beyond and the fact that all assessments have to be conducted exclusively in English stands in contradiction to the same policy's goals of embracing and treating all the Namibian languages equally. In addition, the policy also emphasises that schools should be "sensitive and appreciate learners' linguistic and their multicultural diversities" (MBESC, 2003:3). In contrast, research has found other Namibian national languages to be far less fortunate in getting robust support in the Namibian schooling system or in materials development (Wolfaardt, 2005; Chavez, 2016; Iipinge, 2018). These languages are not considered as suitable to curriculum implementation, thereby, once more reflecting the hierarchy within monolingual ideologies, where English is regarded as a legitimate language for teaching and learning; this despite the Namibian Constitutional obligation to treat all the languages equally.

This policy contradiction is partly due to the fact that the Namibian LiEP fails to provide clear guidelines as to how indigenous Namibian languages should be promoted in schools (Wolfaardt, 2005). The same policy has left the schools to decide for themselves how other Namibian languages should be treated equally within their curriculum. In the same vein, Probyn et al's (2002) investigation of the language policy and practices in a sample of South African primary schools, reported a wide gap between the national language policy's multilingual goals and actual policy implementations in South African schooling.

Furthermore, the monolingual ideology of what language counts as MOI, such as is evident in the LiEP, raises serious concerns over how languages are treated as bounded entities, by not embracing the heterogeneity of the Namibian linguistic situation, thereby, promoting what McKinney (2017) termed 'anglonormativity'. It is often the 'anglonormative' ideology along with the monolingual ideologies that inhibits teachers to embrace their learners' linguistic resources as a legitimate resource for teaching and learning (McKinney & Makoe, 2014). These ideologies not only impact negatively on the learners' performances, but they can also infringe on their language rights, thereby, promoting inequality within education (Mkhize and Balfour, 2017). The study of Gorterand & Cenoz (2017) propose "holistic approaches in language education policy and

multilingual assessment that consider language-as resource and promote the use of the whole linguistic repertoire in order to substitute more traditional approaches of language isolation policies in language teaching and assessment" (2017:231).

The school language policy: Ideologies and Practices

I selected sets of extracts to exemplify moments within the data that illustrate how the participants' language ideologies and also others' language varieties are discursively constructed within this school. This also sheds light on how these constructions impact on language practices and classroom learning. According to the responses during the interviews, the home language of all the teachers, learners and parents is Oshiwambo. The language spoken by learners and their parents in the community is overwhelmingly Oshiwambo. Learners in this school are also exposed to urban varieties that are distinct from what is regarded as the standardised forms of languages named in the Namibian constitution that informs the LiEP. Learners said they have little contact with English speakers and their only exposure to English outside the classroom is through limited access to television and radio. Again, these learners have even less exposure to written English, as evidenced from their admission profiles which showed the majority of their parents are unemployed and the fact that most people in this area are not formally educated.

School Language Policy

The school does not have a formally constituted written language policy. The only explicitly stated language policy is the national policy formulated for the entire education system, which states that the mother tongue should be used as the MOI from Grade 1 to 3, after which English takes over as the MOI from Grade 4 onward. In this school, all school documents such teachers' lesson planning, scheme of works, subjects' curriculum, policy documents, minutes of the meetings and textbooks are written in English are written in English. Oshiwambo was never formally used in writing, however the bilingual practices of using Oshiwambo and English were common in oral interactions. Despite the fact that all languages are expected to be treated equally as highlighted in the earlier discussion on the LiEP, there is no clear direction in this school as to how this goal can be realised. I will thus draw on the school principal and the teacher's interview to give an account

of the language policy used in this school. Based on the school principal's reflection on the language policy:

Extract 5.1

Researcher: All school supposed to have the internal language policy that need to be drawn up in conjunction with the parents and the entire school community, do you have any language policy at this school?

School Principal: Mhmmm, yes, I am aware that each school supposed to draw up it is own LiEP in conjunction with the Namibian LiEP. Our school follow the national Language in education policy, but we did draw up our school LiEP document. What we have, is the minutes where we had a meeting with the school parents to decide on the language of instructions that can be used as MOI in our school. We have decided collectively to use Oshiwambo as the MOI from Grade 0-3 and English is taught as a subject while English is the LoLT from Grade 4 to 7. The decision to use Oshiwambo from Grade 0-3 was motivated by the fact that most of our learners' parents are not formally educated. Therefore, these learners will struggle to learn through English of medium from Grade 0 -3 because they have no English exposures from home. However, my wish as a school principal was to use English from grade 0 beyond because I believe children need a strong foundation in English in order to cope throughout their school career (principal interview, 20-06-2018).

In the extract above, the school principal reflected that the school does not have a formally constituted language policy, however in practice, Oshiwambo is used as a MOI from Grade 0-3 and English is taught as a subject while English is the MOI from Grade 4 to 7. The school principal was aware that the school should have formulated a school language policy in accordance with the Namibian LiEP. She said there was a meeting with parents, where they collectively agreed on the MOI for grades 1-3 and 4 upwards, and that this decision is recorded in the minutes of the meeting. There is an indication of the lack of will from the school management to interrogate the LiEP document since the school community failed to adopt and amend the National LiEP' expectation and the fact that the school did not draw up a school specific language policy to be made available to the entire school community . However, the principal was adamant that she prefers English to

be used as MOI from Grade 0 but due to the fact that most of their learners' have no English exposure from home it was not possible to implement such a policy. The school principal holds a personal belief that English as MOI as early as possible has a positive impact in helping learners to develop fluency in English. The conflating of learning English language while using it as MOI in this school setting assumes the superiority of English language while barely acknowledging the other languages spoken by the learners. According to Probyn et al., (2002:31) "it would be mistaken to view the formation and implementation of policy as a simple hierarchical, linear process. The ways in which policy is interpreted and reinterpreted needs to be understood and fed back into policy-making".

On the other hand, the choice of actual language use was left in the hands of the teachers, who sometimes disregard the language policy in order do what they think is suitable. However, teachers were constantly reminded verbally by the school management to adhere to English as the medium of instruction from Grade 4 onwards. According to Mr. Shilumba.

> *"I always use the language according to the need on the ground, although we are always reminded by the subject advisory and our school principal verbally to adhere to the language of instruction [i.e., English] during the lessons. However, I was never punished by using Oshiwambo during my lessons and I'm still doing it to ensure lesson comprehension" (teacher interview, 28-02-2018).*

This suggests that the Namibian LiEP is not always adhered to at the classroom level. In bi/multilingual classrooms where the MOI is English, a corpus of studies have made similar observations stating that the frequent use of two or more languages is regularly practiced during the lessons to achieve communicative needs and also for meaning- meaning without adhering to the boundaries that exist between the named languages and codes (see Blackledge, 2010; Canagarajah, 2011; Garcia and Kano, 2014; Probyn, 2015, 2009; McKinney and Tyler, 2016; García et al., 2017; McKinney & Tyler; 2019). Yet, at the management level, it is evident that English is elevated and given a special status over other Namibian local languages in this school. Referring to the language policy and the school principal's dominant English language ideology at his school, the school principal responded in this way:

Extract 5.2

Researcher: As a school principal, do you have a specific rule on which language should be used in this school, and why?

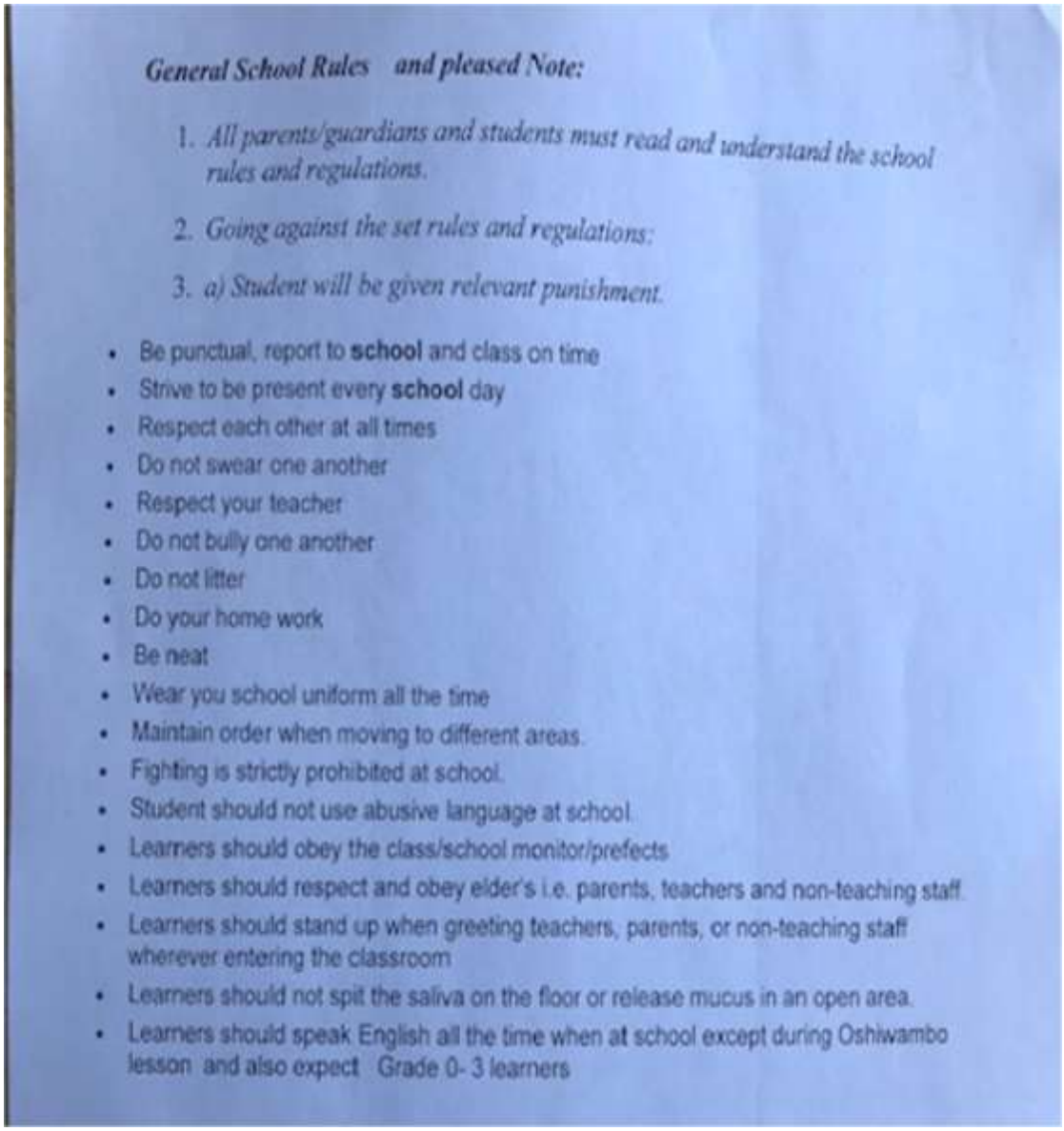
School Principal: Mhh, personally, I always remind the Grade 4 -7 learners that the moment they entered the school premises I say, now we leave all other languages home. In this school, only English that matter. I always encouraged them to speak English only in school, hence it is the only language that can liberate them from poverty. English is everything my friend, if you don't own it you will be drowning in the pool of poverty. They need to be proficient in English in order to succeed in their entire school career and for them to have a decent job. If you allow them to speak Oshiwambo at school, they will suffer in future, because Oshiwambo won't take them anywhere. You can't trade internationally using Oshiwambo language, and how do you expect learners to cope at the university if there were instructed in Oshiwambo in throughout their early years of schooling (Principal interview, 20-06-2018).

It is clear that the school principal's view of the MOI at Grace Primary, is that of promoting monolingualism, as is evident in her repetition of the importance of English in the use of phrases "Only English that matter; English is everything; English only". This is the strongest representation of how the principal's ideology is evident in how she is trying to position learners as monolingual beings. In this monolingual ideology, other Namibian languages are stigmatized and viewed as unfit to successfully acquire employment opportunities. In the principal's words, "learners need to be proficient in English in order to succeed in their entire school career and for them to have a decent job. If you allow them to speak Oshiwambo at school, they will suffer in future, because Oshiwambo won't take them anywhere".

Again here, the school management is instituting and creating English-only zones with a ruling that communications should be conducted solely in English, thereby banning the use of local languages. It appears that, in privileging the use of English only rather than treating all languages equally as enshrined in the Namibian LiEP document and in the Namibian constitution, the principal has misinterpreted the policy. In extract 5.2, she emphasises that, "in school, only English that matter" and her remarks are clearly advocating the monolingual ideology in this school. It is

observable that the school principal's view on the use of English only is influenced by her own personal ideologies that 'proficiency in English enable learners to succeed in their entire school career and to have a decent job' arguing that English is the only language that emancipates people from poverty. To follow this line of argument, English is associated with the language of wealth, while Oshiwambo is aligned with poverty: "Oshiwambo won't take them anywhere". It is clear that the school principal's language ideologies are tied up with her view of the power of English from economic perspective but not from an epistemological perspective. The language ideologies observed here are aligned with earlier studies that reported on the power of English-only ideologies for the construction of socioeconomic and language hierarchies (Alexander 2007; Makoe and McKinney 2014; McKinney et al., 2015). Probyn et al., (2002: 39) made a similar observation in the study she conducted in South African multilingual schools where South African teachers hold the ideologies that 'English puts bread on the table,' positioning English as a language of access to wealth as opposed to the language of epistemological access.

The data from my field notes shows how the use of Oshiwambo is positioned as a defilement of the school rules placed alongside other school violations such as, littering, swearing, stealing, absenteeism and other rules, as we can see from the final rule of the written school rules below:



General School Rules and pleased Note:

1. *All parents/guardians and students must read and understand the school rules and regulations.*
2. *Going against the set rules and regulations:*
3. *a) Student will be given relevant punishment.*

- Be punctual, report to **school** and class on time
- Strive to be present every **school** day
- Respect each other at all times
- Do not swear one another
- Respect your teacher
- Do not bully one another
- Do not litter
- Do your home work
- Be neat
- Wear you school uniform all the time
- Maintain order when moving to different areas.
- Fighting is strictly prohibited at school.
- Student should not use abusive language at school.
- Learners should obey the class/school monitor/prefects
- Learners should respect and obey elder's i.e. parents, teachers and non-teaching staff.
- Learners should stand up when greeting teachers, parents, or non-teaching staff wherever entering the classroom
- Learners should not spit the saliva on the floor or release mucus in an open area.
- Learners should speak English all the time when at school except during Oshiwambo lesson and also expect Grade 0- 3 learners

Figure. 5.1 Written school rules pasted on the school wall

From figure 5.1, we can see how the school rules reproduce the dominance of English and promote one language over the others. Here, learners are expected to refrain from using their multilingual practices despite their limited proficiency in English language. According to the school's rules, "Learners should speak English all the time when at school except during Oshiwambo lesson expect (sic) Grade 0- 3 learners". The use of Oshiwambo in this school is equated to the violation of school rules such as swearing and others ill behaviours, and learners are expected to be punished if they violate any of these school's rules. This is another dominant English monolingual ideology

articulated and sanctioned by the school management. This action is clearly reflecting how this Namibian school as an institution continues to be deeply rooted in a 'monolingual habitus' (Gogolin, 1994, in Busch, 2014: 22) while trying to keep languages as a bounded, separate entities and preferably leave the multiple languages and varieties out of the school premises.

Given the principal's view of an English-only language ideology in this school, it is not surprising that the school did not implement the Namibian LiEP's guidelines of treating all Namibian languages equally in schools. This could be attributed to the duality of the LiEP, and the lack of enforcing the policy actively within the school system. The devaluing of the use of African languages in schools, is the linked to negative attitudes towards and stereotypes linked with these languages (Makalela, 2013). Therefore, this study also investigated how the school principal and Mr. Shilumba justified their arguments related to the use of English MOI policy in the classroom as well as their views over the others language practices as can be seen in the following extracts:

Extract 5.3

Researcher: Do you think teachers should follow the English only policy during their lessons? Why?

Principal: I don't support the teachers to use excessive mother tongue during the lessons. Yes, there are times where learners struggle to comprehend technical concepts in English, but if you resort to mixing too much of English and Oshiwambo during the lesson, learners will end up speaking Namlish instead of Standard English. However, I always encouraged my teachers to stick to English only during the lessons. If learners have poor command in English, it will hinder their academic performances. My wish is for teachers to stick to English only during their lessons for the learners to develop good English proficiencies. Oshiwambo is available everywhere, home, community, neighbourhood, church and elsewhere, why do we need to use it again the school ground. The challenge I have, is to control if teachers are adhere to the school language policy during their lessons because it's difficult to move between my office and classrooms to reinforce the language policy (principal interview, 20-06-2018).

Extract 5.4

Researcher: Do you think teachers should follow the English only policy during their lessons? Why?

Mr. Shilumba: It's a pity that these learners were instructed through Oshiwambo medium of instruction from Grade 0-3. I wish if our language policy can be reversed so that our learners can be instructed from Grade 0 through English medium of instruction. Oshiwambo is not doing any justice to these learners; they need a strong foundation in English as from grade 0 for them to succeed in their schooling (teacher interview, 28-02-2018)

While it might appear that the Namibian LiEP is liberal in embracing all Namibian languages to be used in all schools, on the other hand, in this school Oshiwambo is constructed in deficit terms and there is no positivity towards supporting its use in the schooling system. Both Mr. Shilumba and the principal hold a strong view that being instructed in English is the only route to proficiency in English, while seeing the goal of schooling as developing proficiency in English rather than developing knowledge and concepts. For instance, Mr. Shilumba says that; "*Oshiwambo is not doing any justice to these learners, they need a strong foundation in English for them to succeed in their schooling".* For Mr. Shilumba, it would seem that Oshiwambo is not a legitimate language for engaging in the school curriculum activities and he argues that it is pointless to teach in the language that learners are already proficient in. The principal is of the view that languages should operate in silos to prevent what she termed *"Namlish".* While it might appear that the Namibia LiEP strives to treat all languages previously marginalised during the colonial era equally, the school principal and Mr. Shilumba's views on multilingualism, however, are far from embracing all languages as useful resources for teaching and learning. This is because their language ideologies are deeply rooted in a monolingual ideology that imposes a language policy regulating the use of one language at the expenses of the others. It seems like the principal and Mr. Shilumba are afraid of being exposed to be in contravention of what they consider as the official language of instruction.

In the extract 5.4, the principal strongly condemns teachers who allowed the use of Oshiwambo abundantly during the lessons. However, she raises the challenges of reinforcing and controlling the use of English during the lessons, arguing that the teachers have to try themselves to reinforce

the language policy seriously. On the other hand, the moment the language and culture resources are forced to remain outside the classroom door, Salazar argues that "this can result in a sense of humiliation at the rejection of vital aspects of being human" (Salazar, 2013:121). Under the ideologically monolingual policies advocated by the school management, the translanguaging practices in this school happen behind closed doors. As reflected by Mr. Shilumba in the extract below, it is practised because of the pressure to cover the curriculum on time, for lesson comprehension and also to attain the lesson objectives:

> *"It's really hard to covers the topic on time with Grade four learners. These learners are finding it hard to learn through the English medium, and I' m always forced to integrate the vernacular in my lessons to attain the lesson objectives and to ensure lessons comprehensions" (teacher interview, 28-06-2018).*

The fact that learners were constantly reminded about the value of English by the school management, that the use of English is also sanctioned in the school's rules, and the fact that all the subjects are taught and assessed in English only, places a substantial negative judgment against their mother tongue as reflected in their responses below:

> *Extract 5.5*
>
> *Researcher: Ohokala wuudite ngahelipi ngee tolongwa Melaka loshiingilsha [Tell me how do you feel over the use of English in the classroom]?*
>
> ***L1**: Onda hala ngeno okwali haindi popi Oshiingilisha nawa, opo ndikale hai piti nawa mofikola ame ndika kale nonakwiiwa iwa. Ondi udite nai eshi hai popi ashike Oshiwambo, shoo ihashi longifwa mofikola, nomokunyola omakoonaakono, ile meemovie edi handi tale koTV. Omunhu paife owafa ashike elai eshi uheshii kupopya Oshiingilisha. [I wish if I can speak English fluently in order to be smart in school and also to be successful one day. I feel very bad that I only know how to speak Oshiwambo, but I can't use it in school, I can't write examination in Oshiwambo and I can't use it to watch my favourite movies on TV. Now I look very dumb the fact that I don't know how to speak English].*

***L2**: Onduudite nai eshi ndili omupopi welaka loshiwambo shaashi nghina apa handililongifa kakele kokupopya meumbo, ile nookaume kange. Onda hala ngeno okwali ndimupopi welaka loshiingilisha opo ndikaninge omuyamba monakwiiwa, ame ndikale hai piti nawa oilongwa yange mofikola. EePrinces adishe edi hai mono koTV ohadi popi ashike moshiingilisha, ame onda hala okuka kala ngaashi Princes Sofia. [I felt bad for being an Oshiwambo speakers because I can't do anything with Oshiwambo apart from communicating with my friends, my siblings and my parents at home. I wish if I was an English native speaker to become very rich one day, and to pass all my subjects very well. All the princess that I watched on TV they only speak English, and I want to be famous like Princess Sofia]*.

***L3:** Oshiingilisha elaka liwa, omanga Oshiwambo elaka lii,shaashi ngee kushi kupopya Oshiingilisha itokala hopiti mofikola. Onanhu aveshe Ava valongwa naava vayamba ovapopi vOshiingilisha, omanga onanhu ava vahepa hava popi Oshiwambo. [English is a good language, and Oshiwambo is a very bad language because if you don't speak English you will not be smart in school. All educated and rich people are English speakers while poor people are Oshiwambo speakers]*.

***L4:** Ngee owa hala okukaninga ondokotola ile hahende, ouna okukala hopopi oshiingilisha nawa. Oshiwambo ekalaka longaho shaashi ihalilongifwa mofikola ove ito mono oilonga iwa ngee ohopopi ashike Oshiwambo. [If you want to become a doctor or lawyer, you must know how to speak English very well. Oshiwambo is a useless language because you can't use it in school to learn or to get to get a good job]. (Learners' interview, 22-06- 2018).*

From learners' responses above, there is an indication of how they are alienated from their home language, and how this may affect their sense of self-worth. These learners have internalised the

idea that English is a special language that is essential for a successful school career, getting a good job and a bright future. It appears that they are heartbroken, and they have internalized the perception that Oshiwambo is a 'bad' and a "useless' language, thereby, constructing English monolingualism as a positive practice. For instance, L3 says that; "*Oshiwambo is a very bad language because if you don't speak English you will not be smart in school"* while L4 stresses that; *"Oshiwambo is a useless language because you can't use it to get the good jobs if you only speak Oshiwambo".* Learners expressed low self-esteem associated with poor English proficiency, seeing themselves as being stupid ('dumb') compared to their peers or English speakers they see on TV. The frequent use of the phrase "I can't" reflected in the learners' responses above, reflects the feelings of inadequacy on the part of learners. This proves the point that these learners have negative attitudes towards their mother language and are also doubtful over their mother tongue's value for their personal successes. Learners aligned themselves with the dreams and aspirations of English speakers. For instance, we see how L1 wishes to be an English speaker because she wants to be famous like Princess Sofia that she sees on TV. This data on the learners' negative attitudes towards their mother tongue confirms Cummins (1989:17) study which found that children in bilingual schools in the United States internalize that Spanish is an inferior language to English.

The dominant English language ideology enacted in this school inculcate in children the idea that English speakers are more special, famous, and intelligent than others language speakers. English is constructed and positioned by these learners as a linguistic asset for one's intelligence and successes. From the learners' responses above, they have shown their desires for the mastery of English for particular purposes, which is '*to pass examinations, to secure a good job, for being rich and also for being famous'*. The data presented in this study on the ideologies of intelligence being conflated with English proficiencies, confirms a study conducted by Makoe & McKinney (2014) as well as McKinney et, al. (2015), whose research reported on the similar findings in the South African multilingual contexts. These studies reported on how African languages were devalued with negative perceptions placed against them and constructed as a hindrance to learning, while good proficiency in English was aligned with intelligence.

Despite the fact that learners have placed a substantial negative judgment against their mother tongue, on the other hand, they also placed a value on their mother tongue as a useful language for teaching and learning as illustrated in the following extracts:

Extract 5.6

Researcher: Ohokala wuudite ngahelipi ngee omulongi talongo mOshiwambo [Tell me, how do feel over the use of Oshiwambo in the course of teaching and learning]?

L5: *Ngee omulongi ta lesha membo ile ta fatulula moshiingilisha, oha ndikala ndafya eemhofi, shaashi kandi uditeko nawa Oshiingilisha. Askike shamha omulongi atameke okufatulula moshiwambo, ohaikala nda pwilikina nawa motundi, ame haikufa yoo ombinga motundi shaashi onduuditeko nawa Oshiwambo [The moment the teacher starts reading from the textbook or explaining in English only, it makes me fall asleep, because I don't understand. But the moment he starts explaining in Oshiwambo, I start to concentrate and participate in the lesson, because I understand the language very well]*

L6: *Ame onda hala ngeno okukala hai longwa noshiwambo shaashi olo ekaka eli handiiduko nawa. Ngee omulongi talongifa Oshiwambo ohai kala nduuditeko oitya yoshiingilisha ei ikukutu. Oshiwambo ohashikwafelenge yoovali oku kufa ombinga moutundi. Ngeno okwali ndapitikwa okulongifa Oshiingilish ashike motundi, ngeno ohai kala ndi udite nai, ame hai kala ndamwena efiku alishe [I prefer to be taught in Oshiwambo, because it is the language that I understand better. When the teachers use Oshiwambo during the lesson, I understand better the difficult English words. Oshiwambo helps me to express my self during the lesson. If I was restricted to use English only, I will feel very bad and I will remain quiet the whole day]*

L7: *Ngee omulongi okwa kala talongifa Oshiingilisha ashike motundi, ohai kala nduudite nai neenghono shaashi itandi udukosha motundi ndee hai dopa oilongwa yange [If the teacher restrict us to use English only, I'm always very disappointed because, I don't understand anything during the lesson, and I will the fail my subjects].*

L8: *Ohandi kala ndi udite nawa ngee omulongi tafatulula moshiwambo, opo nduudeko nawa motundi, ame ndikufe yoo ombinga motundi. Onda hala ngeno Oshiwambo osho shali hashi longifwa mokulongwa nomokunyola omakoonaakono, opo ndipite nitwa yopombada [I always feel good the moment the teacher start explaining in Oshiwambo, because it helps me to understand the science content , and also to participate during the lesson. I prefer to be instructed in Oshiwambo and also to write my examination in Oshiwambo so that I can pass with flying colours (learners' interviews, 20-06-2018).*

From the learners' responses above, it is evident that they have conflicting ideologies over the choice of English. While learners acknowledged the power of English in relation to success, they also recognized the value of learning through the language that they understood better in order to pass their examinations and for classroom participation. Learners have admitted that they would choose their mother tongue over English as MOI for them to pass their exams 'with flying colours; For instance, during the interview; L8 stresses that *"I always feel good the moment the teacher starts explaining in Oshiwambo"* claiming that Oshiwambo would aid him in understanding Science better and assist him to participate in the lesson. Learners also expressed their strong feelings over the use of English only policy in the classroom. For example, L7 expressed the concern over his chances of passing his subjects when the instruction is conducted primarily in English. L6 expressed her anger over the use of English only as MOI arguing that it would make her remain quiet the whole day in the class. Thus, there is an apparent contradiction about the learners' desires to understand the subject matter through their mother tongue, and their wish to have good proficiency in English to pass their examination and fulfill their dream to become successful .These contradictions mirrored the challenges and conflicts that these learners find

themselves in with regards to their personal language ideologies and the demands of the LiEP' on the other hand and the classroom realities.

Language Ecology: Patterns of School Language Practices

Despite the principal's strong advocacy for parallel monolingualism, and her efforts to maintain a separation between English and the use of languages other than English outside the classrooms, I observed that the use of Oshiwambo still forms a significant part of the school interactions. At this school, Oshiwambo is used for most communication outside and in the classroom. As Mr. Shilumba put it, "learners in this school use Oshiwambo everywhere inside the classroom and outside, and they barely speak English in the classroom." The field notes below documented the principal, learners and teachers using Oshiwambo during their conversations:

> *Extract 5 .7: Extract from field notes on the school language practices*
>
> *All learners and the teachers met at the assembly point to do morning devotion and also for general announcements. At the assembly point, the principal greets the learners in English. The song and the prayer by Mrs. Simon were both in Oshiwambo. The principal uses a higher proportion of Oshiwambo than English. While the principal announced the school's rules, she spoke only Oshiwambo. The principal observed switches to English at a very small proportion especially when she was mixing the non-standard words within the phrases or words such as eeschool uniforms/ the school unform; opunishment / the punishment; meeclass/ in the classes; eeteacher deni/your teacher; poassembly/ at the assembly. Okurespect/ to respect. Eeschool rules/ the school rules. At the assembly, all learners are having conversations in Oshiwambo. After the assembly, I went to the principal's office. I tried to start our conversations in English, but she would always respond in Oshiwambo. In the school corridor, I observed the conversations among teachers in Oshiwambo. Learners were having conversations in Oshiwambo only during break time and in their play (reconstructed from field notes, 22 February 2018).*

The field notes above illustrate some of the language practices within this school. They show how Oshiwambo is part of the school communication despite it being banned in the school rules. For instance, Oshiwambo was used at assembly, during extramural activities and informally in the staff room. A mixture of Oshiwambo and English is used during staff meetings, between teachers and also among learners themselves in the playground. As teachers and learners generally share a common home language, at the assembly point Oshiwambo was used in higher proportions compared to English, to convey the information about school rules, general conduct, and new arising matters. The principal was observed switching to English at a small proportion especially when she was mixing the non-standard words within the phrases or words such as *eeschool uniforms/ [the school unfirms]; opunishment / [the punishment]*. While emphasising the school's rules, the principal used mostly Oshiwambo to convey her message and to connect with her audiences. In this case, the principal was using both English and Oshiwambo languages as resources to negotiate meanings and to connect with her audiences despite her strong contestation of the use of Oshiwambo in the school premises. There was somewhat of a contradiction between the school principal's personal views on the implementation of English only policy within the school premises and her actual language practices. While the school principal did not honour the ban on use of Oshiwambo in the school premises, she still feels pressured to communicate meaning to her audience in English only as reflected in her responses in the extract below:

Extract 5. 8:

Researcher: You have said earlier, "in this school only English that counts' and yet, you are communicating with the learners in Oshiwambo, is there any reasons for doing this?

School principal: Mhh, your questions is very tough! Sometimes, I find myself in the situation where I'm forced to communicate in Oshiwambo in order to engage my audiences and for my message to be understood by everyone, especially the younger learners. I believe that when it's comes to serious matter concerning the school rules and learners' behaviours the message is strongly conveyed in their mother tongue and for the learners take the message seriously. It is also important to use the language that understood by everyone so that no one will violates the school rules (the principal's interview, 20-10-2018).

In this extract, the principal reflected on how Oshiwambo is a critical language to communicate meaning and to connect with her audiences despite her strong view on the use of English only in the school premises. On the other hand, when it comes to the school principal's language ideologies over the use of Oshiwambo particularly for teaching and learning, her beliefs were more negative, and did not appear to support multilingualism in the classroom. The principal emphasised that when it comes to the disciplinary measures, learners will not understand when it is conveyed in English. What is noticeable, is that the principal is fully aware that children do not understand English, and through using Oshiwambo, she is ensuring that it is critical to understand the school rules. Therefore, in this school Oshiwambo was regarded as a legitimate language to convey the school's rules but not necessarily for subject-specific concepts learning while English is positioned as weaker language to handle the school disciplinary matters. This revealed how the powerful English dominant ideology is enacted in actual practices in this school.

The reason for how language is being constructed in actual school practices might be attributed to the school principal's strong ideological position regarding the functions of languages within the school. In this school, Oshiwambo serves the function to convey the disciplinary meanings and to include everybody in the conversations during public gathering. On the other hand, English serves a different function, that of information dissemination, for all written communications, and it is also a dominant language for MOI in this school. All these functions resonate well with the school principal's language ideologies.

Moreover, there are direct indicators from the school's general linguistic environment that Oshiwambo is positioned as deficient for knowledge and general information dissemination in the school. In the school environment, Oshiwambo is invisible as a written language. Displayed writing around the school was sparse and there were no posters written in Oshiwambo. One might expect to see a bilingual word wall, labelling common objects in the classroom in multiple languages considering English learners' poor English proficiency, so as to help them in building their verbal repertoires. This can be associated with the school principal's strong perception of the prestigious status of English over the vernacular languages. What is interesting to note here, is that the multimodality of posters with images incorporated in the displays, are in fact an indication of embracing the multiple semiotic resources for meaning making. The visual clue of the images might help learners to construct meaning in an environment where their English proficiency is still

limited, and insufficient to understand messages written in English. When I asked the principal to explain the reason for multimodality in the school displays, she explained that they are useful to draw learners' attention to read the information. Therefore, the use of multimodality here, was not meant for meaning making, but regarded as a means to attract learners' attentions.

Figure. 5. 2 represents some of the posters displayed on the school premises

Language Ecology that shapes classroom teaching and learning

Classrooms are sites where apparent pressures and tensions between the language policy and classroom realities are visible. It is in the classroom where teachers are faced with doubled challenges that are both pedagogical and political (Probyn, 2009). One of the biggest challenges faced by the teacher and learners in this study, is of learning science language, concepts and processes and also learning English simultaneously. Despite the principal's view on keeping languages separate, and the strong advocacy of a monolingual approach to the school policy, my analysis of data in chapters 7 & 8 will show in depth how the teacher uses both English and Oshiwambo to construct Science meaning during classroom discourse. Mr. Shilumba claimed that

the expectation was that in Grade 4, teachers and learners should stick to English only. However, he claims that it was not always possible to adhere to the policy since learners will find it difficult to grasp the subject content. From my field notes, the burden of incomprehension of the content presented in English, was the reason why most of the learners were gazing away from the teacher, lying on the tables, or engaging in off-task conversations. When I asked Mr. Shilumba about his feelings concerning the use of English only MOI, he expressed displeasure with regards to English-only policy as a way of excluding learners' voices during the lesson as we can see in the extract below:

> *Extract 5. 9:*
>
> *Researcher: Do you experience any challenges of teaching Natural Science through English MoI to your Grade 4 learners?*
>
> *Mr. Shilumba: Oh yes! The fact that these learners speak only Oshiwambo, it is hard for them to learn through English medium. These learners cannot construct a simple sentence in English, therefore learning though the English medium is blocking learners to participate during the lesson and also affects their understanding of the subject matter. In this situation, I left with no choice to use Oshiwambo and also encouraging my learners to respond in Oshiwambo otherwise the lesson will be turned into the ICU. I have to admit that I 'm doing an illegal thing of using and allowing Oshiwambo during my lessons. However, I'm compelled to use Oshiwambo to remedy the situation on the ground. The realities on the ground made it impossible to use English only especially with the Grade four learners with poor proficiencies in English (Teacher interview, 28-06-2018).*

Although Mr. Shilumba, on the one hand, expressed positive attitudes toward the trend of using English as MOI as a path to school successes, on the other hand, he wondered if an English exclusive policy will be beneficial to learners with poor proficiencies in it. In extract 4.8 above, Mr. Shilumba expressed displeasure with the English-only policy, saying that it is a way of excluding learners' voices during the lessons. The use of the 'ICU' metaphor implied a tense or uncomfortable classroom environment that will not facilitate classroom interactions to enhance effective learning and that will have disastrous consequences for learners if they are forced to

remain silent. Again, Mr. Shilumba is conscious that the English-only policy might result in a very unnatural feeling in class, creating a psychological uneasiness where learners' language is not being recognised as useful resources for learning. For him, *"the realities on the ground made it impossible to use English only, especially with the Grade four learners with poor proficiencies in English".* Mr. Shilumba emphasised that he is always forced to incorporate Oshiwambo during his lessons to ensure learner comprehension, arguing that *"the lesson will be turned into the "ICU".*

On the other hand, Mr. Shilumba consistently framed the use of Oshiwambo as an "illegal" practice, and never as a valid learning strategy: *"I have to admit that I'm doing an illegal thing of using and allowing Oshiwambo during my lessons".* These data are in line with Probyn's (2009) study conducted in South Africa where the teacher viewed their acts of using codeswitching in the classroom as illegitimate and they referred to their conduct as 'smuggling the vernacular into the classroom' . One could say that it is the common myth of using English as monolingual MOI that will enable learners to become proficient in English that causes this guilt on part of the teachers. What is clear from Mr. Shilumba's interview responses is that he is trying to implement the English MOI policy because he believes it will give learners' access to the powerful resource of the English language. However, in his daily life experiences he finds the use of English as MOI as obstructing learners from learning and thus also his ability to teach science successfully. It seems that teachers take responsibility for not complying with the language policy in the classroom rather than critiquing the policy itself and the policy makers. This because there is no context created in Namibian education system where the teachers can voice their critique over the language policy. Although Mr. Shilumba displays guilt of not complying with the language policy, he continues practicing multilingualism regardless of the language policy. This is because he knows that learners will understand science better through the practices of that way. In principle, Mr. Shilumba does exercise some agency, although it fills him with guilt in doing this.

While the classroom interactions are expected to be monolingual in accordance with the English-only policy of the school, in this study English along with Oshiwambo, urban varieties and multimodality were also employed during the science lessons (see chapter 7 & 8). My field notes revealed that during classroom observations learners only interacted with one another in Oshiwambo. Learners were drawing on various linguistic resources, for example while checking

their answers with each other or when speaking about things unrelated to the exercises at hand. However, if noticed by the teacher, the learners were often reprimanded for not speaking English, and as a result many of these conversations were hidden from the "front stage" of classroom activities (Goffman, 1959), instead they become part of illegitimate "backstage" language practices. This is in line with previous research that has shown how multilinguals have resisted the monolingual language policies enforced in educational settings in the context of teaching and learning (Kiramba, 2019; Makalela, 2015, Chimbutane 2013). For instance, Chimbutane's study found a strong monolingual ideology of language separation at play in the Mozambique primary school bilingual context, while translanguaging was being practiced in the classrooms.

Conclusion

In this chapter, I investigated the language ecology that shapes the classroom practices, as well as how language ideologies could be observed and interpreted from how it actually used in the classroom. I analysed the language ecology though a wide range of data including the Namibian LiEP document; interviews with the principal, the science teacher, and learners; fieldnotes of school assembly and break time; and posters around the school. This variety of data sources revealed a clear representation of the monolingual language ideology of an 'English-only rule' and also how English is given a special status over other Namibian languages in this school. The analysis of the language ideologies shows the dominance of a monolingual norm, reflective in the participants' strong beliefs and practices of keeping languages separate in time and in space. The school system tries to impose this static context of how language should be used, whilst actual practice disrupts it. On the other hand, the language policy does not speak to the actual context of linguistic needs within schools.

Again, the data has shown how the school management is instituting and creating the English-only zones with its ruling of communications to be conducted solely in English. English continues to be viewed as a powerful commodity and its position in this school is inevitably allied to the socioeconomic forces, while multilingualism and practices are not equally acknowledged as useful resources for general communication as well as for teaching and learning in this school.

While the Namibian LiEP emphasises the schools to be 'sensitive and appreciate learners' linguistic and their multicultural diversities', by contrast, the data reveals that other Namibian national languages were far less fortunate in getting robust support in this school. These languages are not thought to be suitably adapted to deliver the curriculum, or for assessments purposes, thereby, reflecting the monolingual ideologies that some languages are less important than others. Given the dominant view of English-only language ideology in this school, it is not surprising that the Namibian LiEP's guidelines of treating all Namibian languages equally were not implemented. The language ecology of this school reflected the contradictions between the language ideologies, policy, and actual language practices in classrooms and in the running of the school. Though Oshiwambo is not given a high status in this school, in practice Oshiwambo is still used in both formal and informal spaces, such as at the school assembly, during children's play, informal conversations, and also in the classrooms.

