Teachers' beliefs and practices when teaching life sciences using their second language

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African township schools are characterised by cultural and linguistic diversity, hence, teachers have the dual task of ensuring that learners grasp scientific concepts, while also catering for the diversity in the learners' backgrounds. The study reported on here was aimed at investigating teachers' beliefs and practices in teaching life sciences using English, a language that is not their own home language. The study was underpinned by a socio-constructivist perspective, emphasising how one's personal context, including prior experiences, influences the development of beliefs about language use in life sciences classes and the manner in which teaching and learning might occur. The sample comprised 6 teachers who all spoke English as a second language. We collected the data using structured interviews to ascertain the teachers' beliefs about the teaching of life sciences in English to Grade 11 classes, and classroom observations to identify their classroom practices. The findings indicate that the beliefs that the teachers expressed differed from their actual choices and practices in the lessons observed.

Keywords: beliefs; English second language (ESL) speakers; language of instruction; life sciences; teacher choice of practice; township schools

Introduction
South Africa is characterised by diverse cultural and ethnic groups, with each group having its own unique language, enabling individuals to share a sense of belonging and cohesion (Gudula, 2017; Setati, 2002). In addition, South African schools consist of diverse learners from different cultural backgrounds (Feez & Quinn, 2017; Nomlomo, 2007). Also, teachers are often required to teach through the medium of English, which is not the home language for many teachers in township schools. Thus, the process of teaching can be a monumental challenge, especially when teaching learners who are not familiar with the language of instruction (Mthiyane, 2016; Oyoo, 2004). Vygotsky (1978) claims that language is a powerful tool that one can use to acquire both higher cognitive skills and social belonging. An additional problem is that each school subject is associated with specialised vocabulary and a unique language register. The uniqueness comes from the fact that scientific language is precise, objective and information-oriented (Wellington & Osborne, 2001). For instance, in life sciences, scientific terms that have been adapted from both Greek and Latin are used. This can be problematic for ESL speakers, who in most township schools can be both teachers and learners, as they may have the challenges of teaching and learning science in an unfamiliar language.

Previous researchers have found that township teachers who are ESL speakers often face a difficult task in teaching life sciences using English (Ferreira, 2011; Mthiyane, 2016; Oyoo, 2004; Prinsloo, Rodgers & Harvey, 2018). Their experiences in teaching using English may inform their beliefs of what ought to occur in science classes. Therefore, teachers' beliefs about teaching life sciences to ESL learners arise partly from the interactions that occur in the classroom (Dos Santos, 2019). In addition, choices made about teaching strategies are driven by encounters that teachers engage in throughout many aspects of their teaching (Dos Santos, 2019; Mthiyane, 2016; Setati, 2002). The practices that life sciences teachers choose may differ from what they believe to be the best way to teach life sciences through the medium of English. This could be because of the contexts in which they find themselves teaching. Teaching in a second language and also teaching a subject with complex terminologies, compounds the language challenges. For instance, the process of code-switching may arise from a teacher attempting to explain a certain abstract concept to learners who may be struggling to understand the English words. Teachers' beliefs inform their teaching practices, but the relationship is a complex one. This distinction between beliefs and practice is central to enhancing meaningful teaching of life sciences using English (Msimanga, Denley & Gumede, 2017).

Aims and Research Questions
In our study we investigated the use of English for teaching life sciences in classrooms that are linguistically diverse. As increasing linguistic and cultural diversity is a trend noted in schools in many nations; the findings of research in this area are widely applicable. In order to address language issues in South Africa (and other previously colonised nations), it is important to acknowledge a historical perspective because, previously, language was used as a form of cultural capital by some minorities who had access to the medium of instruction.

In addition, a great deal of educational research worldwide uses beliefs data via questionnaires and interviews with the implicit assumption that teachers' stated beliefs are a true reflection of the way they engage with learners in their classrooms. In this study, we investigated this assumption by examining both teachers' beliefs about language and their actual classroom practice. We sought to answer the following research

questions: 1. What are teachers' beliefs regarding the teaching of life sciences using English as their additional language? 2. What practices do teachers use in the teaching of life sciences using English when it is their second language?

Background

In summary, the South African (SA) Language-in-Education Policy (1997) is aimed at:

i)   Promoting individual full participation socially and economically by accessing equitable and meaningful education
ii) Establishing an additive multilingualistic approach to language in education
iii) Promoting and developing all SA official languages
iv) Supporting the teaching and learning of all languages used by South African communities
v)   Thwarting disadvantages arising from differences between home languages used for teaching and learning
vi) Redressing previously marginalised languages (Department of Education, 1997).

