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Exploring the Use of Tshivenda Scientific Register in Physical Science Teacher's Classroom Practices

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Abstract

This paper explored the use of Tshivenda scientific register in the teaching and learning of Grade 10 physical science in the Vhembe district, Limpopo Province of South Africa. It was an interpretative qualitative study wherein three physical science teachers and physical science learners from three selected schools participated in the study. The data of the study was obtained from three physical sciences teachers and thirty-two learners through face-to-face semi-structured interviews and classroom observations. The results of the study revealed that using the Tshivenda scientific register in the classroom improves learners' participation and interaction. Since instruction was given in Tshivenda, an indigenous African language, there was interaction between teachers and learners as well as amongst learners themselves. Additionally, the findings demonstrate that teachers as well as learners in the physical sciences who took part in the study interact through explanation, demonstrations, questioning and feedback. Therefore, it is suggested that learners should be given chance to receive their school education in a language they are familiar with. Additionally, it is suggested that physical science teachers should be developed, trained and equipped with necessary language skills for them to develop Tshivenda scientific registers on other sciences topics.

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INTRODUCTION

South Africa is a multilingual country which comprised of 12 official languages (i.e., Tshivenda, Sesotho, isiXhosa, isiZulu, siSwati, Setswana, Sepedi, English, Afrikaans, sign language, isiNdebele, and Xitsonga). The Republic of South Africa's 1996 Constitution states that these official languages ought to have the same rights as Afrikaans and English. Children in the foundation phase of education in South African public schools are taught in their mother tongue. However, learners are instructed in either Afrikaans or English starting in grade 4. According to a study by Madavha (2024), despite the fact that the South African constitution recognizes 12 official languages, only Afrikaans and English are currently used as teaching languages in subjects like the physical sciences. This has led to concerns regarding accessibility and inclusivity, especially for speakers of indigenous languages.

Andrews et al. (2023) indicates that the use of mother tonguein teaching and learning allows learners to integrate new information with prior knowledge, resulting in increased engagement and enhanced knowledge retention and application.. Mother tongue instruction is the cornerstone of the fundamental reforms in basic education, according to President Cyril Ramaphosa, who made this statement in his virtual keynote address during the 2024 Basic Education Sector Lekgotla at the Birchwood Hotel and OR Tambo Conference in Boksburg on March 14, 2024. This spoke to the larger imperative of decolonizing and transforming education. He added that rather than being a barrier, language serves as a bridge to empowerment and knowledge. According to Karasenga and Nzanana (2022), from kindergarten to grade 3 learners in Rwanda receive teaching in Kinyarwanda, whereas learners in grade 4 through university receive instruction in English. Diko (2023) reported that English continues to dominate as the primary language of teaching and learning across most primary, secondary, and tertiary institutions. According to Muhayimana et al. (2022), policymakers therefore saw this change as a pragmatic step in preparing Rwandan learners for innovation and entrepreneurship on a local and international level.

According to Sheikh et al. (2023), Kenya's language in education policy stipulates that, while indigenous languages continue to be taught in schools, Kiswahili or indigenous languages should be the primary language of instruction from grades 1 through 3, with English taking over from grade 4. Therefore, only at the foundation phase is the use of indigenous languages as a teaching and learning language in schools taken into consideration. According to Sibomana (2020), both teachers and learners faced difficulties while switching from their mother tongue to English as the medium of teaching. Leonet et al. (2020) stated that because English is not the first language of the learners and they struggle to participate in the lesson, the adoption of English as the language of instruction in African schools resulted in few to no interactions. It is a fact that some learners find it difficult to participate fully in class since the language being used is different from what they speak at home. Learners may become anxious about the material and feel inadequate as a result of this lack of engagement throughout the class.

Parveen et al. (2022) indicated that learners who are not native English speakers may be more inactive during class discussions. According to Mogashoa (2017) inlearners who are not native English speakers experience difficulties in understanding and conceptualising physical sciences content when taught in English. Additionally, Ngema (2016) observed that the problem is worsened if the science teachers are not proficient in English. Therefore, to improve learning outcomes and raise learner performance, it is essential that curriculum disciplines like physical science be taught and learned in the mother tongue. Additionally, a child's participation and integration into their community can be promoted through the usage of their mother language in the classroom. According to section 29 of the constitution, everyone has the right, where it is reasonably possible, to receive an education in the official language or languages of their choice at public educational institutions. Since both teachers and

learners use language as a communication tool in the classroom, Netshivhumbe's (2022) study concluded that language has a substantial impact on the educational system.

According to Msila (2021), a language is a necessary instrument in the classroom, and teachers should employ their native tongue with the same seriousness as they do while speaking their own. The study was carried out at schools located in the rural Vhembe district of the South African province of Limpopo. The majority of the population in the multilingual Vhembe district speaks Tshivenda and Xitsonga as their native tongues. However, because many people in the rural area where the study was conducted speak Tshivenda, an African indigenous language, the study concentrated on this language. With the exception of their native tongue, learners in the rural area where the study was carried out are currently receiving their curriculum-based education in English.

According to a study by researchers Makgato & Mji (2006), more experts have asserted that the use of English as a medium of instruction worsens grade 12 results because second or third language learners must struggle to understand the English language before they can understand the subject matter. After years of teaching in rural areas, the researcher found that learners learning physical sciences in a language other than their native tongue face two difficulties: learning English as the medium of instruction and learning physical science material in English classes.