CHAPTER 6: The effect of English monolingual policy in the classroom and assessments practices

Introduction

In this chapter, I will explore the effect of English monolingual ideologies in the classroom as well as in science assessment practices. In particular, I will analyse in depth how language ideologies shape and constrain the use of language as a resource for learning in a bilingual, linguistically diverse Science classroom. Previous scholars have documented the negative effect of English monolingual ideologies on the ability of bilingual learners to employ multiple language resources within their semiotic repertoires for learning (see Blommaert, 2006c; Kusters et al, 2017; McKinney, 2017). In post-colonial educational contexts, standardized testing materials given to students whose primary language is not English, are being developed at the same language standard of the native English speakers, without considering various cultural and linguistic differences (Krause and Prinsloo, 2016, 2019; Kiramba, 2016).

Currently, there is increasing awareness around the 'multilingual turn' (see May, 2013) as a means to address the effects of historically shaped language inequalities that marginalised and oppressed native/ indigenous languages in favour of the European languages of the minority (see Makoni and Pennycook 2007; García, 2009; Blommaert, 2010d). In this chapter, I proceed from an acknowledgement of the significance of the linguistic diversity and language resources that learners bring to the classroom as well as to science assessments and asking the important question: What is the effect of English monolingual policy on scientific concepts learning as well as on the assessment practices through a lens of 'monolingual language ideologies', 'heteroglossia' and 'multivoicedness'. I specifically draw on a translanguaging perspective to examine science teaching and learning where heteroglossic languaging practices are not being addressed in the school language policy as well as in assessment practices.

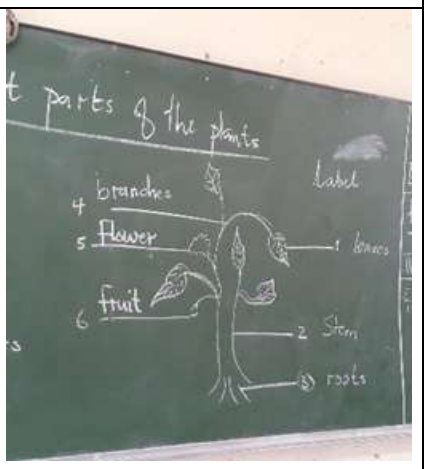
The English monolingual policy verses the Discourse of Silence

This study has investigated the affordances and constraints of the language choices, and from the field notes across all lessons, the most observable impact of monolingual ideology in this classroom was constant prolonged instances of silence from learners. Learners'emerging proficiency in the English language affected their participation during the lessons and also their ability to comprehend the science content that was presented to them. In addition, the observations in the classroom suggested that the use of English during the lessons was incomprehensible to students, regardless of the time spent during the content delivery. Learners responded to instructions in English either with rote repetition of the teacher's words, guessing the correct answer or with prolonged silence as will be shown in extract 6.1 and 6.2 below.

Extract 6.1 drawn from a teacher/ learner's interaction during the Natural Science lesson about plants, illustrates how the monolingual language policy excluded learners from active classroom participation. From observation, Mr. Shilumba asked learners questions in English on what they had learnt in the previous lesson. The learners did not answer his question immediately. The teacher continues to ask the same question several times, yet learners remained silent. The fact that the learners were not responding to his question upseted the teacher, as revealed from his tone and facial expressions.

Extract 6.1

Turns	Actor/ action	Speech	'Translation and Images
1	Mr. S	I'm asking you questions, but you are just quiet, remember next week you will be writing your first test. *Otamu shanga otest yeni yotete monext week*	You will be writing your first test next week
2	S: Interjects	*Omapulo otest okuli moshiingilisha ile omoshiwambo*	Are the questions in English or they in Oshiwambo?
3	Mr. S	*Omapulo okuli moShiingilisha* Remember the medium of instruction that we use in Grade four is English. Therefore, your test	The questions are written in English.

		questions and examinations are written in English.	
4	Ss: Learners' facial expressions show disappointment, and some were scratching their heads.		
5	Mr. S:	Now what is the function of the stem?	
6	Ss: Prolonged silent		
7	Mr. S: Pointing to the drawing of the plant on the board	Why do the plants have this stem?	 Figure 6. 1 Drawing of the plant
8	Ss: Prolonged silence		
9	Mr. S: probing further	Is to…. ?	
10	Ss: Prolonged silence		
11	Mr. S	*Olye tetu lombwele kutya oilonga yefina kutya oyashike; otodulu okunyamukula moshiwambo*	Who will tell us the function of the stem to the plant; you can respond in Oshiwambo as well
12	S	*Okula teleleko ngee hatu londo komiti*	Is to enables us to climb on the trees

In this revision lesson, we can see the learners' inability to explain the function of the stem that they were taught in the previous lesson. The use of English here evidently silenced the learners' voices, and restrained them from engaging in the discussion, and thereby also constraining them from the opportunity to acquire science knowledge (turns 6, 8 & 9).

The fact that the learners do not comprehend the question posed to them as evidenced in their silence, was met with a double threat from the teacher: an upcoming test and the language policy

of the written assessment (turn 1). Learners were positioned as if it is their own fault that they cannot respond in English or remember what was taught in the previous lesson. These learners were expected to be proficient in English, yet this is an unrealistic or impossible expectation, as these learners had limited English exposure at school in their previous grades and also in their environment. The directive given about the language policy in turn 3 evoked different emotions from learners, given their facial expressions. For instance, most of the learners were very anxious and some were scratching their heads while others were seen biting their lips as an indication of frustration (turn 4). Above anything else, they wanted to know in which language the test questions and answers must be given (turn 2). The teacher reminded the learners that even if he allowed them to respond in Oshiwambo during the lessons, they have to write in English only (turn 3). Reading from the learners' body language, these learners were suffering emotionally, and this is linked to the monolingual policy that was sanctioned for written assessments. These monoglossic conceptions of language that informs language in education policy, planning, curricula, and teaching that severely inhibits children's participation during the lessons and ultimately denies them access to quality education (see McKinney, et al., 2015).

On the other hand, while the classroom interactions are expected to be monolingual in accordance with the English-only policy of the school, in the extract above the teacher allowed the use of Oshiwambo for a specific aim, that is for translations and for meaning making (turn 2, 11 & 12). We can notice here that Mr. Shilumba responds to his learners' prolonged silence by rephrasing the same question in Oshiwambo to ensure that it is understood by his learners (turn 11). Once the question is asked in Oshiwambo, learners started to raise their hands as a gesture that they wanted to answer. A learner gave an immediate response in (turn 12) after the teacher translated the question in Oshiwambo. In this case, one can clearly see that the use of Oshiwambo enabled the learners' voice to be heard and also opens up avenues for classroom participation. The silencing would exclude the learners from meaningful engagement in the process of knowledge production as it will be shown in extract 6.2. The use of translanguaging in this case, gives greater status to learners' mother tongue, as it is utilised as a useful tool for teaching and learning. It has been established that recognizing students' identity, their culture and language is fundamental in keeping them engaged and invested in their schooling and to perform better in school (Cummins, 2011). Similarly, this observation corroborates with the study of Li Wei and Wu (2009) in China, who observed that although schools try to impose an official language policy of 'One Language

Only', such policies are always contested when both teachers and students are frequently using code-switching between English and Chinese.

The Discourse of Rote repetition and Guessing

The way the teachers organise their instructional talk determines the extent to which learners get access to talk about science, thereby, gaining scientific knowledge (Lemke, 1990). Therefore, it is essential to understand how the teacher structured the classroom discourse in terms of taking an authoritarian role and controlling the classroom talk, topics and all activities and the implications thereof for science teaching and learning. My observations were premised on the understanding that when teachers and learners engaged in discussion, sharing ideas, and shaping each other's understandings, their talk facilitated co-construction of meanings and understandings. In what follows, I will first give an overview of all lessons episodes in order to get a general view of the classroom discourse patterns across all lessons observed.

Teaching and learning activities across all lessons observed

The Namibian curriculum prescribes what to teach and how Science content should be taught within a given timeline. Thus, all classroom activities tend to follow one another in a more or less definite order. Mr. Shilumba's lesson plans were in line with the prescribed topics and time allocated to teach each specific unit. Although lessons are allocated equal time of 40 minutes per period, it was observed that on many occasions the length of lessons observed varied considerably from 45-55 minutes. The development of each lesson from one activity to the next, is highlighted in table 6.1 below and all the lessons observed followed a similar pattern.

Lesson stage	**Lesson activity**
1.	Introduction of the topic based on the previous lesson taught
2.	Teacher/ whole class questions and answers sequences based on the content taught on the previous lesson,
3.	Reviewing & textbook expositions
4.	Presenting & explaining textbook content

5.	Teacher/ whole class questions & answers session generated from the content taught.
6.	Learners writing notes from the board

Table: 6.1: An overview of lessons structure

Most of the lesson time was spent on asking questions generated from the previous lesson's content. The lesson episodes highlighted the routines of the teacher reading from the textbook followed by discussing the textbook content. No other materials, apart from the teacher's textbook, were used in all lessons observed. As a result, teaching and learning was based on the prescribed Natural Science textbook's content. Often, the teacher would read a phrase from the textbook, followed by a further explanation of the science concepts, yet learners were inattentive, and most of them would lie down on their desks, or chat to one another on non-subject related matter (field notes data).

In most of the lesson episodes, Mr. Shilumba guided the discourse very strictly following questions-and-answers sequences while encouraging the discourse of rote repetitions and guessing as exemplified in the extract (6.2) below. This extract was taken from a Natural Science lesson in which the focus was on the characteristics and features of vertebrates and invertebrates. It is a new topic presented to the learners. This particular extract was selected to illustrate how the teacher and learners engaged in typical IRF discourse moves as will be highlighted later. The first classroom activity, lasting for 30 minutes, was spent in whole-group activity, with the learners seated in vertical rows facing the teacher and the chalkboard, and where the teacher asked closed questions.

Extract 6.2

Turns	Actor/ action	Speech	Moves	Act
1	Mr. S	The vertebrates are animals that have a ba…..?^	I	Initiation CQ
2	Ss: Prolonged silence			
3	Mr. S	The vertebrates are animals that have got what?	I	Initiation CQ
4	Ss: Silent			

5	Mr. S	The vertebrates are animals that that have the backbone. All animals that have the backbone are called vertebrates	F	Provided an answer
6	Mr. S	And the invertebrate animals; are animals that do not have what?	I	Initiation CQ
7	Ss: Silent			
8	Mr. S	That do not have bones.	F	Provided an answer
9	SS: Not paying attention; some are lying on their tables			
10	Mr. S	T: *Opena oinamwenyo imwe ina ekipa lokombuda; opena imwe kaina shike* [There are animals with backbones and there are also animals without what]?	I	Initiation CQ
11	SS: Shouting	*ekipa lombuda* [a backbone]	R	One-word answer
12	Mr. S	Okay, that do not have the backbones	F	Teacher restates
13	Mr. S	Can you mention any animals that do not have the backbones	I	Initiation CQ
14	SS: Silent; and some learners are looking away			
15	Mr. S	Animal you can remember with a backbone.	I	Initiation CQ
16	S: shouting	Goats!	R	One-word answer
17	Mr. S	Goat, yes	F	restates & evaluate
18	Mr. S: Nominating another learner	What else, yes?	I	Initiation CQ
19	S	Dog	R	One-word answer
20	Mr. S	Dog, yes!	F	restates & evaluate

21	Mr. S	Give me an example of animals without the backbones?	I	Initiation CQ
22	SS: Silent			
23	Mr. S	*Popya oinamwenyo kaina ekipa lopombuda* [mention any animals without the backbones?]	I	Initiation CQ
24	S: Shouting	Snake!	R	One-word answer
25	Mr. S	Does the snake have a backbone or not?	I	Ignore & Initiate
26	SS: Shouting	Yes/ No!	R	One-word answer
27	Mr. S	*Kali nasha* [does it have]?	I	Initiation CQ
28	SS: Shouting	*Aaye; olina; kali na* [yes it has, no it does not have]!	R	One-word answers
29	Mr. S	When we say, hit the snake on its back; why do you hit it there?	I	Ignore & initiate
30	Ss: Prolonged silent			
31	Mr. S	*Omolwashike holidengele kombuda* [Why do you hit the snake on its back]?	I	Ignore & initiate
32	Ss: Prolonged silent			
33	Mr. S	*Osheshi wa hala uteye shike* [because you want to break what]?	I	Prompt & clue
34	SS	O*mbuda* [the back]	R	One-word answer
35	Mr. S	*Uteye shike* [to break what]?	I	Initiation CQ
36	SS	*Ekipa* [a bone]	R	One-word answer
37	Mr. S	*Ekipa,* [a bone] yes*!*	F	restates & evaluate
38	Mr. S	Are you still saying it does not have the backbone?	I	Initiation CQ

39	SS	*olina sha* [it has]	R	One-word answer
40	Mr. S	*Paife eyoka olili kongudu ilipipo* [So now; the snake belongs to which group]?	I	Initiation CQ
41	SS: Prolonged silent			
42	Mr. S	T: Verte…….?	I	Initiation CQ
43	SS: Shouting	SS: Vertebrates	R	One-word answer
44	Mr. S	Yes, vertebrates	F	restates & evaluate
45	Mr. S	What is the invertebrates' animals?	I	Initiation CQ
46	S	Animals with wings	R	Provided explanation
47	Mr. S	What are invertebrates animals	I	Ignore & Initiate CQ

Key codes used: I = Initiation R= Response F: Feedback CQ= Closed question

The discourse patterns in this teaching episode demonstrates the teacher-fronted talk, combined with the dominant patterns of IRF interactions. We can see the teacher's preferences of asking questions that are not meant to probes learners' understanding or to elaborate on their ideas (CQ). For instance, the questions in turns 1, 3, 6. 10, 15, 18 & 20 are designed to elicit a quick one-word response or correct phrases in order to cover the science topics within the given time. We can see how learners' responses were generally limited to brief or one- or two-word answers, or chorused (equally brief), formulaic responses. For example, Mr. Shilumba asked learners a closed question in (turn 1), "the vertebrates are animals that have a…" This question offered learners with only one option where they are expected to reply with a specific word immediately without being able to justify their answers. The fact that the content is new to these learners and possibly and their limited English language proficiency, can explain why they did not raise their hands to respond. Instead, learners remained silent for a while. Mr. Shilumba then repeated the same question in (turn 3), yet none of the learners volunteered a response. In some instances, the teacher responded

to his own questions (turns 5& 8). Though the exposition of the lessons appeared to be in the form of questions and responses (IRF) move, in fact the teacher occupied both I and R moves. There is a clear representation of English as MoI inhibiting learners to respond to the English questions.

Important to note here, the use of English to formulate the elicitation in most of the turns resulted in learners' prolonged silence. For instance, in turn 29, he asked a question; *"when they say; hit the snake on its back; why do you hit there";* this question was followed by prolonged silence (turn 30), an indication of their inability to reply in English. These factors might explain why the teacher resorted to monologues, and to the learners' inability to produce extended talk during the lessons. It is clear that the learners' responses were far from those that would possibly communicate science meaning as occurs in turns 11, 16, 19, 24 & 26. Although the teacher poses some questions in Oshiwambo, learners still resort to one-word answers (turns 11, 24, 28, 36, 39), or sometimes to prolonged silences (turns 32 & 41). This indicates that the learners' lack of participation is not only influenced by the use of English as MOI, but also by the teacher's closed questioning techniques that discouraged learners to engage in extended talks or exploratory talk . Ironically, the nature of the questions posed by Mr. Shilumba and the forms of the answers they required, and the fact that learners have limited proficiencies in English, further constrained their engagement in more dialogical and exploratory verbal interactions. As the Grade 4 learners are still in the process of developing English competencies, one would expect questions that elicit more than one-word answers, and instead as a full sentence. On the other hand, it is because the teacher is aware of his learners' poor competencies in English and their brief responses that leads Mr. Shilumba to resort to a 'safe-talk' zone (Chick, 1996) of less cognitively demanding questions.

A discourse strategy that Mr. Shilumba followed was to restate the learners 'answers (turns l, 11, 17, 19 & 20) which he used indirectly as a confirmation of their responses without providing them with elaborated feedback. Mr. Shilumba did not ask learners to elaborate on their ideas or ask for further clarifications. Rather, he encouraged learners to provide a specific word answer that he is looking for (turns 16, 19, 24). In return, Mr. Shilumba ratifies learners' responses as correct by an affirmation of 'yes' and by a repetition of the learners' answers; he kept on nominating another learner to respond to the same question (turns 17, 20, 37, 44) . The teacher's questioning patterns encouraged learners to guess the correct answers. For instance, in turn 25, he poses a question, *"does the snake have a backbone or not",* and the learners shouted together immediately

for the answer (turn 26). Mr. Shilumba went on further to ask the same question without evaluating the learners' response , 'does it has' (turn 27) and learners shouted by guessing the correct answer in turn 28. These types of questions might limit learners to engage in cognitive thinking and possibly result in low levels of cognitive and linguistic development on part of the learners. This is enormously problematic as the learners are not provided with access to knowledge production or afforded with the opportunities to understand the new scientific concepts.

There were also some incidences of choral responses/repetition in this lesson episode in which learners are responding to the teacher's questions, while giving a verbal response collectively as we can see in (turns 11, 26, 28, 34. 36. 39 & 43). These learners seem to be accustomed to choral responses encouraged by the teacher's questioning style. For instance, a question like 'are you still saying it doesn't have the backbone' (turn 38), by its nature, it is directed to the whole class. The whole class responded in chorus to this question by guessing the correct answer in Oshiwambo; "olina sha [it has]" (turn 39). Again, learners use choral responses in a defensive way which may indicate that they are not certain of their answers and they are avoiding making bids for individual turns (turns 34, 39 & 36). The teacher affirms the choral response through restating the learners' choral response (turns 37 & 44). Important to note here, is that not all learners contributed to the chorusing responses; instead, some learners pretended to move their lips without making any contributing to the utterances (field notes).

Again, some of the learners' responses appear to be formulaic in nature. For instance, in turns 26 & 28, learners make the use of formulaic chunks such as: *'yes/ no; yes, it has, no it doesn't have*". However, such formulaic chunks, as Wood (2002:2) noted, could be construed as "basic to language development, processing, production, and learning", particularly since these learners are in the transitioning Grade. Certainly, the formulaic and choral responses observed here enabled Mr. Shilumba to get his Grade 4 learners to make contributions during the lessons, that would have been unlikely if questions were open-ended, considering learners' proficiencies in the MOI. Chick (1996) has given the term 'safe-talk' to the chorusing in a Grade 7 mathematics lesson in KwaZulu-Natal. He noted that chorusing responses provide means to maintain learners' dignity, despite the fact that learning might not be effective. The safe-talk enacted here, with cued elicitation and choral responses, enabled the learners to participate in classroom discourse and take up the positioning of knowers and active learners, despite their limited proficiencies in English.

While the safe talk prompts learners to contribute during the lessons, this kind of talk might prevent learners from producing their own meanings, and as a result they are left without opportunities to participate meaningfully in learning and to access the curriculum (McKinney et al. 2015).

Also noticeable in extract 6.2, is the teacher's tendency of cued elicitations. This incidence occurs when Mr. Shilumba repeatedly asked the learners to complete a sentence or a word, signaled by a rising intonation at the end of the sentence or a word. For instance, in turn 1, the teacher uttered the incomplete sentence *"the vertebrates are animals that have a……",* and then he skipped the last two letters in the word *back* as well as a word *bone* while using the rising intonation [^] signaling to the learners to complete the sentence with the predetermined answer. Again, the teacher omitted the last syllable within the word "verte…*brates'* which he leaves out in his word 'cues' with the rising intonation, as we can observe in turn 42. In turn 43, learners completed the word 'vertebrates in a choral response. Important to highlight here, is the monological talk revealed when Mr. Shilumba himself completes his utterances simultaneously with the learners' chorus responses. When learners did make mistakes or provided 'incorrect' answers, the answers were either passed over or, more rarely rejected, and they were not discussed further by the teacher during the lesson. For instance, in (turn 46), a learner had a misconception that invertebrates are, "animals with wings. The teacher did not probe the learner further to elicit improvement on this incorrect answer, and thus did not encouraged the learner to verbalize his understanding, so as to determine what the learners was thinking. Mr. Shilumba's evaluations of learners' answers, as it can be seen in turns 11, 17, 19 , 20 & 47, were achieved chiefly by redirecting the same question to another learner or by moving on to ask a different question. This is indicative that explicit evaluations were rarely observed in this lesson episode. This echoes Westaway's finding (2017) regarding the sparseness of teachers' 'evaluation' or 'feedback' in the study she conducted with Foundation Phase mathematics teachers in the Eastern Cape Province in South Africa.

The amount of pressure placed on Mr. Shilumba to cover the curriculum on time, might also explain why no time was devoted to feedback, group work, science experiments, or to give learners enough time to think before they respond to the teacher's questions. What I found striking during the classroom observations was the limited space for peer collaborative work or discussions, despite the teacher's firm beliefs in the importance of collaborative work and oral language development, as he expressed during the interviews. This might be attributed to classroom seating

configurations in which learners were seated individually in rows facing the teacher and the chalkboard. The classroom seating arrangement, as well as the physical space of the classroom, was not designed in a way that positively influenced classroom discussions and collaboration amongst the peers (McKeown et al. 2015). All classroom routines were regulated by the teacher's common belief and his personal goals as a teacher of covering the Science curriculum on time in order to prepare his learners for their final examinations, as illustrated in the extract below:

Extract: 6. 3

Researcher: As a science teacher, do you a have a specific vision in your teaching career?

Mr. Shilumba: I've the great responsibility to make sure that the lessons objectives and the content are covered in the given time and my learners are well prepared to write their final exams. Despite of learners' English limited competencies; I have to push harder to keep up with the National syllabus. I don't want to be pointed fingers if I failed to cover the content in the given time. As a subject's expertise, I have to facilitate and transfer my science knowledge to my learners in the given time. I have to control all the activities during the lesson and make sure that the time is well preserved on the targeted goals (teacher, interview, 28 /06/2018).

From the extract above, there is an indication that Mr. Shilumba is working under pressure to teach science through English as MOI, combined with the demand to cover the curriculum on time and also, the pressure of preparing his learners for their final exams. This is the second time Mr. Shilumba talks about getting into trouble if he does not conform to the external sanction, while expressing his concerns over losing his job. This emphasises the lack of agency on the teacher's part in making his own choice over on how to adapt time for curriculum delivery based on any needs that may arise. The lack of agency might have contributed to Mr. Shilumba's use of highly controlled IRF discourse moves without creating spaces to interrogate his learners' ideas through exploratory talk. The fact that Mr. Shilumba was always cautious about being judged as an incompetent teacher by the highest authority which is the school management and subject advisory ; his main concern was to cover the curriculum on time and to protect his integrity.

Mr. Shilumba emphasised the benefits of exposing learners to questioning and answers during the lesson as a way of preparing them for their final exams. Subsequently, Mr. Shilumba's personal

view of being a subject expert, of controlling classroom activities and transferring knowledge though a questioning strategy as a means to high performances in Science, have influenced the manner in which he structured the classroom discourse. While the teacher considered the questioning and answer techniques as a way to equip learners to excel in examinations, on the other hand these learners might not engage in the discourse that afforded them with opportunities to construct scientific ideas. Mediation of the scientific concept, in Vygotskians terms, might not be a probable outcome in the kind of IRF patterns enacted in this extract. Even though Mr. Shilumba assumed that the IRF pattern is beneficial to quickly assess the learners' understanding of scientific concepts, it is also labelled as a controlling device where the teacher applies "intellectual brakes" (Perrott, 1988). The IRF patterns can potentially preclude effective learning and thus these learners are not free to engage in independent thinking (Tharp & Gallimore 1988). Therefore, the manner in which science content was presented to the learners in extract 6.2 might remain implicit to the learners despite the efforts and intentions of a good teacher (Lemke, 1990).

While the Namibian curriculum is advocating learner-centered education, in extract 6.2 Mr. Shilumba controlled how the science lesson should proceed, which left relatively limited space for learners' interactions, or to talk science in their own way, or to make a substantive contribution during the lesson. Mr. Shilumba also acted as an expert of science knowledge who is in charge of leading the classroom interaction and evaluating the accuracy of his learners' responses. Learners were not encouraged to challenge the teacher and initiate questions since the assumption is that the teacher is the one who initiates the talk. Thus, the teacher takes most of the turns and holds an authoritative role on the conversational floor. For instance, in most of the lessons observed, Mr. Shilumba planned lessons to read from the textbook and ask closed questions for a longer period of time. Thus, all lessons observed typically involved the teacher introducing and closing each lesson, managing the classroom, covering the syllabus, and discussing the textbook content that was only available to the teacher, as children did not have textbooks (field notes).The fact that the classroom activities were highly controlled within the framework of IRF moves, positioned the learners as passive recipients of the teacher-mediated knowledge. This discourse pattern has been criticised for its detrimental effects on learners' maximum participation in meaningful learning (Lemke, 1990), and also "excluding the negotiation of meaning which is necessary for the collaborative construction of knowledge" (Van Lier, 1996:151–152).

Monolingual Ideology in Science written assessments

Previous scholars have noted that emergent writers find it difficult to draw from their multilingual resources as a result of the authoritarian single voicedness advocated by the school and the national curriculum (see Kiramba, 2016; Canagarajah, 2013). When I interviewed Mr. Shilumba about the monolingual policy of written assessments, he recognised learners' poor proficiency in English as contributing to high failure rates. Despite the fact that learners do not know how to express themselves in the targeted language during written assessments, and the density of science language, the teacher emphasised that *'they are expected to follow what the policy says'*. When I asked Mr. Shilumba about his feelings concerning the use of English only during written assessments, he expressed a firm conviction of not allowing learners to use other languages during written assessments as illustrated in the extract below:

Extract: 6.4

R: To what extend do you follows LiEP when it comes to written assessments?

Mr. Shilumba: Mhh, remember the medium of instruction is very clear that, From Grade 4 English is MOI. Although learners have challenges of comprehending and answering questions in English during the written tasks, we are compelled to follow the policy very strictly during the written assessments. The fact that the learners' scripts are send to school external moderations there is no room for sympathy, or to maneuver their responses, otherwise your integrity will be questioned. Therefore, I have to make sure that I protect my integrity to keep my job (teacher interview, 28-06-18).

Extract 6.4 reflects the pressure placed on Mr. Shilumba to endorse the language policy that emphasises the monoglossic approach to written assessment. There is a signal of political pressure linked to teachers' being expected to comply to the LiEP and enforced by controlling devices imposed upon teachers by the highest authority (school external moderators) to stick to what is considered as the correct language for summative assessments. Regardless of the learners' proficiency in English, Mr. Shilumba purports that 'there is no room for sympathy or to maneuver his learner's responses when it comes to written assessment'. According to him, he is compelled to follow what the policy says so as to protect his integrity and keep his job. Thus, his lack of

agency might increase the pressure not to make a well-informed decision during the assessment of his learners, as is evident in his learners' written scripts that will be shown later in Chapter 8.

It is observable that Mr. Shilumba did not assume the position of acting independently and to make personal decisions that suit his learners need with regards to the language policy for assessments For instance, when he emphasises that *"we have no choice; "we are compelled'*; it's a clear reflection that he internalised the policy expectations, as enforced by the moderating system, instead of positioning himself as an individual teacher. While Mr. Shilumba is cognisant of learners' poor English proficiencies as a barrier to handle the demand of science assessments, he is yet constrained by the pressure of the 'controlling devices' over the language usage during the written assessments. For this reason, Mr. Shilumba is always mindful of the language policy's expectations. Mr. Shilumba has appropriated what Bakhtin (1981) terms 'the voice of others', in this case the monolingual LiEP's voice. This phenomenon is demonstrated on a number of occasions where he spontaneously reminded his learners of what language should be used during the written assessments as exemplified in the in extract 6.5 & in figure 6.2. In the extract below we can see how the monolingual language policy is strongly supported. The conversation started with the teacher reminding learners of the upcoming test and the written language policy.

Extract: 6.5

> *1. S: Aatu dulu okunyamukula nomoshiwambo [is it possible to respond in Oshiwambo as well]?*
> *2. T: Inamu pitikwa okushanga moshiwambo meetest nomekonaakono; nande ohandi mweefa mu nyakule omapulo motundi moshiwambo; ngee ota shiya kokunyola; omu na okunyola moshiingilisha ashike [you are not allowed to respond to the tests and examinations in Oshiwambo. Even if I allowed you to respond to questions in Oshiwambo during in the lesson, when it's come to writing; you need to write in English only].*
> *3. Ss: {learners look extremely disappointed by the news; from their facial expressions and their body gestures]}*
> *4. T: Remember; nande owashanga enyamukulo lili mondjila Moshiwambo; itandi kupe ongobe [even if you give a correct answer in Oshiwambo, I will not allocate any marks to your answer]*

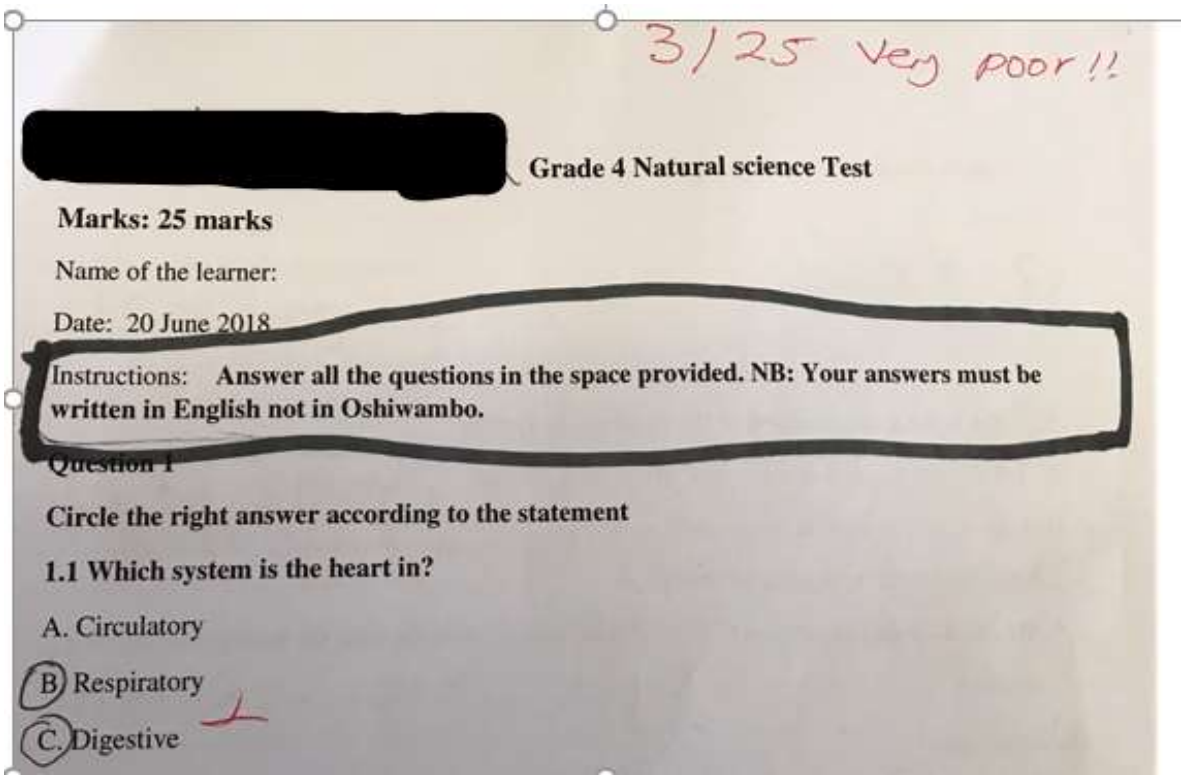
A learner was very curious to know if they are allowed to use Oshiwambo during the test (turn 1). The teacher responded immediately that learners are expected to give answers in English only (turn 2). The written language policy sanctioned here, does not sit well with the majority of the learners.

From their facial expressions and their body gestures, they look disappointed and they seem not to agree with the teacher's directives. Despite learners' poor competencies in English, they were threatened with marks reduction even if they provided correct answers in Oshiwambo (turn 4). The language ideologies observed here is in line with what is regarded as a legitimate language for 'doing' and 'writing Science'. Learners are expected to use what is regarded as the correct written English.

The use of Oshiwambo and other language varieties during written assessments was found by the teacher to be a constant dilemma as a consequence of learners' lack of proficiency in the English medium as reflected by Mr. Shilumba' responses below:

> *"Due to learners' lack of proficiency in the English medium, learners use the wrong language during written assessments. They always insert Oshiwambo words if they can't recall a word in English".*

In the scripts below in figure 6.2, we see further evidence of assessment policies and testing practices based upon an English monolingual and monomodal approach.


3/25 Very poor!!

[redacted] Grade 4 Natural science Test

Marks: 25 marks

Name of the learner:

Date: 20 June 2018

Instructions: **Answer all the questions in the space provided. NB: Your answers must be written in English not in Oshiwambo.**

Question 1

Circle the right answer according to the statement

1.1 Which system is the heart in?

A. Circulatory

B. Respiratory

C. Digestive

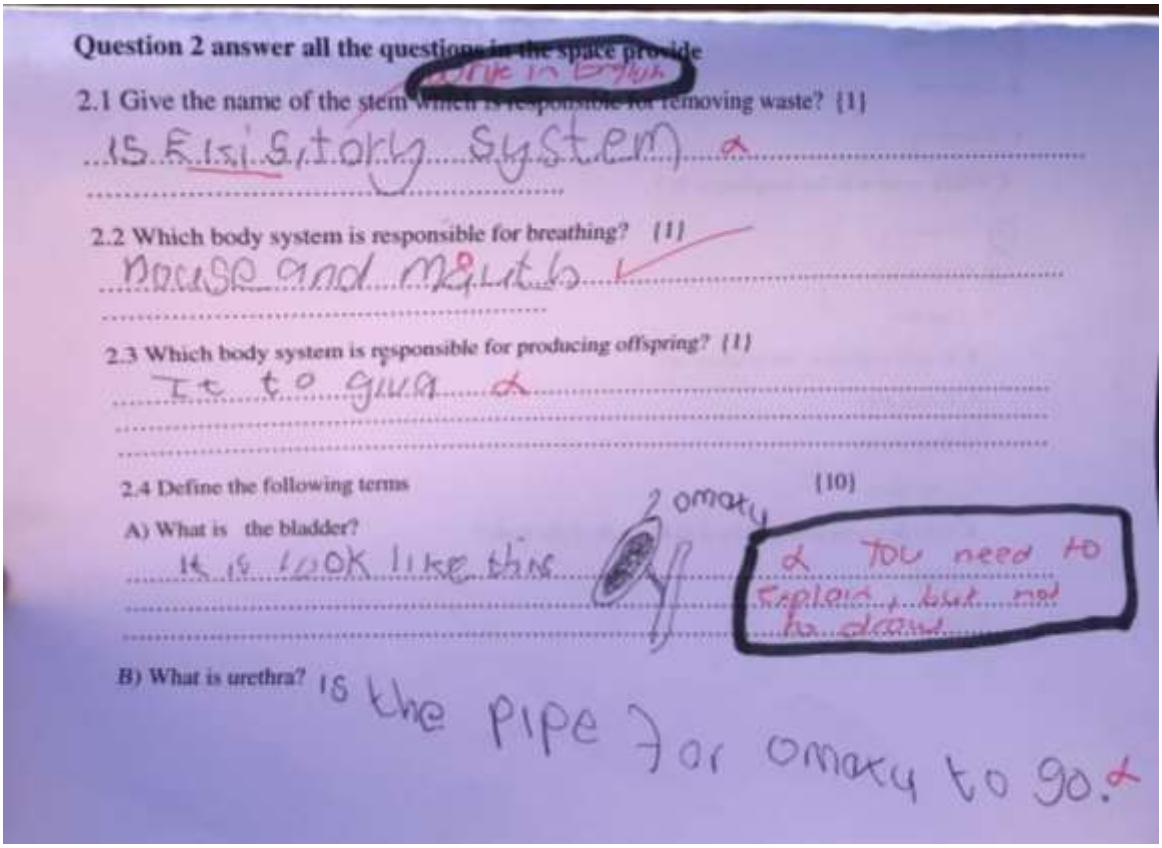


Figure 6.2 Learners' written assessments texts

As we can see in figure 6.2, the monolingual language ideologies were made explicit in written assessments discourse in the form of invocations of 'English only rules' as is it can be seen on the circled instructions imposed on a learner's science written assessment; "**NB: your answers must be written in English but not in Oshiwambo; Write in English; You need to explain but not to draw".** In these instructions, there is an authoritative voice, as indexed by the imperative phrase *'"must be and you need to"* that serves as obligatory rules to control the monopoly of monolingualism. What is clear from the said obligatory rules, is that the assessment is not only aimed to evaluate if the learners have appropriated the science content presented during the lessons, but it is also concerned with what language to give the answer in. Another English language policy sanction is reflected when Mr. Shilumba tries to strictly follow the language policy that mandates that the written assessments be carried out exclusively in the target language, without accommodating any other linguistic resources. For an example, in question 2.1 in figure 6.2 Mr. Shilumba asked learners to mention the name of the organ that is responsible for removing the waste. A learner gave a correct response of '*Ekisitory system'*. As a result of what is regarded

as incorrect language resources by the monolingual policy, her response (unconventional spelling of 'excretory') was rejected, In this case, a learner uses her semiotic resources at her disposal to make Science meaning. From the teacher's evaluation, it is correct but with incorrect language use. The teacher demanded a learner to provide the correct English standard form. The level of the standard language demanded here, is significantly higher than the language competencies that this Grade 4 learner has.

Conclusion

In this chapter, I investigated the impact of the English monolingual policy on classroom language practices as well as in science written assessments. The most observable impact of a monolingual ideology in this classroom was constant prolonged learners' silence and the discourse of rote learning. Learners' emerging proficiency in the English language affected their participation during the lessons and also their inability to comprehend the science content presented to them. In addition, the classroom observations suggested that learners found the use of English during the lessons incomprehensible, regardless of the time spent during the content delivery. Learners responded to instructions in English either with rote repetition of the teacher's words, guessing for the correct answer or with prolonged silence.

The data presented here also revealed that classroom discourse was dominated by the IRF structure, made up of teacher explanation and question-and-answer sequences in which the teachers maintained tight control to ensure curriculum coverage in given time. However, the discourse rules being imposed by the teacher, as indicated in the data might not allow learners with sufficient opportunities to engage in discourse that could be considered as the result of scientific thinking. It is the English MoI that proved challenging for the learners to engage in science learning, turning them into passive recipients of the science knowledge. In addition, the language policy that mandates the use of English in the written assessments, discourages learners from using their semiotic resources at their disposal. Therefore, these learners might face challenges to execute their assessments tasks because their language competencies do not meet the requirements of what is regarded as a standard language for assessments (further analysis in Chapter 8). In the following chapter (Chapter 7), I will analyse how the discourse interaction patterns during the science lessons engage or constrain learners in developing science knowledge.