While the policy gives an individual the right to choose the language of learning and teaching (LoLT), English has been given preference as a LoLT by most schools considering its strong global status as a medium of communication. This is despite English being a second or third language to most South African people. However, there are no measures to ensure compliance in the implementation of the language-in-education policy (Potgieter & Anthonissen, 2017). For instance, schools in townships mostly have Black, Coloured and Indian teachers and learners, whose home language is different from the medium of instruction. In the township of Orange Farm, where the study was conducted, the majority of teachers and learners speak IsiZulu, Sesotho and IsiXhosa, with Xitsonga, Tshivenda and English as the least-spoken languages. As such, teachers are expected to teach in a linguistically diverse environment. In a life sciences classroom, learners need to comprehend English to learn the subject matter meaningfully (Ferreira, 2011). For this reason, language is central to issues arising in science classes (Oyoo, 2017). Prinsloo et al. (2018) underscore the pivotal role that language plays in such science classrooms. Thus, it is crucial that teachers examine the way they use language in science classes. In addition to language issues, there are many other contextual factors that impact on the teaching and learning of science in these township schools, such as overcrowding and a lack of basic resources (Ferreira, 2011). Furthermore, in evaluating how teachers use language in science classes, studies by Mthiyane (2016) and Setati (2002) have shown that teaching and learning occur most effectively when learners are familiar with the instructional language.

Literature Review
Teachers' beliefs in general

Beliefs have been defined as subjective and experience-based knowledge (Pehkonen & Pietilä, 2003) and as "perspectives and conception of teachers' roles, positions, and teaching and learning strategy" (Dos Santos, 2019:10). As early as 1992, Pajares conceptualised teacher beliefs as personal constructs that help in understanding, judging and evaluating teachers' practices. Teacher beliefs shape their classroom practices and help them comprehend their teaching approaches and decisions made for the classroom (Gilakjani & Sabouri, 2017). Teachers' beliefs are indicative of their memories and have more influence than the teachers' knowledge regarding lesson planning, decision-making and ultimately on how they teach (Gilakjani & Sabouri, 2017). While it is difficult to understand the actual meaning of beliefs, our study is informed by Pajares' (1992) distinction between beliefs and knowledge: knowledge is derived from objectivity whereas beliefs are derived from evaluating and judging situations. This is made clearer by Mansour (2009) who described science teachers' beliefs as being more about their teaching behaviours and attitudes than their knowledge.

The beliefs that teachers hold about teaching and learning arise from their experiences as learners, which are modified at tertiary level (Abdi & Asadi, 2015). We believe that it is critical to study the impact that teachers' beliefs have on teaching life sciences when teachers are ESL speakers. As mentioned before, language is the basis for a range of cognitive processes such as thought, knowledge construction and social interaction (Vygotsky, 1978). Hence, beliefs that teachers have about teaching life sciences in English influence their choices of strategies to use in their classrooms (Gilakjani & Sabouri, 2017).

Teachers' beliefs of language

Studies by Dos Santos (2019), Ferreira (2011) and Gilakjani and Sabouri (2017) have shown that teachers' beliefs and experiences of language are embedded in their larger sociocultural environments, which include learners, peer teachers, parents, administrators, families, communities and political or government environments. In addition, teachers have shown low levels of proficiency in English, which is the LoLT (Potgieter & Anthonissen, 2017). Since all these factors influence teachers' beliefs and experiences of language, it can be deduced that they ultimately influence the teachers' instructional practices. Life sciences is influenced by foreign languages such as Greek and Latin (Ferreira, 2011), so, teachers' beliefs and prior experiences in the teaching of life sciences using English and their

experiences as learners pose difficulties for these ESL teachers. These difficulties tend to inhibit effective teaching and learning from occurring in science classes and may further shape instructional practices in life sciences classes and how these practices are carried out (Dos Santos, 2019; Gilakjani & Sabouri, 2017).

The medium of instruction

There is a misinterpretation of the language-in-education policy in South African schools, which brings about a level of uncertainty. This is mainly because there is a belief that South African language policy stipulates that learners from Grades 4 to 12 are supposed to be taught in English and schools adopt that. Consequently, both teaching and learning are affected negatively, and language disparities are commonly experienced in multilingual classes. Some teachers believe that due to the use of English, learners lose touch with their home languages, which form part of their identity (Kretzer & Kaschula, 2020). It is more difficult in science classes because the language that is used has very precise meanings and ESL speakers struggle to comprehend some of these concepts (Mthiyane, 2016). Therefore, to some extent, the use of English as a LoLT marginalises ESL speakers.