Numerous investigations in scientific language registers of indigenous African languages have been carried out. Madavha (2024); Netshivhumbe (2022); Netshivhumbe and Mudau (2023); Ntuli (2022); Ntuli (2023) and Phalandwa (2024). According to a study by Phalandwa (2024), which concentrated on creating a Tshivenda scientific language register for teaching agricultural sciences, classroom interactions and meaningful learning experiences were influenced by this register, which ultimately resulted in better performance in agricultural sciences. The usage of the Tshivenda scientific register in classrooms promotes engaging and meaningful learning experiences, according to Madavha's (2024) research on creating a scientific language register for teaching electricity to grade 10 physical science learners. In their study of the difficulties in using the Tshivenda scientific register to teach and learn state of matter and kinetic molecular theory in grade 10 physical science classrooms, Netshivhumbe and Mudau (2023) discovered that both teachers and learners were unfamiliar with some of the scientific terms used in the Tshivenda scientific register and were not accustomed to physical science being taught and learned through this method.

Ntuli (2023) examined how classroom practices were affected by the scientific register of natural sciences in isiNdebele and found that when learners were taught natural sciences in isiNdebele, there was the highest level of engagement in the classroom. According to a study by Netshivhumbe (2022) on the creation and application of the Tshivenda scientific register for physical science, the use of the Tshivenda physical science scientific register (TPSSR) has been demonstrated to influence classroom interactions and discourses, which is important for meaningful learning and improves academic performance. The development of the scientific language register for natural sciences in IsiNdebele and its implementation in certain Siyabuswa 2 circuit classes were the main topics of Ntuli's (2022) study. It was discovered that the scientific language register for natural sciences in IsiNdebele influenced classroom discourses and interactions.

This study investigated how physical science teachers use the Tshivenda scientific register in their lessons. The Tshivenda scientific register focused on content of state of matter and the kinetic molecular theory in grade 10 physical science. The author finds this topic interesting and wishes to explore on it. This is one of the topics that learners find it difficult to comprehend due to language barrier. The researcher noted that these topics comprised terminology/ concepts which are difficult to comprehend in English such as diffusion, Brownian motion, kinetic energy, properties of phases of matter, physical condition of a substance and phase changes. However, these concepts can be easily grasped and better understood when explained in

a familiar language which is learners' native language, i.e., Tshivenda which is the language used in the register. The study demonstrated the effects of using the Tshivenda scientific register in physical science instruction. Examining how teachers and learners participate in the teaching and learning of physical science lessons was the primary objective. Furthermore, it was thought to be crucial to comprehend how teachers and learners felt about using the Tshivenda scientific register in the teaching and learning of physical sciences. The following research issues were addressed by the researcher using a qualitative approach:

- What are the difficulties and opportunities in the use of Tshivenda scientific register in the teaching and learning of physical science?
- What are the perceptions of teachers and learners in the use of Tshivenda scientific register for physical science?
- How the use of Tshivenda scientific register influences interaction and discourse in physical sciences classroom?

Literature Review

Black people who speak African indigenous languages like Tshivenda and Xitsonga make up the majority of the population in the rural areas that have taken over Vhembe district. South African schools were not allowed to choose the language of instruction and learning (LoTL) during the apartheid era. Furthermore, schools experienced a new era where they were free to select any language or languages to teach and learn in the classroom following the uprisings of June 16, 1976, and the country's independence in 1994 (Madima & Makananise, 2020). Black children were permitted to use their mother tongue in primary school under the Bantu Education Act of 1953. From the age of 11 to 14, however, Afrikaans and English were the official languages. After being utilized in secondary school, the indigenous languages of Africa were eventually taught as subjects in schools.

According to Chikiwa & Schafer (2019), realizing the goal of enabling every kid to learn science in their teaching language requires the creation of scientific language registers for the physical sciences in indigenous languages. Because Tshivenda is their native tongue, some learners feel that studying physical sciences in Tshivenda will improve their academic performance, according to a study done by academics (Madavha et al., 2024). According to Madima and Makananise (2020), the usage of mother tongue in South African schools is still a concerning topic. According to a South African education expert, Mary Metcalfe (2017), the fact that children are not taught in their home tongue is one of the main problems facing South African education. Furthermore, because their subjects are taught in English at that level, Metcalfe contends that learners from South African provinces with sizable rural communities performed worse in grades three and four (Time Media, 2017).

According to a study by Moletsane & Salie (2021), non-mother tongue English speakers face a number of learning obstacles, including cultural diversity, psychological and social barriers, and teachers' insufficient familiarity with the learning language. According to a study by Meyiwa et al. (2013), incorporating indigenous knowledge into the curriculum would enable parents to be more involved in their children's education, thereby fostering a close relationship between the school and the community. Because there won't be any code-switching for teachers to help learners understand the material, mother language instruction will facilitate learning and help learners perform better in their curriculum topics. Studies conducted by Ntuli (2025) and Ntuli & Mudau (2023) indicates that using native languages for instruction and learning improves classroom discourse and interaction, which results in meaning learning and improved performance. Because they will comprehend what they are being taught, learners will be able to actively participate in their education when the mother tongue is used in the classroom.

Particularly at schools located in rural areas, the quality of education suffers. According to the researchers (Makgato & Mji, 2006; Prew, 2013; Van der Berg et al., 2011), there has been a lot of worry about how Black African learners in particular are struggling in the fields of technology, mathematics, and the natural sciences in South African schools. Several critics

have discovered that language is one of the barriers preventing learners from making progress in these subjects. In rural schools, the majority of learners struggle to learn through the medium of teaching, which has led to poor student performance (Makgato and Mji, 2006; Prew, 2013; Van der Berg et al., 2011).