CHAPTER 7: The construction and misconstrual of science in classroom discourse

> *"… It is essentially in the discourse between teacher and pupils that education is done or fails to be done" Edwards & Mercer (1987:101).*

Introduction

In this chapter, I will provide a detailed analysis of how the teacher attempted to support the construction of science knowledge through classroom discourse, paying particular attention to how meaning is made through the use of multiple modes within a linguistically constrained context. Data analysis in this chapter focuses on the classroom discourse in which conceptually demanding science topics and processes (such as plants as living organisms, photosynthesis, nervous system, and respiratory system) were taught to Grade 4 learners. Science as a specialized language has "a specific grammar (passive voice), certain rhetorical structures or figures of speech" (Lemke, 1990:21) as well as terminologies that are not familiar to the emergent bilingual learners. I will show that it is the thematic patterns of the scientific language, concepts and their relationships that are not made available to the learners and that obstruct them from learning to talk in the language of science (Lemke, 1990). Lemke (1990:1) referred to "the thematic pattern of the science content', to exemplify how the science ideas or concepts are introduced from different perspectives to the learners, and in turn, learners are expected to master science thematic patterns in order to talk science in the acceptable scientific ways. The basic tenet which Lemke suggests is that science learning entails the process of learning "to communicate in the language of science and act as a member of the community of people who do so' (Lemke, 1990:1).

Lemke argues "we do not want students to simply parrot back the words. We want them to be able to construct the *essential meanings* in their own words and in slightly different words as the situation may require" (1990:105). The purpose of this study is to investigate how a teacher navigates the difficulty entailed in teaching children in a language that is not their own and simultaneously developing academic language proficiency and science-specific disciplinary content knowledge. I will explore the ways in which the teacher and learners use semiotic resources to construct science meanings and how such practices enabled or constrained his learners to construct science meaning in whole class teaching situations. This chapter is concerned with, "the ways in which knowledge is presented, received, shared, controlled, negotiated, understood and misunderstood by teachers and children in the classroom" (Edwards and Mercer, 1987:1). I will

therefore address my second research question in this chapter: How do the teacher and the learners attempt to make science meanings in a context where English is used as the official medium of instruction?

I analyse the attempts made by the teacher to model scientific concepts while using different modes to facilitate learners' meaning-making of science concepts. In the first part of the chapter, I apply Gibbons' notion of "bridging discourse," which "meshes the everyday register with subject-specific ways", thus building on students' prior knowledge and current language as a way of introducing them to new language" (Gibbons, 1999: 62). I employ the notion of "bridging discourse" to interrogate how the teacher supported the learners to progress from their common-sense knowledge toward the more technical scientific knowledge through understanding/mastering technical science. The bridging discourse allows the teacher to move between languages and registers, to make the connections from unfamiliar to familiar science knowledge and language and to enhance effective science learning. In the final part of this chapter, I focus on how the teacher attempted to support the construction of science knowledge and how science meanings were constructed through the use of multiple modes. Important to note, the effectiveness of the classroom discourse in Mr. Shilumba's class is uneven. Therefore, my data analysis will show both moments where learners seem able to engage in meaning-making and develop their understanding as well as those moments where meaning-making is unsuccessful.

Lessons and topics in the Grade 4 Science class

The Namibian National curriculum for Basic Education (2016) provides a coherent and concise framework on what content should be taught, the competencies to be achieved and pace at which each topic should be covered, specifying exactly how many lessons should be taught on each topic to ensure consistency in the delivery of the curriculum throughout the country. The same curriculum also prescribes a framework for the syllabus development of learning material, textbooks for the various subjects and areas of learning, to guide teachers' schemes of work and lesson plans (The National Curriculum for Basic Education, NIED 2016). Mr. Shilumba planned to follow the content and the time allocated to each unit or topic. Thus, all Mr. Shilumba's lessons plan were in line with the curriculum's prescriptions.

To guide the reader, Table 7.1 presents an overview of lessons and the topics from which each extract used in this chapter, was taken from.

Extract no	Lesson no.	Date	Topic
7.1	1	06-02 2018	The structure of the plant & the process of photosynthesis
7.2	2	07- 02 -2018	The structure of the plant & the process of photosynthesis
7.3	2	07- 02 -2018	The structure of the plant & the process of photosynthesis
7.4	Interviews	22.06.2018	Interview with x
7.5	Textbook passage	15. 08-2018	Textbook passage on the definition of the process of photosynthesis
7.6	2	07- 02 -2018	The structure of the plant & the process of photosynthesis
7.7	5	10-06-2018	The system of the body
7.8	6	11-06- 2018	Respiratory system
7.9	6	11-06-2018	Respiratory system
7.10	7	12-06 -2018	Respiratory system

Table 7.1: The lessons and topics from which extracts were taken

The use of everyday analogies that constrained Science meanings

Mr. Shilumba attempted to use different metaphors and analogies to facilitate his learners' understanding of scientific terminologies and concepts highlighted in the textbook passages. In doing so he aimed to explain the new and/or abstract scientific terminologies and concepts into more familiar terms that are easily understood by his learners. As Aubusson, Harrison & Ritchie (2006) highlighted, metaphors and analogies are incorporated into science lessons to help learners bridge their understanding and make connections between everyday familiar concepts and the unfamiliar scientific concepts. In the lesson discussion about 'plants as living organisms', Mr. Shilumba attempted to mediate his learners' understanding of the specialized science language

by including everyday experiences, analogies and metaphors in order to construct the meaning of the targeted scientific concepts. The extract that follows, illustrates the occurrences where the teacher attempted to use analogies from everyday life in order to lay a foundation for constructing the meaning of the scientific concepts. The whole lesson activity is concerned with the process of photosynthesis, which is one of the most important concepts in Grade 4 Natural Science under the theme: living and non-living things. The teacher informed the class that the lesson is a continuation on the previous lesson about the plant structure and the process of photosynthesis. The extract below is based on revision of the content taught in the previous lesson.

Extract 7.1: When analogies are unsuccessfully construed to convey science meanings (for transcription conventions, see appendix c)

Turns	Actor/ action	Speech	Translation and Images
1	Mr. S	For the plant to make their own food…that process is happening where?	
2	Ss: gazing away; prolonged silence		
3	Mr. S	It take place in the... ^?	
4	Ss: silent		
5	Mr. S	In the leaves	
6	Mr. S	So; those are the functions of the leaves. That's; why plants have leaves because they cook food for the plants. We also get the oxygen through the leaves (.). We said there are tiny hole in the leaves.	
7	SS: learners are not paying attention; some are having private conversations; some are looking out of the window		
8	Mr. S: very annoyed	*Mweneni utale! Otwati momafo omuna oumbululu; hashoo*	Can you please keep quiet! We said there are holes in the leaves. Is not so?

9	Ss: Shouting	Ee	Yes
10	Mr. S	Do you guys understand what I'm explaining?	
11	Ss: Shouting	No!	
12	Mr. S Mr. S: using the gesture of folding his hands wide open while looking through his hands and moving his hands closer to the eyes to demonstrating looking through the microscope	*Oimeno opo ininge oikulya; oya pumbwa osunlight yoenergy taidi ketango; yoo oenergy ohai pitile moumbululu vashona vomafo; ihava monika nomesho; shapo ongee tolongifa omicroscope* Those tiny holes (..); we cannot see them with our own eyes; but we can only see them with the microscope like this	For the plants to make their food, they need energy from the sun, and that energy pass through the tiny holes in the leaves that we cannot see with our naked eyes.
13	Ss: looking very confused from their facial expressions, some were scratching their heads, and some were biting their nails		

14	Mr. S: walking toward the chalkboard and start pointing to the drawing that was already on the chalkboard	So, you see here, these are the tiny holes I' m talking about, where the gasses passes though for the plant to breath. Do you understand?	 Figure 7.1: the drawing of the structure of the plant
15	SS: Learners look very confused and are not paying attention; some are looking outside some are busy drawing their personal drawings		
16	Mr. S	Another function of the leaves?	
17	Ss: prolonged silent; and most of the learners were looking outside through the window		
18	Mr. S	Is where the food is…. ^?	
19	Ss: silent		
20	Mr. S	T: Is where the food is… ^ ?	
21	Ss: prolonged silent		
22	Mr. S : Reading from the textbook	Is where the food is produced. So; "the plants make their own food, and	

		they are produced in their leaves. The plants need sunlight from the sun; they need water from the soil, and they need air that is passing through their leaves".	
23	S: Very curious	Sir! *oimeno nayo ohaiteke oikulya yayo*	Sir! Does the plants cook their own food as well?
24	Mr. S	*Oimeno nayo ohaiteleke oikulya yayo ndee ihai longifa oprocess yafa eihatu longifa ngee hatu teleke;* for example, oimeno *ihai longifa oikuni; ihai lande omakoloni; ombelela; ocooking oil; eespice; eenyanga; omatama nosho tuu komarkert.* The plants use sunlight instead of the firewood, they use mineral salt instead of salts and spices, and they also use carbon dioxide instead of oxygen.	Yes, plants cook their own food, but they don't use the same processes we use when we are cooking. For example, the plants don't use firewood and they do not buy macaroni, meat, cooking oil, spices, onions, tomatoes and other things from the markets
25	Ss: learners look very shocked with the mouths wide open, and they were all listening attentively		
26	S:	*Sir! Oimeno ohaili ngeipi oikulya yookaina okanya nomulungu*	Sir! How do the plants eat their food if they don't have mouth and stomach like us?
27	Mr. S	*Ondati oimeno ihaili yafa aanhu noinamwenyo; ihaili yetufa nande ohai ningi oikulya yayo*	I said plants do not feel like us human beings and animals, although they make their own food
28	Ss: Learners seem not satisfied with the teacher's explanation, they look very confused and some learners were scratching their heads and started		

	talking to one another.		
29	Mr. S	So; the moment those four ingredients are mixed up; then the plant can produce its own food through the process of photosynthesis. Photosynthesis means to cook food. *Ophotosynthesis otashiti; okulongekida oikulya yoshimeno*	photosynthesis means the preparation of the food for the plants

In this extract, Mr. Shilumba asked questions to elicit one-word answers and answers that required learners to complete the slot provided, without probing if learners had conceptually understood the questions posed to them (turn 1, 3, 16, 18, 20). In most of the turns, the learners did not answer the lower order questions, even if they were asked in both English and Oshiwambo (turns 2, 4, 17, 19, and 21). This is an indication that learners might not understand the scientific concepts that were presented in the previous lesson given the fact that this part of the lesson is revising content taught previously. After Mr. Shilumba's various failed attempts to get his learners to respond to his questions, he asked the learners if they understood the process of photosynthesis (turn10), in which learners confirmed that they do not understand (turn 11). Mr. Shilumba try to clarify again the process of photosynthesis to his learners. Firstly, he incorporates Oshiwambo as way of 'bridging between the discourse' (Gibbons, 2006), and yet, as a language resourcefor explaining the process of photosynthesis (turn, 12). The fact that the content he was conveying was unfamiliar to these learners is evidenced by the number of confusions in their facial expressions, although the content was explained in Oshiwambo (turn 13). Secondly, Mr. Shilumba walks to the board to refer to his drawing of the structure of the plant (see figure 5.1) to supplement his verbal explanations (turn 14). Mr. Shilumba pointed to the leaf on the drawing, although it is not big enough to be seen by learners seated at the back, to show the tiny holes he was referring to. While pointing to the drawing, he explains that; *"you see here, these are the tiny holes I' m talking about where the gasses passes though for the plant to breathe".* Learners were very confused because the tiny

holes were not visible to them (turn 15). In this instance, the use of the drawing here introduced an ambiguity among learners and did not support the teacher to convey the scientific concepts meaningfully as per his intentions.

The process of photosynthesis and its attendant concepts are 'semantically dense' (Maton, 2013) and thus, difficult to be conceptualised by Grade 4 learners, considering their limited proficiency in English. As we can see in turn 23, a learner is very confused by the teacher's explanations of the process of photosynthesis. She asked the teacher if *"plants cook their own food ".* It seems Mr. Shilumba's explanations in turn 22 was unclear and sounds very ambiguous for the learners to construct the correct scientific idea of photosynthesis. According to the Natural science textbook's definition; "photosynthesis is the process by which plants make their own food". Mr. Shilumba went on to utilise the everyday life analogies and metaphors as a mediational tool to bridge more familiar knowledge and language and connect it with the targeted process of photosynthesis and its related concepts (turn 24). For instance, he tried to contextualise the process of photosynthesis by relating it to a practical and concrete experience of cooking food (turn 22 & 24). While providing a generalized account of everyday life experience of cooking in the efforts to explain the process of photosynthesis, Mr. Shilumba makes use of translanguaging to ensure learners' comprehension. For instance, he started explaining first in Oshiwambo; *"that plants cook their own food, but they don't use the same processes as the way we cook. For example, the plants do not use firewood and they do not buy macaroni, meat, cooking oil, spices, onions, tomatoes and other things from the market"* (turn 24). Here both languages are employed flexibly in an organised manner to mediate learners' understanding (García & Wei, 2015). However, the use of the everyday term "cook' involves the process of preparing food to eat and it has no direct relation to the scientific word 'produce'.

Mr. Shilumba goes on to explain in English while using the everyday experiences of using firewood to refer to the scientific ideas of 'sunlight energy' and the analogies of salt and spices as the metaphors of the 'mineral salts' (turn 24). Again, Mr. Shilumba equated the ingredients for cooking with the raw materials used during the process of photosynthesis such as *sunlight energy, the carbon dioxide* and *water* that are combined to form the final products of *glucose* and *oxygen*. However, there is a sharp contradiction between what Mr. Shilumba has said and the thematic patterns he was trying to fit into (Lemke, 1990). Thematic patterns are defined as "the

pattern of connections among the meanings of words in a particular field of science' and as 'constituted by a web of semantic relations" (Lemke 1990: 12). The contradiction on the thematic patterns used by Mr., Shilumba might cause a miscommunication of scientific knowledge and confusion on the part of the learners. There are no direct connections between an everyday life cooking experiences with the scientific process of photosynthesis. Thus, the analogy of cooking food is not ideal. Thus, Mr. Shilumba's attempts to bridge between an everyday life experiences analogy with the scientific process of how plants produce their own food might not be counted as an instance of bridging discourse because the analogy he used is misleading. This type of information might result in learners developing misconceptions and they might struggle in future to differentiate between the analogies and the realities.

As we can see in turn 26, a learner is confused, and she was skeptical to know *"how plants eat their food if they don't have mouth and stomach like human beings".* Mr. Shilumba responded to the learners' question in Oshiwambo, *'plants do not feel like us human being, and animals, although they make their own food* (turn 26). Again here, it seems the teacher's explanations lacked clarity and did not assist the learners to visualise and conceptualise the abstract process of photosynthesis as being distinct from the cooking process. From the learners' facial expressions, it is noticeable that they are not satisfied with the teacher's explanations. Some were scratching their heads, and some were biting their nails as an indication of confusions (turn 28). Mr. Shilumba realised that learners need some clarifications, and he tries to simplify his explanations of photosynthesis using a different analogy (turn 29). For instance, he says; *"the moment the plants mixed up those four ingredients (referring to sunlight, mineral salts and carbon dioxide and water), they will eventually produce their own food through the process of photosynthesis".* This is another clear transmission of misconceptions to the learners. The analogies of 'mixing up the four ingredients' is non-scientific and thus would not help learners to make a correct connection with the scientific process of photosynthesis. The kind of language that Mr. Shilumba produced here is what Lemke (1990) referred to as; 'abstract or decontextualized' language which can be misleading and possibly constrained effective science learning. The only occurrences where Mr. Shilumba uses the correct everyday life metaphor is when he defined the concept of photosynthesis in (turn 29) as; *"preparation of the food for the plants"* to consolidate his learner's conceptual understanding. This was the only observed incident where the teacher attempted to use the metaphor that is line with the target concept of photosynthesis in this episode. The word

‘preparation’ is more appropriate to be used as a metaphor for the process of photosynthesis, unlike the metaphor of ‘cooking food’ that Mr. Shilumba initially ulitilises during lesson.

In the context of science teaching, Lemke (1990) emphasises that the thematic pattern must be appropriately fitted to the content to avoid meanings coming into conflict. Lemke (1990) warns teachers to refrain from using generalised information based on the here and now, and to avoid the use of references that are directed at human actions or specific events when referring to science ideas. Mr. Shilumba has established a space where translanguiging practices were normalised and encouraged learners to draw from their full semiotic repertoires for meaning making. But it is important to note that the use of translanguaging did not always develop conceptual understanding as is the case in this extract. While translanguaging practices have the potential to free the multilingual learners from the oppressions of monoglossic and monomodal communicative practices as commonly observed in the bi/multilingual classroom contexts , translanguaging can only be ‘ transformative’ and fruitful for teaching and learning depending on how it is being used to see whether it is transformative or not (McKinney & Tyler:2019). I argue that it is not just about planning language use, but also, that the teacher's conceptual or content knowledge is pivotal to convey the correct scientific concepts. In this extract, however, one can clearly see that the practices of translanguiging was never purposefully planned to be used as a legitimate resource for learning and that the teacher’s conceptual or content knowledge was incorrect in some instances. The way translanguaging was practiced in extract 7.1, definitely enables children to understand the content of what is being said, but unfortunately the content itself is incorrect and misleading. In light with this observations, McKinney & Tyler (2019:7) argues that “no communicative practice is by definition transformative or constraining.

Science meanings are not simple and easily appropriated by learners, but rather the manner in which individuals acquires and appropriates the new science discourse entails the process, as Bakhtin explains, of ‘populating’ the new discourse with one’s own intentions and purposes’ (Bakhtin, 1981:133). Bakhtin stated that “language becomes one’s own when the speaker populates it with his own intention, his own accent, when he appropriates the word, adapting it to his own semantic and expressive intention” (1981:133). This means that learners need to learn/appropriate the language of science to express science meanings efficiently. However, it is questionable if the way in which the science discourse was presented to the learners, whether

learners indeed appropriated the correct science discourse that might influence their developmental trajectory. Though we see some balance between everyday types of spoken language and science written register, in this episode there was no evidence of blended 'exploratory talks' (see Mercer, 1995) to move learners 'along the mode continuum towards more specialised scientific reasoning' (Gibbons, 2003). There were no occasions created where the learners could explain and justify their ideas to one another through 'exploratory talks' (see Mercer, 1995). Again, in this episode, learners were not encouraged to use and to discuss how to apply a newly learned scientific idea in both spoken language and written formal language, because such language was used primarily by Mr. Shilumba.

Bakhtin (1981:341) emphasised the importance of 'dialogic utterances' interactions/events between the speakers' utterances in order to gain the real meaning of the words through collective negotiations and reconstruction of a 'word meaning with one's own tone, accent and nuance'. In this episode learners did not get many opportunities to practice science talk (Lemke, 1990). This is indicative of dominant patterns described by Lemke's notion of 'triadic dialogue' 'which favors teacher dominance of the dialogue while using the strategy of transmitting the knowledge to the learners that resulted in teacher-dominated monologue. The 'triadic dialogue' can inhibit the establishment of a thematic pattern of science content, also making the science content implicit and inaccessible to learners regardless of the teacher's good efforts (see Lemke, 1990). In the extract above, one can see how learners were confined to contribute to the discourse that was already established by the teacher' questions and answers moves. During the classroom interactions, learners are supposed to appropriate other speakers' words, and in the process of understanding, they must combine these words with their own conceptual system.

The exchange in the extract 7.1 above follows the same patterns where learners' turns tend to be few and short, and they were rarely engaged in what Barnes (1992) termed 'exploratory talk' that was observed only in turn (23). In this episode, learners were made submissive, unable to dialogize or use their own discourse to 'liberate themselves from the authority of the other's discourse' (Bakhtin, 1981:348). Wells, (1999:140) criticizes this type of teaching by stating that it restricts learners' participation arguing that; "knowledge is neither fixed, autonomous, and free-floating nor contained only as propositional objects in individual minds". Rather, from this perspective, knowledge is "constructed and reconstructed between participants in specific situated activities,

using the cultural artifacts at their disposal, as they work towards the collaborative achievement of a goal" (Wells, 1999:140). Consequently, there is a call for the establishment of 'exploratory patterns of talk' in the classroom discourse, in which the teacher's initiation and feedback is more open and collaborative and in return, learners are encouraged to make self-initiations to enhance the dialogic teaching (see Lemke, 1990; Alexander, 2008).

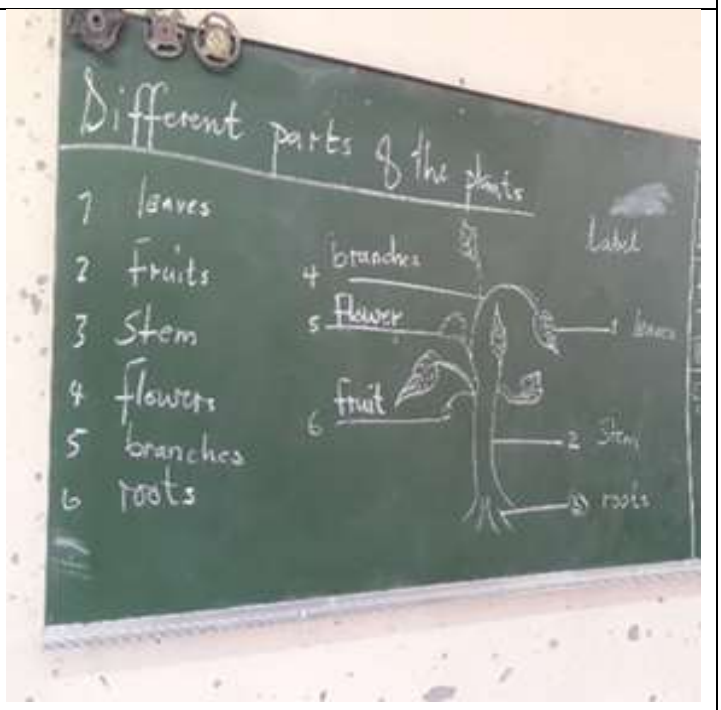
Successful construction of Science meaning through various representational modes

Growing interest in science education research emphasises the need for learners to understand and to learn science content through different representational modes, such as graphic and verbal modes, gestures, visuals, and body language. (Lemke, 1998; Kress, 2008, Canaragarajah, 2018). For Lemke (1998), each resource or mode can positively impact on the constructing of science meaning-making in specific ways and offers a certain level of redundancy that can be valuable for science learning. Given the increasing recognition from previous research as highlighted in chapter 3 of the role of multimodality for communication of scientific knowledge, my study aimed to analyse how science meanings are made available through the use of multimodality in the course of science teaching and learning. In this study, the multimodality seems to be a decisive aspect for science meaning making, and worth considering when analysing how science meaning is constructed for teaching science in a linguistically constrained bilingual context. My study is based on the premise that; "how knowledge is represented, as well as the mode and media chosen, is a critical aspect of knowledge construction, making the form of representation integral to meaning and learning" (Jewitt, 2008:241). This means that the manner in which science ideas are conveyed to the learners can influence the extent to which the knowledge is being constructed in the course of learning.

Lemke (1990:137) emphasises that 'scientific theories and the conceptual systems' are best taught when the language is supplemented by diagrams, images or by practical hands-on experiences. The construction of science meaning is made through the words that are said, the diagrams that are drawn, the formulae that are written down, and the experiments that are conducted (Lemke, 1992 & 1998). It is important for this study to understand the use of the drawing mode together with the other modes while the teacher is presenting the science content during the lesson. In the

extract that follows, I will explore the evidence of how the multiple representations of science ideas serve an important role in science education (Kress, 2008), while also looking at how science meaning was made possible through the use of the drawing of the structure of plants together with other modes.

Extract 7.2

Turns	Actor/ action	Speech	Translation and Images
1	Mr. S: Turning around and moving to the board to draw the structure of the plants while learners are observing him drawing and pointing to the drawing with the ruler to explain	Let me show how the structure of the plants looks like	 Figure 7.2 Structure of the plant
2	Ss: whole class looking at the drawing and listen attentively to the teacher		
3	Mr. S: pointing to the drawing with the ruler	If you look at this drawing here; these are the different parts of the plants I'm talking about.	
4	Ss: Learners were looking at the drawing		

	while the teacher is pointing to the drawing		
5	Mr. S: pointing to each part on the drawing except the fruit Labelling all the different parts of the plants on the drawing, and the moment he was pointing to the stem he also pointed to his legs ; when he pointed to the leaves he went to points hands, and when he pointed to the branches he went to points to his arms while explaining at the same time	*oshimeno oshi na efina, omidi, omafo, eengalo, oitai oshoyoo oyiimati* These body parts that you can see here have different functions just like the parts of the plants. This stem is like my legs, these leaves are like my hands, these branches are like my arms . In this instance the plants make their own food, and they are produced in their leaves	The plants have ; roots; leaves; flowers, branches and the fruits
6	Ss: learners listening very attentively		
7	Mr. S: writing the numbered column of labels on left side of the chalkboard	Okay; now we have the roots, leaves, flower, stem, branches, and fruits, I told you that these parts are very important. They have a role that they play; that's why we said they are very important.	

In this extract, Mr. Shilumba introduced the scientific idea of 'the structure of the plants' while establishing spaces for multi-representational of learning to support his learners. In supporting his learners to comprehend the structures of the plant, Mr. Shilumba supplemented his verbal explanations with a drawing of these structures. Mr. Shilumba moved to the board and began drawing the structure of the plants he was referring to (turn 1). While he was drawing, learners showed an interest in what he was doing and most of them were paying attention to him (field notes; lesson 2; 06-02-2018). It seems that most of the learners were impressed by Mr. Shilumba's drawing. This was reflected in their expressions of an exclamation of "woow" that they were frequently uttering while Mr. Shilumba was busy drawing (field note data, lesson 2; 06-02-2018). In turn (3), Mr. Shilumba turned from facing the blackboard , faced the whole class and started to speak slowly and slightly louder in a more deliberate voice (field note data lesson 2, 06-02-20180). His action of turning around and looking to the whole class while using a particular tone of voice drew learners' attention. In this case, learners stopped engaging in their private conversations and they were all quiet and keen to listen to what the teacher is saying. Mr. Shilumba uses a 'boundary signal' (Lemke, 1990) when he says, "Now let's look at the drawing here " to emphasise the point he was raising and to show the learners the structure of the plant and its parts (turn 3) which was the main focus during the review episode (field note, 06-02-2018). Again, here, Mr. Shilumba is directing the learners' attention and their interest to look at the drawing on the board and to start with his explanations. In turn (5) Mr. Shilumba described the diagram on the board that represent the visual appearance of the flowering plants, which is beautifully drawn and displays all the important features of the plants (see Figure 7.2). The teacher non-verbally pointed to the diagram and began introducing science content to the learners. He pointed directly to each central feature of the diagram while identifying all the important parts on the drawing, together with his verbal explanations of naming each part (turns 3, 5 & 7). The use of the drawing mode might enable learners to begin to visualise the physical characteristics of the structure of the plant, not usually visible to them.

Mr. Shilumba inserted the written mode that clearly labelled all the parts he that he was referring to and he also wrote down all the vocabularies needed on the left side (see figure 7.2). There are apparent shifts between the modes, that is, from image to verbal and to the writing modes. These switches served to mark a clear boundary between the events of 'seeing' and 'doing'. While Mr. Shilumba was explaining, learners were listening attentively while looking straight at him and

some nodded in understanding. Noticeably, the teacher gave the direct instruction that focuses on the important elements of producing the science text, such as composition and labelling and the standard form of drawing in science. Mr. Shilumba has exercised his authority to regulate the procedures that he considered as important to present science in a meaningful way. In turn, learners are learning to imitate what the teachers has produced and to see what is relevant, so as to make sense according to the particular thematic pattern (Lemke, 1990). The fact that the different modes of representation was utilised might offer learners with greater opportunities to appropriate the science content and to be able to make personal interpretations of what is being conveyed. These practices might be especially useful, given the constraints of a monolingual classroom; learners can use other means of communication to acquire science meaning. Again, Mr. Shilumba has asked learners to copy down the drawing as well as the chalkboard notes in their books, and this would give learners chances to appropriate the written science discourse as well as the drawing.

In this lesson episode, Mr. Shilumba also drew attention to the different discourses. We can clearly see in this episode how more than one discourse were employed to conveyed science meaning. In (turn 5) Mr. Shilumba shifted between Oshiwambo and English language , when he first mentioned the parts of the plants in Oshiwambo "*oshimeno oshi na efina, omidi, omafo, eengalo, oitai oshoyoo oyiimati "* and then he inserted an English phrase when he says; *"these parts that you can see here have different functions just like the parts of the plants".* Again Mr. Shilumba shifted between the science register and an everyday register in his utterance when he first used an analogy of the legs to explain the scientific function of the stem, and the analogy of hands to resonates the function of the flowers while using the analogy of arms to resonate the function of the branches to deepen his learners' conceptual understandings. He went on to use the scientific register to explain the functions of the leaves when he said, *"the plants make their own food, and they are produced in their leaves"* (turn 5). Later he switched from the spoken register into the written register when he inserted the science written register labelling the words; leaves, branches, fruits, stem, flower, and roots on the drawing (see diagram 7. 2).

Gibbons (2003) coined the term "message abundancy" to refer to 'multiplicity of meaning' in which English as Second Language Learners (ESL) can be offered multiple opportunities to learn scientific ideas or concepts from multiple perspectives. This can be done when the teacher uses alternative semiotic resources such as talk, relating scientific concepts to familiar words,

demonstration, graphs, chalkboard work and images to provide the contexts for meaning making and to ensure that science meanings are examined at a greater level to deepen learners' conceptual understandings. In this extract, Mr. Shilumba's pedagogic moves reflected the 'message of abundance' as it enabled the multiple ways of making meaning for the learner. This suggests the shifts between discourses in a 'multidirectional' manner (Tyler, 2016), when the discourses shifted back-and-forth. According to Gibbons (2006), an important pedagogical move in discourse shifting, between the different registers is not only directed to the correctness of one register and the incorrectness of another, but rather creating a context of the targeted new science register that is to be learned (Gibbons, 2006:132). In this extract, Mr. Shilumba is exposing his learners to the scientific terminologies and giving them more opportunity to understand new scientific concepts through the visual diagram. However, learners are still not engaged in talking or writing science themselves.

The constraints of English monolingual policy for learners to talk and think Science

Extract 7.3 below is from a whole class question and answer session during the review stage of a continuing lesson about the structure of plants. Learners were required to present the knowledge they have learned from the current and previous lesson presentations. This extract was chosen because it exemplifies the type of meaning that learners gained from the classroom discourse of the expositions of the structure of the plants, particularly the process of photosynthesis. Mr. Shilumba began the lesson by recapping the lesson contents of the previous day, conducting this review within framework of 'Triadic Dialogue' (Lemke, 1990).

Extract 7. 3

Turns	Actor/ action	Speech	Translation and Images
1	Mr. S	What is the function of the leaves?	
2	S: Shouting	*Omafo oikulya youpuka ngaashi omaungu*	They are food for insects like mopane worms
3	Mr. S	Okay; *Okwati; omafo oikulya youpuka ngaashi omaungu*	She said, the leaves are food for insects like mopani worms.

	Nominating another learner	Okay; tell us please	
4	S:	*Omafo amwe ohaa pange omikifi dovanhu*	Some leaves are used to cure diseases
5	Mr. S Nominating another learner	Okay; for medicine. *Otati omafo amwe ohaapanga* Okay who else?	He said, some leaves are used for treatment
6	S	*Omafo amwe ohaafuda*	Some leaves are breathing
7	Mr. S Nominating Sam	Okay; for breathing. *Anuwa ohaafuda; oilonga youmafo oyo* Okay; tell us Sam	Apparently, they breathe; that's the functions of the leaves.
8	Sam	To make fire	
9	Mr. S Nominating another learner	To make fire. Okay; tell us please	
10	S	Leaves are used for treatment	
11	Mr. S	Okay; the functions of the leaves is to cook food for the plants; and what do we call the process for cooking food for the plants	
12	SS: prolonged silence		
13	Mr. S	Guys! Don't forget that our education system is the learner centered. Let's all contribute. *Oprocess yoimeno ngee tai ningi oikulya yayo ohaii fanwa shike?*	What do we call the process where plants make their own food?
14	Ss: prolonged silence		
15	Mr. S	Is to co…… (↗)?	

16	S	To cook food for the plant	
17	Mr. S Reading from the textbook	To cook food for the plant. Okay good, you are correct. "Plants use sunlight from the sun; water; mineral salts and carbon dioxide to make their own food"	
18	SS: learners are not paying attention; some are whispering to one another; some are yawning; some are staring outside.		
19	Mr. S	Okay people, I told you that plants are very important, and they are living organisms; and they are also producers. So, the leaves help the plants to make food using the sunlight from the sun. Do you understand?	
20	SS: Learners are looking away while the teacher is explaining; some are busy cutting papers		
21	Mr. S	I told you that the sunlight is very important because it help the plants to make its own food. Can anyone tell what the sunlight is?	
22	S1 : volunteer to answer	*ofewa ei hatwiikosho nayo noikutu yetu*	Is the soap that we use to wash our body and our clothes:}
23	Mr. S	No! It's not that one. We are talking about the one that plants use to make their own food.	
24	S1: Looks very embarrassed he covered his face with his hands		
25	Mr. S Reading from the textbook	Okay number two. "The leaves have tiny opening in the surface that enabled the plants to breathe".	

		What is the word tiny means?	
26	Ss: prolonged silence		
27	Mr. S	*Oshitya tiny otashiti ngahelipi*	What does the word tiny means?
28	S1: Shouting	*Ovili*	It's means a watch
29	Mr. S	*Ovili?*	A watch?
30	S1	*Ee*	Yes
31	Mr. S	Anyone else?	
32	S2: confused between the word tin-y and tim-ee because of the silent e at the end of the word 'time' that is not part of Oshiwambo phonetics	*Efimbo*	Its means time
33	Mr. S	No! It's not the time but tiny, which means very small.	
34	Mr. S	Okay, what does tiny means?	
35	SS: Shouting	Very small!	
36	Mr. S: Trying to pronounce the word using phonetically IPA	The word is not time; but it's tiny". This how we pronounce the word tiny; "taeni [IPA}	
37	Mr. S	Can you all say "taeni" {IPA?}	
38	SS: Shouting together	Taeni [IPA]	

The whole-class activity in extract 7.3 started with the teacher asking questions based on the previous day's lesson content, which required learners to recall one-word answers (turns 1, 13, and 21). The most frequent feature in this extract, is Mr. Shilumba's strategy of restating the learners' answers, as it occurs in turns 3, 5, 7, 9, 11, 17. This act of restating serves as a way for the teacher to reaffirm that their responses although they are not the scientific answers he was looking for. In addition, his affirmations were not used for clarifications, and thus, not encouraging of discovery learning. There was no further examination of whether learners are truly ready to move on to the next phase of the lesson or probing them around what they think and why they think so. For instance, in turn 1, the teacher asked learners to state the function of the leaves, as discussed in the previous lesson. This question is ambiguous because it could be asking for the general functions of the leaves rather than the scientific roles that the leaves play in relation to the plants. The

learners' responses to this question indicates the huge gaps in their conceptual understanding (turns 2, 4, 6, 8, 10). One would expect them to simply give the correct answers because the content was already presented in the previous lesson. Yet, learners' responses remained at the level of factual knowledge they gained in their everyday life encounters of how they understood the functions of the leaves in relation to humans or other creatures. For instance, learners understood the functions of leaves as: *'food for insects like Mopani worms'*, *'leaves are used as medicine', 'leaves are used to make fire', 'leaves are used for treatment'* (turns 2, 4, 8, and 10). This means learners have prior understanding of the notion of 'functions' but not in all its forms; here they do understand the function of the leaves at their everyday spontaneous level (Vygotsky, 1987) but not at the level of scientific (or the school science) knowledge. It is only in turn (6) where a learner's response approaches the direction of scientific when he says, 'some leaves are used for breathing". Although a learner had tried to offer an almost scientific response the meaning remains implicit. From the learners' responses it is evident that they have not conceptually understood what was being asked of them.

Learners gave their views on the functions of the leaves using Oshiwambo to respond and explore their ideas. It is observable that learners' mother tongue enabled the unveiling of their misconceptions, as well as their ability to engage in exploratory talk that would be impossible if they were restricted to use English only. But despite what the learners are able to reveal, the teacher does not respond appropriately to enable them to understand how the term 'function' is being used in this context. Here, learners are not exposed to what Lemke (1990:151) calls; "the ideology of the special truth of science". From an ideological perspective, learners are taught factual science premised on the specialised skills and knowledge packaged by scientists that is distinct from that based on common sense knowledge. Again, learners are not being taught to distinguish between the language of 'human experience' and the 'language of science' or to recognise the fact that "science stands somehow outside of the world of human experience, rather than being a specialized part of it "(Lemke, 1990:151). The data presented here corroborates Fleer's study (2008:20) which found that children in a rural Australian preschool community were "experiencing the materials physically rather than conceptually". In other words, children's investigations of the science materials were predominantly at the everyday level of understanding of what the tools do, as opposed to the scientific ideas and relationships between the 'materials and their properties. Fleer saw learning in this case as based on what a learner already knows in his or her everyday life,

rather than on explicitly scientific knowledge. She criticises the teacher's pedagogy on the grounds that it had no potential to awaken children' scientific thinking as it was situated in, and limited to, the everydayness of the materials.

An extensive body of research demonstrates the powerful impact of high-quality discourse on children' cognitive development and educational outcomes, arguing that this can only be possible when children are encouraged to express their knowledge through exploratory talk and to co-construct their new knowledge though collaborations with others (Mercer & Littleton, 2007, 2013; Alexander, 2008b; Mercer, 2013). Due to the constraints of monolingual policy, in this episode learners had little or no opportunity to initiate their own idea and they have no control over the direction of the classroom discussion or counter on the teacher's prerogatives 'Triadic dialogue' (Lemke, 1990). In this respect, the teacher is, not creating a dialogic ethos in the classroom to enhance learners' classroom participations (Littleton & Mercer, 2013). Mr. Shilumba has limited his evaluation of the learner's responses with a form of declarative of neutral evaluation; "Okay" while nominating other learners to answer. Here, the teacher makes no evaluative comment and he ignored learners' responses without probing for "different opinions", possibly imagining that other learners would provide the right responses, which is not actually what happened. Here the discourse is not open to different points of views where learners can compare and contrast one another's ideas. In addition, learners were not encouraged to discuss and to apply the newly learned scientific idea in speaking or in writing. From this kind of lesson sequencing, Lemke (1990) stresses that learners are expected to access the science content in the process of the dialogue and to learn how to talk science. This data conforms to the previous research studies that highlighted the scarcity of "cumulative talk' amongst primary children (Wegerif & Scrimshaw, 1997; Mercer, 1995, 2000) as well as the lack of classroom talks that support the co-construction of knowledge and the dominant teacher's' monologic talks of knowledge transmissions (Alexander, 2008b; Shepherd, 2012; Mercer , 2013). According to Wells (1999) accumulative talk by its nature entails the multi-voices of the different speakers, and the teacher should encourage learners to give their own ideas through the use of open-ended questions and while trying to clarify science meanings through questions and follow-up moves to enhance effective science learning.

Despite learners' obvious misconceptions that are evident in this extract, Mr. Shilumba did not try to scaffold his learners' understanding by explaining further the functions of the leaves or by

integrating multiple modes and ultimately replacing learners' misconceptions with the appropriate scientific conceptions. Instead, the teacher went on to add another layer of the "factual" information when he says; "the function of leaves is to cook food for the plants" (turn11). The teacher's explanation here might not benefit learners to get a mental representation of the correct scientific functions of the leaves and possibly to make progress in their conceptual development. Again, Mr. Shilumba went on to restate the general statements from the textbook; "plants use sunlight from the sun; water; mineral salts and carbon dioxide to make their own food'; plants are living organisms because they are only producers" (turns 17& 19). Instead of simplifying the meaning of the word 'photosynthesis' first, Mr. Shilumba went straight to explain the process of photosynthesis by merely uttering the raw materials required during this process (turns 17 & 21). One would expect the teacher to break down the concepts of photosynthesis into its key words: photo, referring to '*light',* and synthesis, which means '*to manufacture something'*. This might ease the learners to construct the meaning of the scientific ideas of 'photosynthesis'.