It is imperative to comprehend the role that teachers play in teaching using an official language of instruction. Teachers play a very crucial role of bridging the gap between scientific language and the language of instruction in life sciences classes (Ferreira, 2011). This gap can be bridged if a teacher is able to integrate the learners' home languages with both the scientific language and the language of instruction. However, since the language of instruction differs from that of learners and teachers, this may lead to language difficulties in life sciences classes (Ferreira, 2011). Boateng (2019) points out that "significant evidence demonstrates that teachers' English proficiency impacts on the quality and type of teaching that teachers can engage in" (p. 8). Equally so, learners have a poor understanding of the medium of instruction for them to engage and understand the subject matter they learn (Clegg, 2005). This shows that English as the language of instruction influences the way in which lessons are conducted in life sciences classrooms. In addition, life sciences teachers in township schools need to be proficient – not only in English – but also in other South African official languages due to the low English levels of many learners. Thus, it is challenging for life sciences teachers to bridge the gap between the learners' languages, the LoLT and scientific language. As such, the strategies that teachers employ depend on their understanding of the LoLT because Alidou and Brock-Utne (2011) argue that the use of languages familiar to both

teachers and learners motivate learner engagement in class activities as communication is enhanced.

Strategies teachers implement to counteract language-related difficulties in science classes

Township science teachers have adopted various strategies to reduce language difficulties in science classes and work towards eliminating them. However, as South Africa is linguistically diverse, it is imperative that teachers implement strategies that are effective and increase the acquisition of scientific concepts by learners. The following strategies have been frequently used when combating language barriers that may cause or lead to difficulties in learning science.

Code-switching

Schools in South Africa are generally multilingual and multicultural schools and since learners in these schools are mostly ESL speakers, life sciences teachers resort to code-switching as a way of explaining scientific concepts that are problematic to learners (Feez & Quinn, 2017; Mthiyane, 2016; Nomlomo, 2007; Prinsloo et al., 2018; Probyn, 2016). However, these studies show that, although regarded as a fruitful process, code-switching can also contribute to the science language problems that occur in life sciences classrooms. Since code-switching involves moving from one language to another (Prinsloo et al., 2018), it can be difficult for teachers to accommodate all learners from different cultural backgrounds if the teacher is not proficient in all languages spoken by the learners in the class. Learners in a life sciences class have different linguistic backgrounds and, because of this, teachers may only explain some concepts to learners who speak the same language as the one they speak, and thus disadvantage those who speak a different home language.

Transliteration

Transliteration is one of the methods widely used where a learner who is fluent in both the home language and English, interprets and explains concepts to other learners (Mphahlele, 2004). In this way, life sciences concepts can be made more accessible to other learners who are not proficient in English. However, Msimanga and Lelliot (2014) suggest that transliteration leads to more confusion and the meaning of some valuable scientific concepts is lost. This is because learners may not be proficient in all the home languages that are represented in the classroom and, since teachers and learners in township schools are mostly multilingual, it can be difficult for other learners who do not speak the same language as the one used in explaining these science concepts.

The above-mentioned studies offer alternative methods for reducing language problems that arise

in science education, although problematic issues are associated with both code-switching and transliteration. Proficiency in English is of the utmost importance for science teachers, and a lack of proficiency in the language of instruction impedes meaningful learning from occurring (Boateng, 2019; Msimanga & Lelliot, 2014; Mthiyane, 2016; Nyika, 2015).

Theoretical Framework

The study was underpinned by a socio-constructivist perspective, emphasising how one's personal context, including prior experiences, influences the development of beliefs about language use in life sciences classes and the manner in which teaching and learning might occur. Vygotsky (1978) posits that society and culture are the heart of learning and development, and that teachers are part of the social structures that promote changes in these social structures.

Socio-constructivist perspective

Vygotsky argues that language serves to arbitrate higher-order thinking (Vygotsky, 1978). Therefore, teachers must consider the critical role of language in the teaching-learning process. Constructivism focuses on how knowledge can be constructed meaningfully by individuals. This highlights that learning occurs in the presence of language, and the way in which teachers use language to portray certain concepts to learners is important (Jones & Brader-Araje, 2002; Vygotsky, 1978; Wertsch, 1991). Hence, the use of language to construct meaning is of central importance for this study on the way that ESL teachers use language to teach life sciences. The social dimension of constructivism (hence the term socio-constructivism) is vital in acknowledging the complexity of the situation in township schools. Teachers' beliefs about language use impact on their choice of strategies to use in their practice. However, the relationship is not simple; often there are other considerations besides pedagogical ones that impact on their choice of strategies. Furthermore, the influence of constructivism in education today can be seen in a variety of published curricula as well as instructional practices (Leach & Scott, 2003; Steffe & Gale, 1995), including those advocated officially in South Africa.

Methodology

Research Design

In this study we followed a qualitative phenomenological approach. Creswell (2011) points out that a qualitative research design allows for the investigation of the phenomenon within its real-life context. In phenomenological research, no assumptions are made by researchers, but rather an effort is made to understand the experiences of the participants (Converse, 2013). The design was suitable for this study because data were collected from life sciences teachers in real classrooms in township schools. Similarly, a qualitative approach makes it possible to study "things in their natural settings, attempting to make sense of or interpret phenomena in terms of the meanings people bring to them" (Denzin & Lincoln, 2005:3).