Language has become a human right imperative, according to Msila (2006), because education would continue to perpetuate social injustice and inequality for mother tongue speakers as long as learners are unable to use their native African languages in the classroom. According to Katonga (2017), the dearth of resources for studying and teaching indigenous languages affects both the content and the method of instruction. Teachers support the use of African indigenous languages in teaching and learning across all curricular disciplines (Msila, 2021).

Effective teaching and learning can occur in a school setting if there are sufficient resources and trained teachers on hand, claim Netshivhumbe and Mudau (2021). Thus, one of the most important factors that might improve efficient teaching and learning in schools is the availability of teaching aids like textbooks to assist instructors and learners during their education. When compared to English textbooks, Murwamphida (2008) discovered that there are remarkably few textbooks in African indigenous languages, such as Tshivenda. As a result, the only curriculum topic published in an African indigenous language is the home language course, which disadvantages learners whose mother tongue is not the language utilized in the textbooks.

Physical science textbooks and other teaching resources are currently written in either Afrikaans or English, which hinders instruction and learning. Because the language utilized is different from their own, some learners who are solely exposed to English education in the classroom are struggling to comprehend some of the most important physical scientific principles. Tshivenda has few scientific terminologies, which has led to its underutilization as a teaching and learning language in schools (Madiba, 2001). According to a study by Netshivhumbe (2018), some teachers in the rural Vhembe district schools used code-switching to help their learners comprehend the material.

Theoretical Framework

The Classroom Language Investigative Framework by Netshivhumbe (2022) was used as the theoretical framework for this study. The main component of this framework is classroom setting (Figure 1) which is where the target individuals of the study was found. This is where the researcher was able to examine what is truly happening in the physical science classroom setting. The language used in schools and its influence on teacher classroom activities were the primary focus of the Classroom Language Investigative Framework. In order to comprehend the influence of language in the teaching and learning environment (i.e., classroom), the researcher used the Classroom Practice Investigative Framework (Figure 1)

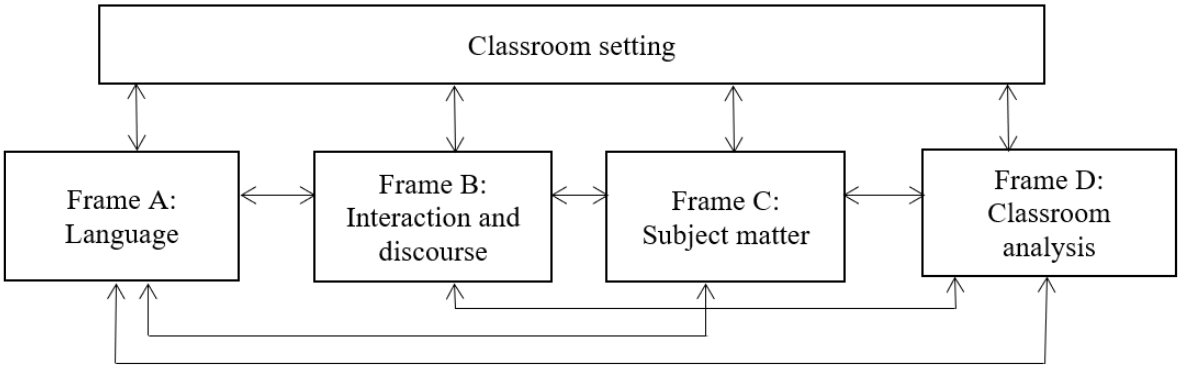

Figure 1. Classroom Language Investigative Framework (CLIF) (Netshivhumbe, 2022)

The classroom setting is crucial for diagnosing the language used in the teaching and learning by both teachers and learners. CLIF comprised of four frames as indicated in Figure 1 above. In the frame A the researcher examined how language influenced teaching and learning of physical sciences when Tshivenda scientific register was employed. Frame B is affected by the language used in the classroom. Frame B helped the researcher identify the interactions and discourses between teachers and learners in the classroom. The researchers learned how teachers and learners handle subject matter in frame C, which is influenced by frames A and B. In frame C, teachers' expertise, and experience as well as learners' prior knowledge of the physical sciences concepts were also noted. As a result, it is crucial that teachers reconsider the language they use with their learners in the classroom. Thus, frame C can be shaped if frames A and B are completed correctly. The events in frames A, B, and C had an impact on the language analysis conducted in the classroom. Therefore, learners can be optimistic about acquiring the concept of science and actively participate in their education if these three frames are executed appropriately.

METHODS

Research Design

The paper's primary goal was to investigate the implementation of Tshivenda scientific register in the teaching and learning of physical science at schools. The researcher used a qualitative research design for this investigation. Researcher can concentrate on actions taken, such as reading and listening to words in all of their complexity as they occur in a real-world context or in a natural setting, by using a qualitative method (Nieuwenhuis, 2016). Qualitative approach was employed to provide rich descriptions on the influence of Tshivenda scientific register in physical science lessons for grade 10 learners. For this study, a qualitative approach was essential since it enabled the researcher to look at classroom interactions and discourse between teachers and learners as well as understanding their perceptions on the use of Tshivenda scientific register.