It seems like Mr. Shilumba might be confused in his own understanding of the scientific process of photosynthesis as he constantly referred to it as '*cooking food for the plants'*. While Mr. Shilumba was supposed to guides his learners to construct the scientific ideas of the process of photosynthesis, he chose to ask low levels cognition questions (turn 1, 13, 21). As we can see in the extract above, Mr. Shilumba acknowledged incorrect learners' responses without drawing attention to their intuitive science information (turn 3, 5, 7, 9, 19). Learners' misconceptions could be easily remedied on the spot through visual presentation of the structure of the plant. Again, their understanding can also be supported through the use of 'translanguiging pedagogy' (Probyn, 2015), to explain the meaning of the word photo and synthesis in Oshiwambo bearing in mind the learners' proficiency in English. Crucial in science learning is to guide learners to imitating the semiotic practices that are used in science by professional scientists in writing (Martin and Veel, 1998). Again, learners need to be taught science terminologies based on 'underlying semantic and syntactic structure of the language to know the rules for broader applications' (Lemke, 1990). Contrary to that, learners were not guided to express themselves and to engage in the discourse of 'more-written-like' science texts and thus, to add a scientific register to their repertoire (Gibbons, 2006).

Now, I will synthesise evidence where the teacher's discourse supported or constrained the construct of science meaning in the extract above. In turn (11) the teacher poses a question in English that requires learners to recall the name of process where plants make their own food. After learners' prolonged silence as an indication of inability to respond, Mr. Shilumba switches to Oshiwambo to encourage learners' participations (turn 13). Although the question was posed in Oshiwambo, Mr. Shilumba did not offer the equivalent terminology in Oshiwambo for the word 'process' that is '*omukalo'*. Instead, the teacher used a non-standard word '*oprocess*' where he adds an Oshiwambo prefix 'o'= '*oprocess'*. The English word 'processes' might not sound familiar to these learners. The use of Oshiwambo word *'omukalo'* [3]would possibly have helped these learners to understand the name of the process he was looking for considering their lack of fluency in English. In this case, the use of the 'heteroglossic' term of *'oproces'* does not successfully convey the nuance meaning as per teacher's intentions. The learners' prolonged silence in (turn 14) might be an indication that they did not appropriate the scientific process of the photosynthesis, and also possibly their lack of understanding of the English word 'processes'. Again, learner's inability to respond to the teacher's question, might be influenced by the manner in which Mr. Shilumba directs his lessons as highlighted in the previous section. Mr. Shilumba went on to provide a clue by omitting the last letters within the word 'cook' where learners are expected to complete the last letters in the words refers as cued "elicitation' in Gibbons terms (turn 15). A learner responded immediately in turn16, and Mr. Shilumba restates the learner's answer as a way of confirmation that her answer was correct turn 17. The teachers' follow-up moves here functioned as positive evaluation or repetition of learners' responses. Although the follow-up move is visible here, it is not helpful to inform learners whether what they might think or produced is right or wrong because there is no elaborative feedback given. Mr. Shilumba is consistently formulating questions that might fall short of successful probing learners' understanding and exploring science ideas.

In (turn 21), he posed a question to the whole class, 'can anyone tell what the sunlight is'? Though the grammatical form of this question appears to be asking for a suggestion, it actually expects a factual answer considering the grade level and learners' proficiencies in English. A learner

[3] Sunlight is a South African brand name for household soap such as dishwashing detergent washing-up liquid, laundry detergent and kitchen soap that mostly used in Southern Africa. This brand is equivalent to the UK Tide and Persil brand names.

responds to this question using his everyday knowledge, as he commonly understood the sunlight in his life as a 'washing detergent' (turn 22). It clear that this learner's understanding of the concepts of sunlight is quite different from the scientific meaning of sunlight as energy generated from the sun. Instead of the teacher correcting the learner's intuitive knowledge, Mr. Shilumba dismissed the learner's contribution by saying that it is not what he was looking for (turn 23). Mr. Shilumba did not reduce the learner's ambiguity of the conceptual understanding or provide the whole class with both the explanation and the justification for the correct meaning of 'sunlight'. Again, the teacher did not unpack the word 'sunlight' by identifying its basic words: *sun+ light* in order to establish the scientific meaning. In this occurrence, learners' appropriation of scientific concepts of 'sunlight' might be supported through bridging between known and new information (Rogoff, 1990). According to Vygotsky (1978, 1987), instruction is only fruitful if it transcends learners' current development thereby, focusing on the functions that are in the process of maturing. This is particularly relevant to this study, where the teacher did not succeed to move his instruction ahead of the learners' current developmental level and awaken those functions that are in the maturity processes.

The vivid English language dilemma together with learning a science discourse is evident in this extract. For instance, Mr. Shilumba asked the meaning of the word 'tiny' in (turn 27). The word 'tiny' might not be familiar to these learners as they struggled to give its correct meaning. For instance, a learner applied her Oshiwambo phonetic knowledge to give the meaning of the word 'tiny' by saying 'tiny means *efimbo'* which means 'time' in English (turn 28). Since the English word 'tiny' and 'time' have the same initial sound, a learner thought these two words carry the same meaning. This might be attributed to the silent letter 'e' that is not applicable in Oshiwambo phonetics and possibly the mother tongue transfer might confuse a learner to make a distinction between the time and tiny. Mr. Shilumba rejected the learner's answer and went on to give the meaning of the word, "tiny means small" (turn 32). The teacher's explanations of the word tiny is not accurate enough, because the word tiny means something extremely small that may not be visible to the naked eye. Mr. Shilumba went on to teach the whole class the correct pronunciation of the word 'tiny' to differentiate it from the word 'time' (turn 35). Then after, he asked the whole class to repeat after him while pronounced the word tiny phonetically (turn 36). In this instance, the teacher was not only teaching the science content, but he was also concern with teaching the English language features such as pronunciation and vocabulary development.

In the context of science teaching, studies conducted in rural and township schools in South African multi-lingual contexts have reported on similar challenges of teaching and learning science in English while learners are still in the process of acquiring proficiency in English (see Probyn, 2015; Setati et al, 2002). Probyn (2015) reported on how learners were struggling to cope with the science curriculum because they have not obtained the necessary English to learn science through English as LoLT, and thus are, 'swimming up the waterfall' (Macdonald, 1990 in Probyn, 2015). The fact that learners in township and rural schools have limited out of school exposure to both spoken and written English language prevents them to have access to science content successfully (Probyn, 2015). It clear that learners in this study still need to develop basic competencies in English language such as pronunciations, English phonology, and vocabulary to be able to engage in discourse-specific talk (Setati, et al., 2002) "which is part of learners' apprenticeship into the discourse genres of *science* subject" (Wells, 1992:291).

From the pedagogical perspective, the dilemma of learning science enacted in the extract above does not lies only on the level of learners' English proficiency , but also in the pedagogical approaches that failed to ascertain learners' ZPD. Since "the ZPD has more immediate significance for the dynamics of intellectual development and the success of education than the actual level of development" (Vygotsky, 1982:247). Critically, Mr. Shilumba failed to operationalise his learners' developmental level, and he did not clarify learners' misunderstanding for instance of the word 'function' in science context and he did not correct their misconceptions. Therefore, how well learners appropriate the scientific discourse is linked to how effectively their teachers mediate the scientific concepts to them. As Vygotsky wrote: "The teaching is not development, but correctly organized teaching leads a child's intellectual development by giving rise to processes that would be impossible outside of the education "(1991:388). This argument implies that the classroom teaching should not only focus on what learners have already achieved, but it should aim to develop the functions and skills that children have never attained. Whilst Vygotsky encouraged the use of systemic instruction to develop children's high cognitive functioning such the scientific concepts, in extract 7.3 Mr. Shilumba did not establish favourable conditions that would develop these potentials since his instruction was focusing more on what learners already know. This kind of teaching might not result in scientific concepts formation. Vygotsky explicates that: "The main function of education is to teach a child something new. Therefore, the zone of proximal development, which defines this area of transitions accessible to a child, presents the main moment

with respect to education and teaching" (Vygotsky, 1982: 250). In what follows, I will investigate how the teacher attempted to explicates highly dense science terminologies to his fourth-Grade learners.

Exposition of Science meaning constrained by the use of textbook only

When Mr. Shilumba draws from the textbook science language, he does not show awareness of the difficult and potentially confusing nature of specialized science discourse (Halliday and Martin, 1993; Gee, 2004b). Though Mr. Shilumba attempted to employ different modes in his teaching, such as the use of diagrams on the board and gestures, the field notes reveal that there were times where he drew extensively from the textbook content during the discussions of the photosynthesis process. These terms were repeatedly introduced, yet without further elaboration during the lesson. However, in an interview with me, Mr. Shilumba expressed criticism of the use of textbook as main resources for science teaching and learning:

Extract 7. 4:

"You know that natural science textbook science has a lot of abstract terminology that make it difficult for the learners to understand the science concepts and performing very poor in science. I always present science concepts by means of using visual aids in order to demonstrate concepts by means of drawing or use images to help my learners to understand the science concepts. I hate presenting the natural science content using the textbook only, its content is too high, and learners can easily lose their interest. I need to simplify the textbook language hence this language is not familiar to the learners in order to draw their attention. But the fact that the textbook was prescribed by the highest authority, I have no choice I need to use it. Here in Grade 4, you must have real objects to model concepts to help your learners to understand the textbook content better. Remember you are dealing with learners with limited English language, you need to show and demonstrates to them how science processes work in their mother tongue. For example, if you are teaching them the sunlight

energy from the sun, you need to show them why the sun is the source of energy with some practical examples instead of explaining the concepts in abstract. Therefore, I always use other modes to supplements the text content" (Teacher interview, 22. 06. 2018).

Mr. Shilumba strongly feels that the sole use of the textbook contributes to learners' under performance ; *"I hate using the textbook only, its content is too high, and learners can easily lose their interest, I need to simplify the textbook content to avoid high failure".* He emphasised his own powerlessness and lack of agency to determine what content to teach to his learners. This might explain why Mr. Shilumba opts to adhere to departmental guidelines, although he knows it is not the most effective means to facilitate science meaning making to his learners. Acting against his own interests, and that of his learners, Mr. Shilumba instead opts to adhere to the expectations from the "higher authority". This reflects 'the monologic voice' that "demands our unconditional allegiance" while controlling others' behaviour and directing their thinking (Bakhtin 1994:78). Mr. Shilumba, however, does regard the sole use of textbook as a "barriers for learners' abilities to understand science concepts". He gave various reasons such as *"science language is unfamiliar to learners and terminology are too difficult to be comprehended by Grade 4 learners who are not proficient in English'.* When I asked him how he supported his learners to conceptualise science terminologies, he mentioned that he presents science concepts in visual format and simplified concepts in the learners' mother tongue.

While Mr. Shilumba criticised over-reliance on textbook for science teaching and learning, there were some incidences were he utilises the textbook content without simplifying it to his learners. For instance, during the lessons about 'the plants as living organisms', Mr. Shilumba draws to a large extent from the textbook while introducing the new science terminologies to his learners (field notes, lesson 1, 06-02-2018) . Along with his textbook explanations, at times he generalized events from everyday life experiences to bring in everyday knowledge and language, where learners could connect to the scientific ideas presented to them (field notes data lesson 2, 05-02-2018). In the next section, I will further analyse how Mr. Shilumba's attempts of explaining the textbook content failed during the lesson on the process of photosynthesis. It must be noted though, that, at the time the data was collected, there were only 4 Grade 4 Natural Science textbooks at the

school, and these textbooks were shared among the three teachers. Learners do not have Science textbooks and they relied on the teacher's explanations thereof.

The teacher normally follows the same routine of reading aloud from the textbook while learners listen to him passively. The following textbook passage embodied typical science language that is highly dense and unfamiliar to most Grade 4 learners.

Extract 7. 5: Textbook passage about the process of photosynthesis

"**Photosynthesis**: the process by which plants make their own food. This process requires the **transportation** of the water through their roots from the soil and receive the **carbon dioxide** from the air through their leaves during the process of **respiration**. For the plants to make their food, they need **energy** from the sun, and that energy passes through the tiny holes in the leaves. Plant leaf **cells** are unique in that they also contain special **components** called chloroplasts. **Chloroplasts** are filled with a green substance called **chlorophyll**. It is this **substance** which gives plant leaves their green **appearance** and enables the **absorption** light energy t. When plant **cells** have water, carbon dioxide and **sunlight** the chemical process of photosynthesis occurs. When this happens the water, carbon dioxide and sunlight join together to form a sugar called **glucose**, plus water, and **oxygen"** (Grade 4 Natural science textbook, pg., 56).

Researchers have emphasised the complexity of science learning for children, stressing that it resembles the process of learning a new language, yet where scientific meaning of conceptual words sometimes, but not always, match the similar meaning of the word as used in everyday life (see Wellington and Osborne, 2001:5). This is evident in extract 7.5 and its use of technical language, bearing in mind the highly dense bolded scientific concepts that might be alienating to Grade 4 bilinguals' comprehension level. The neoVygotskian would suggest that many of these learners would have misconceptions about these bolded scientific terminologies in this passage. For instance, the author uses a lot of nominalisation where the abstract nouns such as transportation, respiration, and absorptions are derived from the verbs transport, respire, absorb. This will present some comprehension difficulties to emergent bilingual learners who are still in the process of learning English and the language and genres of science simultaneously.

For these learners to comprehend this type of text, requires many modifications such as: explaining the major concepts through the use of multiple modes; by providing the linguistic bridge from everyday spoken language towards more specialised written language (Gibbons, 2002) and by identifying the key information. While introducing the process of photosynthesis to his Grade four learners, Mr. Shilumba, however, during this particular lesson, did not make any attempts to unpack the meaning of the bolded words in extract (7.5) or by bridging learners' everyday life meaning to connect them with the science meaning. Judging from the learners' body language and their actions, most of them appeared to be discouraged and disinterested in listening to the teacher's verbalisations of the textbook language (field notes, lesson 2, and 07-02-2018). From the learners' facial expressions there were numerous frustrations that can be debilitating to their concentration and prevent them from engaging in science discourse presented to them (field notes, lesson 2, 07-02-2018 & video recording reviewing). In what follows, I will present the data to show how Mr. Shilumba instructed his learners in ways that did not deepen their conceptual understanding of the textbook passage in (extract 7.5).

Extract 7.6:

Turns	Actor/ action	Speech	Translation and Images
1	Mr. S	Let's say it's raining, and the water evaporates or disappear into the soil; now when its dry the function of the roots is to absorbs or take water and mineral salts from the soil through the process of absorptions and supply it to what?	
2	SS: prolonged silence		
3	Mr. S	To the plants	
4	Mr. S Reading from the textbook	*Omidi doshimeno ohadi kufa natango omeva noipumbiwa yoimeno hayuufanwa eemineral okudja medu; tai yandje nee okshimeno* The roots play a major role for transportation of water and mineral salts to the rest of the plants. Do you understand?	The roots of the plants take water and other needs of the plants known as minerals from the soil and the roots supply to the plants

5	SS: Prolonged silence, and learners look very confused; many are not paying attention, and some were looking away from the teacher		
6	Mr. S	Okay, the leaves are part of the plants from which the water is lost. I told you that plants lose water through their leaves in the process of transpiration. When we lose the water from the ground; we say its evaporation; but the one that is lost through the leaves; we say it's the transpiration.	

Although Mr. Shilumba criticised the use of textbook only for science content delivery (extract 7.4), he made no effort to simplify and elaborate on the textbook passage or explain the terminologies from multiple perspectives during the lesson. As we can see in this extract 7.6, the scientific concepts were presented in abstract form. For instance, Mr. Shilumba says *"when it's dried the function of the roots is to absorb or take water and mineral salts from the soil through the process of absorptions"* (turn 1). This statement went unexplained further in the lesson. The two processes of transpiration and evaporation were both explained as *'losing water'* (turn 6). Mr. Shilumba did not use concrete visual or graphic materials to represent science concepts, so as to enable his learners to cognitively construct the scientific idea of these concepts. Mr. Shilumba did nothing to guide his learners to unpack the scientific concepts and processes such as transportation, respiration and absorption, transpiration, or by offering their constituent verbs transport, respire and absorb. The use of these verbs might help learners to understand the nominalization of nouns that is (transportations, absorptions, and respirations) based on their verbs meaning, and to link these verbs' meanings with their targeted scientific meanings. For instance, on the basis of the generalized meaning of the noun 'transportation', which most of the learners are more familiar with (i.e., moving from one point to another by means of transport). In this case, learners have experiences of using different types of transport in their everyday life encounters. Learners could possibly apply this knowledge and connect it with the science terminology of 'transportation'. In the context of conceptual learning, Lemke (1990) suggested that learning science requires learners to grasp the semantic and conceptual relationships in the colloquial language first before they substitute it with the scientific terms. This would allow learners to eventually speak pure science, and they will acquire the 'interlanguage' or the language 'hybrid of both 'colloquial and technical

registers' (Lemke, 1990:185). Therefore, I argue that it is important for the primary schools science teachers to be sensitive to their learners' linguistic needs and their indigenous knowledge when they teach scientific concepts, since reading out loud the words alone does not guarantee that the scientific concepts will be automatically understood by the learners. It seems that the teacher's primary teaching strategy is that of rote teaching and learning.

Moreover, there were no opportunities created for the learners to move from their everyday spoken language of how plants make their own food towards more specialised science written language of the textbook passage in extract 7.5. Mr. Shilumba did not note down on the board the major concepts he was explaining and did not connect the spoken science language with the written science vocabularies throughout the lesson. This could have been a good opportunity for learners to easily get access to science written genre since they do not have Natural Science textbooks. Again, there were no opportunities created for learners to apply both spoken and written science language instantly in the course of learning since these languages were used primarily by the teacher himself. This can also be aligned to the pressure Mr. Shilumba felt to implement the curriculum and to adhere to the prescribed time schedule and to make sure his learners are ready for mid- examination as he stated during the interview). Pimm's research (1991), emanating from mathematics context, is applicable to this study, and suggests that learners can be provided with the opportunities to write down their informal discussions and allowed to use their own language whilst working on the formal language.

Science meaning making through bridging between discourses

Both Lemke (1989, 1990) and Gibbons (2003, 2006) recognize the importance of "register-switching" between every day and science language in the teaching and learning of new scientific ideas and concepts within the science classroom discourse. The process of discourse bridging entails the practice of creating a "bridge' from informal everyday expressions into the more formal, specialised, and written-like language associated with precise subject-specific meaning. In earlier research, Gibbons (2003) posited that effective science teaching entails the process of "mediation across orders of discourse" as students "learn to use language for a range of purposes" (2003:250). Subsequently, Gibbons (2006) also reported on the benefit of register meshing to achieve the goal

of science meaning making for ESL learners and to perfect the new language, which leads Gibbons to arrive at the explanation of "bridging" to be that of "building on students' prior knowledge and current language as a way of introducing them to new language" (2009:62). Gibbons, and Lemke's work are of great significance within this study, and my approach to analyse the way in which Mr. Shilumba applies a type of shifting between various modes, language, and registers in the classroom discourse as way to explain the science meanings from multiple perspectives.

In what follows, I will analyse how the teacher attempted to bridge between everyday language and analogies and the scientific language in the exposition of the unit about 'the system of the body' where the lesson focus is on 'the central nervous system'. In this session, Mr. Shilumba presented the textbook content through attempting to employ everyday knowledge and language. He did this in order to explain the unfamiliar science concepts and terminology in a more familiar language to these learners, in order to establish specialised scientific meaning:

Extract 7. 7

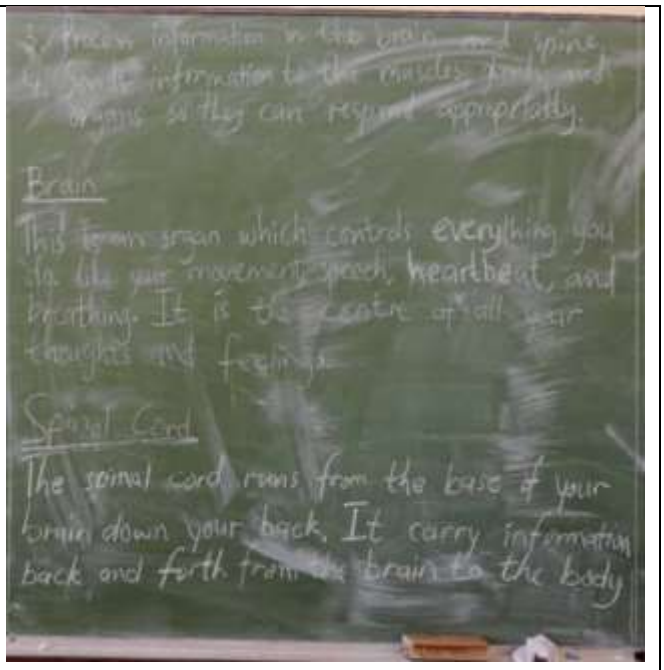
Turns	Actor/ action	Speech	Translation and Images
1	Mr. S	Which organs are involved in the nervous system?	
2	Ss: Prolonged silence, and most of the learners were looking away to avoid being nominated		
3	Mr. S: Nominating a learner	Can you please tell us please boy	
4	S: very hesitant (….) as he took while to answer	Tongue	
5	Mr. S	Tongue, no	

6	Mr. S	Which organs are involved in nervous process?	
7	Ss: Prolonged silence		
8	Mr. S	We have the spinal cord and what are the main parts?	
9	Ss: Prolonged silence and they look annoyed from their facial expression		
10	Mr. S	*onervous system oyo ngoo hatuti omadilaadilo* What is the part of your body that help you to think?	In other words, nervous system means thought.
11	SS: majority of the learners raising their hands and shouting to be given the floor to answer	Sir! Sir! Sir!	
12	S	*ouluvi wetu*	Our brain
13	Mr. S	Okay	
14	Mr. S: Writing on the board while talking	Now here, we have two main organs such as brain and the spinal cord that play major role in the nervous system. These two parts play major roles when it comes to nervous system.	
15	Mr. S	Then we have got the nervous system. *Onervous system ohai longo nomadilaadilo ngaashi ngaa vamwe tavadilaadila kutya ngee nda dimbuka, oha ndii*	The nervous system involved thought, like now some of you are thinking that when I knock off, I will go to my friend's birthday.

		ko birthday yafriend wange It is because you are using your nervous system.	
16	Ss: Looking straight at the teacher while he is explaining; and some learners were smiling.		
17	Mr. S	Okay, now let me tell you something, we have brain as well. *Ouluvi otou dimbulukwa*	Can you remember what the brain is?
18	Ss: Shouting	*Eee*	Yes!
19	Mr. S Pointing to his backbone	*Ouluvi owa kwatafana nobackbone* You see your backbone here. In your backbone there is something we call the spinal cord. *Ngee mwadipaa oshikombo keumbo ndee to shitale kombunda yasho, otomono kuna ekipa lile muna okaline kaendaamo* That straight line you see in the backbone of the goat is what we call the spinal cord, and most of animals including us human being we have that spinal cord	The brain is linked with the backbone When you slaughter the goat at home, you usually see the backbone and there is a straight bone with the straight line.
20	Ss: listening very attentively to the teacher, and starring straight at the teacher		

21	Mr. S	Can you guys show me where your backbone is?	
22	Ss : Prolonged silence		
23	Mr. S: Using his hand gesture to point to his backbone	*Obackbone oyeyi ngaha apa,* That line on the back is very important, because it is there to send SMS to the brain. *Okaline kokombunda, okohakalongo* of sending messages	This is the backbone here That line on the back it's the one that serves functions
24	Ss: Paying no attention, while the teacher is busy explaining		
25	Mr. S	*Omuuditeko*	Do you understand?
26	Ss: shouting	*Eee/ aaye*	Yes/ No!
27	Mr. S: demonstrating by holding a learner's hand Pulling the learner's hand backward	*Paife ngee onda kufa onyala yoye ndee handii tula momundilo, ngaha* Your hand moves away quickly before you even feel the pain	If I take your hand now like this and I put it on the fire  Figure 7. 3 The demonstration of how the central nervous system works
28	Ss: Learners looking at the teacher while doing the action, and listen attentively		

29	Mr. S	You will see that the spinal cord will send the message and to alert your brain that you are burning. *Ospinal cord yoye otai tumu etumwalaka didvadiva ukufemo onyala yoye momundilo*	your spinal cord will send a message to remove your hand from the fire]
30	Ss: Listening very attentively and looking straight to the teacher while he is using the gesturers to show how the spinal cord works		
31	Mr. S	This the nervous system I'm talking about, the central nervous system consists of the brain and spinal. *Onervous system ohailongo nokutuma omwatumwalaka, yoo oina nee oitukulwa ngaashi ouluvi nospinal cord , spinal oyo haitumu omwatumwalaka molutu yaukifa kouluvi, omega ouluvo owo hau kwatele komesho omainyengo olutu, okufuda, okupoya, okukudilaadila nomaliudo aeshe.* In other words, (...), the nervous system is a system in the body which deals with the transmissions or sending the signals around the body.	The nervous system works with sending the messages around the body, and it consists of the main organs such as brain and the spinal cord. We have the spinal cord that carry messages from the body to the brain. While the brain controls everything you do, movements, speech, breathing, feelings and thought.

	Speaking in a very slow voice while emphasising the ideas and writing the key ideas as he speaks on the black board.		 Figure 7.4 Chalkboard notes on the nervous system

In this extract, we witness the discourse move of teacher question-and-answer techniques that tap into the learners' prior knowledge of the organs involved in the nervous system (turn 1, 6, 5, 11). It appears though, that the language and the content asked in turn 1, is too demanding for the Grade 4 learner to relate to. The content is being introduced for the first time, which may be why there were no volunteers to answer this question (turn 2). Mr. Shilumba nominated a learner to respond in turn 3, and a learner hesitantly offered a one-word answer; *"tongue"* (turn 4). The teacher evaluates the learner's answer negatively by saying *'no'* (turn 5), and he goes on to pose the same question to the whole class (turn 6). This is followed by learners' prolonged silence, indicating that they do not know the answer (turn 7). Mr. Shilumba offered an answer himself; *"we have the spinal cord"* and he continues by asking learners to mention another organ that forms part of the nervous system (turn 8). Responding to the learners' uncertainty of what he is asking for, Mr. Shilumba gave them a clue by inserting an everyday word using Oshiwambo; '*Omadilaadilo'* (which in English means 'thought') to refer to the nervous system (turn 9). On the other hand, there is no direct word in Oshiwambo with an equivalent meaning for the scientific term 'nervous

system'. However, the teacher did not offer a simple explanation to explain what the 'nervous system' means for the learners to know what nerves are and how they send/carry messages through the body. In this case an appropriate Oshiwambo word *'omaluudo'* which means 'nerves' would be more suitable as an explanation, as opposed to '*Omadilaadilo'*. Thus, in this instance, Mr. Shilumba's translanguaging practice did not go far enough to develop the learners' understanding.

The use of the word 'thought' as an attempt to explain the scientific vocabulary of the 'nervous system', might not be a proper analogy to bridge the two languages. Again, Mr. Shilumba is eliciting an English everyday language to rephrase his question; *"Do you know the part of your body that help you to think"* (turn 10). Here he tries to incorporate the everyday language when he says, "the part of the body" to refer to the scientific terminology of the 'body system'. At this juncture, the teacher moves between English and Oshiwambo as well as between the everyday languages to establish the scientific meaning of the targeted science terminology. After Mr. Shilumba's attempted efforts to clarify his question through bridging between the discourses, most of the learners start raising their hands to be given the floor (turn 11). A learner responded immediately in Oshiwambo saying; '*ouluvi'* (in English 'brain') (turn 12). Mr. Shilumba acknowledged the learner's answer without asking him to elaborate on his idea (turn 13). One can clearly see in this episode how the dialogue was limited to the teacher's long monologues and his initiations of questions that discouraged learners' explorations of ideas.

Mr. Shilumba attempted to engage the learners in his explanation about how the nervous system works while referring them to how they (the learners) think about leisure time after school (turn 15). This explanation might be seen as a bit of a joke and to reprimand learners for not paying attention to him, but not necessarily geared towards creating science meaning. Mr. Shilumba also incorporated learners' everyday life experiences to explain the scientific idea of nervous system in more familiar terms. As we can see in turn 19, he refers to an everyday life experience and makes a concrete example when he says; *"when you slaughter a goat at home, you usually see a backbone with the straight line. That straight line you see in the backbone of the goat is what we call the spinal cord"*. Here, Mr. Shilumba is trying to assist his learners to construct science knowledge about the nervous system discourses bridging (Gibbons, 2009), through linking the learners' everyday life understandings of the spinal cord to the scientific ideas of the spinal cord. The use

of this generalised event here might enable learners to make clear connections between the examples given with the targeted conception of the nervous system.

Lemke, (1990) emphasises that science meaning making should entail the process of identifying the semantic relationships between the words or phrases and to connect them to similar contexts where it was previously used, in order to interpret science terminologies from different perspectives. Lemke's argument is apparent in this extract of the lesson, where Mr. Shilumba tries to interpret the scientific idea in a different way. For instance, Mr. Shilumba substituted the terminology of the 'spinal cord' with everyday language; *"the line on the back".* Mr. Shilumba translated this English phrase into Oshiwambo to ensure his learners' comprehensions (turn, 23). However, considering the learners' fluency level in English, the use of translanguaging in this way might not impact positively on aspects of the learners' conceptual understanding, as they are unfamiliar with some of the English words used. Thus, most of the learners did not pay attention to the teacher, and some learners were gazing away from the teacher during his explanation, and as such most learners showed no interest in his explanations (turn 24).

Mr. Shilumba also inserted an everyday language example from mobile communication of *'sending SMS'* while referring to the scientific ideas of "transmission of nerve signals from the spinal cord to the body" (turn 23). The fact this analogy was expressed in English means that learners might miss its intended meanings, though it was meant to bridge their understandings. Thus, learners might make a different connection to the thematic pattern, and thus, their interpretations might be different from the targeted thematic pattern of the scientific ideas of *"transmission of nerve signals".* To avoid learners' misinterpretations, Mr. Shilumba could possibly define each word in a sentence, such as 'nerve, signals, transmissions and spinal cord' and by providing the thematic patterns or synonyms for each word to make science more explicit and unambiguous. Mr. Shilumba could have allowed himself to use more Oshiwambo as an important additional linguistic and conceptualising resource whilst explaining the function of the spinal cord. We have to remember that Mr. Shilumba is severely constrained by the monolingual policy that insists on English medium teaching only, a view also expressed by the principal (see chapter 5).

Mr. Shilumba has attempted to make use of bridging between the register that is everyday life analogies, and metaphors while presenting new scientific ideas about the nervous system by using

familiar examples and non-scientific registers. However, the fact that analogies and metaphors were mainly expressed in English, even though they are everyday, means they are still likely to be inaccessible to these learners. What was observed in Mr. Shilumba's lesson has been observed in previous studies as well. For example, metaphors and analogies, as emphasized by Lemke (1990), are frequently employed to explain the new and abstract scientific concepts while tapping into the learners' prior knowledge as well as from their familiar everyday life experiences. From his classroom observations in secondary school science, Lemke (1990) stresses that students are more likely to pay attention when the content and language used in the metaphors and analogies is more familiar to them as opposed to unfamiliar content and abstract scientific language and terminologies. When analogies and metaphors are more familiar to the learners, it makes science content more meaningful and accessible (Lemke, 1990). However, in the context of science learning in a bilingual setting, I argued that the analogies and metaphors are more likely to be understood by the young learners when they are explained in the language that they understood, and they must also relate to their everyday life experiences.

Mr. Shilumba tries to support his learners to understand the function of the nervous system works, as this concept is particularly challenging to be explained in abstract terms (interview field notes data, 22-06 -2018). In this instance, Mr. Shilumba's verbal explanations of the nervous system was supplemented with the representational action gestures to demonstrate how the central nervous system works (see figure 7.3). The representational mode of the action gestures was used here for the act of modelling, to see how the central nervous system (the spinal cord and the brain) cooperates (turn 29). For instance, Mr. Shilumba first moves toward a learner, and he holds the learner's right hand and start moving it down as an action of pretending to place the hand on the fire. Conversely, when Mr. Shilumba hold a learner's hand, it might give a learner a sense of belonging and to feel appreciated as well. Then, Mr. Shilumba pulls back a learner's hand extremely fast to demonstrate how the nerves simultaneously send the signals of pain, thereby, alerting the hand to move away from the danger. Of significance here, the teacher embedded a physical action and the body movement involving a physical action of demonstrating how the process of sending the pain signals occurs so fast before the message reaches the brain. While using the representations of this gestural action, the teacher simultaneously narrates how the whole process works using both English and Oshiwambo; "*Paife ngee onda kufa onyala yoye ndee handii tula momundilo, ngaha* [*if I take your hand now like this and I put it on the fire], your hand will*

moves away quickly before you even feel the pain and you will see that the spinal cord will send the message and to alert your brain that you are burning" (turn 27). From learners' facial expressions and their body language, this demonstration appeared to impact positively on the learners' conceptual understanding. The inclusion of the action gestures in the demonstration might have facilitated learners' understandings of the scientific idea of the central nervous system. Without an inclusion of this series of movements, coupled with the example of the heat of the fire and the use of Oshiwambo in Mr. Shilumba's explanations, it would be more difficult for these learners to know exactly how the nervous system works. From figure 7.3, we can see clearly how Mr. Shilumba tries to include all the learners in his lesson presentation. As we can see from his body position, his actions are directed toward the learners and he is not trying to individualise his explanation with the child he is demonstrating with. In return, one can see from the learners' physical reaction, through eye gaze (see figure 7.3) which suggests that the teacher's demonstrations and explanations was successful. This is also an indication that Mr. Shilumba's clarifications of how the nervous system works has captured his learners' attention and possibly increased their understanding of the scientific ideas of the nervous system.

Mr. Shilumba modelled the bridging discourses, between Oshiwambo and English language and he also used register-switching between science and everyday vocabularies while discussing the science concepts and the terminologies that are part of the nervous system. For instance, in turn 31, he started his statement in English to highlight how the nervous system works. He then switched to an everyday register while using Oshiwambo and explains that; "*Onervous system ohailongo nokutuma omwatumwalaka, yoo oina nee oitukulwa ngaashi ouluvi nospinal cord , spinal oyo haitumu omwatumwalaka molutu yaukifa kouluvi, omega ouluvo owo hau kwatele .komesho omainyengo olutu, okufuda, okupoya, okukudilaadila nomaliudo aeshe"* [The nervous system works with transmission of the messages around the body, and it consists of the main organs such as the brain and the spinal cord. We have the spinal cord that carry messages from the body to the brain and we have the brain that controls everything you do, movements, speech, breathing, feelings and thought]. Here again, Mr. Shilumba highlights the key ideas of the nervous system by uttering his words at a slow pace, adding emphasis through an appropriate intonation to ensure that all learners hear and understand what he is emphasising (field notes, lesson 5, 10-06-2018).

Mr. Shilumba continues by using the specific scientific registers in English when he says, *"in other words, the nervous system is a system in the body which deals with the transmissions or sending the signals around the body"* (turn 31). This explanation can be identified as a register for science and hence it embodied the features of the technical vocabularies as well as the use of nominalisations (i.e., transmissions). What is striking here, is that learners needed to know the registers of science in English which they would eventually use to solve the problem in future, particularly in their science written assessments. There is a remarkable switching back and forth between everyday register and the science register, as well as switching between English language and Oshiwambo, whilst also using longer phrases in both languages, as we can see in turn 19, 29 & 30. Learners are being exposed to how to bridge from their familiar everyday knowledge and language into their unfamiliar science knowledge and language and thereby, having a greater chance of learning how 'to talk science' (Lemke, 1990). Gibbons calls this kind of pedagogy practices as "seamless shifting between discourses 'register-meshing' (Gibbons, 2006:131). She stresses that that this type of shifting impacts positively on learners to comprehend the new science language and terminologies.

The teacher further consolidated his scientific explanation through writing key ideas on the board, so as to make the written representations available to all learners (see Figure 7.4). Additionally, after the lesson presentations learners were given the opportunity to copy the board notes in their summary books. Here, the discourse of written mode of science is added to the classroom repertoire. In this respect, the teacher gradually moves the classroom discourse toward a 'more subject-specific discourse' (Gibbons, 2006). This kind of shifting might create a path for learners' ability "to move from personal, everyday ways of making meanings toward the socially shared and more written like discourses of specific disciplines" (Gibbons 2003:253). Mr. Shilumba has demonstrated the skill of 'bridging discourse' across modes, discourses, and languages. The shifting between English and Oshiwambo enabled him to support his learners to gain deeper understanding of the scientific ideas that would have been impossible, had he used English only.

The fact that the teacher comes from the same cultural and linguistic background as his learners, enabled him to bridge between Oshiwambo and English language back and forth with ease. This shifting demonstrates a complete 'journey' between Oshiwambo and English; and between everyday language and the science discourse, as termed by Setati et al. (2002); and consequently,

brings the notion of 'pedagogic translanguaging' (Probyn, 2015) into play. The complementary use of a range of modes, registers and languages in this episode might reinforce learners' possibilities to construct the scientific meaning of the nervous system. At this stage, the switching might be an ideal time for the learners to appropriate the written science discourse, as opposed to waiting until the whole unit is being covered. Also, notable here, is how meanings are made and distributed by the teacher through the 'repertoires of linguistic resources' not merely accomplished by the spoken language but rather, through the broader use of a repertoire of semiotic resources (Canagarajah; 2013). Whilst Mr. Shilumba moves back and forth between languages, and registers to convey science meaning to his learners , learners were not actively involved in 'joint construction' (Lemke, 1990) of science knowledge since they were mainly passive during the lesson.

Mr. Shilumba created a hybrid language while shifting between scientific and everyday register as well as bridging between the Oshiwambo and English and using a range of modes. The hybrid language enacted in this data, was also identified by Lemke, (1989, 1990). The hybridity of the language, used together with other modes, opened up the possibility for learners to grasp science meaning by moving from their existing knowledge and language that enabled learners to construct the meaning of the unknown scientific idea. Since the shift from one mode to another changes the nuance of the meaning (Archer, 2006), this study traces the multiple forms of representation which Mr. Shilumba has used. The data presented here resonates with the study of Tyler (2016), who made a similar observation of teachers shifting between the discourses and the modes to support learners accessing mathematics knowledge in the South Africa rural bilingual secondary school context.

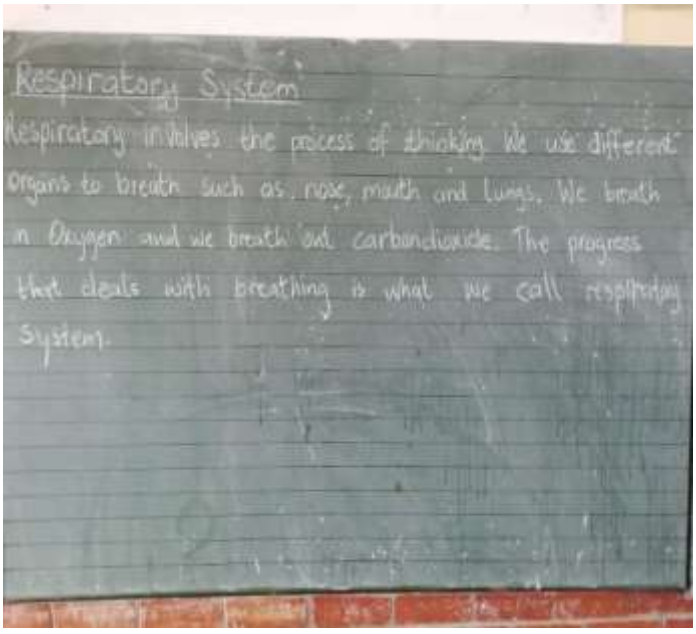
Beyond the linguistics challenges: The possibility of using Translanguaging and Trans-semiotsing in Science classroom discourse

In this part, I illustrate how Mr. Shilumba attempted to support the construction of science knowledge through classroom discourse, paying particular attention to how meanings were constructed with multiple modes and their effect on learners' conceptual understandings.