Sampling

A purposive sampling technique (Patton, 1990) was used to select participants. According to Patton (1990), purposive sampling allows for the selection of information-rich cases, where the researcher can obtain a great deal of data regarding the matter at hand. Etikan, Musa and Alkassim (2016) maintain that purposive sampling allows for the selection of participants that provide a distinctive and information-rich value to the study. Six teachers who are ESL speakers were selected from six township schools for the study. The life sciences teachers had different teaching experiences: two novice teachers (N), Zanele and Mulalo, (0 to 2 years), two relatively experienced teachers (RE), Koali and Sizwe, (3 to 5 years) and two very experienced (VE) teachers, Phale and Shilubane, (6 years and above) (details in Table 1). The assumption was that teachers at various levels of experience may have different beliefs about the teaching of life sciences using English. Denzin and Lincoln (2005) claim that those involved in qualitative research should be directly linked or affected by the problem researched; hence the involvement of these participants.

Table 1 Participants' profiles

	Participants' pseudonyms					
	Mulalo (N)	Zanele (N)	Sizwe (RE)	Koali (RE)	Shilubane (VE)	Phale (VE)
Gender	Male	Female	Male	Male	Male	Male
Home language	Tshivenda	IsiZulu	IsiZulu	Sesotho	Xitsonga	Sesotho
Qualification	Bachelor of Education: Further Education and Training (BEd (FET))	BEd (FET)	BEd (FET)	BEd (Senior Phase and FET)	BEd Honours (Hons)	Senior Teaching Diploma
Subjects taught	Life sciences and mathematical literacy	Life sciences	Life sciences and English	Life sciences and English	Life sciences and Economics	Life sciences and natural sciences
Teaching experience	2	2	5	4	16	37
Topic taught during this research	Gaseous exchange: The ventilation system	Gaseous exchange: Respiratory diseases	Excretion: Role of the lungs, kidneys and bladder	Excretion: Urinary system	Gaseous exchange: The effects of smoking on gaseous exchange	Excretion: Nephron structure and functions

Data Collection

Data collection involved interviewing each of the six teachers once, using a structured interview schedule, to establish teachers' beliefs regarding the teaching of life sciences using English. In the interviews, the teachers were asked about their knowledge with regard to the South African language policy; their beliefs about teaching life sciences in learners' home languages; strategies that they believed to be effective in facilitating the comprehension of life science concepts where language is problematic; and the challenges they faced when teaching in English, their second language.

To gain insights into teachers' practices in teaching life sciences using English, each teacher was observed once through a complete lesson while teaching a life sciences lesson in Grade 11. A revised Reformed Teaching Observation Protocol (RTOP) was used to capture the level of each teacher and their learners' involvement during the lessons (Sawada, Piburn, Turley, Falconer, Benford, Bloom & Judson, 2000). Table 3 shows the categories in RTOP. Incidents of learner engagement with the content, teacher-learner and learner-learner interactions were captured and scored using the RTOP rubric. The interviews and lessons were audio-recorded and video-recorded respectively, with permission from the participants. Mills (2011) pointed out that observations allow the researcher to examine non-elicited behaviour as it happens. The observations conducted in this study focused on the type of language that was used in life sciences classes and the type of strategies that teachers used to eliminate the language barriers that were prevalent in science classes. Creswell (2011) notes that observations provide a more complete description of the phenomenon that would be impossible by only analysing interview documents.

Data Analysis

Both interviews and observations were transcribed verbatim. Data were coded and analysed using an interpretive approach (Fontana & Frey, 2003). The information was broken down into smaller units and each response was thoroughly interpreted, explained and analysed to make meaningful cohesion between participants' responses (Cohen, Manion & Morrison, 2000). Trends between the participants' responses were examined for any emerging themes. The themes were formulated and interpreted in response to the research questions.

Reliability and Validity

To improve reliability and validity of the data from interviews and observations, the first and second authors read the textual data repeatedly, coded and reviewed any emerging patterns and trends soon after data collection. The process was repeated after some time to check for consistency. Additionally, to ensure that the results obtained were trustworthy, transcripts were sent back to participants to review whether the contents of the transcripts correctly reflected their views. The interpretations were later further validated by sharing the emerging themes with the participant teachers.

Findings

Table 2 shows the findings from the interview schedules and the emerging themes that were formulated based on the participants' responses. Table 3 shows the RTOP rubric scores for the six lessons observed. The scores that the teachers obtained were compared with the teachers' responses from the interviews.

Findings from Interviews

Table 1 shows the coding and analysis of data from the interviews which informs the themes under which the findings are presented.

