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ORGANIC TRANSLANGUAGING IN SCIENCE CLASSROOMS: PERCEPTIONS OF PRE-SERVICE PRIMARY SCHOOL TEACHERS

Erasmos Charamba

ABSTRACT

In spite of today's science classrooms being linguistically diverse, languages are still kept separate during academic instruction with education policymakers and stakeholders emphasising language purism and a strict separation of languages in the classroom. The overarching aim of this article is to investigate science teachers' perceptions regarding linguistic potential and language competence in relation to translanguaging strategies. The data presented consists of interview responses, lesson observations, and questionnaire responses from purposefully sampled 25 pre-service teachers at 6 different primary schools in South Africa. In analysing the data collected from the questionnaires, descriptive statistics were used to calculate the percentages of each Likert-type item in the questionnaire while qualitative data was analysed using structural coding. The present research findings corroborate previous research findings which affirm the pivotal role language plays in the science classroom and suggests teachers do away with 'named languages' through the use of students' linguistic repertoire in the classroom. The study also shows how translanguaging assists science students and teachers in multilingual South African classrooms achieve voice and agency by challenging discourses otherwise framed in monolingual perspectives. Given the academic and social benefits as well as the fluid nature of a translanguaging approach, the study also recommends teachers to implement translanguaging pedagogy in their linguistically diverse multilingual science classes.

Keywords: translanguaging; science education; multilingualism; monolingual bias; multiculturalism; home language

INTRODUCTION

The emergence of a global village leading to increased transborder movements has contributed to a multiplicity of cultures and languages in South African schools. This assemblage of cultures and languages doubtless places significant demands on the country's educational system in general and on science education in particular (Silver& Bokhorst-Heng 2016). This cultural and linguistic fusion can be seen as an important educational asset and resource in the classroom (Karlsson, Larsson & Jakobsson 2018). Regardless of the prevalent linguistic diversity in South African schools, monolingualism has remained the default educational practice in most science classrooms across the country. Although the country has twelve official languages (including the South African Sign Language), all but two South African languages are actively excluded from being used for instructional purposes.

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In classrooms across the country, science is taught through either English or Afrikaans which happen to be the home languages for a combined 19.7% of the country's total population (Statistics SA 2011). With regards to science education, a body of research suggests that one of the major causes of students' academic underachievement in the subject is the use of a language of instruction that is different from the students' home language (Duarte 2019; McKinney & Tyler 2019; Somerville & Faltis 2019; Windschitl, Thompson & Braaten 2018). If students do not have necessary language skills in the language of instruction, they often have problems obtaining access to the science content (Bonomi 2019), which precludes them from demonstrating their actual knowledge (Garza & Arreguín-Anderson 2018).

In most cases, science teachers might end up focusing on the students' reading and writing skills at the expense of scientific knowledge development (Charamba 2019a). Another body of research on language acquisition, suggests that second language learners who are allowed to use their first language as a resource in subject-related learning situations develop conceptual subject knowledge to a greater extent than students who are not offered the same opportunity (Creese & Blackledge 2015; Fogle & King 2017; García, Johnson, & Seltzer 2017;Meyerhöffer &Dreesmann 2019). The present study sought to investigate how pedagogy in which teachers and students use all available linguistic resources in the classroom may benefit science learning. The research question was: How does translanguaging in a science classroom contribute to the meaning-making process of scientific knowledge?

REVIEW OF LITERATURE

Heteroglossic Practices in Multilingual Science Classrooms

In spite of today's classrooms being linguistically diverse, languages are kept separate during academic instruction. Education policymakers and stakeholders emphasise language purism (Kiramba 2016) and a strict separation of languages in the classroom. Such monolingual orientations have become the default mode in educational spaces shaping language policies and practices in schools. This has resulted in the disregard of multilingual realities in classrooms as pedagogic resources for the constructive alignment between students' home languages, the medium of instruction, and content taught.