Sample and participants

Thirty-five people participated in the study overall, which included three physical science teachers and thirty-two learners from three chosen schools in the Vhembe district of the province of Limpopo. Purposeful sampling was employed in this study because it allowed the researcher to save time when gathering participant data. In other words, time was preferred for the researcher. In qualitative research, purposeful sampling involves finding and choosing participants who are knowledgeable about and have first-hand experience with relevant phenomena (Annan et al., 2019).

Through the use of deliberate sampling, the researcher was able to include thirty-five participants who were chosen based on the following pertinent criteria: teachers and learners are from three chosen schools in the Vhuronga 2 circuit in the Vhembe district, Limpopo province; teachers and learners used Tshivenda as their mother tongue; and grade 10 physical sciences teachers and learners.

Table 1 below displays the demographic information for the three physical science teachers: Physical science teacher one/school one (PST1/S1), physical science teacher two/school two (PST2/S2), and physical science teacher three/school three (PST3/S3).

The data presented in Table 1 below obtained from physical science teachers during interviews. Table 1 show that the participants hold teaching qualifications specialising in the same subjects.

Table 1. Demographic details of physical science teachers

Teachers and school code	Gender	Qualification/s	Teaching experience in years
PST1/S1	Male	Higher Education diploma (mathematics and physical science)	27
PST2/S2	Male	Higher Education diploma (mathematics and physical science)	21
PST3/S3	Male	Bachelor of Education (Mathematics and physical science)	3

Written consent was acquired from University of South Africa (UNISA) college of Education, the Limpopo Department of Education, and the circuit manager of the Vhuronga 2 circuit in order to conduct research in schools. After that, the researcher went to three selected schools and asked the principals for permission to carry out the study in their schools. Physical sciences teachers and learners were also asked to take part in the study by the researcher. The researcher asked for permission in writing, explaining the study's goal both orally and in the letters. To preserve their genuine identities, study participants' names are not disclosed. As a result, the chosen participants helped the researcher answer research questions and accomplish the study's goal.

Data collection tools

The developed Tshivenda scientific register was done in consultation of different grade 10 physical sciences textbooks such as study and master physical science, successful physical science, mind action series physical science, siyavula, platinum and theory and workbook. However, during the process of Tshivenda scientific register the researcher experienced some challenges in obtaining scientific words. The researcher was assisted by various people for the register to be successful, e.g., family, friends, Tshivenda teachers, colleagues, senior citizens, physical sciences teachers, and supervisor. Example of words the researcher with include, Acid (dungi), Latent (dzumbama), Hypothesis (khumbulelo), Crystal (Magwada a muxwatu), Curve (mukombamo) and Transition (Tshanduko). The study employed semi-structured interviews and classroom observations as data gathering methods. The three aspects observed during teacher classroom practices when Tshivenda Scientific register was employed indicated in

Figure **2**. The three aspects that the semi-structured interviews of teachers and learners focus on are shown in

Figure **2**.

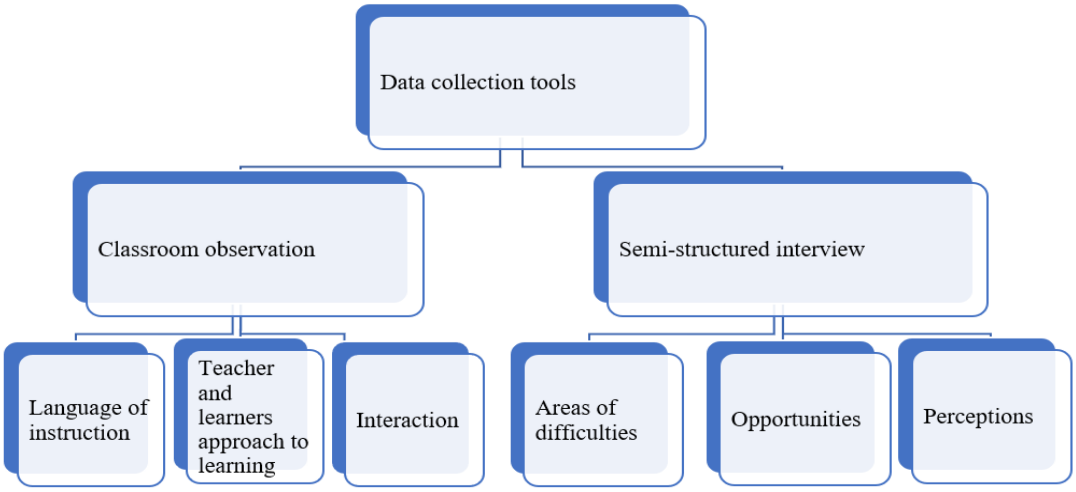

Figure 2. Data collection tools

The data collection tools (i.e., observation and semi-structured interviews) were formulated based on the study research questions so that the aim of the study could be achieved. To ensure credibility in this qualitative research, some of the physical sciences teachers who were not the participants of this study has assessed interview and observational tools to ensure that they serve the purpose they were designed for. Additionally, these teachers were requested to make comments and additional information where applicable. from the teachers. Therefore, one of the teachers was used in a pilot study where all instruments proposed for data collection were tested before conducting data with the proposed instruments from the participants of this study.