Table 2 Coding analysis of data from interviews

Codes	Category	Emerging themes
i. Most learners become disadvantaged because English as a language is only used at schools. ii. Most of the learners don't understand English. iii. In life sciences there are words that you cannot express in vernacular. iv. Learners who are doing sciences don't have language barriers. v. Stick much to English. vi. Teaching life sciences in English is good. vii. Interact with people. viii. Some words that you cannot translate to English.	a. The language policy lacks inclusion of other diverse cultural groups. b. There is a strong need to revise the South African language policy. c. English as the medium of instruction allows for learner participation in the global scientific field. d. Communicative skills. e. Misconceptions. f. Lack of classroom engagement. g. Learners' poor performance.	Teachers held mixed views regarding the South African language policy disadvantaging township learners who are ESL speakers.
i. Videos from YouTube. ii. Make notes that are more accommodative to learners. iii. Code-switch every now and then. iv. Use the language that is familiar.	a. Code-switching (the strategy mostly preferred by the participants). b. Transliteration. c. Demonstrations. d. Practical examples. e. Reciting.	The strategies perceived by teachers as most effective to counteract language difficulties in life sciences classes and elicit learner engagement.
i. Learners participate in their home languages. ii. Less learner participation in English. iii. Learners use their home language.	a. Little engagement in the language of instruction. b. More engagement in the home language.	Teachers perceive the use of English as their second language as a barrier in the teaching and learning engagement in life sciences classes.

Theme 1: Teachers had mixed views regarding the South African language policy disadvantaging township learners who are ESL speakers

Although some participants supported the South African language policy, others argued against it. The views of Phale, Shilubane and Sizwe were all opposed to the South African language policy. For instance, Phale highlighted that the South African language policy mostly benefits learners from former "Model-C schools" (the Model-C schools were for white-only learners during the apartheid era) as opposed to learners from township schools. This was further corroborated by the views of Shilubane and Sizwe, who also stressed that the use of English in South African schools mostly benefits learners from affluent schools. The basis for their argument was that most township schools consisted of both teachers and learners who are ESL speakers. The teachers showed their lack of knowledge and understanding of the South African Language-in-Education Policy, which they misinterpreted as stipulating that English should be the LoLT. Furthermore, the studies of Ferreira (2011), Makgato and Mji (2006) and Oyoo (2017) also support the notion that the South African language policy impedes learning and teaching in township high schools, since the majority of learners and teachers are ESL speakers. The argument that the teachers held was that, because South Africa is both culturally and linguistically

diverse, it is imperative that the teaching and learning process should be inclusive of all learners, which is not possible when English is used as the only medium of instruction. There has been an incorrect assumption that the policy identifies English as the medium of instruction and yet the decision is placed on schools, parents and school governing bodies to choose a language that can be used for teaching and learning of a particular group of learners. Unfortunately, most schools choose English because of the global status that English has attained as a means of communication, thereby disadvantaging the ESL speakers.

Theme 2: Teachers identified strategies they used to address language difficulties in their life sciences classes

When asked about the teaching strategies or approaches that they employed in their life sciences classes to address language difficulties, teachers mentioned code-switching, transliteration and demonstrations among other teaching strategies.

Code-switching

Life sciences teachers have the difficult task of ensuring that they teach life sciences concepts in a meaningful and productive way while also ensuring that the language of instruction does not impede learning (Ferreira, 2011; Greenfield, 2010). Most teachers and learners in township schools are ESL

speakers and this implies that proficiency in the language of instruction, learners' home languages, and the language used in science is highly recommended (Mavuru & Ramnarain, 2020). Thus, it is imperative that ESL teachers in township schools develop strategies that will ensure that scientific concepts are acquired by learners in these schools. The findings indicate that the preferred strategy of ensuring scientific concepts is acquired through code-switching. All participants described code-switching as one of the strategies that they implemented to ensure that life sciences concepts were understood by the learners. Sizwe and Mulalo described code-switching as beneficial for learning life sciences because it simplifies scientific terms that are rather difficult to comprehend in the language of instruction. However, Zanele and Koali highlighted a very important aspect that makes science teachers sceptical about code-switching. They posited that code-switching inhibited learners' acquisition of scientific concepts because during assessments "learners have to write using English"; hence, it may be difficult for some learners to understand certain scientific concepts simply because they were taught such concepts in their home languages. Additionally, Phale and Shilubane emphasised both the advantages and disadvantages of code-switching. The teachers' beliefs that code-switching helped to eliminate some language difficulties in life sciences classes was largely influenced by the context in which teaching occurred. In township schools, code-switching occurs on a regular basis, and many life sciences teachers have adopted this strategy.

Theme 3: Teachers believed the use of English to be a barrier in the teaching and learning of life sciences
Interaction plays a vital role in the school environment, particularly in classrooms. The level of classroom interaction practices is facilitated by the type of language used; the more learners use their home languages, the more they actively engage in science lessons. By contrast, when using English, learners tend to interact less in science classes. Thus, the research findings concur with what previous studies have found: the level of interaction that occurs in the classroom is dependent on the language that is used. Furthermore, the findings indicate that the six teachers believed that most learners were reluctant to interact in English and that most interactions occurred in the learners' home languages. This supports the views of Alhamami (2019), Ferreira (2011), Mavuru and Ramnarain (2020) and Msimanga and Lelliot (2014), all of whom have maintained that more effective learning takes place when learners are more familiar with the language of instruction. Shilubane indicated the importance of interacting in English, but also highlighted that

in most cases learners tended to revert back to their home languages.