Classroom discourse: The use of multiple modes and languages for Science meaning-making

In what follows, I will analyse how different modes were used in the exposition of the content about the respiratory system. I selected specific extracts that exemplified the use of multimodality in a coordinated manner to convey science meaning from different perspectives. According to Mr. Shilumba, the aim of this lesson was for learners to grasp an understanding of how the respiratory system works, and to know its main functions within the body (interview data). The following extracts were purposefully selected because they embody rich evidence of where science meanings were made available in the classroom discourse through the use of complimentary multiple modes.

Extract 7.8

Turns	Actor/ action	Speech	Translation and Images
1	Mr. S: Writing the definition on the board while talking.	Today we are going to talk about respiratory system (..). Respiratory system involves the process of breathing	 Figure 7.5 Chalkboard notes on the Respiratory system
2	Ss: Not paying attention, some learners are looking outside, and some are engaging in private talk		

3	Mr. S: What are the two gases that are involved during the process of respirations?		
4	S	*omududilwamo mhepo*	It's the air that we breathe out
5	Mr. S	Can you mention the name in English?	
6	S1 : Prolonged silence and scratching her head		
7	Mr. S	The air that we breathe out is carbon dioxide in English	
8	Mr. S: Using gestures of inhaling and exhaling while explaining. Placing emphasiss with rising intonation	*Ohatufudilemo Ooxygen fyee hatu fudamo ocarborndioxde* through the process of respi (↑)ration *Orespiratory system ohai longo nokufuda. Okufuda oko ngoo orespiration*	We breathe in oxygen and we breathe out carbon dioxide The respiratory system is the system that deals with breathing. In other words, respirations mean breathing
9	SS: Paying attention and looking straight at the teacher		
10	Mr. S: Demonstrating to the learners while closing his mouth with his left hand and also closing his	Without the respiratory system it would not be possible for us to breathe. Can you close your mouth and	

	nose with his right hand for a while, and he looks like running out of breath before he started to breathe again.	your nose like this, and tell what happened?	
11	Ss: Learners closing their mouth and their nose with their hands for a while to experiment what will happen		
12	Mr. S	Okay, tell me what happened to you now?	
13	S: Using the gesture of breathing in and out	I was not doing like this	
14	Mr. S: Nominating another learner	Okay, you were not able to breathe. And you what happened to you?	
15	S	*Eshi ndeli kwata komayulu nokokanya, eshi handi fuda omhepo itayipiti, ame onduudite ashike ndafa haihale okufya, shaashi omhepo kaina apa tai piti*	While I closed my nose and my mouth with my hands, I was not able to breathe, because the there is nowhere the air can pass though. I was feeling very dizzy, and I almost collapsed
16	Mr. S	Okay, you were all struggling to breathe in, because oxygen passes through your nose and your mouth.	

17	Ss: Learners looked very shocked from their facial expression, some open their mouth wide, some put their hand on their mouth, some were blinking their eyes		
18	Mr. S: Using his body movement and hand gestures pretending to administer Oxygen therapy putting an object on his nose with his hands , and starts breathing at normal pace	So; for us to be healthy we need oxygen. *Ohamu mono ovanhu vamwe hava kala tava vele nande oasthma ile OTB ile ngoo vena oupyakadi wokufufa, ngee vai koshipangelo, ohava pewa nee ooxygyen ngaha shaashi orespiration system yavo italongo*	We have those people suffering from asthma or TB or having difficulties of breathing when they go to the hospitals. They are put on oxygen like this so they can breathe normal again, because their respiratory system are not functioning well.
19	Ss: Listening very attentively and looking straight ar the teacher		
20	Mr. S	That, way we say the respiratory system is the most important system in our bodies, if your respiratory system gets blocked, then you won't be able to breathe.	
21	Mr. S	Do you understand?	

22	Ss: Shouting	Yes teacher!	
23	Mr. S: Writing the statement on the chalkboard and encouraging the children to start reading the statement pointing word by word with the ruler	The function of respiratory is to supply oxygen to rest of body through inhaling oxygen and exhaling carbon dioxide, which is a waste gas.	

In this extract, Mr. Shilumba skillfully structures a classroom discourse that encourage learners to view science knowledge from multiple perspectives. As he makes the point, Mr. Shilumba firstly introduced a verbal definition of the scientific idea of the respiratory system; *"respiratory system involves the process of breathing"* (turn 1). He explains the concept further, by writing down the definition he introduced earlier. Thus, he draws the learners' attention to the written statement on the board, which denotes that the process of the respiratory system is one of the critical concepts for Grade 4 Natural Science curriculum. When the teacher makes a statement; *"today we are going to talk about respiratory system"* in turn1, it implies that Mr. Shilumba is taking an authoritative role of controlling what science discourse is to be learned during the lesson.

Mr. Shilumba then asks a closed question where learners have to mention two gasses used during the respiration process (turn 3). He framed this question directly, aiming to elicit the exact words he was looking for. A learner responded in Oshiwambo using his everyday knowledge: *"it is the air that we breathe out"* (turn 4), and thus, positions herself as a capable knower of the science knowledge. In this case, Oshiwambo enabled a learner to speak regardless of her poor proficiency in English. With English being the MoI, Mr. Shilumba asked learner to interpret the meaning of her contributions in English (turn 5). The learner, however, does not have a scientific repertoire of the word "carbon dioxide" evidenced by the fact that she hesitates to express herself in English (turn 6).

Mr. Shilumba expanded on the learner's response through translanguaging between the everyday and formal scientific register while also inserting gestures in the same utterances (turn 8). For instance, Mr. Shilumba started explaining that *"we breathe in oxygen and we breathe out carbon dioxide";* and he inserted the actions and gestures simultaneously of inhaling and exhaling to

support his verbal explanation (turn 8). In this occurrence, he uses multimodality abundantly when he emphasises the key ideas, first with rising intonation in Oshiwambo and then translating the same utterance in English, to provide learners access to science meaning. Interestingly here, Mr. Shilumba directly selects an Oshiwambo word *"okufuda*" (in this case, the English equivalent word is breathing) to refer to the scientific idea of 'respiration' (turn 8). Mr. Shilumba again utilised non-standard words by attaching Oshiwambo prefixes to the already existing English science terminology such as: *oasthma, oTB, o-oxygen, ocarbondixide and orespiratory* (turns 8, 18). These terms are heteroglossic in nature, as it consists of lexical items drawn from different languages (Bailey, 2007). The translanguaging strategies enacted here reflect a teacher's intent to support scientific learning through embracing all language resources as legitimate for teaching and learning. He also explained the concept of 'respiration', while switching between every day and science registers, as well as between English and Oshiwambo language. In this way, Mr. Shilumba has achieved 'message abundancy' (Gibbons, 2003:259) by referring to more than one register and using synonyms (i.e., respiration means breathing) through the deliberate use of multiple modes to convey the same science information from different perspectives in order to make science meaning more comprehensible to his learners. Ideally, the teacher in practice actually translanguages, although he knows English is the required MOI. So, in terms of his agency, or lack thereof, his actions here reflect something that does not resemble ack of agency.

Mr. Shilumba goes on to guide the learners to make a connection between the observable phenomena of withholding oxygen in order to establish the scientific functions of the respiratory system. In turn 10, Mr. Shilumba asked learners to imagine how the respiratory system works through actual practices and by mental recall imagery. He instructed the learners to close their nose and their mouth for a few seconds and observe what happens. Here, the process of respiration is introduced in a more familiar context when learners are required to imagine an abstract scientific process though a shared experience. Again here, the scientific processes are being communicated in more observable ways with the support of the concrete evidence to back up the claims Mr. Shilumba made earlier on the function of the respiratory system. In this process, learners are positioned as 'co- constructors' (Lemke, 1990) of the scientific knowledge, thereby becoming agents in the learning process. In turn 12, Mr. Shilumba asks the class to share their experience of what happened while they closed their mouth and their nose. In this case, his question formulation requires learners to elaborate on their ideas, and thus, positioning learners to view themselves as

capable contributors to the discourse. A learner responds through a combination of spoken discourse in English as well as the action of breathing; when he says, *"I was not doing like this" (turn 13).* Here, a learner incorporated the action of inhaling and exhaling to compensate for his limited proficiency in English. To ensure that the learner constructs the verbal meaning of the breathing gesture, Mr. Shilumba acknowledges the response and validates his feedback with the verbal representations of the breathing gesture (turn 14). In this instance, Mr. Shilumba allowed learners to use actions freely as another form of communication. Again, in turn 14, Mr. Shilumba nominated another learner to share his experience with the whole class. A learner responded in Oshiwambo; *"while I close my nose and my mouth, I was not able to breathe, because there is nowhere the air can pass though. I was feeling very dizzy, and I almost collapsed"*. In this case, a learner draws freely on her multiple linguistic resources despite the monolingual English policy.

The lesson's focus was not on which language or which register (science or everyday) to be used but rather Mr. Shilumba encouraged learners to draw on their full range of semiotic resources in their repertoires for meaning making. The use of translanguaging here provided learners with opportunities to engage in exploratory talk and action which maximised their participation. At the same time, here the discourse becomes dialogic in a Bakhtinian (1981) sense because the speakers take turns in the course of the discourse and the utterances are filled with 'multiple voices'. The teacher established a space where learners are encouraged to speak without fear of being contradicted, and their talk exhibited the features of exploratory talk as highlighted by Mercer (et al, 2004) and Barnes, (2008). This suggests that learners' development of their understanding is encouraged through the exploratory actions of science ideas and also through the use of different mode rather than verbally. In this episode, learners presented their science idea on what they have explored though their body actions of closing their nose and having to justify their ideas in both English and Oshiwambo. This indicates that learners were engaged in an experimentary actions as part of science inquiry to develop science understanding.

Barnes (2008) defined exploratory talk as that of expressing different ideas or opinions and reflecting the explicit reasoning and constructive engagement in the classroom discourse. This fact that exploratory talk talks takes an account of learners´ points of view through the use of effective questions, and the ample time' for learners to think before they respond, it is considered to be substantial in science learning (Lunetta, Hofstein & Clough, 2007; Mortimer & Scott, 2003). It

can be argued that the use of translanguaging and multimodal strategies during the class activity on respiration (extract 7.8) offered the potential for learners' engagement in high level cognitive thinking, and thus results in the opportunities of exploratory talk. The data reported here corroborate with the study of Flewitt (2006) on preschool children's interactions during play-based activities, that highlighted the significance of non-verbal interaction that enabled children's meaning-making, suggesting that 'children use the full range of material and bodily resources available to them to make and express meaning through exploratory talk' (2006:46).

Mr. Shilumba continued the lesson by introducing an example of how people who experience respiratory problems are given oxygen to enable them to breathe more effectively (turn18). In this case, Mr. Shilumba knew that most of his learners are familiar with asthma and they have seen how people with Tuberculosis experienced breathing difficulties because of the high rate of TB cases in their community. In this scenario, the abstract ideas of the respiratory system were made more plausible to the learners, as the teacher linked its meaning to an everyday event that learners are familiar with (turn 18). This explanation communicates the epistemological function of the respiratory system. The spoken narrative used here by the teacher might increase learners' understanding of the scientific process of the respiratory system. Mr. Shilumba then switched to another semiotic modality to provide another perspective of the process of respiratory system (turn 23). Here, Mr. Shilumba wrote the scientific function of the respiratory system on the board using the specialized science language (see in figure 7.5). In this case, he is trying to move his learners towards more scientific representations of the respiration system. Mr. Shilumba highlights the statement he wrote by moving to the board and pointing with the ruler at each word while reading it slowly : *"The function of respiratory is to supply oxygen to rest of body through inhaling oxygen and exhaling carbon dioxide, which is a waste gas"* (turn 22). Through using body movements, his actions of pointing on the board together with the written text implies that the points he is making are critical for the learners to construct the fixed wording that defines the respiratory system.

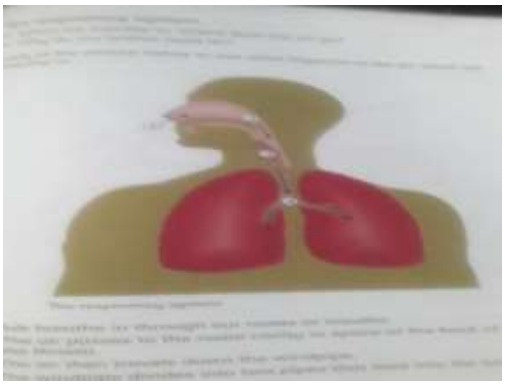
It is critical to note that, in this episode, the discourse move from that of the informal conceptual discourse into the formal discourse of the respiratory system was possible because of the use of different modes of language (for example, use of spoken language accompanying action, oral reflection on what was learned and blackboard writing) to construct learners' understanding of the

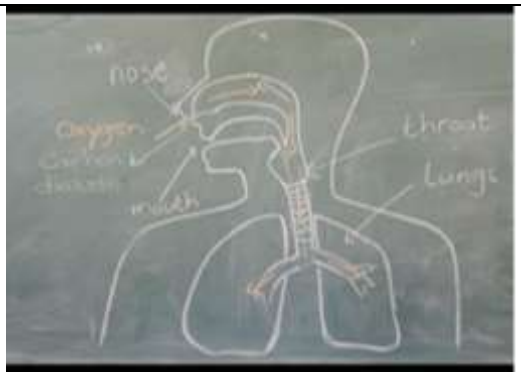
scientific process of the respiratory system. However, learners were not afforded an opportunity to express their newly acquired scientific concepts in writing, so as to see if they are indeed ready to move to the next topic.

Science meaning making through visual and gestural representation

The following episode will show how Mr. Shilumba supplemented his oral and written modes with rich multimodality such as the visual representation of the textbook image, the modified drawing on the board as well as the use of gestures.

Extract 7. 9

Turns	Actor/ action	Speech	Translation and Images
1	Mr. S Showing the diagram of respiratory system from the textbook; only the teacher has a textbook	*Okwali hatu popi kutya orespiratory system ohai longo nokufuda* There are parts that are involved in the respiratory system. Okay let me show you something here	We said the respiratory system deals with breathing.  Figure 7.6 : The textbook diagram of the respiratory system
2	Ss: Learners making noise and trying to move toward the teacher because they can't see the image		
3	Mr. S: Pointing on the image in the textbook	Can see these parts here?	
4	Ss: shouting and most of the learners seated	Yes/No!	

	at the back are not looking at the image		
5	Mr. S: Moving to the board to draw the structure of respiratory system	Okay, let me draw a clear drawing on the chalkboard	 Figure 7.7 Chalkboard drawing of the respiratory system
6	Ss: Making excessive noise while the teacher is drawing		
7	Mr. S Pointing to the drawing with the ruler while explaining	*Opena oitukulwa ya involvinga moresipratory system* Okay if you look at this drawing here, we have the nose here, we have the mouth here and we have the lungs here. These are all parts involved in the respiratory system.	There are parts that are involved in the respiratory system.
8	Ss: Looking straight at the teacher while he is explaining		
9	Mr. S: Pointing to the picture while explaining	*Otwa ti ngee hatu inhaling, ohatu fuda oOxygen tai piti komayule ile kokanya, tayee nde apa ndee taii komapunga; ngee hatu exhaling, ohatu fudamo ocarbondioxide taidi komapunga tai pitile komayulu ile kokanee*	We said when we are inhaling; we breathe in oxygen that goes through the nose or the mouth and it pass here and go straight to the lungs and when we exhale, we breathe out carbon dioxide and it will comes from the lungs passing through the nose and the mouth .

10	Mr. S: Using the gestures of inhaling and exhaling	Let me tell you something, during the process of respiration, we breathe in this oxygen like this, and we breathe out carbon dioxide like this	 Figure 7.8 Gesture of inhaling& exhaling
	Pointing to his nose	And then the air comes through the nose	 Figure 7.9 gesture pointing to the nose
	Using gesture to points to his lungs	And then the air goes to our lungs and again it comes from our lungs and goes out through our noise and we supply it to the plants. That is the respiratory system we are talking about class.	 Figure 7.10 gesture of pointing to the lungs
11	Mr. S	Okay, *paife olye tetu lombwele kutya oshike*	Now, who can tell what happened during the process of respiratory system?

		hashi ningwa mosystem yorespiratory	
12	S	*Mutu Morespiratory system, ohatu fuda omhepo yo oxygen tai pitile komayulu ile kokanya, ndee tayii komapunga, fyee hatu fuda mo ocarbondixide taipitile komayulu taii koimeno* During the process called respiration.	I think, during the process of respiratory system, we breathe in oxygen through the nose or the mouth and it goes to the lungs, and we breathe out the carbon dioxide that pass through the nose and it goes to the plants
13	Mr. S Nominating another learner	Okay very good. Tell us please what happened during the respiratory stem	
14	S	We breathe in oxygen through our nose	
15	Mr. S: probing further	Yes, and what happened when we breathe oxygen?	
16	S1	And then, the oxygen goes to the lungs, and we breathe out carbon dioxide that pass through the nose and go to the atmosphere to be used by the plants.	

Mr. Shilumba wanted to convey science information to his learners in the manner that would give them a clear view of how the respiratory system works (interview, date: 28-6-2018). In extract 7.9, Mr. Shilumba created a visual space for his learners to participate in the meaning-making process by employing a range of modes such as (verbal explanations, visual images through picture from textbook, and then drawing on the board, written mode, gestures, and physical movement engaging learners in experimenting with holding their breath). This means that Mr. Shilumba planned to introduce new scientific concepts and processes through combining various modes. For instance, in turn 1, Mr. Shilumba expands on his verbal explanations through using visual representations of the textbook image of the respiratory system. He began his verbal explanation by showing his learners the diagram in the textbook. In this case, the teacher's body language and his actions of opening the textbook and pointing to the image figure 7.6) is an indication that the structure of

the respiratory system is particularly important. The fact that the textbook diagram was not visible to all learners because they do not own textbooks created a lot of chaos in the classroom. Learners were trying to move forward and at the same time they were pushing one another and making a lot of noise (field notes, lesson 6, 11-06-2018). Mr. Shilumba proceeds to draw a modified structure of the respiratory system on the board, labeling the organs that form part of the respiratory system (see figure 7.7). Then, Mr. Shilumba uses verbal expressions to describe the drawing, simultaneously pointing at the drawing with a ruler so as to direct his learners' attention (turns seven &8). Mr. Shilumba clarifies that; *"if you look at this drawing here, we have the nose here, we have the mouth here, and we have the lungs here"* (turn7). The drawing on the board indeed attracted learners' attention, as most of them gazed at the drawing whilst listening attentively (field notes, lesson 6, 11-06-2018).

Again, Mr. Shilumba supplemented his verbal expressions with gestures, using his hands and fingers to show the body part he was referring to (turn 8). In this moment, he simultaneously maintains eye contact with his learners, so as to include them in his explanations. Mr. Shilumba was at an appropriate position of where he can manage to convey meaning using the gestures and the ruler while pointing to the diagram on the board and his body positioned that facing the whole class. Here, once again he compensates for the physical distance between himself and his learners with his constant eye gazing, which remained directed to them, along with his body orientation that faced the whole class (field notes, lesson 6, and 11-06-2018). Thus Mr. Shilumba used body language to tell learners that he is available for interrogations, whilst also making science meaning available to all learners in the class. These actions by Mr. Shilumba provided learners with concrete visual representations that enabled them to gain a mental representation of the scientific ideas of the respiratory system. It is also an apparent use of trans-semiotsing in a lesson episode, employed to make science meanings more accessible to the learners.

Mr. Shilumba goes on to deploy multiple gestures to help his learners visualise what he is describing to them. In turn 10, the verbal explanation of the breathing process was further exemplified and emphasised using non-verbal and visual representations gestures (see figure 7.8) to enable his learners to construct the scientific meaning of the respiration. The images in figures 7.8, 7.9 and 7.10 illustrate the use of deictic gestures to reinforce the scientific idea of the processes within the respiratory system. In image 7.8, Mr. Shilumba employs hands movements to represents

inhaling and exhaling. Whilst performing this gesture, Mr. Shilumba starts moving both his hands in an outward and downward motion while simultaneously saying; *"we breathe in this oxygen like this and we breathe out carbon dioxide like this".* This gesture acts as an organizational resource to emphasize the process of the respiratory system. The image in figure 7.9 depicts the deictic gesture of Mr. Shilumba pointing to his nose while emphasising that "the gasses pass through the nose during the process of respiration". While the image in figure 7.10 shows Mr. Shilumba inserting the deictic gesture when he positioned his hands where his lungs are located, whilst explaining that; *"and then the air goes to our lungs and again it comes from our lungs and goes out through our nose and we supply it to the plants".* At times, he gazes at the learners, while turning his body toward them during these gestures. Again, Mr. Shilumba makes a quick sequence of the breathing gestures for the act of seeing what happened during the process of respiration. While performing an action gesture, learners looked straight at him and listened attentively (field notes data, lesson 6; 11-06-2018).

Here again, the repetition of the rapid gestures of inhaling and exhaling coordinated with verbal expressions, supported learners to appropriate the science meanings that were being conveyed to them. For instance, Mr. Shilumba prompts learners to apply a newly learned scientific idea to explain what happened during the processes of respirations in (turn 11). Here, Mr. Shilumba invites learners' ideas through open-ended questions as an attempt to clarify science meanings through the follow-up moves. In response, a learner hesitantly begins to answer by saying *"I think …,"* and she goes on to explain what happens during the process of respiration in an elaborated scientifically correct way while drawing freely from her language repertoires of both English and Oshiwambo (turn 12). In turn 13, the teacher positively evaluates the learners' response, *"okay very good",* and he goes on to nominate another learner. A learner responded with a short phrase; *"we breathe in oxygen through our nose"* (turn 14), and the teacher makes a prompt move requesting further elaboration (turn 15), where the learner managed to provide correct scientific ideas (turn 16). This means that the affordances of alternate modes allowed learners to develop greater understandings of the new scientific concepts. In Bakhtinian terms, a learner internalized the words of her teacher (authoritative discourse), and she transformed the authoritative talk of the teacher into her own words and re-accented the words with her own intonations (Bakhtin, 1990). Interesting here, learners' turns become longer and much more elaborated, at the same time providing evidence of dialogic exchanges within the scientific discourse. The discourse becomes

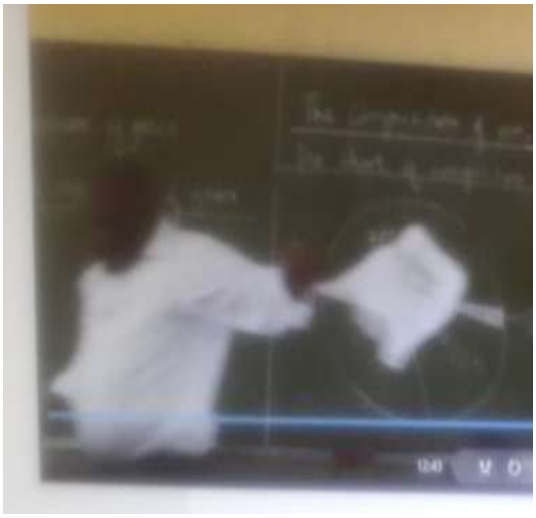
'multi-voiced' (Bakhtin, 1987) here in which different speakers contributed to the discourse while articulating their scientific knowledge. This suggests the effectiveness of enriched meaning making through simultaneous use of multiple modes, registers, and languages.

Again here, we are witnessing how the learners are positioning themselves as capable knowers through the process of justifying their science knowledge. The teacher's instructional practices aimed at probing learners' understandings of the scientific view of the respiratory system brings the notion of "interactive/authoritative communicative approach" (Mortimer & Scott, 2003) into play. There is clear evidence that the learners are progressing in making the authoritative scientific point of view as their own, because they managed to provide elaborated correct scientific views. This suggests that Mr. Shilumba's instruction was successful. The use of rich multimodality such as the combinations of heteroglossic practices, visual representation, and the verbal language as well as the use of gestures is a clear testimony of how scientific concepts were presented through the use of different modes to realise science meaning making and to enable learners to engage in exploratory talk. This practice shows how multiple semiotic resources are working together "as an assemblage, without the possibility of separating them" (Canagarajah, 2018:39) because language in itself to facilitate the construction of science meaning. This means that all modalities as well as the language used, compliment and shape each other the course of communication.

The use of artifacts for mediating the scientific concepts

One of the teaching approaches that Mr. Shilumba employed to develop and consolidate his leaners' understandings of the scientific ideas is the utilization of artifacts. Artefacts in science such as science instruments and real objects are extremely useful to present and demonstrate scientific ideas or concepts. Using artifacts can offer transformative possibilities for an understanding of the subject matter as well as to make the learning process more engaging. (Patchen and Smithenry, 2014). In the following analysis, I will show how the teacher uses and artefact to successfully explain the abstract phenomenon of the mixture of gases that can be found in the atmosphere.

Extract 7. 10

Turns	Actor/ action	Speech	Translation and Images
1	Mr. S: Taking a plastic bag from a cardboard box	We have the combination of gases in the atmosphere and some of those gases are involved in the process of respiration. Okay, let me show you something *Taleni oku ndi mu ulikile kutya mewangadjo omuna eemhepo dihapu, nande iha mudimono nomesho eni. Paife ngaha ohai kufa omhepo mewangadjo ndimu ulikile omhepo ei haopopi* Look at what I'm doing now!	Look here! I want to show you something, there is a mixture of gases in the atmosphere that you can't see with your naked eyes. Right now, I'm going to put the air in this plastic to show you the mixture of the air I' m taking about  Figure 7. 11: The teacher's body movement while getting air into the plastic
	Running with the plastic bag on his hand to let the air in the plastic		

2	Ss: Learners leaning toward the teacher to see what is happening and looking straight at the teacher		
3	Mr. S showing the plastic to the learners and bumping the plastic from the bottom at the same time. Showing the plastic with the air to the whole class	*Okay; paife oumuwete kutya moplastick omuna omhepo ndee katwali twii wete mewangadjo* Can see now, there is a combination of gases in this plastic, and we have also oxygen and carbon dioxide here that used in the process of respiratory system	You see now, we have the air in the plastic that we took from the atmosphere, but you can't see it with your naked eyes  Figure 7.12: The use of artefacts to represent abstract ideas
4	Ss: looking straight at the teacher and listening very attentively		
5	Mr. S:Using hands gestures to touch a learner using gestures of inhaling and exhaling while explaining and writing down on the chalkboard the statement he is making	It can't not be touched like touching a person, but the air is around us. and the air that we breathe in comes from the plant, while the air that we breathe out goes straight to the plant in the process call respiration	

Extract 7.10 exemplifies a memorable demonstration of the abstract phenomenon of the mixture of gases that can be found in the atmosphere. In turn 1, Mr. Shilumba employs a verb of visual

perceptions; *"look here"* while emphasising the point he was making, to attract the learners' attention on what he is going to say. Mr. Shilumba proceeds to emphasise that; *"there are mixture of gases in the atmosphere that you can't see with your naked eyes"* (turn1). In order to convince his learners, he created a space for learners to observe the phenomenon, so as to support his claims. For instance, Mr. Shilumba uses his body movement while running horizontally in front of the classroom whilst holding the plastic bag wide open to capture air (see figure 7.11). Then, he immediately ties the plastic to prevent the air from escaping. In turn 3, Mr. Shilumba initiates the deictic gesture of pointing to the plastic bag with the mixture of the air (see figure 7. 12). Again here, Mr. Shilumba initiates an elaborated explanation when he says; *"we have the air in this plastic that I took from the atmosphere, but you can't see the air with your naked eyes. There is a combination of gases in this plastic, and we have also oxygen and carbon dioxide here that used in the process of respiratory system"* (turn 3). Whilst the teacher points to the plastic bag, most learners where leaning attentively towards him whilst observing his actions (turn 4). The learners' body language shows an interest in what the teacher is saying. This is a clear example of trans-semiotsing at play, which views the language practices as intertwined with the multiple semiotics repertoires such as visual images, gestures, and bodily movement that are used to make an explanation (Lin, 2019). The use of trans-semiotising observed here, provide a clear focus on the importance of bridging between discourses more efficiently so as to enhance conceptual development for emergent bilingual learners.

In this scenario, the teacher was trying to connect the abstract idea of the mixture of gasses that are found in the atmosphere to a physical artefact, that being the air in the plastic. Here again, the orientations towards science knowledge with an incorporation of the physical representation of scientific ideas enabled the teacher to produce a more explicit account of the scientific ideas at stake. The learner's physical reaction through eye gazing, and nodding suggests that the use of demonstration was successful in sparking their interest and possibly they have constructed the meanings that were presented to them. It is important to note that without including these concrete demonstrations, it would be difficult for the teacher to convince the Grade 4 learners about the mixture of gases that are found in the atmosphere. In turn 5, Mr. Shilumba repeats the scientific explanation in a joint construction with the whole class. He first highlights the key component of how oxygen and carbon dioxide form part of the air that can be found in the atmosphere. Here, he promotes shared meaning by repeating the scientific explanation in the written modes and making

it available to all learners. The teacher goes on to adopt a 'special voice' or tone to emphasise the key words and by repeating the written scientific idea once more, speaking in a very slow and deliberate voice, thereby, stressing the importance of these ideas (field notes, lesson 7; 12-06-2018) . The teacher tries to involve his learners in his presentation through gazes, the position of his body and his deliberate voice. Here again, his actions are clearly oriented toward the learners and he does not personalise the knowledge. Here, Mr. Shilumba engages in a rich semiotic performance while deploying multiple modes strategically to represents the same scientific idea from a different perspective. It is important to note that multiple modes were used concurrently throughout the teaching sequence (e.g., talking while pointing at a diagram or drawing while using a specific voice tone, and pitch, gesturing while explaining, using the body while speaking and gazing to the learners while speaking as well).

The analysis of extracts 7.8 – 7.10 reveals how Mr. Shilumba skillfully structures the classroom discourse to support his learners in developing their understandings of the scientific process of the respiratory system. This was achieved chiefly by establishing the context of more familiar everyday experiences as well as presenting the science concepts from multiple perspectives. These perspectives include the use of different modes, the use of translanguaging and trans-semiotising practices, the use of spoken language accompanying actions, demonstrations, experiments, and oral reflection on what was learned. The use of rich multimodality observed in the three episodes played a critical role in supporting learners to construct science meaning and to make the notion of trans-semiotising visible in the lesson since the science content was presented from different perspectives. An important point to recognise is the sequencing approaches that were taken in the preceding episode in 7.10 that necessitated the juxtaposition of everyday and scientific point of views, which was indispensable for the constructing of science meaning. Thus, learners have a greater chance to position the authoritative discourse of the science knowledge in connection to their everyday life experiences while engaging in exploratory talk and in return, they have a better chance to appropriate the new science content.

Conclusion

In this chapter, I showed how the teacher attempted to support the construction of science knowledge during science lessons, paying particular attention to how science meanings were made

through multiple languages and modes within in a linguistically constrained context. I have illustrated both moments where learners seemed able to engage in meaning making and develop their understanding, thus successful science meaning making; and those instances where Science meaning were unsuccessful. In the first part of the data analysis, I presented how the science discourse presented to the learners constrained their opportunities to appropriate the correct scientific concepts. However, the data analysis revealed some balance between everyday spoken-like language and science written register evidenced in the teacher's teaching approach of blended 'exploratory talks' (Mercer, 1995) to move learners 'along the mode continuum towards more specialized scientific reasoning' (Gibbons, 2003). I have also explicated how Mr. Shilumba attempted to make use of register switching between everyday life analogies, and metaphors while presenting new scientific ideas, through using familiar examples and non-scientific registers. The data shows that the fact that the analogies and metaphors were mainly expressed in English even though they are every day; and that the learners, who had limited proficiency in English, found it difficult to link the used analogies to what they are familiar with in their everyday life, commonsense concepts) and to what they need to know (in scientific English, scientific concepts).

In the second part, I illustrated how Mr. Shilumba skillfully incorporated rich multimodality such as the combinations of heteroglossic practices, visual representation, and the verbal language as well as the use of gestures and artefacts to ensure more comprehensive science meanings to be examined at a greater level. In addition, I also presented the way in which Mr. Shilumba created a path for smooth progressions for the learners to move from personal, everyday knowledge towards scientific knowledge. The data also showed that, even if the teacher demonstrated a good teaching, approach (e.g. in extract 7.8- 7. 10), learners were not encouraged to use and discuss the application of a newly-learned scientific idea in written formal language apart from copying the notes off the board. This can relate to the Setati et al' (2002) "metaphor of incomplete journey which describe teachers and learners in ability to move from informal, exploratory talk in learners' main languages to discourse-specific talk and writing in English" (p, 128). In this chapter, I have argued that by combining Bakhtinian and neo-Vygotskian theory, the concepts of translanguaging and trans-semiotising as well as multimodality which draws on a social approach to bilingualism is particularly useful for effective science teaching, and for supporting learners to appropriate scientific concepts within in a linguistically constrained context.

CHAPTER 8: "I do not know it in English": Learners' (mis) appropriation of science discourses

Introduction

In this chapter, I present analysis of learners' written assessments to assess their ability to appropriate new scientific concepts. Closer links will be drawn between what learners have produced in relation to the science resources that were made available by the teacher during the lessons, along with the resources they have taken from their everyday life experiences. It is imperative to see how science meaning delivered to the learners as a fixed transmission of knowledge, as opposed to that of the active construction of knowledge, impacts on the learners' ability to appropriate the science meaning. I also investigate the roles of the multiple modes in science written assessments with regards to science meaning making. It has been well established that assessment is an important factor of determining how best learning was perceived by the learners and also how science meaning was established during the classroom discourse (e.g., Drotner & Erstad, 2014). An analysis of science written assessments, therefore, is important to determine if there is any relationship with the scientific concepts presented during the classroom discourse with the learners' written science discourse. The analysis will be based on the learners' written science assessment, the teacher's interview, transcribed classroom observation data, as well as from field notes.

As it was demonstrated and argued earlier in chapter 5, the Namibian school system subscribes to a separatist language policy and ideology that advocate "a one language at a time ideology" (García & Li, 2014: 67). As a result, there is an English only policy for all written assessments as from Grade 4 and beyond. However, the linguistically diverse students do not always meet the requirements for the Standard written English required to complete their written assessments, and this might have devastating consequences for learners' abilities to perform well throughout their entire school careers (Prinsloo & Krause, 2016). The analysis of learners' written assessments was ideal for examining the impact of an English monolingual policy on the learners'ability to appropriate the science classroom discourse and to fulfill the demand of English monolingual assessments policy.

From a Bakhtinian perspective (1981), "language is not a neutral medium that passes freely and easily into the private property of the speaker's intentions it is populated overpopulated with the

intentions of others. *Expropriating* it, forcing it to submit to one's own intentions and accents, *is a difficult and complicated process*" (1981:293-294). In other words, learning how to appropriate the scientific ways of reasoning or talking' is not a simple process of acquiring specific rules, but rather it entails the process of transformations in which individual learners acquired the new ways of science knowing and reasoning (Roseberry et al., 1992). For this study, the notion of appropriation is an important conceptual tool because it emphasises how learners find their own ways to appropriate the scientific discourse and to facilitate their science meaning making (Bakhtin, 1981). However, as I argued earlier in Chapter 5, learners' abilities to appropriate the scientific ideas and to construct their own scientific voices (Gee, 2002) are contingent upon the manner in which the scientific ideas were presented to them in the course of learning. It is in the Zone of proximal development (ZPD) that science meaning can be made through merging of understanding from a more a capable expert and the novice. A fundamental premise of Vygotskian theory is that higher cognitive functions such as scientific concepts arise initially as the intrapsychological functions, with the more knowledgeable others while guiding the child's activities, before being internalised as intrapsychological functions (Vygotsky, 1978). It is here, within this 'zone of potentiality', that the presence of mediator or more knowledgeable other provides the impetus for effective learning and consequently, transforms the learners to reach their highest level of science learning.

Science written assessments and the selection of learners' written scripts

All tests and classroom activities were administered by Mr. Shilumba himself in the respective classroom. After two weeks of field work, learners were given the first assignment based on unit One that is; 'plants as living organisms' and after three days they were given a test on the same unit. Thereafter, the second test on the unit of 'animals' was written followed by a third test on the unit of the 'system of the body'. All science assessments collected for this study were based on the topics that were covered during my classroom observations. All learners were expected to take the tests at the same time, but the teacher was not strict with the finishing time. What is noteworthy, is that after the teacher administered the test papers, most of the learners would become passive, instead of working on their science assessments. After a few minutes, when the teacher passed by

to check if everyone is writing, most of the learners would show discomfort in their faces as an indication that they do not understand the assessments expectation. Thereafter, Mr. Shilumba would read the questions out loud, one by one, and translate it into Oshiwambo; with learners still passively listening to him (field notes, 16-02-2018). According to Mr. Shilumba, this strategy serves as an intervention to ensure that all learners understand the assessments questions, although they are still required to write their answers in English only (interview field notes , 22-06- 2018). In the event where the teacher did not provide an explanation in Oshiwambo, learners would constantly request this translation. Following his translations, Mr. Shilumba would then request the learners to start answering the questions monolingually in English (field notes, 22-06- 2018).

Learners always looked uneasy during the administering of tests. The tests' administration would always take place in a formal atmosphere. During the tests, learners are expected to be seated in rows and joined tables are separated. The teacher always cautioned the learners to refrain from copying from each other's notebooks. The time allocated for each test was 40 minutes, however, the learners spent approximately 70 - 80 minutes to complete writing their tests (field notes 22-06-2018). For this study, I selected some of the learners' written tests scripts as well as their classroom activities for analysis. The selection criteria were based on the learners who frequently participated during the lesson. Since I am also interested to understand the role of multiple modes for science meaning making, I considered to select the learners' scripts who use the multiple modes for science meaning making as well as those who make use of 'translanguaging ' in their science written assessments. In addition, some lessons extracts were chosen because they are representative of how science meanings were constructed during the classroom discourse. The learners' original names have been changed to anonymise their identity.

In what follows, I will analyse the learners' written scripts to find out the extent to which they have appropriated the scientific processes and concepts that were introduced during the classroom discourse. Jewitt et al. (2001) claim that learners' produced texts can serve as evidence to find out whether the learning processes that they have engaged in was fruitful while focusing on the impact of the teacher's discourse on the individual learner's conceptual understandings. To examine the degree to which Mr. Shilumba's explanations of scientific ideas and concepts influences the learners to assimilate the science concepts, I looked for evidence of how learners have demonstrated an understanding of science ideas in their written assessments.

The complexity of English monolingual assessments and the kind of Science discourse learners have appropriated on plants and photosynthesis

In the following part, I present the data from the learners' written test for test 1 based on the unit of' plants as living organisms. The most prevalent classroom discourse activity structure during the lesson on plants as living 'organisms', as we have already seen in Chapters 7, is 'Triadic Dialogue' (Lemke, 1990), in which Mr. Shilumba use the strategy of initiations of questions and responses with little evaluative feedback given to the learners. There were also a number of occurrences of the teacher's long monologues, presenting science ideas using long explanations and reading aloud long extracts directly from the textbook. The role of the learners during the lessons on the topic about the plants was often passive and the lesson patterns were mostly teacher directed, preventing learners from taking agency in their learning process. Again, Mr. Shilumba assumed the role of transmitting the ready-made science knowledge to the learners without considering if learners are indeed able to talk and do 'science (Lemke, 1990).