The researcher used semi-structured interviews to evaluate whether teaching and learning using Tshivenda scientific register is effective or not based on teachers and learners' perspectives. The observation was used by the researcher to examine teacher and learners' interaction and discourse in physical science classroom when Tshivenda scientific register is implemented. Data was gathered during teacher classroom practices utilizing the Tshivenda scientific register and the researcher used observational tool to record the data during the entire lessons. Data on the participants' perceptions about the usage of the Tshivenda scientific register in physical science teaching and learning was gathered using an interview method. A semi-structured interview is a qualitative research technique in which the researcher might prepare interview questions in advance of the interview yet ask open-ended questions to facilitate conversation with the interviewee (Doyle, 2019).

Teachers and learners were questioned at their own schools and learners were interviewed in groups. Examples of questions that physical science teachers and learners were asked are indicated below:

Examples of teachers' questions:

- kuvhonele kana muhumbulo wavho kha u funza nga luambo lwa damuni ndi kufhio? (What is your perception or view towards teaching through mother tongue instruction?)
- Kuvhonele kwavho kha u shumisa Tshivenda scientific register (TSR) kha u funza physical science kufhio? (What is your perception towards the used of Tshivenda scientific register (TSR) in the teaching of physical sciences?)
- Vha vhona unga u shumisa Tshivenda scientific register (TSR) register khau funza physical science zwo thusa vhagudiswa u pfesesa maipfi kana luambo lwa physical science? (Do you think the use of Tshivenda scientific register (TSR) in the teaching of physical science helps your learners to understand words or language of physical sciences?)
- Ndi vhukondi kana khaedu dzifhio dze vha vhagudiswa vha khou tangana nadzo musi vha khou funziwa nga Tshivenda scientific register (TSR) nahone vha vhona unga tshivhangi tsha khaedu hu nga vha hu mini? What difficulties or challenges did your learners experienced during the physical sciences lessons taught using Tshivenda scientific register (TSR) and what do you think could be the possible cause of such challenge?
- vhangari mini nga phimo ya vhagudiswa kha physical science musi vha khou vha funza nga Tshivenda scientific register (TSR)? How do you rate your learners' participation in the learning of physical sciences using Tshivenda scientific register (TSR)?)

Examples of learners' interview questions:

- Ndi khaedu kana ndi vhukondi vhufhio hune na tangana naho musi ni khou funziwa nga luambo lune a si lwa hayani? (Which challenges or difficulties do you experience when you are being taught through language which is not your home language?)
- No dipfa kana no farea hani ni khou funziwa physical science nga Tshivenda scientific register (TSR? (How did you feel about learning physical sciences through TSR?)
- Ndi dzifhio thaidzo kana khaedu dze vha tangana nadzo musi vha khou dilugisela ngudo kana pfunzo ya physical science vha tshi khou shumisa TSR? (What problems or challenges did you encounter when preparing for physical sciences lessons using TSR?)

To guarantee the accuracy of the data gathered, the entire lessons were videotaped, and the interviews were audiotaped. To ensure reliability and prevent errors in the data acquired during the data analysis, the researcher obtained participants' agreement before recording voice interviews and video lessons. The researcher transcribed the information recorded by the recording devices into a word document.

Data Analysis

Each participant's data was analyzed and interpreted independently for this study. CLIF served as the theoretical framework for the study, which examined the impact of language in the classroom. Since the study's main goal was to investigate how the Tshivenda scientific register is used and how it affects physical science instruction, this framework was essential. During the analysis, theme identified was application of Tshivenda scientific register and the data collected analysed using this theme. The theme was divided into two categories i.e., interaction and discourse, and perceptions of participants (Figure 3).

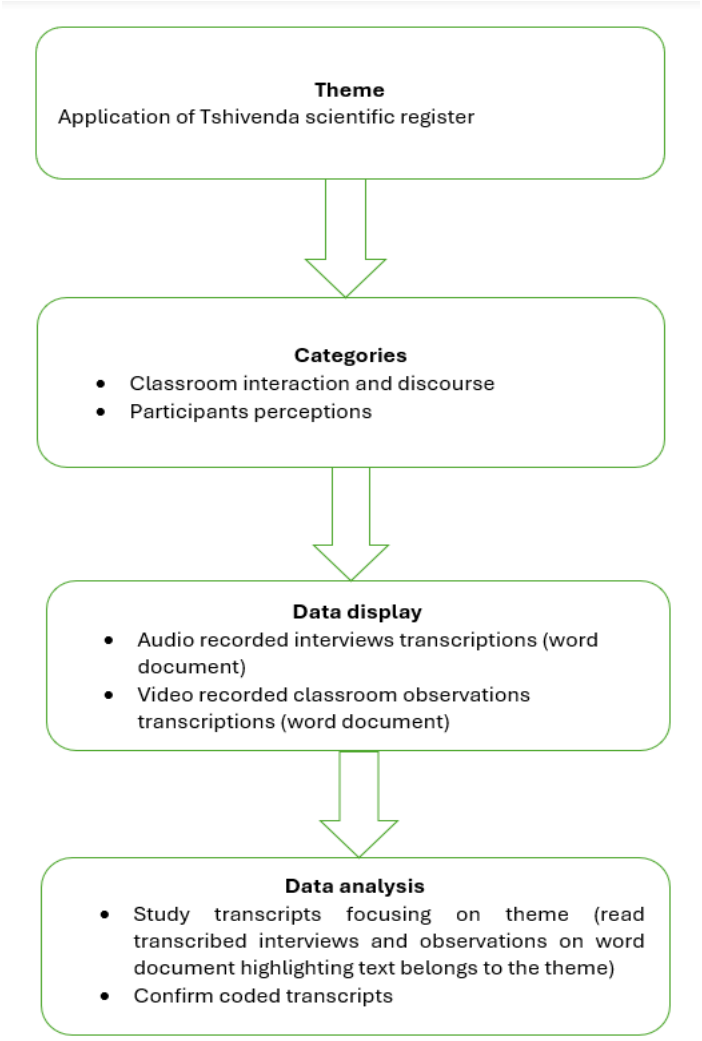

Figure 3. Data analysis

Using recording devices, such as audio-taped semi-structured interviews and video-recorded lessons, the researcher transcribed the data into a word document. To make sure that the information transferred to the documents matched what was on the recording devices, the audios and videos were played again once all the transcriptions were completed. The transcribed