Discussion of findings from interviews
The findings from the interviews with the six participants revealed that the teachers expressed that the South African language policy should be revised to accommodate the diverse cultural groups in South African schools. For instance, the six participants implied that because the language policy encouraged the use of English in township schools, it does not accommodate diverse linguistic groups. Hence, there is a need for the revision of this policy. This confirms Oyoo's (2017) views that the South African language policy is, to some extent, distinctively disadvantageous for both teachers and learners who are ESL speakers. For instance, Phale, Shilubane and Mulalo held very strong views about the revision of the South African language policy. Their responses alluded to the fact that teachers and learners from affluent schools were advantaged by this policy since they were mostly first-language speakers of English. Similarly, this concurs with a study by Bourdieu (1991) that language forms part of cultural capital and those from affluent schools possess a relevant cultural capital that allows them to succeed in the school environment. As already mentioned, it shows the lack of knowledge by these teachers and the previous authors who misinterpret the language-in-education policy. The argument should be on the lack of efforts to monitor the compliance by schools in the implementation of the policy (Potgieter & Anthonissen, 2017). However, some of the responses from other participants, especially Koali and Zanele, highlighted the importance of English as the medium of instruction. They emphasised that the use of English in science classes equipped both teachers and learners with skills that allowed them to become active members of the scientific community. Similarly, in a study to analyse teachers' language practices and attitudes, Kretzer and Kaschula (2020) found that, even in a situation where teachers had the liberty to use learners' home languages, the use of English dominated during lessons.

Heugh (2013) highlights the importance of inclusion in the South African school system. Inclusive education suggests that the curriculum is structured in a way that allows individuals from various linguistic backgrounds to cohesively engage in meaningful learning and teaching (Department of Basic Education, Republic of South Africa, 2011). Sizwe believed that there was a lack of inclusive education in their schools as English was preferred as LoLT. In addition, both teachers and learners may not be proficient in English, which ultimately affects the understanding of life sciences concepts. This belief questions the schools' choices of English, yet the SA language-

in-education policy provides for equity in language choices. Such practices could be explained in terms of feasibility to teach learners in their home languages considering that in most classrooms in township schools there are learners who come from diverse linguistic backgrounds. Hence it becomes difficult for schools, school governing bodies, and parents to agree on the language that can be used in a particular school. Consequently, English is selected as the neutral language. Phale, although against the use of English as a LoLT, acknowledged the importance of English as a way of fostering global scientific knowledge. These findings are in line with a study by Stein (2017) who emphasises that English, as the medium of instruction, affords learners with communicative skills to expand their scientific knowledge beyond their immediate surroundings.

Studies by Ferreira (2011), Heugh (2013), Msimanga and Lelliot (2014) and Oyoo (2004, 2017) have found that English as the medium of instruction has both advantages and disadvantages for ESL teachers and learners. One of the prominent advantages of teaching and learning in English is that it equips individuals with communication skills so that they can participate in the global scientific domain; the findings from this study support this point. For instance, Phale and Mulalo pointed out that, since English is regarded as the international language of communication, it is advantageous for ESL speakers to become accustomed to English as it will allow them to be exposed to diverse individuals in the sciences. The findings reveal that, in spite of advocating for a revision in the implementation of the language-in-education policy, some of the participants acknowledged that English is a resource that can be used to stimulate conceptual change.

All the participants believed that teachers should use strategies that would help reduce some of the challenges of not teaching life sciences in one's home language. Some of the challenges that were highlighted by teachers included learners' low proficiency in spoken English, the inability of learners to express themselves in written English when answering questions in the exams, and the teachers' lack of ability to adequately explain science concepts in English. However, some of the teachers highlighted that the most effective strategy to eliminate language difficulties in science classes was code-switching. All six teachers stated that they code-switched every now and then to ensure that scientific concepts were understood by learners. Setati (2002) and Stein (2017) report that code-switching is widely used across South African township schools by teachers as a coping mechanism to bridge the difficulties that are associated with the language of instruction. Sizwe and Zanele highlighted the importance of teachers being proficient in both the language of instruction and learners' home languages. It is important to note that the teachers were not assessed on the level of proficiency in English. Probyn (2016) found that, for effective code-switching, teachers have to be proficient in more than one language. All teachers in the current study advocated the use of code-switching in their life sciences classes. Strategies such as transliteration and demonstration were used, but they were not preferred by the six participants as code-switching was. This correlates with the findings of Mavuru and Ramnarain (2020) that code-switching is widely used by science teachers in township schools to stimulate conceptual change.