The analysis of the teacher's discourse in the exposition of science content on the unit of 'plant as living organisms' in Chapter 7 also found instances of Mr. Shilumba presenting non-scientific conception that might impede the learners' abilities to appropriate scientific concepts. While analogies and metaphors can be useful devices to link abstract concepts with every day, lived experiences, the data analysis in chapter 7 indicate that there are times when they lead to misconceptions rather than to theoretical knowledge. It was also observed that most of the scientific terminologies remained tacit to these learners given the fact that most of the dense terminologies were never fully elaborated during the lessons. In what follows, I will analyze learners' written assessments to find out the association between the classroom discourse and how learners responded to the assessment questions based on the topic taught.

During the test, learners were asked to read the questions very carefully and to answer the questions in English only using their knowledge from the unit on plants as living organisms. In the learners' written scripts below, they were asked different questions about the key ideas of the functions of the different parts of the plant as well as on the process of photosynthesis (see table 8.1). In an interview conducted prior to administering the test, Mr. Shilumba confirmed that learners will be able to pass the test, and he was noticeably confident that he presented the science content in a manner that nurtured the learners to conceptualise the science concepts as per science curriculum

expectations (interview, 22-06-2018). However, it is interesting to find out if the learners indeed grasped the science content as envisaged by Mr. Shilumba. The table below exemplify some of the learners' conceptual understanding on the unit of 'plants as living organism'.

Question	Potential response	Learners' responses	Marks obtained per question
1.Define the concept of photosynthesis	*Photosynthesis* is the process in which plants use energy from sunlight and use it to convert carbon dioxide and water into food.	Dre: Is to cook food of the plants Jan: Is to mix the things and cook food for the plants Juu: Photosynthesis is preparing food for the plants Tre: Is to cook food for the plants Eva: Is when the plants mix water and salt to cook their food	0/2 0/2 2/2 0/2 0/2
2.What is the function of the roots	- to support the plant - to absorb water and mineral salts -To store the food	Dre: The roots give plants water to drink Jan: The roots take water to the plant Juu: I do not know in English Tre: The roots is used to make the medicine Eva: The roots makes medicine for sick people	0/2 2/2 0/2 0/2 0/2
3. What is the functions of the flowers	- the purpose of the flower is to reproduce - It accommodates the sex organs of the plants	Dre: The flowers are used for decorations Jan: Flowers are used at funeral Juu: Flowers are used at the weddings Tre: So that the insects can visit the plants	0/2 0/2 0/2 1//2

		Eva: Flowers are used to make perfumes	0/2
4. what is the function of the leaves	- leaves is where food is produced -is where photosynthesis take place and gas exchange.	Dre: Leaves are food for insects Jan: Is where the plants cook food Juu: Leaves are foods for Mopani worms Tre: Leaves are green Eva: Leaves are food for animals	0/2 0/2 0/2 0/2 0/2

Table 8.1: Learners' written answers to test questions (extracted from their written tests)

While the notion of critical thinking required the learners to critically examine and evaluate their science knowledge (Mintzes & Novak, 2000), all questions in (table 8.1) require the learners to recall factual knowledge from what they have learnt during the classroom discourse. As we can see in table 8.1, there are no open-ended questions that are probing the learners to apply their science knowledge and to engage in critical thinking. These questions are not encouraging the learners to show their deeper understanding of the scientific concepts and competencies that are required to succeed in the Natural science curriculum as envisaged by the Namibian' curriculum.

As we can see from table 8.1, all the questions are meant to test the learners on their knowledge about the process of photosynthesis as well as the functions of the parts of the plants that were presented to them a week prior to the test. For instance, question 1 asked the learners to; "define the concept of photosynthesis". The nature of this question required a concise statement of an exact definition of the process of photosynthesis while using the science terminology in complete grammatical sentence using a discipline-specific language. Learners' responses to this question revealed that they seemed not to appropriate the required scientific definition of the process of photosynthesis. Therefore, this question was poorly answered by most of the learners as is evident in table 8.1. Out of five learners, only Juu managed to offer a correct definition of the concept of photosynthesis as; "preparation of the food for the plants" was awarded the full marks 2/2. Juu's responses reflected that she has indeed appropriated the teacher's exact words uttered during the

classroom discourse when he says, *"in other words, photosynthesis means the preparation of food for the plants"* (see extract 7.1 in chapter 7). In addition, this explanation was also made available in the written mode on the chalkboard notes during the lesson (field notes, lesson 1, 06-02 -2018).

On the other hand, Dre, Jan, Tre, and Eva's definitions of the process of photosynthesis were obviously different from generally accepted definitions by biologists on the process of photosynthesis. It is interesting to note that these learners have also managed to reproduce the teacher's precise speech of the definition of the process of photosynthesis. For instance, Dre & Tree reproduced the exact words of Mr. Shilumba's when he uses the analogy of photosynthesis as, *"cooking food for the plants"*. Jan has defined the process of photosynthesis; *"as mixing things to cook the food for the plants"*. On the other hand, Eva defined the concept of photosynthesis as; *"when the plants mix water and salt to cook their food".* Again here, we can clearly see that Jan & Eva have also reproduced Mr. Shilumba's exact speech when he uses the metaphor of *"the plant mix the ingredients such as mineral salts, water and carbon dioxide to cook their own food through the process of photosynthesis"* to explain the scientific process of the photosynthesis (see chapter 7 extract 7.1 & 7.2). This suggests that the learners' views of the process of photosynthesis as "cooking food for the plants as well as mixing things to cook food for the plants primarily originated from the teacher's classroom discourse. This implies that the learners have indeed successfully appropriated the classroom discourse. However, the teacher's description of the concept of photosynthesis was not only incomplete according to neo-Vygotskian' notion of what constitutes as the true scientific concepts, but his explanations was also scientifically incorrect. This means that Mr. Shilumba failed to consider the science pedagogy that would potentially direct the learners towards the acquisitions of the authentic scientific concepts. This would leave the learners with the challenges of applying their scientific knowledge efficiently in a more scientific written language, as they do not have such language in their current repertoires.

The fact that Mr. Shilumba drew the memorandum from the textbook content is an indication that he expected the learners to reproduce an exact textbook science content in their written responses. Thus, learners were penalised with no marks for not complying with the textbook definition of the concept of photosynthesis. However, learners gave the description of the process of photosynthesis in accordance with what they have appropriated from the teacher's classroom discourse. One can infer that learners have indeed managed to grasp the scientific meaning of the shared experiences

that were made available during the lesson, although what they have reproduced is merely fragmented everyday knowledge. As has been mentioned already in chapter 2, there is substantial research that support the claim that young children should be equipped to think abstractly , arguing that learning of the scientific concepts is a key vehicle for abstract thinking (Fleer, 2010); Murris, 2012). However, due to the teacher's ineffective mediation of the scientific concepts and the processes of photosynthesis inaccurately, learners might fall prey to logical fallacies and biases of the process of photosynthesis and its attendant concepts.

The possible definition of the process of photosynthesis would be the process in which plants make their own food in order to provide the plants with the energy. It must be noted though, that the food that is used in the contexts of the process of photosynthesis is distinct from the common meaning of the food that learners experienced in their everyday life. For instance, food in the context of photosynthesis can be defined chemically and it requires the inorganic law materials but not as common knowledge of the food for human and animals' consumptions. Learners' conceptual understanding of the process of photosynthesis is contingent upon their everyday 'context-dependent sensory experiences' of the observable visible phenomena (Morris et al., 2016). On the other hand, in the context of scientific concepts learning, the appropriations of "the everyday concepts are scientifically unacceptable because they are couched in everyday terms, are not transferable and do not portray the 'essence' of a concept" (Morris et al., 2016: 147) by having acquired only an everyday concept, learners' concepts can be erroneous (Morris et al., 2016). For instance, in this study, learners are thinking that plants cook their own food using the same process that required in everyday of cooking. In this case, one could argue that science teaching was not developmental since it fails to transform learners to internalise the accepted definition of the process of photosynthesis, and thus, their conceptual understanding remains at the level of the everyday understanding.

In the absence of explicit scientific definition of the process of photosynthesis and its related scientific procedures, it is unlikely for these learners to produce the accepted science definitions of the process of photosynthesis of 'plants making their own food using raw materials' , and thus to improve their science performance. It was therefore not surprising that the learners' reasoning in table 8.1 did not reveal any patterns suggestive of 'science talk' (Lemke, 1990) and their sense of reasoning seems to be akin to what Vygotsky argued as a 'pseudo- conceptual form of thinking'

(Vygotsky, 1986; 1987) . This implies that learners rely heavily on the everyday concepts yet failed to link it to the appropriate scientific concept, thereby signaling that they do not understand the abstraction but still operate at the concrete everyday form of thinking. For Bakhtin, any degree of appropriation of a certain discourse entails a learner's individual effort to assimilate different points of views through active engagements (Bakhtin, 1981). However, this process cannot be enabled successfully though a passive understanding of scientific concepts and processes (Bakhtin 1981). From a Bakhtinian perspective, learners can only successfully gain access to various form of thinking as well as interpret new experiences when their own discourse are free from the authority of others' discourse. This required a transformative process in which learners become less dependent on others and eventually they will gain the 'innerly persuasive discourse' (Bakhtin, 1981). Hoverer, in this study, learners' responses are clearly reflecting the authority of the teacher's discourse.

Moreover, questions 2, 3 & 4 in table 8.1, asked learners to explain the functions of the roots, flowers, and the leaves. These questions are vague and imprecise as they do not specify whether they are looking for the function of the plant parts in general, or the scientific one. Again, during the lesson, Mr. Shilumba did not provide a context for how learners can attend to these questions and for them to know exactly what the questions were asking for. Without prior contexts, these questions appeared to be ambiguous. In retrospect, a proper mediation and relevant scientific information to motivate the learners to answer these questions was absent during the classroom discourse. Therefore, learners might have thought that they are being asked for an explanation of their personal knowledge on the functions of the different parts of the plants. For instance, in question 2, learners were asked to give the functions of the roots. Some of the learners' responses in table (8.1) revealed that they were not prepared to answer this question. Dre offered an explanation that *"roots give the plants water to drink".* Considering the Grade level and Dree's English language proficiency, his answer was close to the scientific function of the roots, that is; 'the absorption of water to the plant'. However, it might not be possible for Dree to use the word 'absorption' given the fact that he does not have a repertoire of the scientific word 'absorption'. We can clearly see that the word absorption is a technical term and yet very dense because of the use of nominalization. Thus, Dree employed the term 'drinking' that is available at his disposal to convey his science meaning. Given the fact that Mr. Shilumba anticipated the learners to use the scientific term 'absorption', he did not award any marks to Dree's responses. The fact that Mr.

Shilumba was always mindful of the 'controlling devices' imposed by the highest authority that is (the subject moderator as mentioned in Chapter 6), might explain why he did not take up the position to act independently and use his personal discretions to consider Dree's linguistic needs. Thus, his lack of agency might influence him of not making well-informed personal decisions while assessing his learners' science knowledge (see chapter 6).

Whilst responding to question 2, Jan responded that "the roots take water to the plant", and she scored the full marks 2/2. It is clear that Jan has appropriated the teacher's explanation of the function of the roots that he presented to the learners during the lesson; *"the roots are used for the transportation of water and mineral salts to the rest of the plant"* (see Extract 7.6 in chapter 7). On the other hand, Juu did not offered any explanations to question 2. It is very telling that rather than writing his answer to question 2 in Oshiwambo, Juu writes *"I don't know in English".* He recognises the power of English as so strong that it is better to say in English that you do not know than to give a correct response in the "wrong" language. It is also touching in that Juu seems to want to tell the teacher that he does know the answer, and therefore, he made a confession that he does not know the answer in English. This is another challenge of what counts as the legitimate language for science assessment in inhibiting a learner from conveying his science meaning manifested in this study. What is striking here, is that the use of English as the only valid language for science assessments silenced Juu's voice and rather serves to disengage him from the science meaning making, and thus, constraining his performance.

Moreover, both Tre and Eva offered similar explanations in question 2, when they both wrote that; *"the roots are used to make the medicine for sick people".* It clear that both Tre and Eva possess the knowledge about their immediate environments due to their direct experience of how roots are used within their daily lives, which preceded formal education. (Palmer, 1993). In effect, the learners are utilising spontaneous everyday concepts. Tre and Eva's explanations to this question are located within an everyday discourse of how they experience the functions of the roots of common practices of using roots to produce medicine in their own community. It clear that the knowledge that both Tre & Eva constructed is different from a scientific one of the roots anchoring the plants, absorbing water, and mineral salts as well as to store the food. These learners' responses are not in line with the teacher's discourses. During the lesson, Mr. Shilumba explained the function of the roots as; *"the water evaporates or disappear into the soil; now when its dry the*

function of the roots is to absorbs or take water and mineral salts from the soil through the process of absorptions. For the plants to have water; the roots are used for the transportation of water and mineral salts to the rest of the plant" (see extract 7.6 in Chapter 7). The teacher did not explain the dense language in familiar terms to learners, or through using a 'translanguaging pedagogy' to support learners to comprehend its meaning. Instead, this statement was presented as mere facts taken from the textbook to be memorised by the learners. Therefore, is not surprising that learners did not gain an understanding of the science concepts.

My analysis shows that learners will not fully develop science meaning if scientific concepts are explained to them, without linking its meaning within the context of the learners' everyday life experiences. These learners might display resistance towards acquiring the science information and it is highly possibility that they will continue to resort to their personal experiences when solving the science problem, instead of using the newly learned science ideas (Hannust & Kikkas, 2007). This goes against Vygotsky's ideas of how scientific concepts should be taught in formal schooling. According to Vygotsky (1962:93), "the very notion of scientific concepts implies a certain position in relation to other concepts that is a place within a system of concepts", therefore these concepts will remain a verbatism as opposed to the true concept (Vygotsky, 1987). It is worth noting that science concepts are abstract, and therefore, teaching science concepts generally warrants a more meditational role from the teacher. In the absence of actual teaching of the scientific functions of the roots to the plants itself, it is not surprising that learners drew upon their everyday understanding of the functions of the roots. For Vygotsky, it is only through the formal schooling through systemic instruction that metacognitive awareness as well as the acquisition of the scientific concepts develops.

Question	Potential response	Learners' responses	Marks obtained per question
3. What is the functions of the flowers	- the purpose of the flower is to reproduce - It accommodates the sex	Dre: The flowers are used for decorations Jan: Flowers are used at funeral	0/2 0/2 0/2

	organs of the plants	Juu: Flowers are used at the weddings Tre: So that the insects can visit the plants Eva: Flowers are used to make perfumes	2//2 0/2

Table 8.2: Learners' written answers to question 3

In Question 3 (table 8.2), learners were asked to give the function of the flowers. However, most learners performed very poorly on this question, except for Jan who managed to score 1/2. While answering to the question, learners employed their everyday knowledge of the functions of the flower that they witness in their daily lives. For example, Dre explained the function of the flower as; *"flowers are used for decorations"* and Jan explained that *"the flowers are used at the funeral"*. Juu responded that; *"the flowers are used at the wedding"* while Eva has answered that; *"the flowers are used to make perfumes"*. Only Tree responded correctly to this question; *"so that the insects can visit the plants"* and he scored full marks 2/2. Tree's utterance is reflecting the classroom notes in the learners' summary books, as you can see in the diagram (8.1) below: *"The flower attracts the insect to pollinate them"*.

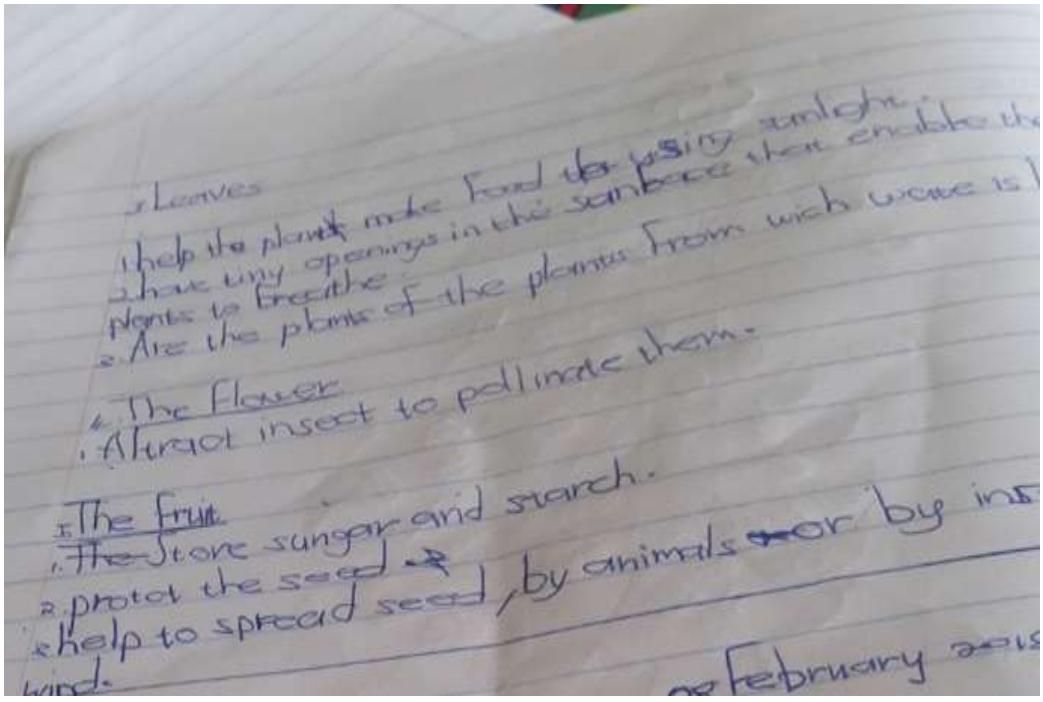


Diagram 8.1: learner's written note on the function of the leaves, flower, and fruits

On the other hand, the ideas that flower attract the insects was not part of the teacher's verbal explanations during the classroom discourse. It seems that Tree developed an understanding of the function of the flower from going over his written notes, and not necessarily from the teacher's verbal utterances. The way science concepts were presented to the learners might explain why they failed to appropriate the teacher's discourse of the function of the flower. When Mr. Shilumba draws from the textbook science language, he seems unaware of the difficult and potentially confusing nature of the science discourse. During the lesson he explained the function of the flower; *"as the reproduction system of the plants where the pollination take place"* (field notes, lesson 2, and 07-02-2018). This statement was too vague for the Grade 4 learners to relate to, and thus, it warranted further explications in terms of linking it with the familiar concepts as well as explaining it in a more familiar language to learners. Again, he did not simplify the concept of pollination, or refer this abstract term to the learners' everyday life experiences (field notes, lesson 2, and 07-02-2018). In this context, one can assume that within their every day life learners observe how insects frequent flowers, pollen on the ground and flowers attracting honeybees, and that this existing knowledge would be pivotal to help them to integrate the scientific concept of pollination learned in school with their own experiential observations.

Question	Potential response	Learners' responses	Marks obtained per question
4. what is the function of the leaves	- leaves is where food is produced -is where photosynthesis take place and gas exchange.	Dre: Leaves are food for insects Jan: Is where the plants cook food Juu: Leaves are foods for Mopani worms Tre: Leaves are green Eva: Leaves are food for animals	0/2 0/2 0/2 0/2 0/2

Table 8.3: Learners' written answers to question 4

Moreover, in question 4, learners where asked; "what is the function of the leaves"? This question would not be ambiguous if Mr. Shilumba indeed explained the scientific meaning of the functions

of the leaves to the learners. During the discussions Mr. Shilumba accepted learners' answers such as: *"Leaves are food for the insects" and "leaves are used to make medicine"* where their understanding of the leaves' function was not in relation to the plant itself. Again, since Mr. Shilumba failed to evaluate learners' responses and their understandings, learners got the impression that their answers were acceptable, when actually, it needed more explication. Thus, when they answered this question during the test, they once more used their intuitive every day knowledge, similar to how they did within the classroom. As seen in table 8.3, no learner was able to give the correct scientific ideas of the expected answers. For instance, Dre responded that; *"leaves are food for the insects"*. On the other hand, Juu responded that, *"leaves are foods for the mopani worms"* while Eva has responded that *"the leaves are food for animals".* We can clearly see how learners' responses are not in line with the scientific functions of the leaves to the plant itself where the process of photosynthesis and gas exchange take place.

On the other hand, Tre, and Jan's responses to question 4 do not reflect an everyday understanding of the function of the leaves nor is it based on the correct scientific function of the leaves. For instance, Tree responded that; "leaves are green". Instead of giving the function, Tree gave the description of the leaves based on his visual perceptions. This is a clear manifestation of the English language dilemma mitigating the learner from comprehending the question's intention. On the other hand, Jan has reproduced the teacher's explanation of the function of the leaves as; *"where the plants cook their own food".* This is not surprising given the fact that the teacher repeatedly referred to the functions of the leaves as *"where the process of cooking food for the plants takes place".* For instance, in (extract 7.1 in chapter 7), Mr. Shilumba explained that *"that's why plants have leaves, because it's where they cook their own food".* This means that Jan has indeed appropriated Mr. Shilumba's exact words of the function of the leaves. In the diagram (8.1.) we see that none of the learners reproduced the science written notes on the function of the leaves; that is "leaves helps plants to produce food using the sunlight ; leaves have tiny openings that helps the plant to breathe and is where water is lost from the plants". The fact that, during the lesson, Mr. Shilumba did not expand on the written notes on the chalkboard, the learners might not be in the position to discover the science meaning on their own without the proper mediation of the scientific concepts from the teacher. Therefore, the science written mode alone is not enough to convey the scientific concepts without systemic mediation of the scientific concepts from the more knowledgeable others as envisioned by Vygotsky (1987).

The learners' inability to provide the right scientific answers might be attributed to the fact that the functions of the leaves was presented to them in too abstract terms and it was not physically manifested or demonstrated to the learners to visually represent the knowledge of the concepts taught. Again, learners held the same misconceptions during the classroom discourse, and their fallacious scientific ideas remained unchallenged. This translates into poor performance during their written assessments, as learners repeat their unchallenged misconceptions of science concepts in their responses.

During the lesson, Mr. Shilumba introduce the statement; *"the leaves have tiny opening in the surface that enable the plants to breath, and they absorb the light energy, so that the sunlight can get to the chloroplasts in the cells".* This explanation was extracted from the science textbook and yet it is was very vague, abstract, and confusing to the learners. Yet, Mr. Shilumba did not rephrase this statement, or make use of translanguaging to make it easier for his learners to comprehend its meaning. In addition, he did not ask his learners if they had indeed understood, or if they had any questions concerning his explanation (field notes, lesson 2, 07-02-2018). Since the school language policy privileges the use of English as a MOI, it carries critical implications for ensuring quality science instruction in the early years of schooling, especially in a bilingual Grade 4 where learners lacked English language proficiencies to learn and be assessed in. In summary, the written assignments show that, poor language proficiency as a result of an enforced MOI, and a lack of thoroughly explicated science concepts through translanguaging, will preclude learners in this study from expressing their scientific knowledge during the science written assessments and thereby, poorly affects their performance in science.

Moreover, learners' thought, and their understanding are related to the ways in which they socially interact with the world which is influenced by the elements of cultural practices, rituals, and beliefs (Oliver & Venville, 2012). We can clearly see how learners' cultural influences appeared to play a major role in regulating their thinking. It is clear that learners were not taught to distinguish between the language of human experience and the language of science, and what they have learnt can't lead them to sense that "science stands somehow outside of the world of human experience, rather than being a specialized part of it "(Lemke, 1990:151). Thus, from the Vygotskians' perspective, learners' knowledge is pure spontaneous and empirical knowledge as opposed to the scientific procedural knowledge. The correct scientific language adhered to certain 'stylistic

norms' without any reference to the 'here and now' or based on spontaneous language features of immediate classroom discourse situations or directly relating to people, event and time (Lemke, 1990).

While the Mr. Shilumba resorts to ask close questions to in order to assess his learners' science knowledge , doing 'real' science entails higher-order thinking (Mestre et al, 2009) as well as evidence-based reasoning (Cetina, 1999). It also encompasses a specific discourse of "talking science by 'observing, describing, theorizing, questioning, challenging, arguing, designing experiments, following procedures, judging, evaluating, deciding, concluding, generalizing, reporting" (Lemke, 1990:9). These critical skills for science learning were not part of the questioning techniques in table 8.1. As it was already established earlier in Chapter 7, the construction of science meaning is not only expressed through the spoken words, but science meanings are complimented by pictures and images (Choi & Yi, 2016). However, in table (8.1) none of these questions embedded visual images or graphics as contextual clues to aid the learners' comprehensions, especially considering their level of proficiency in the English language.

The incomplete journey, moving from spoken-like language into written-like Science Discourse verses learners' abilities to appropriate scientific concepts

Lemke (1990:51) recognises the "ideology of the special truth of science". From this perspective, learners are taught a special science truth based on specialised skills and knowledge that are not based on common sense knowledge. Now let us see how the classroom discourse enabled learners' transformation from their everyday knowledge of taking into the scientific ways of knowing during the science content of the 'excretory system'. One week prior to the written test, Mr. Shilumba devoted some time to introduce his learners to the scientific process of the excretory system. The extract that follow exemplifies how Mr. Shilumba introduced the scientific ideas of the execratory system in a very confusing manner while trying to link the everyday language with the specialized science discourse. In this part, I will focus on the relationship between how the teacher discourses influences or constrained the learners' abilities to appropriate the scientific concepts and processes presented to them during classroom discourse.

Extract 8.1

Turns	Actor/ action	Speech	Translation and Images
1	Mr. S	In other words, we can say the urethra it's a canal or a pipe	
2	Ss: Some learners shouting	What? A canal? Mhh, yoo! A pipe? A canal?	
3	Mr. S	Yes, it is a canal or a pipe where the urine pass through. In other words, you can also say it's a corridor. The urine is store in the sack called bladder. Do you know what the bladder is?	
4	Ss	No	
6	Mr. S	*Obladder okapunda komaxu, omaxu shamha a didwa keefiyo, oha tuvikilwa mokamhunda oko*	The bladder is the sack where the urine is stored, after the kidney filters the urine, it is then stored in that sack.
7	Ss: Looking very surprised from their facial expressions		
8	Mr. S Drawing on the board an image of the bladder	The bladder can be referred as a storeroom. Okay, let me show how the bladder looks like	*Obladder oyo ostoreroom yomaxu*  Diagram 8.2: The image of the bladder

In this episode, Mr. Shilumba employed a strategy which Lemke (1990) terms 'glossing' to explain an unfamiliar science terms to his learners. This strategy entails a process in which a teacher repeats exactly what he has said in a more informal way to give a description of the scientific term

using an equivalent word or a familiar expression. For instance, the strategy of 'glossing' occurs when Mr. Shilumba incorporated an everyday term such as 'pipe, canal' (turn 1) as well as a word 'corridor' in (turn 2) to give the description of the word urethra. These specific terms 'pipe and canal' in everyday language have some thematic connections with the word tube and these words are interchangeable. Although these words have minor distinctions, they are all used for moving or passage of fluids. Therefore, if the learners understood these everyday words, they may be able to gain an understanding of the notion of carrying fluids, in this case the urethra as a tube to transport the urine from the bladder. Ironically, the use of unfamiliar everyday terms 'pipe' and 'canal' can be more challenging for emergent bilingual learners to understand and might require more than just a translation of the scientific term "urethra" to Oshiwambo, to enable meaningful understanding. Ultimately, the use of multiple 'everyday' words in this case do not support the conceptual understanding of the scientific concept urethra because these everyday terms are unfamiliar to these learners. From the learners' facial expressions, they seemed to be confused and some of them went on to ask what the words canal, and pipe meant (turn 2).

Mr. Shilumba went on to offer another unfamiliar term "corridor "in turn 3 to thematically link it with the word 'pipe' to make his learners to get an understanding of the passage of fluid. The term 'corridor' might not be part of the learners' language repertoire considering their proficiency in English. Therefore, it might be challenging for these learners to construe the relationship between the everyday unfamiliar terms (corridor, pipe, and canal) with the targeted scientific concept urethra. During his lesson planning, the teacher did not consider using the suitable words that might be fitting for science meaning making. If he displayed awareness of his learners' linguistic resources, he could consider Oshiwambo familiar words such *Omunino* (pipe) or *Omulola* (water passage) to explain the passage of fluid. These Oshiwambo terms are familiar to these learners and they are more ideal to be thematically linked with the notion of the 'tube' that commonly referred for the transportation of the fluid.

This suggests that Mr. Shilumba's instructional practices was shaped by the language policy which dictates what language should be used for MOI and the fact that the Namibian curriculum is highly prescriptive on what and how to teach. Again, there is no formal policy that advocates teaching of science bilingually in the Namibian teacher training institutions. Therefore, Mr. Shilumba might not be always be conscious to teach bilingually although he has highlighted the essence of using

Oshiwambo as a resourceful language for teaching and learning during his interview (interview, 22-06-2018). Thus, I would contend that, the learners' linguistic resources were not fittingly utilised during the process of science meaning-making, including the semantics of the words used during the lessons. Therefore, the manner in which the scientific concepts were presented to the learners might hinder their chances to appropriate the targeted scientific concepts. In the South African multilingual classrooms' context, Setati and Adler (2000) cautioned that, the discourse should move from the learners' familiar language towards the unfamiliar language of the medium of instruction.

In turn (3), Mr. Shilumba went on to introduce the concept of bladder. He gave the description of the concepts of bladder in Oshiwambo as*; "the sack that store the urine"* in (turn 5). He tried to translate the word bladder into Oshiwambo; Obladder *oyo ostoreroom yomaxu* {the bladder is the storeroom for the urine} in (turn 5). However, since the word *ostoreroom* was not familiar to the learners, the Oshiwambo equivalent word *okamhunda komaxu* would be more appropriate to be used to explain the scientific concept bladder. The empirical part in this instance illustrates a translanguaging practice when Mr. Shilumba uses available language resources flexibly in an attempt to clarify and to construct the scientific meaning of the concept bladder. This implies that he not only moves between different discourses (scientific and every day) but also between Oshiwambo and English. However, he is not optimally utilising the linguistic resources available at his disposal although he comes from the same cultural and linguistic background as his learners. From the learners' facial expressions, they seemed confused when the teacher used the term 'storeroom' which is glossed as '*ostoreroom*' in this occurrence. In this regard an Oshiwambo equivalent term for the English term 'storeroom'- '*onduda yokutuvikila'* - could be more suitable to facilitate the learners' understanding. Thus, it was impossible for these learners to construct the scientific meaning of bladder despite the teacher's best efforts of using translanguaging. These learners might think that the teacher is referring to different things, such as the 'store' in their everyday life (referring to a shop) and the room in which they understood as the (bedroom /classroom) in their everyday life. I therefore argue that translanguaging practices can only be effective if it is systematically and strategically used to act as a mediational means and also when it is geared towards the learners' ZPD; in which learners' current linguistic abilities and their actual development is carefully taken into consideration. In light with this, Ganuza & Hedman (2017:11) emphasise that "By using the term pedagogical translanguaging in contexts where multilingual

practices are used by teachers and students without reflection and/or without a deliberate aim to mediate learning, we argue that the concept runs the risk of losing its inherent power". Equally, McKinney & Tyler (2019:7) argue that translanguaging can only be 'transformative and productive for learning, if its deliberately planned to get teaching and learning done and to liberate the multilinguals learners from the autocracy of monoglossic and monomodal orientation to school language policy".

The teacher attempts to further clarify the concept of bladder to his learners, by drawing an image of the bladder on the board (see figure 8.2) and labels the drawing bilingually: including the scientific term along with the corresponding everyday terms in Oshiwambo that resonates with the scientific terms. The drawing has enough information to model the concept of bladder to the learners and how the process of excretions works. Here, his intention was to show the learners visually what the bladder looks like. However, Mr. Shilumba did not explain all the important details of the drawing. Nor does he explain how the excretory system works in relation to the different organs used in this process, such as kidneys, ureters, bladder, and urethra to construct meaningful scientific knowledge. Ideally, the explanations of the excretory system might require the semantic relationships between the meanings of science terminologies (Lemke, 1990). This would allow the learners to master the relationship of the key scientific concepts and to see how they fit together. During the lessons, science writing was very minimal, mostly consists of a single word or labelling the diagram that was done by the teacher himself. Despite the fact that science is assessed in a written paper, science teaching was more orally orientated, since there were no opportunities created for the learners to practice reading and writing science during the lessons observed (field notes data) .

Moreover, we can see that the teacher tried to bridge between English and Oshiwambo; he also and he switched between the everyday and science register; along with the drawing mode in an attempt to construct and mediate the scientific concept of bladder to his learners. However, I would argue that the pedagogical potential of bridging between the discourses and the use of multiple mode was not necessarily realised by the teacher as per his intentions. The observed teaching approach contrast quite sharply with the notion of pedagogical translanguaging, which refers to a deliberately and systemic use of students' various linguistic resources to mediate learning (Probyn, 2015). It clear that Mr. Shilumba lacked adequate skills of implementing the bilingualism

effectively during his lessons. The lack of such skills can be the consequences of being trained to teach monolingually. While Vygotsky (1978) consideredlanguage as a primary tool for mediation of science concepts, in this study I argue that the verbal language alone is not enough to convey the science meaning but that using other semiotic resources such as gesture, images, written text, drawing, three dimensional models are fundamental in the teaching and learning of an abstract scientific concepts when the teacher made a deliberate decision to use translanguaging and trans-semiotising pedagogies.

Since the scientific process of the excretory system was introduced to the learners in abstract terms, let us now see to what extent learners have appropriated the scientific concepts in their written assessments scripts below. I purposefully selected 3 learners' written scripts based on the criteria such as reproducing the teacher discourse and trans-semiotising. The data analysis that follows offers an insight to the kind of science meaning that these learners have constructed during the classroom discourse and how they make personal science meaning about the scientific process of the excretory system in their written assessments.

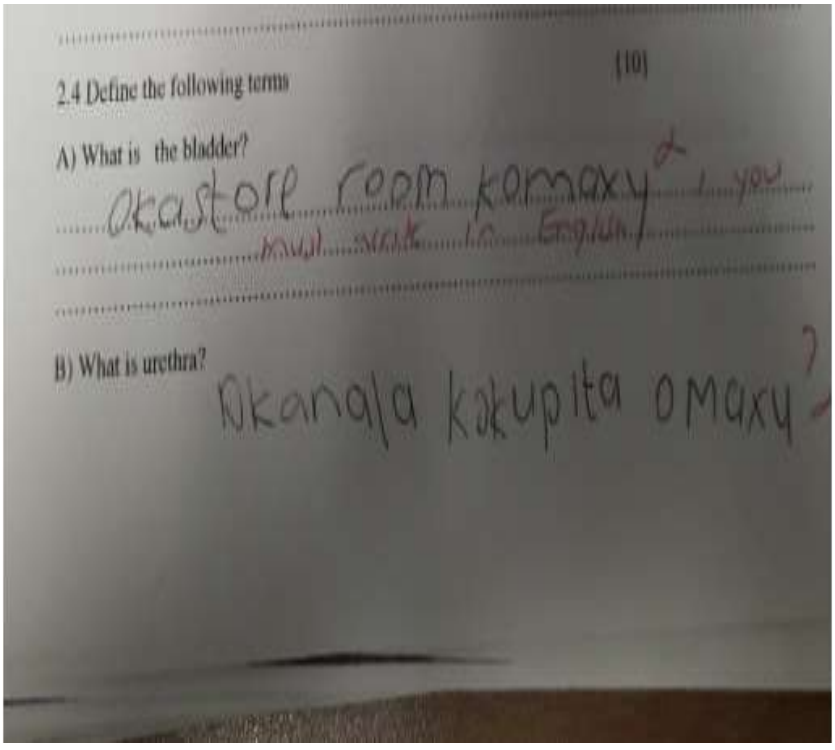


Figure 8.3 Tauno's written text (from test 2)

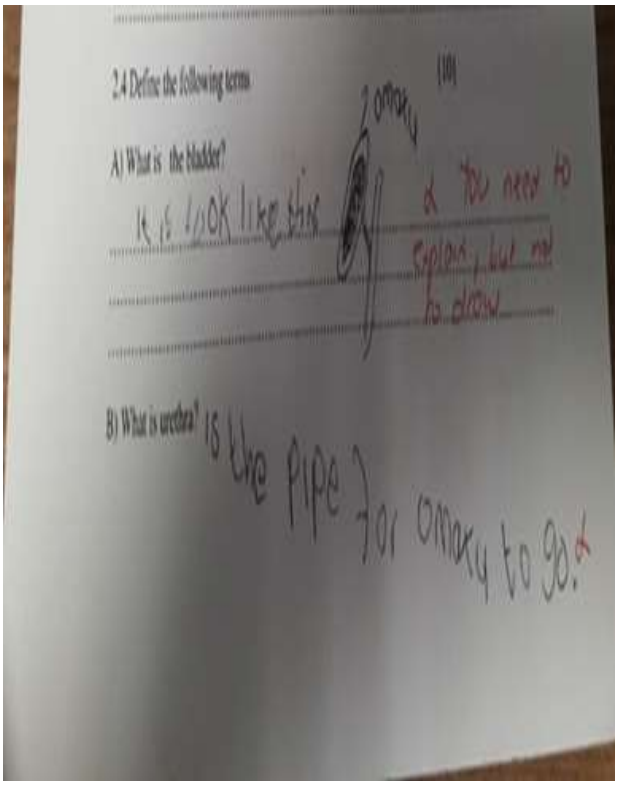


Figure 8. 4 Letty's written text

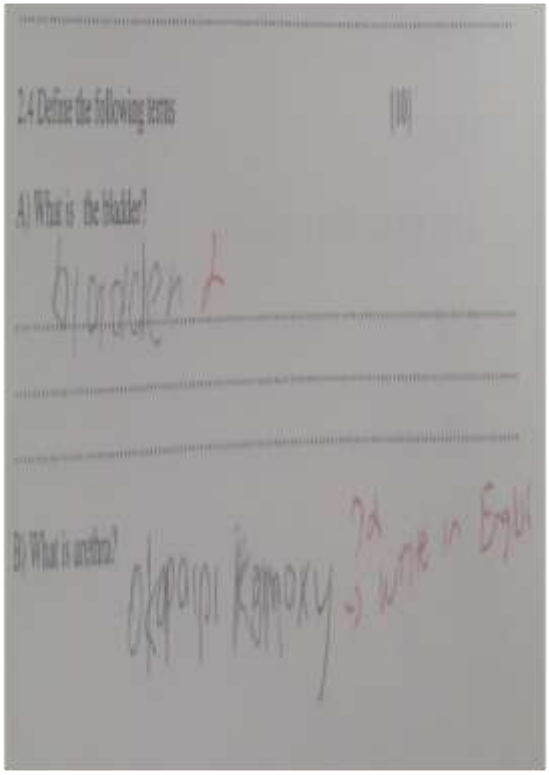


Figure 8. 5 Dree's written text

In the scripts above, learners displayed some trouble in demonstrating their mastery of the scientific concepts. For instance, question (A) in (figure 8.3, 8.4 & 8.5) asked the learners to define the concept of bladder. Instead of providing the definition, Dree reproduced the word bladder, and this designates that he copied down the word bladder from the question. Dree's inability to define the concepts might be accounted to his lack of scientific knowledge of the concept bladder, as well as to the dilemma of using the English language only to conduct the science assessments. Tauno has responded that; *"Okastoreroom komaxu*" which in English means *"is the storeroom for the urine".* Here we can see how Tauno has negotiated the meaning of the word 'bladder' while mixing Oshiwambo and English, similar to what he encountered when the meaning of the concept of bladder was presented to him during the lesson. Here, Tauno is using the language in a more fluid way when he reproduced the teacher's discourse; "*Obladder oyo ostoreroom yomaxu"* (the bladder is the storeroom for urine). This action seems to have allowed him to write what he wanted to convey and to voice his opinions and to show that he indeed knows the answer. However, what Tauno has produced cannot be regarded as the accurate scientific definition of the concept bladder, but he rather produced the fragmented everyday language of both English and Oshiwambo. It is

evident that in Tauno's utterances, Mr. Shilumba's voice can be heard as well. In Bakhtin's (1981) terms; the meanings that are found in the learners' utterances, are always "half someone else's" and they carry the echoes of the previous voices". Although Tauno has managed to appropriate the teacher's voice; there is no evidence in his response of the conceptual understanding of the scientific concept of bladder. One could say that there was a successful appropriation of the teacher's discourse, but no success in communicating the accurate scientific information.