A growing body of research in the twenty-first century, however, suggests that heteroglossic practices in the classroom can recognise and leverage the meaning-making resources of multilingualism for linguistically diverse students (Charamba 2019b; Bonomi 2019; Garza & Arreguín-Anderson 2018; Garcia & Wei 2014; Somerville & Faltis 2019). A number of studies have postulated the beneficial academic effects of acknowledging and using multiple languages in educational settings by following different approaches (Charamba 2020a; Velasco & García 2014). Focusing on a socio-cultural approach, Duarte (2019) examined how 15-years-old students applied their various linguistic repertoires to maintain tasks in content-matter classrooms. The analysis of speech acts showed that the use of multiple languages, especially the home language, occurred in cognitively challenging task-talk activities (Phajane 2019). In peer action talks, students *translanguaged* to clearly present their ideas and to construct new knowledge (Yuvayapan 2019).

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Research by Banda (2010) proved how students and teachers in multilingual South African classrooms achieved voice and agency by challenging discourses otherwise framed in monolingual perspectives. The participants used English and Afrikaans in flexible ways and drew on both languages as linguistic resources to gain epistemic access in the classroom. In another research, Portoles and Marti (2017) investigated the simultaneous use of more than one language in early language learning and revealed strategical employment of first, second and third languages so as to serve different functions. The researchers concluded that the monolingual approach does not facilitate effective teaching and learning.

In their study, Velasco and Garcia (2014) specifically focused on translanguaging pedagogy in the writing of young bilingual students. They based their analysis on five writing texts of bilingual students and how they used translanguaging in the planning, drafting and production stages of their writings. The researchers found that the strategy worked as a self-regulated mechanism that bilingual students actively employed to scaffold and solve challenges of building their own text in a foreign language or understanding concepts (Yuvayapan 2019). For example, Kiramba (2016) noted increased participation among science students in a multilingual classroom when the teacher used and allowed students to use their home languages; as opposed to silence when only the language of instruction (English) was used.

The studies cited herein indicate that the use of students' home language in teaching and learning provides support while developing their proficiency in the language of instruction. Research, therefore, suggests that heteroglossic practices in the classroom expedite the interplay between students' home languages and literacy practices with school literacy practices in ways that are relevant to their everyday lives (Kiramba 2016). Creese and Blackledge (2015) have also highlighted the academic benefits associated withdrawing from multiple linguistic repertoires, constructing student and teacher linguistic practices alike as identity performances.

Multi-competence Theory: Towards Paradigmatic Change in Multilingual Classrooms

The term multi-competence was originally defined by Cook (1991) as the compound state of a mind with two grammars. The author used the term 'grammar' from Chomsky's perspective of the total knowledge of language in the mind (the I-language) leading some people to infer wrongly that multi-competence was restricted to syntax (Cook 2006).

Linguistic multi-competence involves the holistic view of the mind of the speaker, not simply their first or their second. The theory suggests that a bilingual is different from a monolingual and so needs to be looked at in their own right rather than as a deficient monolingual. According to Cook and Li Wei (2016) the multi-competence concept therefore constitutes a bilingual '*wholistic*' interpretation of bilingualism as opposed to a monolingual 'fractional' interpretation of bilingualism. The Multi-competence theory, therefore, views the different languages a person speaks as one connected system, rather than each language being a separate system (Cook 2010) and this connected system can be used to the benefit of the speaker. In the classroom setting the multi-competence theory does not see any integrity in making the students use only the second language for instructional purposes as this opposes the existence of the first language in their minds. As a result the theory calls for principled use of students' linguistic repertoire when classroom goals can be achieved more effectively by the use of more

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than one language (Cook 2010). It presents a platform where the student's entire linguistic repertoire can be viewed and used unitarily as a beneficial resource in the classroom since it involves the whole mind of the speaker and not segments. The multi-competence perspective has been instrumental in opening avenues for new research dimensions with regards to educating multilingual science students.

A body of research on science education suggests that for there to be meaningful comprehension of scientific concepts and satisfactory academic performance in the learning area, students' languages should be acknowledged and used in the science classroom (see for example Charamba & Zano 2019; Charamba 2020b; Henderson & Ingram 2018; Miller, Manz, Russ, Stroupe& Berland 2018; McKinney & Tyler 2019; Windschitl et.al.2018).The use of multiple languages in the science classroom allows students to engage in a practice of generating and creating scientific explanations in their own voice (Brown, Cooks & Cross 2016 p. 454) and this should be used as a resource in appropriating scientific language (Meyerhöffer &Dreesmann 2019; Miller et.al 2018). Such a practice allows the students to move between different languages in meaning- making process (Fogle & King 2017). García and Wei (2014) use the term translanguaging to describe such a practice. Translanguaging has been used in Wales since the 1980s (Lewis, Jones & Baker 2012).