Findings from Lesson Observations

In determining answers to the second research question which sought to explore how teachers practiced teaching life sciences in their second language, lesson observations were done. Each of the six teachers was observed once and scored using the RTOP scoring rubric. Table 3 shows the teachers' scores for each of the RTOP categories.

Table 3 Teachers' scores in the different RTOP categories

	Teachers' scores with RTOP categories (out of 20)					
	Lesson design and implementation	Propositional knowledge	Procedural knowledge	Communicative interactions	Student/Teacher relationships	Total score (max. 100)
Phale	12	13	07	11	14	57
Shilubane	13	12	09	16	15	65
Koali	16	20	11	18	16	81
Zanele	12	14	10	12	13	61
Mulalo	10	13	11	10	11	55
Sizwe	14	13	12	13	13	65
Average scores (max. 20)	13	14	10	13	14	64

Discussion of findings from lesson observations
There was a significant variation in the teachers' RTOP scores recorded during the lesson observations. Most of the teachers had low scores, with Mulalo scoring the lowest (55%). Koali had the highest scores in all but one of the RTOP scales. When looking at each lesson, Mulalo taught in English throughout the whole lesson, probably because he was not proficient in the learners' home languages, and so could not code-switch. The findings from this study affirm those from other studies (e.g. Mthiyane, 2016) that code-switching requires teachers to be fluent in both the home language and English. One conclusion that can be drawn from the relatively low scores in each category of the observations is that the teachers used simple language to explain difficult science concepts to their learners. This illustrates the pivotal role that language plays when teaching life sciences classes using English as a medium of instruction.

The second research question concerned teachers' practices in teaching life sciences in English. Language barriers were prominent in the classes of both experienced and novice teachers. For instance, Phale, the most experienced teacher with 37 years of teaching experience, struggled more than Koali, a novice teacher with 4 years of teaching experience. Studies by Boateng (2019), Ferreira (2011), Mavuru and Ramnarain (2020) and Nomlomo (2010) all suggest that language difficulties in science classes affect most township teachers, regardless of their teaching experience. This notion was confirmed by observations of Koali's and Phale's classes. One observation that could be made from their lessons was that of the nature and quality of the teacher-learner interactions. In Koali's class, the use of the learners' home language stimulated more teacher-learner interactions, whereas in Phale's class, even though some code-switching occurred, there was less teacher-learner interaction. These findings highlight a very important point, which is that the use of their home languages in life sciences provides learners with the opportunity to connect their thought processes and express their ideas clearly, which they could not have done using the language of instruction (Mavuru & Ramnarain, 2020). However, it was also observed that code-switching often led to the misinterpretation of some scientific concepts and may lead to more learning barriers.

The difference between teachers' stated beliefs and their practices
One of the key findings of this study was the differences between teachers' beliefs and their actual practices. It was observed that the teaching strategies that participants used in the classroom were different from the views they had expressed during the interviews. For instance, the teachers implied that they were proficient in the medium of instruction and that English should be used in the life sciences classroom. However, during the observations it was established that some teachers struggled to teach using English, which led to the use of the home language. The observations in Koali's class indicated a contradiction between his beliefs about the use of home language in the classroom; for instance, this was his response when asked whether he experiences difficulties teaching life-sciences using English: "*No, I don't have any challenges, the learners like to be taught in their home language, but as educators we need to ensure that we stick to English so as not to stray from the topics.*"

Although Koali inferred that teachers should "stick to English", it was observed that he mostly taught using the learners' home language. This shows that teachers' beliefs may not be directly translated into practice, possibly due to contextual factors in the township schools. Often there are other considerations besides pedagogical ones, such as pressures from peers or parents; the situation is a complex one.

This correlates with findings from studies by Ferreira (2011), Gilakjani and Sabouri (2017) and Msimanga and Lelliot (2014) that teachers' beliefs and experiences in language are embedded in the larger sociocultural environments. Moreover, the participants did not make the same teaching decisions, even though they were in similar contexts. For instance, there was a difference in the way that Mulalo and Koali conducted their life sciences lessons. Koali conducted an effective lesson. However, in Mulalo's lesson, it was notable that the learners were disoriented and lacked discipline and knowledge. As the lesson unfolded, Mulalo struggled with the pronunciation of scientific terms. This directly contrasted with his beliefs, because he mentioned in the interviews that he was proficient in English. Furthermore, the context of the class could have also impacted on the lesson. Mulalo's class was full to capacity and there was insufficient furniture; learners had to share chairs. In addition, some of the learners kept having conversations among themselves. Mulalo was one of the novice teachers, and his inability to maintain order and discipline contributed to the scores he obtained. Language played a huge role in his class, where it could clearly be seen that there was a barrier in communication for issues quite apart from the science of the topic.