On the other hand, Letty uses multiple modes, including a drawing in her response similar to the drawing that Mr. Shilumba presented during the classroom discourse (see diagram 8.2). Here, Letty has reproduced the teacher's drawing to represent the meaning of the concept bladder. Even if Letty was unable to verbalise the concept of bladder, she demonstrated an accurate description of bladder through the affordances of the drawing accompanied, by a label written in Oshiwambo. This suggests that Letty has indeed appropriated the linguistic features of the concept of bladder presented to her during the lesson into her own language repertoire. Her action of reproducing the drawing of the bladder allowed her to make meaning and to express herself and to show that she understood the scientific ideas. This is reflecting that while teaching can be multilingual and multimodal, learners' responses is expected to be monolingual English and monomodal written discourse. Here again, Letty's actions of drawing, and the use of Oshiwambo is an attempt to disrupt unequal voices and language hierarchies of what is regarded as a standard language in academic writing (Kiramba, 2016). However, her attempt does not succeed. Letty does not pay attention to what language she should use but she rather opts to communicate her science meaning. Thus, Letty positioned herself as a capable meaning maker (self-positioning) as opposed to language deficient, thereby, rejecting what is considered as a single correct written language form but this is not accepted by her teacher (other positioning).

Letty's unsolicited use of non-verbal semiotic resources in this case, was met by explicit reprimand and regulation of her language use from the teacher asking her to put her response in a writing mode (see Letty scripts in figure 8.3) *"You need to explain but not to draw".* This is an indication of how English monolingual ideology is being "embodied in communicative practice" (Kroskrity, 2006: 496), and could be "read from actual usage" (Kroskrity 2006: 505). Ironically, Letty did provide an explanation through the mode of drawing that represents the feature of the bladder. One would expect the teacher to recognise her drawing, considering its accuracy, and

since it was the same mediational tool which Mr. Shilumba used to facilitate learners' understanding in the classroom. Unfortunately, Letty's flexible use of the drawing mode for meaning making was met with the monolingual language ideologies that advocate the standard language correctness in science written assessments. As results of her practices, Letty was not awarded with any marks and thus, there was no acknowledgement of her understandings. An implication of this kind of 'language surveillance' could possibly contribute to Letty to internalise the language ideology and hold the belief that her inability to express herself in English during written assessments make her to feel language deficient (interview, 28-06-2018). It could also possibly communicate to her that the drawing of the bladder is wrong, and thus confuse her in future about the scientific knowledge of the bladder.

When I asked Letty during the interview how she felt about her actions of using both English and Oshiwambo as well as the drawing mode flexibly during her science written assessments, she responded,

> "*inai hala okufiyapo eemhaka inadi nyamukulwa, ohandi kendabala ndilongife oshiwambo ile ndifaneke ngee itai ndimbulukwa enyamukulo moshiingilisha pamwe omulongi ta filenge onghenda ndipite"* (I mean, I don't want to leave some blank spaces unanswered . I have to try my luck to use Oshiwambo or the drawing in the event where I don't know how to write the words in English. I thought the teacher would feel pity for me and give me some marks though I used a wrong language; Letty, interview transcript, June 28, 2018).

During the interview, Letty explains that she always tries her luck: maybe the teacher will consider her answer although she uses the "wrong language". This suggests that Letty is fully aware that she knows the answer, but it is her limited English proficiency that is preventing her from showing what she knows. This means that Letty was able to understand the explanation given through translanguaging, but because she is not allowed to translanguage in her assessment, she could not show what she knows. When I asked Letty, what would happen if she could be allowed to use the language of her choice freely during the science written assessments, she said, "*ohai piti nawa, ndee ovakulunhu vange otava udu nawa* " (I will pass with flying colours and I will make my parents proud" (Letty's interview transcript, June 28, 2018). It can be argued that rather than positioning Letty through the deficit lenses of lacking the proficiency in the English language,

the trans-semiotising perspective acknowledges all the linguistic resources that learners can bring to the science written text , while embracing the assessments methods that provide a space for learners to fluidly use the semiotic resources at their disposal, to express their scientific understandings (Vaish, 2019; Lin , 2010, 2019) .

Moreover, question 2.4 B in (figure 8.3, 8.4 & 8.5) asked "what is urethra". This question seeks a specific answer, that is the precise definition of the concepts of urethra. Here, learners are not encouraged to apply their knowledge or to engage in critical thinking. However, their answers revealed that they were still operating at the concrete conceptual understanding. In response to this question, Tauno defined the concepts of urethra in Oshiwambo; *"Okanala kokupita omaxu" (is the canal where the urine passed through)*. Letty defined the urethra mixing both English and Oshiwambo; *"is the pipe for omaxu to go {"is pipe where for the urine to go")*. Dree responded in a blend of English and Oshiwambo; *"okapipe komaxu"* (is the pipe for urine) and he was reprimanded by the teacher to answer in English. Here again, what learners reproduced is the fragmented science content of the mixture of English and Oshiwambo. Learners applied the heteroglossic practices, but they did not appropriate the correct scientific definition of the concept of urethra as; 'the tube that at the lower opening of the bladder that helps hold and transport the urine inside the body until it's released' (Namibian Grade 4 Natural science textbook). Again, learners' descriptions of the concept of urethra were incomplete and difficult to comprehend.

Ultimately, these learners, similar to their teacher, defined the concept of urethra while mixing both English and Oshiwambo. There is a clear manifestation of the learners' definitions resonating with Mr. Shilumba's explanation of the concepts of urethra. This suggests that during the lessons, learners have indeed appropriated their teacher's discourse, but they have not appropriated the authentic scientific knowledge as per curriculum expectations. No learners were awarded any marks to this question because their responses were in the wrong language, or the wrong mode and also the fact that their answers did not conform to the textbook content. There is a strong emphasis on the learners to write correctly while using the scientific English language only during assessments in contrast with classroom discourse where learners are allowed to 'language' freely. This is a clear language separation informed by monolingual and language purist ideologies observed in the science written assessments.

One can infer that these learners have not achieved the scientific language that is valued in the scientific discourse and the linguistic features that is required for science assessments. Although the teacher tried his utmost best to use the notion of 'trans-semiotising' by making use of the diagram, Oshiwambo as well as other language varieties, he failed to move learners from an everyday life knowledge into the scientific knowledge. Learners' poor proficiencies in the English language on the other hand limited their likelihoods to accurately convey the scientific meaning in their written assessments. Typically, learners' writings demonstrate what can be aligned with Canagarajah's (2006, 2011a) notion of code meshing. In this instance, taking up translanguaging through the use of code meshing in writing enabled the learners to convey their meaning without having to restrict themselves to imaginary language boundaries of linguistic purism that are imposed on them by the language policy. On the other hand, the teacher was concerned with the learners mixing Oshiwambo while learners are expected to respond in English only during science assessments (interview field notes data, 22-06-2018). Learners seems to have trouble of writing science assessments in English because they do not have the linguistic resources to do so. Therefore, they responded by code meshing Oshiwambo and English and based on their everyday understandings. This is in line with previous studies that reported that multilingual students are often resisting the monolingual language policies that imposed on them (e.g., McKinney & Makoe, 2009; Makalela, 2015; Probyn, 2015; Kiramba, 2019 ;).

Cultural taboos preventing the development of scientific discourses

In what follows, I will focus on how two learners transformed the teacher's analogies and gestures to construct the science meaning of the scientific concept 'excretion' during their written assessments. Firstly , I will give an account of how Mr. Shilumba's instructional practices was constrained by cultural taboos whilst trying to explain the process of excretory system in extract (8.2) below.

Extract 8.2

Turns	Actor/ action	Speech	Translation and Images
1	Mr. S	Can we move on to excretory system, let me tell one thing!	

2	Ss: Very curious to listen and they all look straight to the teacher	Yes	
3	Mr. S Using body gestures in which he bends his knees, leans forwards and put his right hand behind his buttocks to show the process of excreting faeces/defecating	Let's say you had a dinner or lunch, and you take some cool drinks, later this system will start working, and you will go to the toilet and remove what is not needed or excrete what is not needed And then you excrete it out like this, and that is the excretion we are taking about	 Figure 8.6 Mr. Shilumba use the gestures to represents a person poo at the toilet
4	Mr. S	*Moshiwambo excretion otashiti okuya kondje*	In Oshiwambo excretion means going outside (an Oshiwambo euphemism used for pooing).

In this episode, Mr. Shilumba was referring to how science works in the everyday life experience (e.g., discussing the eating of food and then afterwards going to the toilet to poo to represent the ideas of excretory system), without creating space to interrogate how the same language experiences is used in science written texts. For instance, Mr. Shilumba explains the concepts of excretory system by saying; *"you will go to the toilet and remove what is not needed or excrete what is not needed and that is excretion we are talking about"* (turn 3). Here, the teacher avoids saying that the person goes to the toilet and makes a poo. Instead, he was referring to "removing what is not needed or excrete what is not needed". This statement alone is not clear for the learners to construct the understanding of pooing in relation to the process of excretion. Thus, learners might have some trouble to comprehend Mr. Shilumba's verbal explanation "remove or excrete what is not needed" because this statement is vague and is conveyed in English.

To consolidate his verbal speech, Mr. Shilumba went on to use the body movement and the gesture in which he bends his knees, leans forwards and put his right hand behind his buttocks to show the

process of excreting feces/defecating (see figure 8. 6). The use of the gesture here assists him with avoidance of talking about poo/feces and what the person actually does in the toilet. In Oshiwambo culture, it is a taboo for an adult to use the word pooing when addressing young children, considered to be unpleasant and embarrassing. In turn (4), Mr. Shilumba went on to use a common Oshiwambo euphemism to substitute the word pooing; "*otashiti okuya kondje*" {literally means in English "going outside"}. The teacher employed an Oshiwambo euphemism to concretise and to provide the context for learning the scientific concept of excretion. Yet, the literal meaning of this euphemism has no direct relation with the scientific concept of excretion. I argue that, translanguaging practices should also take cognizance of these types of challenges that are real, but that might prevent science meanings construction. It is unlikelihood for these learners to establish the relationship between their everyday concepts with the targeted scientific concept of excretion despite the use of translanguaging. The exact scientific definition of the process of excretion that is, the act or process of excreting or removal of metabolic waste products such as urea and carbon dioxide, faeces from the body went unexplained during the classroom discourse.

One might ask how it is possible for these learners to conceptualise the new scientific concept of "excretion" through this kind of explanations. While the fundamental impetus of education entails the process of assisting the learners to move along the 'mode continuum' (Gibbons, 2003), that is from their common-sense understandings towards more formalised and systematic ways of understandings nowhere evident in this episode. The learners 'written scripts below in figure (8.5) exemplify how they have appropriated the shared meaning of the process of excretory system presented to them during the lesson.

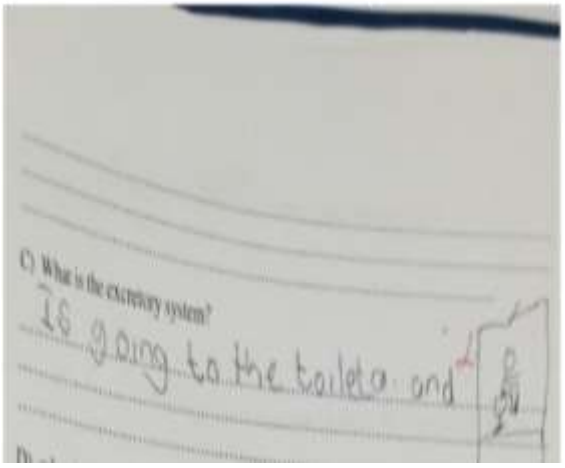
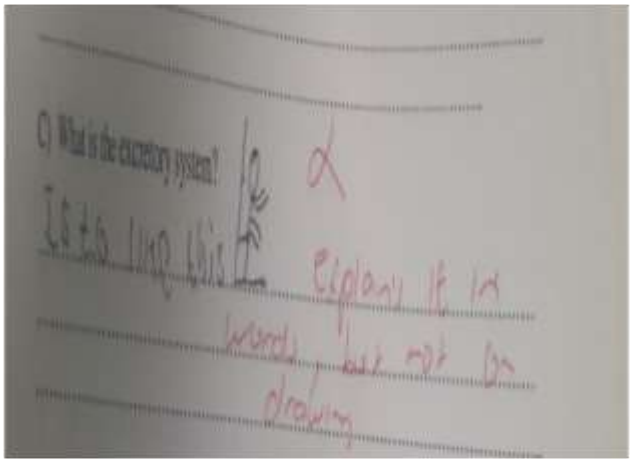


Figure 8.7 Mary's written text (test 3)



Juu's written text

In Figure 8.7, a question is asked; "what is the excretory system". In their responses to this question, both Mary and Juu reproduced the teacher's speech as well as his action gesture, in a different mode of drawings and written word, s to represent their definitions of the concept of the excretory system (see figure 8.7). Instead of defining what the concept excretion means, both Mary and Juu chose to incorporate the drawings of a person pooing on the toilet to represent the teacher's embodied explanation. Here, Mary and Juu have drawn from their repertoires freely to produce the texts which they have recorded visually 'what they saw' and heard and in the mode of the drawing to communicate their meaning. It is noticeable that both Mary & Juu do not have an English repertoire of the descriptions of the gestures that the teacher made during the lesson to communicate their meanings. For instance, Mary started her explanations with the written mode; *"Is going to the toilet and …", while Juu writes that "is to like this....",* because of English language limitations, they both inserted the drawings to convey their meanings. In this scenario, Marry & Juu gave a recount of generalised information based on the everyday language that they draw from the shared experience during the teacher's explanation. Since the teacher avoided mentioning the word pooing or defecating, it clear that learners were entirely relying on the body movement and gesture to construct the word meaning of excretory system. When Mary & Juu offered their responses, they do not only convey their own individual meanings; but their meanings echo Mr. Shilumba's science meaning that they have successfully appropriated during the lesson.

Thus, Mr. Shilumba's pedagogy has not supported his learners to acquire an explicit 'metalinguistic awareness' (Lemke, 1990) of how science specialized language varies from everyday language usage. The linguistic resources that are desirable to construct the science meaning in the exposition of the scientific process of the excretory system was not part of the classroom discourse. This can be problematic for the bilingual learners to construe the scientific meaning of the excretory system. If Mr. Shilumba had an opportunity to translate what the word excretion meant in Oshiwambo, while relating it to an everyday familiar event such as pooing, urinating or sweating to thematically link the science concept "excretion" with the body removal of waste product. This would have accelerated the learners' conceptual understanding and their conceptual gaps might have been filled immediately. An important point to make here is that the process of appropriation, as envisaged by Bakhtin (1981), does not entail a straightforward process of transferring the ready-made science information or knowledge. This process required a platform where an individual reorganises and reconstructs the shared science meaning. For Bakhtin, "not

all words for anyone submit easily to these appropriations, to this seizure and transformed into private property, many words stubbornly resisted and others 'remain(s) alien, sound(s) foreign' in the mouth of the one who appropriated them" (Bakhtin, 1981: 294).

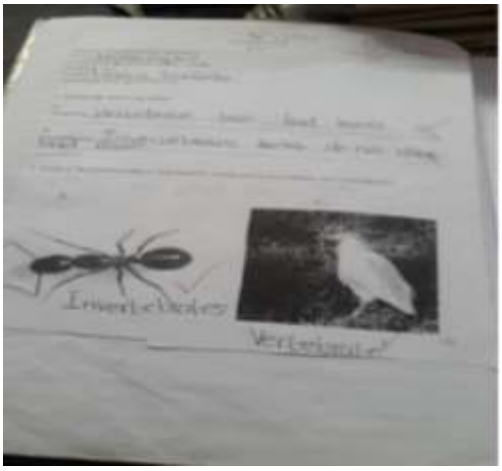
Beyond linguistic challenges, and the possibilities of using multilingual and multimodal practices for Science meaning making in written assessments

In this section, the data analysis will take a heed of how the use of multiple modes or a single mode in science assessments shaped the affordances or constrained the learners to represent their scientific knowledge. In particular, I will analyse the learners' written science assessments in terms of 'what is there', while looking into how the use of alternative modes of representation during science written assessments influences the learners' conveying their science meaning. Assessment is regarded as an important factor that determined how learning was perceived and established (e.g., Drotner & Erstad, 2014).

From the multimodal perspective, science written assessment can be designed to encourage the use of multimodality for meaning making rather than privileging the written mode only. There is no single mode that is sufficient to represent science ideas, science information is best communicated through the deployment of many semiotic resources (Lemke, 1998). It should be considered that when the learners are encouraged to use different modes to negotiate the science meanings there are high possibilities to boost their science performances (Kress, 2010). Below, are some of the learners' selected written scripts taken from various Natural science assessments; the scripts in figure 8.8 were taken from the class activity on the unit of plants as organisms, while figure 8. 9 & 8.10 was taken from test 2 on animals. The learners' written scripts below were chosen on the criteria that they creatively produce the multimodal texts and the fact that the learners were actively shown an interest during the lessons.

Figure 8.8. Betty's written texts (class activity 1) Dre's written text

Question no	Question	Learner's responses
1	Define the concept of photosynthesis	Betty: photosynthesis is to eat food Dre: when cook the own food
2	Draw any two types of living organisms that you know and label them	Betty: person and a dog Dre: person and a plant
3	Draw a flowering plant and show the followings parts: stem, leaves and branches	Betty: draw and labelled leaves, branches, and stem correctly Dre: draw and labelled leaves, branches and stem collect



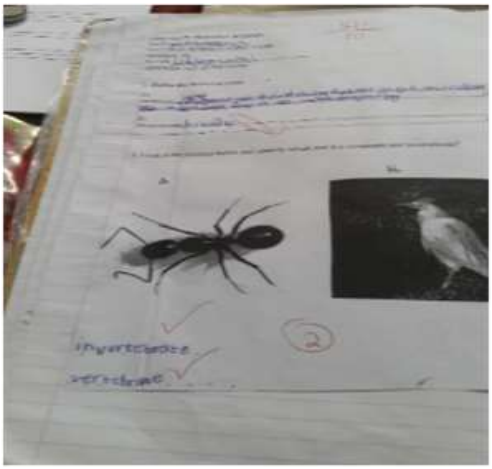
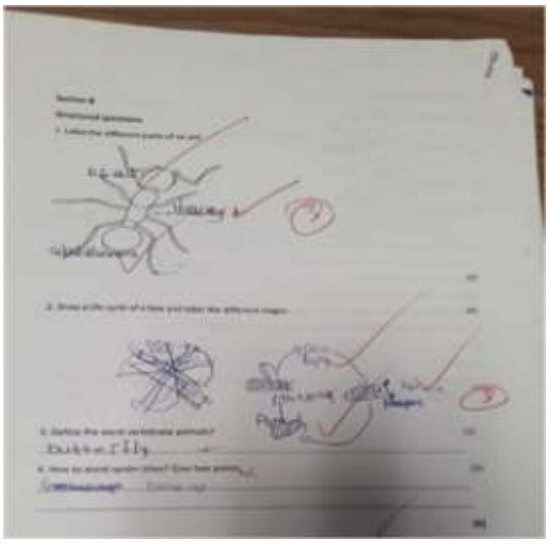


Figure 8.9 Ike's written text (test 2) Tina's written text

Question no	Question	Learner's responses
1	Defines what the following terms: vertebrates and invertebrates	Ike: vertebrates are animals with bad bones (referring to backbone) and invertebrates are animals with no bad bones Tina: vertebrate are big animals with heads, legs and tails and invertebrates are animals with small bodies and no legs.
2	Look at the animals A & B in the images below and label them if they are vertebrate or invertebrate	Ike: Ant: invertebrates' bird: vertebrates Tina: Ant: invertebrates' bird: vertebrates



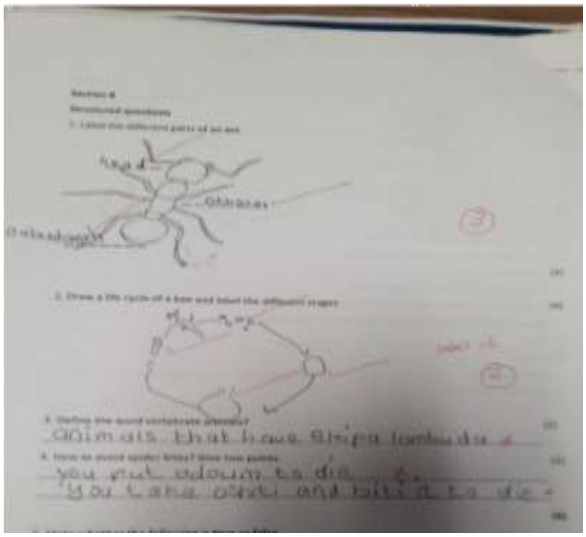


Figure 8.10 Tauno's written scripts (test 2) Jee's written scripts

Question no	Question	Learner's responses
1	Label the different parts of the ants	Tauno: labelled the head, thorax, and the abdomen correctly Jee: labelled the head, thorax, and the abdomen correctly
2	Draw the life cycles of the bees and label all the different stages	Tauno: draw the life cycles and labelled the stages: egg, butterfly, and larva Jee: draw all the stages but not labelled the stages
3	Define the word vertebrates' animals	Tauno: vertebrate is butterfly Jee: big animals that have ekipa lombuda (backbones)

As we can see from the learners' scripts above, at times (e.g., in this assessment of the vertebrates/invertebrates on the topic about animals as well as on the class activity on the unit of the plants as living organisms) Mr. Shilumba strategically integrated multimodality into science assessments unlike on test 1 in table (8.1) that was analysed earlier . In the assessment of the unit on animals, and on the class activity 1 on the unit of 'plants as living organisms', Mr. Shilumba combined different modes in which each mode offered a specific affordance that are salient for communications of science meanings. In this specific scenario, he makes use of the images and drawing as the contextual clue to support his learners' comprehensions of science assessments questions and to boost their abilities to convey their science meanings. During the interview, Mr. Shilumba emphasised the importance of incorporating images and drawing during the science assessments as way to support the learners to understand the questions.

Extract: 8.3

Personally, I believe that the visual aids play a major role in supporting the learners' understanding the science assessments procedures considering their proficiency in English. I always integrate the drawing and images creatively in science tests and

assignments as the clue to boost the learners' understanding of questions and to allow them to express their ideas visually. The questions that integrates drawing and images are user-friendly and they are easily understood by the learners compared to those that required them to express their ideas in writing only. Learners understand the questions with ease when there are images and drawing that accompanied the questions. Since most learners struggle to express their ideas in writing, I also encouraged them sometimes to present their science ideas by means of drawing to prevent high failure in Natural Science. However, it requires a lot of planning and amount of time to select the appropriate images and drawings that are suitable for a specific topic or concept. Despite pressure of time and planning, I'm committed to be flexible and creativity despites in refining the learners' science skills needed in the 21st-century (teacher interview, 22-08- 2018).

Mr. Shilumba elaborated on his strategy of integration of drawing and images in science written tasks to ensure his learners could express their understanding. Mr. Shilumba strongly believed that the assessment techniques that embed drawings and images "are user-friendly hence they are easily understood by the learners". Mr. Shilumba also emphasised the learners' poor proficiency in English as the main reason why he encouraged them to express their science ideas by means of drawing as well; *"personally I believe that the visual aids plays a major role in supporting learners' understanding science assessments procedures considering their proficiency in English"*. Mr. Shilumba also considered the strength of using the visual images in science written assessments as a way to curb under performances in science. His personal beliefs on the importance of multimodality in science written assessments may have been linked to his role as a science teacher, who is highly creative and keen to adapt his teaching style according to his learners' needs (interview, 15-02 -2018). Conversely, Mr. Shilumba voices the challenges of time and rigorous planning of using the multimodality during science assessments. Despite the constrains of time to design the multimodal assessments, Mr. Shilumba emphasises that he will remain committed to be versatile and creative in refining his learners' science skills.

From the learners' scripts above, we can see how Mr. Shilumba repeatedly incorporated questions that required learners to use visual representations, such as images and drawings, in their written Here, the visual epistemology challenged the supremacy of the writing mode in science writing assessments. The use of visual images in science assessments can be viewed as was a way of

directing learners' attentions and to encourage them to express their science ideas freely. It seems like Mr. Shilumba's questioning strategy he employed for test 2 as well as on the class activity on the unit of plants was geared towards the learners' proficiency in English as to what he confirmed during the interview. In this specific instances, Mr. Shilumba's assessments modus of operandi was less dependent on the learners' proficiency in English while allowing them to communicate their science ideas freely. As we can see for instance in figure 8.8 question 2, learners were asked to draw any two living organisms that they know and to label them. While in question 3, learners are requested to draw the structure of flowering plants and label each part of the plants. Again, in figure 8.10 question 2, learners were asked to draw the life cycle of the bee and to label the different stages. All these questions encouraged learners to represent their science ideas using the drawing mode while accompanied by labelling, that is the written mode. Again, learners are prompted to construct science meaning through visual representation and at the same time mapping the visual features with relevant scientific vocabularies. I will now explore how learners responded to these multimodal designed questions discussed above.

From the learners' written answers in the scripts above, learners have demonstrated their abilities to represents their scientific understanding through visual representations and their abilities to associate the visual features with the relevant scientific vocabulary. While responding to questions 2 in figure 8.8, both Betty and Dre managed to perfectly draw the images of the living things that they know. Again, they both labelled their drawing correctly and they both scored full marks 4/4. Betty and Dre reproduced detailed drawings of flowering plants that shows all the parts required in question 3 figure 8.8. Again here, learners were cognisant of the space, colour, size, angle, and position while presenting their science ideas multimodally to convince the marker that they have indeed understood the science content. Learners' responses suggested that they have successfully appropriated the teacher's discourse, because of their abilities to accurately label the features of what they have drawn and to give the authentic context for meaning making. Here, the learners' prior experiences of the demonstrations of the structure of the flowering plants during the lesson significantly shaped their reproduced drawings. Again here, the writing mode provided a description of the scientific concepts while the drawings mode provided a depiction of the shape, size, and features of the flowering plant. Both Betty and Dre managed to label the required parts of the plants correctly, and they both scored 3/3. The labelling process revealed their shared experiences of what was conveyed to them during the classroom discourse.

Conclusion

In this chapter, I have traced the ways in which the science meanings constructed by Mr. Shilumba were appropriate by the learners' in their written assessments, as well as the role of translanguaging and multimodality within this process. I presented the evidence of the learners' abilities and inabilities to appropriate the new scientific concepts and processes during their science written assessments by drawing a closer links between what learners have produced in relation to the science classroom discourse that were constructed during the lessons as well as the resources they have taken from their everyday life experiences . While the learners are fairly successful in appropriating Mr. Shilumba's discourses where these make sense to them (e.g., where these involve the use of Oshiwambo and visual modes), this does not always result in successful appropriation of science discourse because Mr. Shilumba's explanations were sometimes incorrect, vague, or euphemistic. The data analysis presented revealed that the complexity of constructing the science meaning in the context that linguistically constrained, is not only premised on the challenges of bridging between the registers and discourses, but also by the teacher's inability to carefully inspects on the linguistic resources that the learners' lacks and the ambiguities of the teacher's science explanations.

The data presented above showed how, as an institution, the Namibian school in this study is intensely "rooted in a monolingual habitus" (Gogolin, 1994, in Busch 2014: 22), in that it favours monolingual English discourse practices. Through my data analysis I found some instances where multilingual practices are employed freely during the classroom discourse , on the other hand, the current Namibian science assessments is imposed to test the use of standard English language literacy at the expense of measuring what the learners know . As shown in the data, the demand for standard science written language is more acute where learners have transitioned from their mother tongue to English MoI. However, the data analysis has shown that in learners' quests to express their science understandings and to address their communicative need at hand, they navigate the dominant monoglossic ideology of the LiEP while carving out themselves spaces for multilingual practices. However, their multilingual practices were disregarded by the school system that positioning others language varieties as detrimental to the English standard language and literacy development (Prinsloo & Krause, 2019). I would therefore argue that the occurrences of translanguaging and trans-semiotising practices in the space of science assessment demonstrated

how emergent bilingual learners can reposition themselves as science meaning-makers, knowledge constructors and linguistically capable. Using a translanguaging & trans-semiotising framework, this study aligns itself with the body of research on bi/multilingual education setting that challenges the hegemonic monolingual and monomodal practices and supports the pedagogical initiatives that validate learners' bi/multilingualism in the science classroom.

Moreover, the data analysis reveals how the use of multimodality in science assessments influences the learners' science performances despites their level of English language competencies. It is clear that questions that embedded visual representations are more beneficial for helping the Grade 4 learners in achieving higher scores in science subject. The analysis of the learners' written scripts above provide an evidence of a positive relationship between the use of multimodality in written assessments and the greater affordances of meaning making. Learners were unable to present their scientific idea while using the scientific vocabulary accurately in the written mode, but they have managed to represent scientific content through the affordances of the combinations of visual modes and translanguaging. Without the use of multiple mode in science written assessments it would be severely constrained leaners to convey their science meaning, and, thereby, affecting their performances in science.

CHAPTER 9: Conclusions and recommendations

This chapter presents a summary of the findings according to the research questions that guided this study. I also highlight the limitations of the study, reflecting upon the process taken throughout this study. Finally, I offer recommendations, including areas for further research.

Summary of findings

The purpose of this study was to understand the nature of discourse employed by a Grade 4 teacher and his learners as they engaged in science classroom discourse and, to explore how these specific discourses support or constrain learners' opportunities to construct science meaning. In order to attain the main objective of this study, I summarize my findings according to my research questions:

1. What is the language ecology that shapes science classroom discourse in the Namibian primary school in this study?

2. How do the teacher and the learners attempt to make science meanings in a context where English is used as the official medium of instruction?

3. How are science meanings constructed using multiple modes?

4. How do the teacher's practices influence or constrain the learners' appropriation of science meanings during classroom discourse?

Research question 1: What is the language ecology that shapes science classroom discourse in the Namibian primary school in this study?

My first research question sought to investigate the language ecology that shapes the classroom discourse in 'Grace Primary School'. A variety of data revealed a clear representation of 'Anglonormative ideology' (McKinney, 2017) being reproduced and reinforced in the patterns of classroom language practices as well as in the language usage in the entire school environment. Another apparent monolingual language ideology identified in this study is that the Namibian school system is governed by separatist language policy, advocating the use of monolingual

English as MOI for learning and assessments from Grade 4 and beyond. All learning materials, curriculum materials, lesson planning, classroom written notes, textbooks, learners' written assessments and the interviews with the Principal and Natural science teacher as well as the texts displayed around the school, reinforced the dominant monolingual English ideology. Namibian language varieties are constructed in deficit terms and there is no positivity towards treating them equally as enshrined in the Namibian constitution and the Namibian LiEP. The principal certainly argued that teachers should not 'mix' languages in their classes so as to prevent the emergence of what she called 'Namlish'(a hybrid of local languages and English) while seeing the goal of schooling as developing proficiency in English as well as developing knowledge and concepts.

Whilst learners routinely switched between different languages in their everyday social interactions and during the classroom discourse, their heteroglossic practices were regarded as inappropriate and an unacceptable mode of interaction by the school management. On many occasions, learners were prohibited from using multilingual practices despite their limited proficiency in English language. The use of Oshiwambo in this school is equated to the violation of school rules such as swearing and other ill behaviors, and learners are expected to be punished if they use languages other than English on the school premises. Under the ideologically monolingual policies advocated by the school management, the translanguaging practices in this school happen behind closed doors. The analysis found that the teacher translanguages during science lessons knowing that his actions were contravening the language policy. Whilst learners routinely drew on the range of resources in their linguistic repertoires including predominantly Oshiwambo and English, the teacher was forced to disregard the language policy to facilitate meaningful teaching. The interview with Mr. Shilumba exposed that translanguaging is practiced because of departmental pressure to cover the curriculum on time, also for lesson comprehensions and to attain lessons' objectives. In a nutshell, the observed translanguaging practices in this study is relatively distinct from the educational contexts where linguistic resources, and heteroglossic practices are used systemically and intentionally through planned 'pedagogical translanguaging' (see Busch, 2014; Probyn, 2015). From the data analysis, it is evident that both the school management and Mr. Shilumba do not grasp how language ideologies that inform both policy and practices, prevent shifts in classroom language practices where learners' full linguistic repertoires are considered to be resourceful rather than an obstacle for learning (Makoe & McKinney, 2014).

As the analysis unfolded, it became evident that the Namibian curricular and instructional design did not necessarily address the linguistic challenges that the emergent bilingual learners encounter daily in the course of their learning. The data analysis has shown that the monoglossic English language policy is one of the reasons why the unauthorised translanguaging is being practiced during the classroom discourse as well as the teacher's long monologues following the patterns of initiation-response-feedback (IRF, e.g., Mehan, 1979) and the teacher constantly regulates what language should be used during the lessons. The observable impact of this kind of classroom discourse were constant prolonged learners' silence, brief answers, choral responses, guessing for the correct answer and the discourse of rote learning, which left relatively limited opportunities for learners' interactions and co-construction of science knowledge. This implies that the struggle to break away from rote learning towards conceptual understanding through exploratory talk remains elusive for the learners.

Whilst the analysis found the conceptual understanding during the classroom discourse is worked towards translingually, the written reproduction of this knowledge, however, must be in English. The advocacy of monoglossic ideologies were made explicitly in the form of invocations of 'English only rules' ; 'write in English only' while ignoring learners' multiple linguistic resources in science written assessments. However, the data analysis revealed that the expected standard of the written English through which learners must conduct written assessments is considerably higher than their actual English competencies. Noticeable here, is that the assessment appeared to measure learners' language proficiency through the monolingual language ideologies lenses rather than their science knowledge or conceptual understanding. The data analysis revealed how learners' draw from their linguistic repertoires at their disposal to respond to the monolingual assessments. However, the fact that learners use unauthorized linguistic resources; meant that they were consistently being stigmatized and penalized for not conforming to the monolingual norm. The restricted opportunities for 'multivoicedness' (see Bakhtin, 1981) in science written assessments has negatively affected the learners in this study to express their science knowledge and consequently infringes on their rights to air their "concerns or topics of interest" (Busch, 2014: 37). The dominant monolingual English ideology manifested in this study places a substantial negative judgment on the learners towards their mother tongue.

Based on the arguments presented thus far, I will therefore argue that the prevailing monoglossic orientations to the current Namibian education system is a major contributing factor preventing Namibia to realize its' educational goals of access, quality, equity, and social justice in classroom discourse as well as in science written assessements. Against this background, I propose that teachers should have autonomy to exercises their agencies to establish more deliberate spaces for heteroglossic and multimodal practices in classroom discourse as well as in science written assessments.

This current study presented significant insights to a better understanding of the linguistic challenges for emergent bilingual learners who are learning science in an unfamiliar language, and how these problems might be mitigated by moving towards flexible pedagogies that embrace the use of multilingualism and multimodality in science teaching and learning as well as in science assessment discourse. This is necessary to curb the ongoing dilemma in Namibian schooling of positioning linguistically diverse learners through the deficit lenses of monolingual beings while ignoring the semiotic resources, language variety, culture, and spontaneous knowledge that learners bring to school. The second contribution is the paradigm shift from the current debates on what single named language, or which language should be used as MOI in linguistically constrained contexts, to an embrace of the 'multilingualism turn' (May, 2014) which emphasises the use of semiotic resources as valuable resources for teaching and learning, as well as the necessity of bilingual teaching and assessment.

***Research Questions 2 & 3*: How do the teacher and the learners attempt to make science meanings in a context where English is used as the official medium of instruction? And how are science meanings constructed using multiple modes?**

The overarching aim of this study was to develop a better understanding of the discourse strategies employed by a Natural science teacher and his grade 4 learners as they engaged in various science activities within the constraints of the monolingual English only policy. The analysis demonstrated that the classroom interactions varied because of the different forms of instruction the teacher employed to support the construction of science knowledge during the science lessons. The analysis revealed both moments where learners seemed to engage in meaning making and

developing their understanding as well as those moments where meaning making was unsuccessful. As presented in Chapter 7, teaching and learning science in the unit about 'plant as living organisms' was largely textbook content-based in which the science textbook passage in (figure 7.5) encompasses the field-specific vocabularies that are technical, complex nouns, nominalizations, and lexical and nonhuman subjects with no relevant illustrations. In order to respond to the comprehension demanded by the textbook passage, the teacher tries to incorporate substantial instructional supports to facilitate learners' access to scientific understanding. However, the findings of this study revealed that the teacher's support does not always guarantee increased learner understanding of the textbook content or scientific concepts. As shown in the data analysis during the lesson presentations about 'plants as living organisms', Mr. Shilumba attempted to use different metaphors and analogies as well as familiar everyday knowledge and language to put the new /or abstract scientific terminologies and concepts into more familiar terms more easily understood by his learners. Despite the teacher's good efforts, at times, the use of metaphor and analogies along with intertextuality to recounting everyday events were not fruitful in contextualizing the science textbook content and language. As the evidence in my study demonstrated, there were no direct connections between everyday lived experiences used with the targeted scientific explanations since the analogies used were misleading. The kind of language that Mr. Shilumba produced is what Lemke (1990) referred as; 'abstract or decontextualized' language which can be misleading and possibly constrained effective science learning.

Another kind of teacher support offered to the learners, is seen in the moments Mr. Shilumba made use of translanguaging practices in order to bridge between discourses and registers while discussing scientific concepts that are part of the nervous system. Despite enumerated positive benefits of translanguaging pedagogies, the data analysis has shown that there were some challenges to using translanguaging pedagogy productively. On some occasions, the way translanguaging was practiced appeared to ensure learners understood the content of what is being said but unfortunately, the content itself was incorrect and misleading. This suggests that the use of translanguaging cannot overcome lack of content knowledge on the part of the teacher. I would therefore take the same stance of McKinney & Tyler (2019:7) who argue that "no communicative practice is by definition transformative or constraining". Translanguaging can only be 'transformative' and fruitful for teaching and learning depending on how it is being used (McKinney & Tyler, 2019).

At other times however Mr. Shilumba creatively leveraged his instructional practices to support his learners in developing their understandings of the scientific process of the respiratory system with its attendant concepts (Extracts 7.8-10). This was achieved chiefly by integrating the mediational tools such as: multiple linguistic repertoires complemented by semiotic resources (e.g., pictures, gestures, and actions, physical movement artefacts demonstrations, written discourse) as well switching between every day and science register and oral reflections on what was learned. The data revealed that this kind of teacher's support ensured that science meanings were being examined at the greater level to deepen learners' conceptual understandings. Lastly, another critical teacher's support arising from data analysis, is the occurrences where the teacher consolidated his scientific explanations with a written (mode) to make the written representations available to all learners (see Figure 7.4). In addition to that, learners were given opportunities to copy down the board notes in their summary books. In this respect, the teacher gradually moved the classroom discourse toward a 'more subject-specific discourse' (Gibbons, 2006). It can be argued that the teacher's pedagogical practices in this specific scenario met the requirements of systemic 'trans-semiotising' (Lin, 2015). This implies that the more semiotic resources employed to communicate the science meaning by the teacher, the better it served as an essential strategy for facilitating learners' comprehension of the unknown scientific idea. This may have the pedagogical implications for primary school science teachers in striving to diversify their instructions when mediating the scientific concepts to their emergent bilingual learners in the linguistically constrained educational settings. This is because successful science teaching requires a considerations of learners' developmental levels as well as a well-planned pedagogical translanguaging that should be used deliberately to reinforce conceptual understandings.