data was then shown to pertinent participants by the researcher before being regarded as the final product. The researcher read each participant transcribed interview data with the theme in mind while coding until they are all finished. The same procedure was applied to the data of each participant captured during classroom observations by means of video-recorder. Thereafter, the researcher went through the coded data to confirm the transcripts. Moreover, the researcher did not correct any grammatical errors that were presented by each participant.

RESULTS AND DISCUSSION

Results

The study's findings were derived from interviews and observations made in the classroom. The information in this section focused on the Tshivenda scientific register's application theme's categories and characteristics. Gaining understanding and clarity regarding the impact of Tshivenda scientific register on teacher-learners interaction and discourse in physical science classrooms was the researcher's main goal in the suggested theme. To introduce study participants, the researchers utilized codes (Table 2 and Table 3). For instance: PST1/S1; PST2/S2; PST3/S3; School1/Group1 Learners (S1/G1L); School1/Group2 Learners (S1/G2L); School1/Group3 Learners (S1/G3L); School2/Group1 Learners (S2/G1L); School2/Group2 Learners (S2/G2L); School3/Group1 Learners (S3/G1L); School3/Group2 Learners (S3/G1L); School3/Group2 Learners (S3/G2L); School3/Group2 Learners (S3/G2L); School3/Group3 Learners (S3/G3L).

Table 2 below presented teachers views on the use of Tshivenda scientific register for teaching and learning state of matter and the kinetic molecular theory topic in grade 10 physical science. The teachers' perceptions on Tshivenda scientific register focused on the opportunities and areas of difficulties as indicated in Table 2 below.

Table 2. Grade 10 Physical Science teachers' perceptions

Teachers Codes	Mother tongue language	Medium of instruction	Opportunities	Areas of difficulties
PST1/S1	Tshivenda	English	Parental involvement Improve learners' participations Learners understood science concepts	Limitation of scientific terms in Tshivenda Absence of physical science teaching aid in Tshivenda
PST2/S2	Tshivenda	English	Learners' participation increased Simplify teaching and eradicate code switching Learners understood physical science content better compared to English instruction	Some scientific terms in English have different meaning in Tshivenda Some scientific terms do not exist in Tshivenda
PST3/S3	Tshivenda	English	Understanding of science concepts better Parental involvement will increase Learners grasp the science concepts easier through their mother tongue	No physical science materials written in Tshivenda Lack of Tshivenda scientific terms

Table 3 below presented learners views on the use of Tshivenda scientific register for teaching and learning state of matter and the kinetic molecular theory topic in grade 10 physical science. The learners' perceptions on Tshivenda scientific register focused on the opportunities and areas of difficulties as indicated by Table 3 below.

Table 3. Grade 10 Physical Science Learners' perceptions

Learners Codes	Mother tongue language	Medium of instruction	Opportunities	Areas of difficulties
S1/G1L	Tshivenda	English	We felt good learning physical science with Tshivenda scientific register because we understood what the teacher taught us	Some of us were not aware of other science terms in Tshivenda
S1/G2L	Tshivenda	English	We felt good because we were educated in Tshivenda language, and we have learnt a lot	We did not understand other words
S1/G3L	Tshivenda	English	We understand physical science concepts better when taught in Tshivenda compared to English	We are not used to being taught physical sciences in our home language
S2/G1L	Tshivenda	English	We understood almost everything our teacher taught us with Tshivenda scientific register	Some of us did not know the meaning of some of Tshivenda scientific terms
S2/G2L	Tshivenda	English	We perform better in our classwork compared to the English classwork	Some terms were new to us
S2/G3L	Tshivenda	English	It was easy for us to understand physical science content when taught with Tshivenda scientific register	None
S3/G1L	Tshivenda	English	We were able to understand science words better	Other scientific terms in the register were difficult for us to understand
S3/G2L	Tshivenda	English	We understand physical science content without difficulties	None
S3/G3L	Tshivenda	English	We were able to participate more in the lessons Our parent can support us with our classwork or projects	We fail to explain few words used in the Tshivenda scientific register

According to Table 2 and Table 3 above, the study's participants were both teachers and learners, and Tshivenda was their native tongue. According to the information displayed in Table 2 and Table 3 , the language currently employed as a teaching medium in schools is English. To find out how the participants felt about the usage of Tshivenda scientific register in grade 10 physical sciences, the researcher met with them. The researcher met with the teachers and learners at their individual schools. The comments from the teachers and learners in Table 2 and Table 3

above make this clear. Most participants favoured the adoption of the Tshivenda scientific register, according to the results shown in tables 2 and 3. Their opinions were mostly founded on the idea that using the indigenous African language (Tshivenda) would help learners better understand scientific concepts. Their opinions also revealed that the Tshivenda scientific register will provide learners with the chance to learn as much as they can and improve their performance in physical science. Additionally, code switching will no longer be used by the Tshivenda Scientific Register.