This finding that there is a difference between teachers' stated beliefs and their practices is of interest to all teacher educators and educational researchers. As stated earlier, much educational research, conducted using questionnaires and interviews without observations, assumed that teachers' stated beliefs matched the reality of how

they taught in their classrooms. With this study we clearly illustrate that this assumption must be carefully checked in all contexts. The rhetoric-reality gap shown in this study is exacerbated by the daunting challenges of teaching in multilingual classrooms, often in a second, or even third, language. These challenges exist in most nations.

This was a small-scale study. However, even with only six teachers in the sample, such a marked difference between what teachers say and what they do in practice has substantial implications for research methodology, especially data collection involving interviews and/or questionnaires. In addition, the complexity of factors in the context of township schools that impinge on teachers' pedagogical decisions is highlighted. The complexity of the relationship between science teachers' beliefs and their practices is dependent on context (Mansour, 2009) and cannot be investigated outside knowledge of classroom circumstances. When it comes to issues of language challenges, the relationship between teachers' beliefs and their classroom practices has been mainly researched with regard to language teaching (e.g. Gilakjani & Sabouri, 2017) and in teachers' professional development (e.g. Dos Santos, 2019) but not in science teaching. The findings, therefore, form the basis of future studies on identifying the relationship between teachers' beliefs about language and their classroom practices in other science subjects. The findings that beliefs and teacher practices may not always be congruent, which was found in this and other studies, need to be explored further to determine the different contexts in which they are congruent and also when there is a mismatch. The findings of our study may contribute and enrich the debate on whether teachers' beliefs influence teachers' practices or vice versa – particularly with the rich focus on the language of teaching and learning.

Interpretation of Findings

Findings from both interviews with teachers and lesson observations revealed how the use of language that was unfamiliar to the learners impacted on interactions and communication in the life sciences classrooms. This shows the role of language in teaching and learning as social constructivists present language as a social phenomenon. An important aspect is that because teachers were teaching in a language in which they were not proficient, their role as the more knowledgeable other who should scaffold concepts to learners was limited. In these classrooms the teachers could not engage with learners in meaningful challenging activities because of poor English language proficiency; this is explained by Vygotsky's (1978) claim that language is a

powerful tool that one can use to acquire both higher cognitive skills and social belonging.

Conclusion

Language provides individuals with a sense of belonging, social cohesion and cognitive development. The notion of language in science classes continues to be problematic and this impacts negatively on teachers, especially in science classes. In addition, township schools are associated with teachers who are ESL speakers; thus, language difficulties in these schools are prominent. Our study was based on the teachers' beliefs and practices in teaching life sciences using their second language. The findings from the study indicate that the manner in which the South African language policy is implemented in township schools, lacks inclusivity because a small portion of the South African population is clearly advantaged by this policy. Furthermore, the participants highlighted the need for the revision of the language policy but alluded to the fact that such revisions may come with complications. For example, the majority of the subject matter from as early as Grade 4 has been taught and written in English, and it would be difficult to transcribe everything from English to the native languages. The vexed question of how to make education in South Africa more inclusive through more formal use of African languages is explored in detail in Mdzanga and Moeng (2021). The teachers had various beliefs about the South African language policy. For instance, the findings reveal that Phale, Shilubane and Mulalo had very strong views about the revision in the implementation of the South African language policy. Their responses alluded to the fact that teachers and learners from affluent schools were advantaged by this policy since they were mostly first-language speakers of English, thus perpetuating historically entrenched divisions in society (Bourdieu, 1991). However, some of the responses from other participants, especially Koali and Zanele, highlighted the importance of English as the medium of instruction. They emphasised that the use of English in science classes equipped both teachers and learners with skills that allowed them to become active members of the scientific community.

Furthermore, this study explored various strategies that the six teachers perceived as being viable in the teaching of life sciences. Although many strategies were mentioned, the one strategy that was deemed to be effective was code-switching. Previous studies have also advocated for the use of a language that is familiar to both teachers and learners to combat the constraints that are often caused by the use of the second language in science classes. The emphasis in this case was that the teachers' use of language

in science classes influences their teaching, and this could affect changes in their beliefs. For instance, the RTOP scores obtained from teachers, especially with regard to teacher-learner interactions and communicative practices, showed that the teachers who scored the highest often practised code-switching. In interpreting why such findings were obtained, factors such as proficiency in both the home language and English were raised, as some teachers, especially those that were not proficient in the learners' home languages, struggled to convey some of the vital concepts to the learners. We believe that life sciences is strongly affected by the language that a school adopts in response to the language-in-education policy and, therefore, life sciences teachers in township schools should be aware of the difficulties and challenges that are faced by both teachers and learners.

Authors' Contributions

ANM and LM designed the study. ANM conducted all the data collection. ANM, LM and CMcN all contributed to the data analysis. ANM and LM prepared the drafts of the article with CMcN acting as advisor on each draft.

Notes

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