The term was first devised in Welsh as "*trawsieithu"* by Williams and Whittall and translated to English first as translinguifying (Lewis et.al 2012) and later as translanguaging (García & Wei, 2014). Translanguaging is the process whereby multilingual speakers use their languages as an integrated communication system (García & Wei 2014) and also refers to a pedagogical practice that alternates the use of more than one language for input and output in the same lesson (Charamba et.al. 2019). The idea being to get information in one language and to work with that information in the other language (Garcia et.al 2017) and according to Williams (2002), the pedagogical practice of translanguaging in the science classroom works both ways, from home language to the medium of instruction as well as from the medium of instruction into science students' home language. In more than 80% of South African science classrooms students are subjected to monolingual pedagogy where the medium of instruction is not their home language (Statistics SA 2011). With this perspective on translanguaging and multi-competence, I examine how translanguaging in a science classroom contributes to the meaning-making process of scientific knowledge in a multilingual classroom.

RESEARCH METHODOLOGY

The current study aimed to investigate science teachers' perceptions and practices towards the use of African languages in their science classrooms. The research participants were 25 pre-service teachers in 6 primary schools in Soweto. Soweto is a township in Gauteng, South Africa, bordering the city's mining belt in the south. Its name is an English syllabic abbreviation for South Western Townships (Grinker & Gorelik 2014). Soweto was created in the 1930s when the White governmPlease ent started separating Blacks from Whites, creating black "townships" (Grinker 2014). Blacks were moved away from Johannesburg, to an area separated from White suburbs by a so-called cordon sanitaire (or sanitary corridor). Soweto is home to over 1.5 million people from various countries (Statistics SA 2011).

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Because of the diverse backgrounds of the habitants, more than 30 languages are spoken in the township (Grinker & Gorelik 2014). Soweto experienced serious riots in 1976, sparked by a ruling that Afrikaans language be used as the language of instruction in the African schools there. The riots were violently suppressed, with 176 striking students killed and more than 1,000 injured (Grinker 2014). All participants in the present study are studying towards the Bachelor of Education degree (Intermediate/ Senior phase) with a local university in Johannesburg and were on teaching experience for 6 weeks. The intermediate/senior phase ranges from the fourth to the ninth grades. All primary schools included in the study are public schools, fully funded by the Department of Basic Education and all their students are black Africans. Of the 25 pre-service teachers, 7 were in their second-year, 12 in their third-year, and 6 in their final year (fourth-year).

Data Collection

The study was carried out by using three different types of data collection to achieve data triangulation. Creswell (2014) defines data triangulation as the combination of methodologies in the study of the same phenomena. The use of such a design was to deal with the deficiencies of one method by exploring alternative explanations of the data (Creswell 2014). Firstly, a questionnaire adapted from Cohn et.al. (2013) was used to explore teachers' attitudes and practices towards translanguaging. Secondly, the researcher observed lessons delivered by the science teachers to examine their actual practices in their science classes. Finally, a semi-structured interview was held with the 25 science teachers to explore the reasons behind the linguistic practices in the classes.

The sample was purposefully chosen as they were information-rich sources (Creswell 2014) and this type of sampling is practical in situations in which the researcher uses the participants who meet the criteria of the study and are willing to take part in the study (Glăser & Laudel 2010). A questionnaire adapted from Cohn et.al. (2013) was used to explore teachers' attitudes and practices towards translanguaging. The questionnaire had fifteen (15) questions. Eleven items were Likert-Type scale items to examine how the use of students' home language by both teachers and the students is perceived by the teachers and why and how they use translanguaging in their classrooms. In some cases the participants had to choose whether they "Strongly agree, Agree, Disagree, or Strongly disagree". For example:

The use of more than one language in the same lesson can help avoid misunderstanding of scientific concepts.

With open-ended items, the researchers tended to figure out whether and in what situations the use of translanguaging has an effect in the meaning-making process in the science classroom. An example of such a question was:

What is your experience in teaching science using more than one language?