Classroom interaction and discourse is crucial to enhance learners' performance. Figure 4 below illustrates how the Tshivenda scientific register was used to diagnose classroom interactions and discourse in the teaching and learning of physical science. According to Green and Rex (2018), classroom discourses reveal how the language used on a daily basis influences practices, advancements, and syllabus content requirements. Additionally, Green and Rex (2018) reported that academics used classroom interactions to investigate learning and teaching strategies and activities related to the learner learning indices. When adopting Tshivenda scientific register, Figure 4 showed the types of discourse, patterns of discourse, teacher questioning, and communication approach used by teachers in their physical science classrooms. Teachers engaged with learners, and learners had the chance to engage with one another.

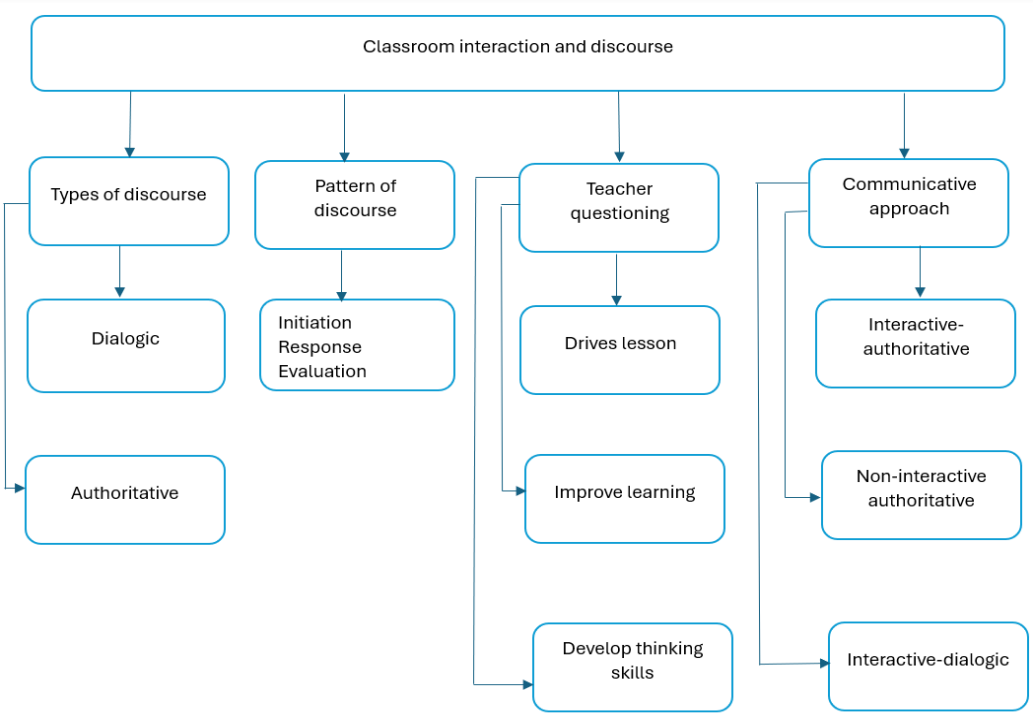

Figure 4. Classroom interaction and discourse

Discussion

Teaching and learning in the public schools of South Africa is presently done through English medium of instruction except for foundation phase because in the foundation phase the language of teaching and learning is mother tongue. Home languages are still taught in schools, nevertheless, as they are one of the disciplines that learner's study there. The majority of people in the Vhuronga 2 circuit of the Vhembe district, where this study was carried out, speak Tshivenda, which is also the language currently used as medium of instruction in some rural schools' foundation phase. Some learners' performance has decreased with the transition from Tshivenda to English as the medium of

teaching starting in grade 4. Some of the learners speak their native tongue with their family and these learners are only exposed to the English language at school.

The usage of Tshivenda scientific register for grade 10 physical science classes in Vhuronga 2 circuit of Vhembe district was investigated in this study, as discussed below. According to the investigation, both teachers and learners expressed optimism about the Tshivenda scientific register's ability to teach physical sciences. According to the participants, learners will benefit from the adoption of the Tshivenda scientific register in physical science instruction. The teachers endorsed the use of Tshivenda scientific register because their learners are good in Tshivenda, and it is the language they mostly use with their family. For instance, teachers' answers regarding the use of Tshivenda scientific register were nearly identical because they believe it will make teaching easier because they won't have to switch between languages (code-switching), help their learners understand science more effectively than they would if they were taught in English, and improve their performance or grades.

The study also found that learners do want to be taught in their own tongue, which they can understand easily. The study's participants view this as a chance to comprehend scientific ideas that they were unable to grasp when taught by their teacher in English. Learners even mentioned that they were able to ask questions and answer their teachers' questions, and that learning in the Tshivenda scientific register boosted their engagement. The learners stated that their parents are not helping them since they do not speak English, but the Tshivenda Scientific Register will allow their parents to participate in their education. Netshivhumbe (2022) asserts that using indigenous language as a teaching medium can improve learners' overall developmental outcomes by fostering parental involvement in their children's education and creating a positive relationship between the home and the community.

Ezeokoli and Ugwu (2019) assert that the creation of scientific language registers in native tongues can improve learning outcomes, foster critical thinking, and improve cognitive development while also reducing low academic performance. All physical science instructors were monitored in this study while they used the Tshivenda scientific register in their physical science classes. In terms of teaching and learning, the researcher found that the application of Tshivenda scientific register was revolutionary. The learners' performance and level of engagement were outstanding. The interactions in the classroom (i.e., interaction between teacher and learners, interaction of learners and physical science content and interaction between learners) exceeded the researcher's expectations.