The contributions of my study offered by the analysis of the classroom discourse on how science meanings were constructed during this study are:

- Whatever learners' level of English proficiencies or their grade level , they are capable of engaging in science discourses, provided that science concepts are introduced from multiple representations using a variety of modes rather than privileging one mode over the others .

- Demolishing of the boundaries that exist between the language and code in order to favor the linguistic repertoires of the multilingual speakers has been recognized as effective pedagogical practices that facilitates science learning.
- Successful science teaching requires consideration of learners' developmental levels, teacher's multilingualism and content knowledge, the use of embodied multilingual resources and multiple modes as well as well-planned pedagogical translanguaging and trans-semiotizing to co-construct knowledge with the learners and to reinforce their conceptual understandings.
- Science learning discourse is more effective when moving between everyday knowledge and language toward the socially shared scientific written like discourses in order to support learners to establish intertextual connections to scientific terminologies and concepts highlighted in science textbooks rather than presenting the scientific concepts as a fixed transmission of knowledge.

***Research Question 4*: How do the teacher's practices influence or constrain the learners' appropriation of science meanings during classroom discourse?**

I did an in-depth analysis of learners' written assessments to find out whether the learning processes that they were engaging in were fruitful or not. Attention was paid to the impact of the teacher's discourse as well as the English monolingual policy on the individual learners' ability to appropriate the science classroom discourse. As I argued in Chapter 7, learners' abilities to appropriate the scientific ideas and to construct their own scientific voices (Gee, 2002) are contingent upon the manner in which the scientific ideas were presented to them in the course of learning. The analysis of this study shown an association between the classroom discourse and learners' inability to appropriate accurate or authentic science discourse since the scientific concepts and processes were inappropriately explained them. There is a clear indication in this study that the learner's inability to offer the correct scientific explanations in their written assessments is not only attributed by lack of proficiencies in English, but it is also influenced by unconstructed science meaning and the use of unfamiliar terms during the classroom discourse.

The analysis has shown that during the lesson presentations on 'plants as living organisms', learners were mostly memorising facts without generating new scientific knowledge or applying the newly taught complex scientific knowledge during the lessons other than being passive recipients of knowledge. While the learners have successfully appropriated the teacher's discourses where these made sense to them (e.g., where these involve the use of Oshiwambo and visual modes), this did not always result in successful appropriation of science discourse because Mr. Shilumba's explanations were sometimes incorrect, vague, or euphemistic. One can infer that learners have indeed managed to grasp the meaning of the shared experiences that were made available during the lesson, although what they have reproduced is merely fragmented everyday knowledge. This means that at times, Mr. Shilumba failed to consider the science pedagogy that would potentially direct the learners towards the acquisitions of the authentic scientific concepts.

In addition, the data analysis revealed how learners' cultural influences played a major role in regulating their thinking. It was therefore not surprising that the learners' reasoning (see table 8.1) did not reveal any patterns suggestive of 'science talk' (Lemke, 1990) and their sense of reasoning seems to be akin to what Vygotsky argued as 'pseudo- conceptual form of thinking' (Vygotsky, 1987; 1986). It is clear that learners were not taught to distinguish between the language of human experience and the language of science, and what they have learnt can be misleading them to hold the view that "science stands somehow outside of the world of human experience, rather than being a specialized part of it "(Lemke, 1990:151). This implies that learners rely heavily on the everyday concepts, and they did not appropriate the scientific concepts or link them well, and as such they do not understand the abstraction yet still operate at the concrete everyday form of thinking. Grounded by Vygotsky's theory, learners' knowledge is pure spontaneous and empirical knowledge as opposed to the scientific procedural knowledge. The correct scientific language adheres to the certain 'stylistic norms' without any reference to the 'here and now' or based on spontaneous language features of immediate classroom discourse situations or directly relating to people, events and time (Lemke, 1990).

The process of appropriation, as envisaged by Bakhtin (1981), does not entail a straightforward process of transferring the ready-made science information or knowledge. This process required a platform where an individual reorganizes and reconstructs the shared science meaning and populates it with their own intentions and own accents. Contrary to that, there were no evidence

in this study of adapting the science language in learners' own personal knowledge structures in line with what the neoVygotskian regards as scientific reasoning. The fact that the teacher's teaching practices focuses on the use of unfamiliar terms in the exposition of the scientific concepts constrained the learners to construct meaningfully the scientific knowledge presented to them. Thus, learners were unable to regulate their thinking behaviour and to solve science problems independently during their written assessments. I would therefore argue that the MOI and the dilemma of using unfamiliar everyday concepts during the classroom discourse can create a predicament for the mediation of scientific concepts within the ZPD zone as envisaged by Vygotsky. Against this background, I would argue that for effective science teaching to occur, the use of the everyday words/ language must be part of the learners' language repertoire and they must be linked appropriately with the targeted scientific concepts to lead to the process of appropriation of authentic scientific concepts. In addition, the findings of this study indicated that the learning environment that draws from multiple linguistic resources and modes have positive effects for emergent bilingual learners to gain nuanced understanding of the scientific knowledge regardless of their limited proficiency in English. Therefore, teachers should consider what emergent bilingual learners are capable to use language for rather than testing their language competencies. This implies that learners are not being positioned as "Limited English Proficient" (LEP), a term that focuses on "what students don't know as opposed to what they do" (Kleyn & García, 2019:70).

Limitations of the study

There are a number of limitations of this research.

- The first limitation is concerned with the small scale of this study; that is one Natural science teacher and his Grade 4 emergent bilingual learners. This implies that the participants of this study are not representative of all Namibian bilingual learners and Natural science primary school teachers. Therefore, it is inappropriate to generalise the findings of this study to all Namibian educational contexts. What the teacher and the learners in this study did, does not necessarily provide a reflection of what other teachers and learners do in different settings. However, the research methods used in this particular

study were perfectly suitable for the small-scale study and to investigate the phenomenon under study in depth.

- Secondly, the number of lessons observed, and the time spent on data collections was limited. A more extended observation might have provided more data to get an even deeper understanding of how classroom discourse influenced or constrained the construction of science meanings by looking further into learners' final examination as well as their overall performance in science.
- Thirdly, my presence as non-participant observer during the classroom observations could have affected how learners' participation during the lessons considering their limited proficiency in the MOI and their fear of expressing themselves in the language that they are not proficient in. Despite the limitations stated above, this study made an effort to explore the classroom discourse patterns and how science meanings were made in the natural science classroom that could resulted on the learners' ability and inability to appropriate the scientific concepts.

Recommendations arising from the findings of the study are:

The research unearthed particular challenges that need further immediate attentions and actions to all Namibian education stakeholders.

Policy development

Despite the irony of Namibia being a multicultural country, the Namibian monolingualist LiEP makes no provision to accommodate these multilingual practices or to fulfill the linguistic needs for the learners from linguistically diverse backgrounds who lack proficiency in English. The separatist language ideologies sanctioned in the Namibian LiEP as well as in science formative written assessments, need further consideration in order to embrace language as an open system that is fluid, evolving, and hybrid. The question arises as to why emergent bilingual learners' linguistic repertoires are being ignored by the Namibian school system?

In line with the above argument, I will argue that without challenging the monolingual language ideologies in the Namibian school systems as well as in the LiEP, Namibian emergent bilingual learners will continue to struggle to have equal opportunities to quality learning. Therefore, the current Namibia LiEP needs to be strategically reviewed at all different levels and to shed more light on how multilingual practices can be seen as productive teaching strategies rather than illegal practices. What is needed is greater directions and clarity by the policy makers and curriculum developers as well as by the proponents of multilingualism, to purposefully embed the multilingual and multimodal pedagogical practices into the Namibian' educational programmes as well in the LiEP, currently dominated by the monolingual language ideologies. This can play an important role in challenging the tradition of monoglossic and monomodal orientations to Namibian curriculum and more importantly to disrupt the current trend of viewing learners as deficient monolinguals.

Instructional practices in bilingual contexts

Mr. Shilumba highlighted the importance of using Oshiwambo as a resourceful language for teaching and learning during his interview. However, the analysis revealed that Mr. Shilumba might not always be conscious of practicing bilingual teaching, or to reflect on effectiveness and consequences of his translanguaging practices. This might be the case for other teachers too. Therefore, this kind of consciousness can be developed if bilingual teaching is encouraged within the language policy. The observed translanguaging practices in this study contrast quite sharply with the notion of pedagogical translanguaging, which refers to a deliberate and systematic use of students' various linguistic resources to mediate learning (Probyn, 2015). The reason behind this is that translanguaging pedagogy was never part of Mr. Shilumba's teacher training. I will therefore suggest that if we are to use the translanguaging pedagogy successfully as a valuable tool for fostering learning, it needs to be entrenched into instructional and classroom language practices. This requires teachers to make deliberate adjustments according to the classroom situational needs while creating more robust multilingual and multimodal spaces to increase learners' opportunities to learn and to conduct science assessments despite their levels of English fluency. Teachers need an understanding that embracing multiple languages and modes does not

necessarily lead to diminishing learners' chances to acquire competencies in the English language. This could be a way of raising the teachers' awareness of how languages do not operate in silos but are always operating fluidly with one another in communicative practices.

Teacher education

The observed monolingual language ideologies in this study, which shaped and constrained the classroom language practices together with the use of unauthorised translanguaging practices required further considerations in teacher training institutions. During teacher education, teachers need to be prepared in how to leverage instructions that are geared towards learners' linguistic needs in the bi/multilingual schools setting. There is a need for the teacher preparation programs to offer preservice teachers with the opportunity to analyze their own beliefs and ideologies as to what counts as language for teaching and learning, to develop their consciousness of 'Ubuntu translanguaging' (Makelela, 2015). To realise this, the teacher training program developers and educators should adapt the bilingual education models that would be expedient in equipping preservice teachers with necessary multilingual knowledge and teaching methods such as translanguaging pedagogies, multimodality approach, switching between the registers and the use of intertextuality. Apart from learning about bilingualism and teaching bilingually, I would propose that the teacher educators must redirect their attention to consolidating the science content knowledge of in-service- teachers and help them to learn about the specific demands of science language (grammatical structure, terminology, and text structure, as well the different registers involved in teaching science) . This can be aided through developing teachers' understanding on how to teach the discourse of science while moving between registers and language resources so that the learners might be able to communicate their understanding of the correct concept using the correct scientific register. This would be necessary to produce a cohort of well-prepared professionals that are capable to adapt their teaching methods successfully as well as teach accurate scientific concepts and also to foster the classrooms linguistic climates that allows learners to use various linguistic resources at their disposal while positioning them as capable language users.

Assessment practices

The findings of the data revealed that the current Namibian science assessments method appeared to be testing the use of Standard English language and literacy at the expense of accurately assessing what the learner knows. On the other hand, the analysis has shown that learners reconfigure the monolingual assessment policy while drawing on their bilingual abilities to express their thinking freely and to reveal their conceptual understandings. However, their multilingual practices were disregarded by the school system that positioning others language varieties as detrimental to the English standard language and literacy development (Prinsloo & Krause, 2019). In order to promote equity and equal opportunities for learning to all Namibian children, this study underlines the need to challenge the current monolingual assessments policy which advocate the use of English only while ignoring the current trends of multilingualism. There is a need to support learners from linguistically diverse backgrounds through a deliberate inclusive language policy that harnesses their multilingualism and their cultural identity to enhance equal education access to all Namibian children. Clear direction is warranted on how a teacher can publicly acknowledge and sustain their learners' linguistic and cultural resources in science written assessments without any fears.

Professional development for science teachers' teaching practices

The shortcomings exposed in this study are the teacher's lack of knowledge in bilingualism education; lack of knowledge of how science discourse works and how to teach science discourse explicitly as well as lack of knowledge (from language perspective and from a constructivist learning perspective) of the importance of children talking to each other (pairs and groups) as well as the teacher's deliberately designing tasks that consider learners' linguistic needs. All these pedagogical limitations raised a serious concern to the current Namibian education system. The contextual analysis conducted in this study revealed some of the teacher's instructional practices that fall short to mediate scientific concepts learning successfully at the same time prevented learners from appropriating the scientific discourse and to talk like scientists such as: the use of unproductive translanguaging practices, the discourse pattern of rote learning, limited spaces for

exploratory talks, in-complete journey from spoken like to the scientific written discourse, presenting of the factual science information as well as the constraint of cultural taboos. To mitigate these factors, there is a need for ongoing teacher professional development to effectively train teachers to go beyond the textbook content and to upgrade their subject content knowledge, their understandings of how classroom discourse works, and how to use talk for learning. In addition, teachers should be empowered to employ a translanguaging and transemiotising approach in a more structured and systemic way in order to successfully facilitate the subject content learning and academic language development of the emergent bilinguals.

Further Research

Beyond this thesis, there continues to exist an urgent need for research into and development of pedagogy for multilingual education in Namibia Education and other post-colonial contexts, which according to García (2009:8) needs to be "adaptive, able to expand and contract, as the communicative situations shift and as the terrain changes". Sadly, the interest towards translanguaging and transemiotising as pedagogical practices has not received momentum in Namibian education spaces as well as in the local research fraternity. There are urgent calls to rethink the current Namibian LiEP which places a greater concern on proactively addressing the issues that are preventing Namibian children from accessing the benefits of official multilingualism outlined by previous scholars in various counties (see chapter 2 & 3). This would require more comprehensive research on a larger scale in a number of school categories, different data, (longitudinally gathered) and different techniques to obtain a wide spectrum on teachers', parents', learners', and school management perspectives toward the monolingualism that underlies the Namibian education system and how these policies conflict with the reality of multilingual linguistic and identity practices.

Future research would imply expanding and complementing the story that this dissertation has tried to accurately tell to substantiate the multilingual turns to education more effective to capture the fluid nature of classroom language practices (Li, 2017) than English monolingual English MOI. This research should be used to come up with deliberate interventions in further research to elicit further the efficacies of multilingual and multimodal approachs to science teaching in the multiple

grade levels and in multiple settings where English is used as MOI. Another fruitful avenue for future research would be to adopt a longitudinal approach to determine the long-term effects of multilingual and multimodal strategies or effects of bilingual and multimodal assessment.

The Key contribution of this study to knowledge

Language policy and instructional practices in bilingual contexts

This study contributes to our understanding of how meaning is made in linguistically constrained bilingual Science classrooms where a monolingual English policy is enforced but where children are not proficient in the MOI, in order to find the solution to establish rich science learning in bilingual contexts. It describes the discourse employed by the teacher and learners as they engaged in various activities and, to see how these specific discourses supports or constrains opportunities to construct science meaning. The findings of this study suggest that in contrast with dialogic practices, monologic practices were dominant, as evidenced by the constrained IRF discourse structure during the classrooms discourse. This suggests that English monolingual policy places constraints on bilingual learners to use their multiple linguistic recourses flexibility and thereby silenced their voices. Therefore, I argue that one cannot argue for dialogism or for conceptually rigorous instruction in scientific concepts if the learners cannot understand the language of instruction. The discussion of dialogism and multimodality as a vehicle for raising the quality of science teaching should be further complimented with a consideration of deliberate use of multilingual and multimodal meaning-making which enables teachers to value their learners' linguistic resources that they brought to school to enable effective science teaching and learning.

Theoretical contribution

A central aim of the thesis is to make a theoretical contribution by developing an analytical framework that integrates and combines theoretical resources from a sociocultural approach to language as social practice, Bakhtinian heteroglossia and dialogism, neo-Vygotskian ideas of what

constitutes the learning of scientific concepts, together with the recent theorising of bi/multilingualism. I also recruited Bakhtinian notions of appropriation to trace the take up of meaning from the classroom discourse into learner's written assessment. In addition to this, it is the notion of scientific concepts from Vygotsky that helps me to evaluate whether what is appropriated is authentic in the first place.

I use these sets of complementary theory to analyse and understand the problem of science meaning making and learning in-depth in a linguistically constrained bilingual context. For instance, both Vygotsky (1978) and Bakhtin (1986) argue for the need to go beyond the isolated individual when trying to understand human development and functioning while highlighting that meaning does not reside in the language itself, nor do individuals construct meaning by themselves. Equally important, theorising of multilingualism emphasizes that instead of focusing on single named languages; or which language should be used as a medium of instruction, we need to focus on the use of multiple linguistic resources for learning. Therefore, in order to understand the dilemma of science learning in the bi/multilingual contexts , one has to understand that problems of instruction are neither limited to language of instruction nor the dilemma of poor instruction in mediating the scientific concepts (in Vygotskian terms) but rather involves a complex combination of the two . This has profound implications for the kinds of studies that try to measure the effects of using English versus mother tongue MOI in the bi/multilingual contexts since this variable on its own is insufficient. However, the teachers' knowledge of the science concepts as well as his/her ability to use multiple semiotic modes and registers to teach is as crucial as the language of instruction.

Conclusion

Despite Namibian curriculum advocacy for moving science teaching in a more learner-centered direction, the findings of this study indicate that achieving this goal poses considerable challenges. This is because the English monolingual policy places constraints on bilingual learners to use their multiple linguistic resources flexibility and thereby constraining their voices from being heard (Blommaert 2005a) while promoting 'epistemic injustice' (Fricker 2007) in which learners are positioned as monolingual beings, and they are often labelled as deficient "English monolinguals" (Fricker 2007 & 2012; McKinney & Tyler, 2019). The observable impacts of English monolingual policy on classroom discourse is that of constant prolonged learners' silence, brief answers , choral responses , the use of unauthorized translanguaging practices, guessing for the correct answer and the discourse of rote learning which left relatively limited opportunities for learners' interactions and co-construction of science knowledge. I therefore posit that the prevailing monoglossic orientations to the current Namibian education system is a major contributing factor that prevents Namibia rom realizing its' educational goals of access, quality, equity, and social justice.

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Addendum A: A letter to parent requesting permission to conduct research with your children

Ref: Set Beatha

Cell: 08120054

P O BOX 2157

Oshakati

17 February 2017

Dear Parents

REQUEST FOR PERMISSION TO CARRY OUT PHD RESEARCH with Grade 4b learners

I, Set Beatha Ndahafa, am a PHD in Education candidate studying in the School of Education at the University of Cape Town. I would like to ask your permission to carry out research that will involves your child. My research aims to explore the nature of meaning- making in Grade 4 Natural Sciences classroom discourse. The study requires me to observe lessons and do interviews with Grade 4 learners.

The purpose of writing you is therefore to ask for your permission for me to conduct the research in Grade 4 where your child will be a participant during the month of May and August 2018. Data collection will be in the form of daily classroom observations from 8- 13 pm over the period of a week 10 weeks. Data construction will include video recordings of lessons, learners' written work, samples of the teaching materials used by the teacher in each Grade 4 class, what the teacher wrote on the chalk board, teachers' lesson plans, field notes and interviews with teachers and learners.

Participation is voluntary and the confidentiality of the school, as well as the teachers and learners, is guaranteed. No images of your child will be published. The school will be given a pseudonym (different name) and pseudonyms will be used for all participants in the writing up of the research.

Hoping in anticipation of your positive response that my request will be considered favorably.

Yours faithfully

Set Beatha

Addendum B: Letter of Permission from the Ministry of Education to conduct research

REPUBLIC OF NAMIBIA

MINISTRY OF EDUCATION, ARTS AND CULTURE

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Luther Street, Govt. Office Park
Private Bag 13186
Windhoek
Namibia

File no: 11/1/1

Ms Beatha Set Ndahafa D.
P O Box 2157
Oshakati
Cell: 0812005420
Email: bset@unam.na

Dear Ms Set

SUBJECT: PERMISSION TO CONDUCT RESEARCH IN OSHANA REGION

Kindly be informed that permission to conduct research for your Doctoral Degree in Oshana region is herewith granted. You are further requested to present the letter of approval to the Regional Director to ensure that research ethics are adhered to and disruption of curriculum delivery is avoided.

Furthermore, we humbly request you to share your research findings with the ministry. You may contact Mr C. Muchila/ Mr. G. Munene at the Directorate: Programmes and Quality Assurance (PQA) for provision of summary of your research findings.

I wish you the best in conducting your research and I look forward to hearing from you soon.

Sincerely yours

Private Bag 13186 Windhoek, Namibia

SANET L. STEENKAMP
PERMANENT SECRETARY

16.2.17.
Date

All official correspondences must be addressed to the Permanent Secretary

Addendum C: Transcription conventions

T teacher

S Student

S1 student one

S2 student two

SS students

Ss- all students

SS-few a few students

[ ] researcher's observations and descriptions

{} translations

? rising interrogative

! emphasis

(.) micro pause

(…) short pause (less than 3 second)

italics L1 (Oshiwambo)

↑ rising intonation

↓ falling intonation

Addendum D: Teacher Interview 1 schedule
Natural Science teacher interview 1: Approx. 90 minutes, before classroom discourse data

Biographical info:

1. Who are you?
2. Where did you grow up?
3. Where did you go to school and university?
4. How did you become a Science teacher?
5. For how long you have been in the teaching profession.
6. How many yearshave you been teaching Natural science?
7. What is your teaching qualification?

Language background information:

8. What is your home language/s?
9. What other languages do you speak/use? (mention them in order of how well you speak them)
10. In which language were you instructed throughout your teaching career?
11. As part of your teacher training, have you learned about the Namibian language in education policy?
12. From a scale of 1 to 10 (1 being bad and 10 being good), how do you rate your English competency?

Information about school language policy and classroom language practices

13. What is the school's language policy?
14. Have you learned about the Namibian language in education policy?
15. What are your attitudes/ beliefs towards the use of Oshiwambo and English at school/ in your classroom?
16. Does your school a have formal language policy – if so, what is it?
17. What are the attitudes of the principal/staff to language use in the classroom?
18. What are the attitudes of the school management /school principal and the entire staff toward the language use in the classroom as well as in the school?
19. Could you tell me a little bit about your learners' languages competencies?
20. Which language/s do you use in the classroom?

21. Do you face challenges conducting your lessons in English? If yes, what are the challenges and how do you normally overcome them? If not, what are your strength in the language?
22. To what extend do you follow the language policy in your classroom? Please describe
23. To what extent does the language policy influence the decision you make in terms of language use in the classroom?
24. How does English as a language of teaching influence interaction in your Science Classroom?
25. Under what circumstances do you use (a) Oshiwambo, (b) English and (c) mixed code in your teaching (Very often, often, barely, never). Why?
26. Do you have any rules about how language should be used in the classroom?
27. Could you pleases tell me to what extent English as the medium of instruction influences learners' optimal participation during the lesson?
28. Do you allow learners to use Oshiwambo during the lesson as well as during their science written assessments?
29. Do you think teachers should follow the English only policy during their lessons? Why?
30. To what extent do you follow LiEP when it comes to written assessments?

Teaching science and beliefs about how science should be taught

31. Do you enjoy teaching natural science?
32. What do you believe makes for good Science teaching?
33. Could you tell me a little bit about your experience teaching Natural science to Grade 4 the fact that they are transitioned from Oshiwambo to English Medium of instruction?
34. Describes the most effective teaching methods for primary science teaching practice.
35. As a science teacher, do you a have a specific vision in your teaching career?
36. How do you help your learners to learn scientific/technical terms in English? What methods do you use?
37. What do you recommend to facilitate your teaching natural Science through English in the context where learners are learning English language at the same time?
38. What is your perception on how scientific concept learning might be more effectively supported in bilingual primary schools?

39. Please talk about the challenges your fourth-grade learners , including the might encounter in learning and conduct science written assessments
40. What is your view on the use of images, drawings, and real objects on learners' opportunity to learn science?
41. Is there anything else you would like to add?

Teaching and Learning Resources

42. How many learners do you have in the natural class?
43. How many textbooks are there for the class?
44. What kind science equipment does the school have?
45. How does teacher cope with challenges of teaching content and language?
46. Do you have the science lab at this school?
47. Apart from the textbook, what other resources do you have for natural science?
48. Could you tell me about the kinds of teaching materials you used to teach scientific ideas to your learners?

Questions on Science Written assessments

49. Do you follow language policy when it has come to writing assessments and why?
50. Is there any challenges do learners experiences during science written assessments?
51. How do you mitigate challenges that learners faced during the written assessment tasks?
52. Can you talk about the question's techniques do you use for Natural science written assessments?
53. Can you talk about your learners' overall performance during written text?
54. What is your view of on the use of multimodality / images and drawing during written assessment?
55. What is your perceptions on the use of English only during written assessments?
56. How do you treat the use of other languages during the written tasks?
57. What do you think of the learners' performance in participating in science classroom discussions and/or science activities?

58. How to you support learners during the written tasks
59. How do you treat the use of other languages and modes during the written tasks?
60. Is there anything else you would like to add?

Addendum E: Teacher Interview 2 schedule

Natural Science teacher Post Lesson Observation Follow-up Interview 2: Approx. 90 minutes, after classroom discourse data collection

Date and time of interview:

_____

Name of interviewee:

_____

Position at the school:

_____

Interview consists of viewing video data together, learners' written scripts, and discussing the teacher's views on the language being used for learning at selected moments in the videos.

The arising issues from natural science written assessments and as well as on overall impressions of the classroom discourse.

Addendum F: Principal Interview schedule
Date and time of interview:

_____

General information about the school:

1. Who are you?
2. Where did you grow up?
3. When the school was established?
4. What is the history of the school?
5. What is your school mission and vision?
6. How many learners and teachers do you have at your school?
7. Are the teachers and learners all Oshiwambo native speakers, if not, how many speak other languages?
8. How many grades do you have in this school?

Experiences of being a principal at Grace primary school

9. What is your experience as a school principal at Grace Primary School? For How long you have been a principal of this school
10. Where did you teach before?
11. Could you tell me about your education?
12. What is your vision as the school principal of this school?
13. What is particularly delightful and/or challenging of being a principal of this schools
14. What is the working relationship with the entire school community?
15. Could you talk about the languages you speak and know? a. What, when, who, why?
16. In which language do you communicate with teachers, parents, learners and others institutional workers or any different kinds of discourse
17. How often do you speak in Oshiwambo with your learners and the teachers?

School Language policy

18. All school supposed to have the internal language policy that need to be drawn up in conjunction with the parents and the entire school community. Do you have any formal school language policy? If yes/ what does it says, and who drew it up?
19. What is your view on the language policy used at your school?
20. As a school principal, do you have a specific rule on which language should be used in this school, and why?
21. Do you think teachers should follow the English only policy during their lessons? Why?
22. You have said earlier, "in this school only English that counts' and yet, you are communicating with the learners in Oshiwambo, is there any reasons for doing this?
23. How is the language policy communicated to the entire school community?
24. How often the director of the education or your circuit inspector address the issue of language of instruction in schools at meetings, and what is their major concerns?
25. What can you say about English as a medium of instruction in Namibia, considering that fact there are approximately 30 languages in Namibia?
26. Do you think it is a good/bad idea to utilize English in schools instead of local languages?
27. Can you please explain how language used in school for learning the content subjects?
28. Is there any continuous staff development about the use of language for learning?
29. Are there any registered concerns regarding the use of English as MOI by your staff members?
30. Do your school management restrict language use in your classroom from Grade 4-7 in all the subjects' content except Oshiwambo? If yes/ no, why?
31. Do you have any thing that you would like to add?

Addendum G: Learners' interviews questions on language and science learning
(These questions were translated in Oshiwambo, and therefore all the learners were interview were conducted in Oshiwambo)

1. What is your name?
2. Which language do you use at home, with friends, in the class?
3. What is your home language/s?
4. What other languages do you speak? (can you please tell me in order of how well you speak and write them)
5. Which language do you read best?
6. Which language do you write best?
7. Which language do you love the most? Why?
8. Can you please tell me how did you learnt English?
9. How would you rate your overall ability in English? Good, average, poor
10. In Natural Science lessons, do you prefer learning through English or Oshiwambo or do you preparer to learn through both English and Oshiwambo & Why?
11. Are you able to interact confidently in English during the Natural Science lesson?
12. Does English as a language of learning and teaching affect your understanding of Natural science concepts (why)?
13. Does the teacher allow you to use Oshiwambo in natural science lesson, if yes/ no when and what do you feel about that?
14. How often do your teacher use English and Oshiwambo in the Natural science lesson?
15. Do you experience challenges/problems while using English to learn and write Natural Science assessments , please specify those challenges?
16. What does your English teacher do to help you reduce or overcome these problems?
17. Tell me how do you feel over the use of English in the classroom?
18. Tell me, how do feel over the use of Oshiwambo in the course of teaching and learning
19. How do you feel about of using both English and Oshiwambo as well as the drawing mode flexibly during science written assessments?
20. What do you recommend could be done to help you learn Science successfully using English as a language of learning?

Addendum H: Summaries of the lesson episodes: Topics and activity types in the class lessons

Lesson:1 **Topic:** lesson continuations parts of the plants **Time:** 10-10:15				
Episode	**organisation**	**content**	**Mode**	**Time**
1.	T/Whole Class Greetings, introduction of the researchers, classroom management and introduction of the lesson topic	Parts of the and Plants structure and the functions of each part of the plants	Spoken	5 minutes
2.	T/Whole Class Q& A based on the content taught on the previous lesson	Learners recalls the parts of the and the structure of the plant	Spoken & gestures	5 minutes
3.	Teacher's explanation	the structure of the plants and the function of the roots	Spoken multimodal drawing gestures	10 minutes
4.	T/ Whole Class questions & answers based on the content taught	recalls the functions of the roots	Spoken and gestures	5 minutes

5.	teacher-led question and answer session with the whole class	tapping on learners' prior knowledge about the function of the leaves	Spoken gestures	5 minutes
6.	Teacher's exposition (following textbook content)	The scientific functions of the leaves The process of photosynthesis The raw material that the plants needs to make food	Spoken, textbook gestures	10 minutes
7.	Reviewing and questions & answers session	The functions of the stem and other parts of the plants	Spoken gestures	5 minutes
Lesson:2 **Topic:** lesson continuations parts of the plants **Time:** 10:10:40				
episode	**organisation**	**Content**	**Mode**	**Time**
1.	T/Whole Class Greeting ,	Parts of the and Plants	Spoken	5minutes

	addressing the classroom management and the introduction of the topic	structure and the functions of each part of the plants		
2.	T/Whole Class Q& A based on the content taught on the previous lesson	Learners recall the parts of the and Plants structure and the functions of each part of the plants	Spoken Gestures	5 minutes
3.	Reviewing & textbook expositions	the functions of the roots and defines the concepts of evaporation	Spoken gestures	5 minutes
3.	Revising on the function of the plants and T/ Whole class questions& answers on the functions of the stem	The scientific functions of the stem	Spoken textbook passage gestures Chalkboard writing	5 minutes
4.	Tapping on the learners' prior knowledge and Presenting & explaining textbook content on the functions of the leaves	the functions of leaves	Spoken The content of textbook passage. Gestures	5 minutes
5.	Tapping on the learners prior knowledge and textbook content expositions and	the function of the flower the process of pollination	Spoken Gestures textbook passage	10 minutes

	further explanations		Chalkboard	
6.	eliciting prior knowledge textbook content exposition and further explanations	the function of the fruits	Spoken Gestures Chalkboard writing textbook passage	5 minutes
7.	Reinforcement asks copy the summary	The functions of the fruits	Spoken and Chalkboard writing	5 minutes
Lesson: 3 **Topic:** Animals. **Time:** 10:10:40				
Episode	**Organisation**	**Content**	**Mode**	**Time**
1.	T/Whole Class Greeting , addressing the classroom management and the introduction of the topic	Vertebrates and invertebrates animals	Spoken	5 minutes
2.	T/ Whole Class Questions & answer sessions tapping on learners' prior knowledge	the vertebrates and invertebrates animals	Spoken gestures	5 minutes
3.	Presenting the textbook content and demonstrates by means of	Definitions of vertebrates and invertebrates animals and	Spoken Gestures Drawings	10 minutes

	images and drawing	characteristics of vertebrates and invertebrates animals	Images textbook passage	
3.	T/ Whole Class questions & answer session and reviewing	features of vertebrates and invertebrates animals	Spoken Gestures Drawings Images	5 minutes
4.	Explaining and presenting the textbook contents	General structure of the insects and the characteristics of the insects	Spoken Gestures Drawings Images textbook passage	10 minutes
4.	T/ Whole class questions & answers session generated from the content taught	Responding on the general features of vertebrates and invertebrates animals	Spoken Gestures Drawings Images	5 minutes
Lesson: 4 **Topic:** system of the body **Time:** 11-11:40				
Episode	**Organisations**	**Content**	**Mode**	**Time**
1.	T/Whole Class Greeting , and introduction of the lesson topic	Introducing the lesson continuations on different types of the	Spoken	3 minutes

		systems of the body		
2.	T/ Whole class Tapping on the prior knowledge on the content taught previously	Responding on the different systems of the body	Spoken Gestures	5 minutes
3.	presenting the textbook content and explaining further	systems of the body and their functions	Spoken textbook passage gestures	10 minutes
4.	T/Whole Class questions & answers sessions	Responding on the different parts of the systems of the body and their functions	Spoken gestures and writings on the chalkboard	5 minutes
5.	T/ Whole class addressing the classroom management		Spoken	2 minutes
6.	Textbook exposition and further explanations	The processes of execratory and respiratory as well as the organs involved	Spoken textbook passage gestures	10 minutes
7.	Reviewing and questions & answers sessions	The processes of execratory and respiratory as well as the organs involved	Spoken Gestures	5 minutes

Lesson: 5 **Topic:**system of the body **Time:** 11:12:20				
Episode	**Organisation**	**Content**	**Mode**	**Time**
1.	T/Whole Class Greeting , and the introduction of the lesson topic	Lesson continuation on the system of the body	Spoken	5 minutes
2.	T/ Whole class Tapping on the prior knowledge on the content taught previously	Responding on the different parts of the systems of the body	Spoken Gestures	10 minutes
3.	Explaining & model the concepts	the different parts of respiratory system and its functions	Spoken Gestures Drawings Images	15 minutes
4.	T/Whole Class questions & answers sessions	Responding on different types of diseases that affect respiratory system	Spoken Gestures	15 minutes
5.	presenting and explaining textbook content and explaining further	how the processes of respiratory system works, and the organs involved in the respiratory system	Spoken Gestures textbook passage drawing	20 minutes

6.	T/Whole Class Questions & answers sessions	personal experiences about different types of diseases and	Spoken Gestures	15 minutes
Lesson: 6 **Topic:** communicable diseases **Time:** 11:11:50				
Episode	**Organisations**	**Content**	**Mode**	**Time**
1.	T/Whole Class Greeting , addressing the classroom management and the introduction of the topic	New topic about on communicable diseases	Spoken	5 minutes
2.	T/whole class questions answers sessions tapping on learners' prior knowledge	Responding on different types of diseases	Spoken Gestures	5 minutes
3.	Textbook expositions and further explanations	Different types of communicable diseases , the definitions of attendant concepts and how communicable diseases are spread and	Spoken Gestures textbook passage	15 minutes

		their symptoms		
4.	T/ Whole Class questions & answers sessions	Responding on different types of communicable diseases and how communicable diseases are spread and their symptoms	Spoken Gestures	5 minutes
5.	Introduce the new topic & and tape on the learners prior knowledge about STDs	the sexual transmitted diseases (STDs	Spoken Gestures	3 minutes
6.	Addressing the classroom management		Spoken	2 minutes
7.	Textbook exposition and further explanations	different types of STDs , how they are transmitted and the attendant concepts of sexual transmitted diseases	Spoken Gestures textbook passage	10 minutes
8.	Reviewing and introduce the new topic	different types of STDs , how they are transmitted and the symptoms of the flue	Spoken Gestures	5 minutes

Lesson: 7 **Topic:** communicable diseases **Time:** 12: 12:51				
Episode	**Organisations**	**Content**	**Mode**	**Time**
1.	T/Whole Class Greeting , addressing the classroom management and the introduction of the topic	Lessons continuations on Communicable diseases	Spoken	2 minutes
2.	T/whole class questions answers sessions on content taught on previous lesson	Different types of communicable diseases and their symptoms	Spoken Gestures	5 minutes
3.	T/whole class questions answers sessions	learners sharing their personal experiences about the diseases and the symptoms	Spoken Gestures	7 minutes
4.	Introduction of the new topic about and tapping on learners' prior knowledge	New topic about chicken pox and polio and measles	Spoken Gestures	2 minutes
5.	T/ Whole class questions & - answer sessions	Narrating on personal experiences of	Spoken Gestures	5 minutes

		chicken pox , and measles		
6. **7.**	Reviewing and explanations Textbook content expositions & further explanations	Descriptions of chicken pox, polio and measles how measles and polio can be transmitted and also how they can be prevented from being transmitted	Spoken Gestures Spoken Gestures textbook passage	5 minutes 10 minutes
7.	Reviewing and T/ Whole class questions & answer sessions	Different ways how diseases can be transmitted	Spoken Gestures Textbook images	5 minutes
8.	Initiation of the new topic by the learner	a learner initiate a new topic about tonsils	Spoken	1 minutes
9.	T/ Whole class question and answers session about the new content introduced	Learners responded by drawing from their own personal experiences of the causes the symptoms and different types of treatment	Spoken Gestures	8 minutes

		they received for tonsil		
8.	Teachers asked about homework that was given yesterday		Spoken	1 minutes

Addendum I: Codes developed to analyse the IRF classroom discourse moves according to their purpose

	Patterns of Interaction	**Definitions**
Teachers talks move		
01	Initiating open-ideas question	Elicits ideas. Includes 'What do you think?
02	Initiation of Closed questions	questions elicits a limited number of responses
03	Directed question	Teacher directs a question to a named student
04	Teacher restates	Teacher repeats or restates what has been said.
05	Ask for elaboration	Teacher asks for elaboration of a response
06	Elaborate	provide an explanation
07	Prompt and scaffold questions	Teacher provides cues before or after a question to prompt
08	Ignore	Teacher ignores a student response
09	Acknowledge only	Teacher just acknowledges a student response with no further interaction.
10	Evaluate	Teacher indicates whether an answer is correct or incorrect
11	Provided the answer	teachers responds to the question he asked
12	Moves on	Teacher asks a question which changes the focus of discussion
13	Nomination:	address learners by names or invite the specific learners to contribute
14	Acceptance:	the teacher granted a response with positive terms like 'yes, that's right'
15	Praise:	the teacher responds with e 'well done', 'right', 'good job' etc.

16	Reframe	Teacher rephrases a student answer to improve expression.
17	Reframe scientifically	Teacher rephrases student answer to correct science
Students' talks Move		
18	Explanation	Student provides an explanation of how or why
19	Reasoning	Student provides reasoning
20	One-word answer	yes/ no or respond by one word
21	Initiate talks	Students initiate the topic or talks

Addendum J: Consent form- parents

Research on Language practices and Language policy in bilingual Science classroom

Please indicate if you give permission for your child to be part of the research by ticking yes or no next to each aspect of the fieldwork and signing your name below. Please return this slip as soon as possible to the Natural Science teacher.

Name: (Print)

(Signature)

(Date)

Child's Name:

Please tick the box to indicate your consent to each part of the research:

I consent to my child:	Yes	No
1 .Being observed in the classroom		
2. His/her written work and assessments to be looked at and make copy from it		
3. Being video recorded during the classroom interactions and the video to be used for this study (to be viewed by the researcher, her supervisor and the teacher)		
4. Being interviewed		