Three classroom observations were done with all 25 science teachers, giving a total of 75 classroom observations. Each lesson was 40 minutes long, amounting to 120 minutes per teacher. The classroom observations were carried out in 6 weeks. During the classroom observations, field notes were written accompanied by audio and video recordings. All ethical considerations were observed by the researchers and consent was obtained from the school principals and

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teachers. The aim of the study was explained to all participants. During the class observations and interviews, all teachers agreed to be audio-and video-recorded.

Interviews were also conducted with the 25 teachers who completed the questionnaire. The interview schedule comprised 3 questions and participants were asked the questions in the same order using the same wording. For example:
Do you think lack of proficiency in the language of instruction leads to academic underperformance in science? Please explain your answer.

During the study, teachers chose their own pseudonyms for anonymity and confidentiality purposes. The researcher also transcribed translanguaging extracts taken from the classes observed. These extracts will be explained in detail in the results and discussion sections.

Data Analysis

In analysing the data collected from the questionnaire, the researcher used descriptive statistics to calculate the percentages of each Likert-type item in the questionnaire. To analyse the qualitative data gathered from the open-ended questions, classroom-observations and interviews, structural coding was used. The data were first coded independently. The codes were then re-examined and attributed to themes explaining why translanguaging was used in the science classrooms. Coding is a good way of organising similarly coded data into categories due to shared characteristics and reflecting on the emergent themes from these categories (Glăser & Laudel 2010).

RESEARCH FINDINGS

Questionnaire responses were analysed by the researcher and presented in Table 1 below is a summary of responses from the participants:

Table 1: Participant Questionnaire responses

Question	Strongly Agree	Agree	Disagree	Strongly Disagree
Question 1 The use of more than one language in the same lesson can help avoid misunderstanding of scientific concepts.	88%	12%	0	0
Question 2 The problem of student underperformance in science can be solved through use of more than one language in the same lesson	80%	20%	0	0
Question 3 Proficiency in mastering English language is the tool for excelling in science	4%	4%	80%	12%
Question 4 African languages can be successfully used in the science classroom	80%	20%	0	0
Question 5 Lack of proficiency in the language of	76%	20%	4%	0

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instruction leads to misconceptions and underperformance in science				
Question 6 The language (s) I use produce good results in the science classroom	100%	0	0	0
Question 7 Multilingual media can serve as a bridge to promoting better understanding of science concepts	72%	20%	8%	0
Question 8 It has been argued that students' failure in science stems from their inability to speak and use English	76%	20%	4%	0
Question 9 Use of students' home language alongside English in the same lesson enhances student participation	80%	20%	0	0
Question 10 Translanguaging during science learning motivates students	88%	12%	0	0

In the following analysis, only questions that had follow-up sub-questions are considered.

The use of more than one language in the same lesson can help avoid misunderstanding of scientific concepts.

All 25 pre-service teachers who completed the questionnaire agreed that the use of multiple languages in the same lesson can assist students understand scientific concepts taught to them. 22 of the 25 teachers (88%) strongly agreed on the positive effects of using more than one language in the same lesson with the remaining 3 teachers (12%) simply agreeing. One of the respondents, Sihle said:

> *At times when I explain some concepts to my students in English, they don't seem to understand. That is when I resort to explaining in the student's home language. This has helped a lot as most of my students seem to understand better after explanations in their home language.*

Another respondent, Nono said:

> *I always encourage my students to discuss in their home languages. I have seen this to be a working strategy as students get to explain and understand scientific concepts through the use of a language they understand.*

Swati, who strongly agreed that the use of more than one language in the same lesson has a positive effective in the tutelage of science said;

> *I have come to realise that most of my students are not good in English. Therefore, the use of their home language helps bridge the gap between the language of instruction and the science concepts. It helps them understand the concepts better, thereby ridding of any misconceptions.*

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During the lesson observations, the researcher also noticed how the teachers were able to explain concepts to students in their home language. In some cases students would answer questions through their home language and the teacher, together with the rest of the class, would then translate the answers into English language. In one such case, Swati asked her students to give the benefits of recycling paper. One student said, in isiZulu:

> *Izinzuzo zokuphinda usebenzise iphepha zibandakanya ukonga amandla, amanzi nendawo yokugcwalisa komhlaba. Ukuvuselelwa kwamaphepha kunciphisa ukuphuma kwegesi yomoya obamba ukushisa.*