The researcher observed that in addition to using the Tshivenda scientific register in their lessons, the teachers also brought resources (such as water, jugs, beakers, stones, and containers of various shapes) for demonstrations and used materials available in the classroom (such as chairs, tables, books, pens, rulers, chalks, and dusters). This enhanced communication between learners and the teacher, as well as between learners and the content being taught. The learners participated fully in the lessons. A few difficulties the learners encountered, though, including their unfamiliarity with Tshivenda scientific lexis, such as muxwatu (ice), tshiomate (solid), tshixwatidzi (fridge), mutsidi (steam), muyamufhe (oxygen), and zwilavhi (particles). As a result, the teachers were able to help their learners understand unfamiliar words by providing explanations and examples.

Learners were given both individual and group activities by the teachers. The individual activities were marked with learners and learners were told to exchange book and they wrote correction after marking. The activities which learners did as a group, one learner from the group presented their work and thereafter the teacher gave feedback on the activities which they did. The teachers used a variety of instructional strategies, including lectures, examples, demonstrations, and question and answer. The teachers mostly used learner-centered teaching methods in their lessons because learners answer questions, discuss, debate, explain and brainstorm during the lesson. Thus, the study's findings demonstrate that classroom interactions

and discourse positively correlate with the use of Tshivenda scientific register.

CONCLUSION

This study investigated the use of the Tshivenda scientific register in Grade 10 Physical Science classrooms. The findings revealed that the use of Tshivenda in teaching and learning Physical Science led to increase in learner participation, primarily because Tshivenda was the learners' and teachers' native language, making it easier for learners to understand the subject content. Hence, these was supported by teachers' perceptions as they reported that Tshivenda scientific register was useful because it enhances teacher-learners classroom interaction, increased learners' participation, and they did not employ code-switching as language used in the register was the mother tongue of the learners. Whereas the learners indicated that Tshivenda scientific register assisted them to comprehend the content taught easily because the language used in the register was their mother tongue, provide them with a better understanding of science content compared to English instruction, improve their performance, and enable them to fully participate in physical science lessons.

The use of Tshivenda scientific register makes it easier for a teacher to interact with the learners and the learners were able to interact among themselves. The findings from this study revealed that teachers facilitated their lessons by creating an opportunity for their learners to be able to interact with their teacher, among themselves as well as with the subject matter. Additionally, teachers were able to foster learners' critical thinking abilities by assigning group tasks and in all the tasks assigned to the learners, learners were able to apply their reasoning abilities. Teacher instructional strategies include illustrations, examples, and demonstrations to enhance their learners' learning. Thus, through explanation, example, questioning, and feedback, teachers and learners were able to engage through the usage of Tshivenda scientific register. As learners answered questions from the teacher and talked with one another during group activities, learners were able to fully engage in the lessons through the use of Tshivenda scientific register. As a result, teachers use authoritative discourse when introducing the concepts of the lesson, then dialogic discourse when learners have a chance to discuss and report back to the class. Because the language used in Tshivenda scientific register was similar to that of both the teacher and his learners, there was no need for code switching to help learners understand physical science subject. The use of Tshivenda scientific register makes teaching and learning easier.

The application of Tshivenda scientific register was successful. However, there were few Tshivenda scientific terminology in the Tshivenda scientific register that teachers and learners were not familiar with such dungi (acid), fulufulu (energy), mudimuwo (evaporation), tshanduko (transition), tshiomate (solid), and dzumbama (latent). However, these did not stop the engagement in the classroom as the teachers have a list of glossaries of terms in both Tshivenda and English. express their ideas during group activities, which could have provided valuable opportunities for interaction. Both teacher and learners interacted well during the lessons because they understood each other as language used in Tshivenda scientific register was similar to theirs. Both teachers and learners were confident when expressing the ideas of physical science content. Due to their familiarity with the terminology used in the Tshivenda scientific register, learners were able to reflect on the lesson and completely participate in it. The lessons were both teacher-centered and learner-centred, which further increased learners' ability to grasp the content taught through the Tshivenda scientific register. As a result, the use of the Tshivenda scientific register did not limit classroom interaction and discourse but increase learners performance and involvement.

The recommendations are as follows:

- To create enough terminology in African indigenous languages, it is recommended that parents, teachers, learners, curriculum advisers, and the Pan South African Language Board (PanSALB) work together as a team.

- The study also suggests giving priority to the creation of Tshivenda scientific terminology and instructional materials.
- Departmental officials should ensure that seminars are held to equip physical science teachers with the necessary language skills so they can create scientific language registers on science topics in African indigenous languages.
- The study demonstrated that the Tshivenda scientific register for physical science in grade 10 enhance classroom interaction and discourse between teachers and learners. Therefore, it is recommended that comparable research be conducted in all science subjects at various grade levels.

Limitation of the Study

The study focused on three rural schools in the Vhuronga 2 circuit in the Vhembe district, Limpopo Province where majority of learners use Tshivenda as their native language. The study's focus on three physical sciences teachers and thirty-two grade 10 learners from the Vhuronga 2 circuit in the Vhembe district may be viewed as a limitation. However, the rich description provided during data analysis suggests that the findings may be applicable to other districts with similar contexts.

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