The answer was translated by the class and teacher into English language as: *The advantages of recycling paper include saving energy, water and landfill space. Paper recycling reduces greenhouse gas emissions.*

A body of recent research suggest that teachers who use translanguaging pedagogies in science education, particularly in cases where the medium of instruction is different from the students' home language engage in a democratic endeavor for social justice (Charamba et.al 2019; Karlsson et.al 2018; McKinney & Tyler 2019), because they do not undermine the students' right to learn in a language of their choice or that with which they are most familiar (Lewis et.al 2013). Translanguaging in the science classroom, therefore, can be viewed as a classroom ecological approach (McKinney &Tyler 2019) where the teacher creates interactive lessons with the languages not rigidly separated (Wei 2018) but used in a flexible and concurrent fashion for the benefit of the student (Windschitl et.al 2018).

The problem of student underperformance in science can be solved through use of more than one language in the same lesson.

All participants (100%) agreed that students' academic underachievement in the science classroom can be solved through the use of multiple languages in the same lesson. This calls for the use of students' linguistic repertoire in the science classroom. The participants indicated that using students' home language alongside English in the same lesson enhances students' academic performance.

Palesa, one of the participants said:

> *Most of my students underperform, not because their IQ is low but because of their low proficiency in English. English is not the home language for all my students and myself. That is why I prefer using their home language to explain some scientific concepts. When I use their home language, I have realized that my students perform better compared to when I use one language.*

This is in line with previous research by the author which suggests that students' academic underachievement in science is mostly attribute to their low proficiency in the language of instruction (Charamba 2019a; 2019b; 2020a; 2020b; Charamba & Zano 2019; Charamba et.al 2019). Translanguaging presents opportunities for English learners to expand the means at their disposal to learn and demonstrate science understanding and skills and create spaces for them to further develop proficiency in English (Seah & Yore 2017).

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Proficiency in mastering English language is the tool for excelling in science

92% of the respondents disagreed with the statement. This suggests that the teachers do not view proficiency in English language as the key to high academic achievement in science. During the interviews, Lisa Wilson said:

> *Being proficient in English is not vital for good achievement in science. Teachers should use whatever language their students have high proficiency in and that doesn't necessarily mean it should be English only. I constantly use isiZulu in my class and my students perform well.*

For instance, instead of having to demonstrate knowledge solely through the use English language, translanguaging allows science students and teachers to demonstrate what they know and can do through the use of a language they have the most proficiency (Windschitl et.al 2018). Research reviewed by Msimanga et.al. (2017) points to the efficacy of using African languages in science classrooms. The research also highlights the advantages of translingual practices where students use their home language alongside English in the same science lesson. Thando, one of the participants, also contributed by stating that:

> *You do not have to stick to English. There are times when students seem lost because of the language of instruction. In such cases, why not use their home language? What is important is for students to understand the concepts. When they do, their English vocabulary also increases.*

African languages can be successfully used in the science classroom

All 25 (100%) participants were in agreement as to the use of African languages in the science classroom. The teachers indicated they had successfully used several African languages in their classrooms and that produced good academic results. During lesson observations, in one of the classes, the students were given a task in English language. The students discussed and wrote their answers in their home language. They then went on to translate the same answer into the English language. Upon asking the teacher (Maqanda), she said:

> *It makes students be able to contribute during class and group discussions. Besides understanding the scientific concepts, translanguaging also improves students' command of English language.*

In a related research by Madiba (2014), the simultaneous use of two African languages, (Tshivenda and isiXhosa), and English in science courses at the University of Cape Town in South Africa has also proved effective in enhancing science and English literacy among university students.

Lack of proficiency in the language of instruction leads to misconceptions and underperformance in science

96% of the respondents agreed that students' lack of proficiency in the language of instruction leads to misconceptions and academic underachievement in science. This is in line with previous research by researchers such as Cenoz et.al (2017), Garcia (2015), Holdway and Hitchcock

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(2018), Serder and Jakobsson (2016), Silver and Bokhorst-Heng (2016), and Wickman (2013) which also proposes that the use of a language in which students have low proficiency is the prime cause for students' academic underachievement in science. The researchers suggest that teachers should make use of a language which students are well conversant in, particularly their home language.

The students' home language can therefore be used as a bridge to the required school's language of instruction and comprehension of scientific knowledge (Bonomi 2019). It is through the mastery and use of students' home language that the basic skills of reading, writing and numeracy are acquired (UNESCO 2018) which can be successfully applied to different facets of the curriculum. Sihle, one of the participants, said:

> *From my observations, when we use more than one language during the lesson, students tend to participate more and get a lot of answers correct. This shows me that they understand better when using more than one language than when I stick to monolingual practices. The quality of their answers and presentations also improves because they are not limited to using English only.*

Takalani also said:

> *Even time I stick to using English only; my students always complain that they did not understand what I will have taught them. The written activities take long to be completed and most of the answers will be incorrect. However, when I use translanguaging pedagogy, most of my students perform well, and their participation in class is good. They appear motivated to learn.*

The general consensus among the participants was that using students' home language alongside English in the same lesson enhances students' participation and academic performance in science. Results of the present study suggest that the use of translanguaging-informed approach in the science classroom improves students' participation, motivation, and academic achievement.

DISCUSSION

For multilinguals, languages are a kind of unified system to be negotiated for contextual conversational goals. Hence, the communicative proficiency for multilinguals needs to be based on the construction of their linguistic repertoire (Cenoz et.al 2017) rather than developing a total mastery of each and every language (Garcia 2015). Researchers Lubliner and Grisham (2017) view translanguaging as the purposeful incorporation of students' linguistic resources as a medium of instruction by allowing science students to shift seamlessly between their home language and the language of instruction. In the present study, the classroom observations and interview responses showed that the participants used students' home languages to clarify and review the scientific content, to maintain classroom routines, to construct rapport and to increase students' involvement during instruction. Rietha, a third-year pre-service teacher:

> *I also use students' home language when they [students] seem not to be following the lesson or appear demotivated. The use of their home language helps students to understand science concepts and enhances their participation in class. I also encourage academically gifted students to help their classmates using their home language.*

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The present study suggests that if science students are encouraged and allowed to use all available language resources in science classrooms, it empowers them in several ways (Charamba 2019a). A study by Stevenson (2013) shows that bilingual Latino students use their linguistic resources in both Spanish and English to seek clarification when they were uncertain regarding experiment directions in the laboratory or the names of tools or artifacts and during the introduction of new scientific concepts. During the 75 class observations, it was also noted how the students often used their home language and the language of instruction to express the subject-specific words in one language, while the descriptive, interconnecting words and phrases describing the semantic relationships in another language (Karlsson et. al 2018).

In this way, both the home language and language of instruction become linguistic and cognitive tools for meaning-making in the science classroom (Phajane 2019). The researcher also observed that through translanguaging, the students' opportunity to develop an understanding of the semantic relationships between concepts increases (Charamba 2019b; Holdway & Hitchcock 2018) resulting in enhanced concept comprehension as evidenced through class activities. The researcher also noted an improvement in the students' ability to argue, discuss, answer questions, and explain ideas. Interview responses from the teachers imply that translanguaging in the science classroom improves the probability that students' understanding of scientific concepts will increase.

Basing on the lessons observed, translanguaging also seems to create a conducive space in today's multilingual science classrooms (Kamberelis & Wehunt 2012), especially for diverse communities such as Soweto, in which the students are able to relate their everyday experiences to the scientific matter. Interview responses from the participants and analysis of classroom observations also suggest that translanguaging seems to create a desire in students to continue learning (Serder & Jakobsson 2016), which contributes to continuity and empowers science learning (Arteagoitia & Howard 2015). The present study also suggests that encouraging students to use all their linguistic resources for instructional purposes in the science classroom facilitates building links and relationships between their various languages and the scientific concepts (Charamba et.al 2019; Seah & Yore 2017).

Given the fluid nature of a translanguaging approach, teachers can implement translanguaging pedagogies in the linguistically diverse multilingual classes for meaning-making. During the class observations, a point to make was how the science teachers' use of translanguaging pedagogy was integral to creating an environment where students began to take risks and break out of the monoglossic mold of science education (Luk& Lin 2015). By taking the initiative to translanguage, the teachers set the stage for their students to make use of their linguistic repertoire. Due to the prevalent school restrictive language policies in South Africa, schools continue to work against students' translanguaging thereby inhibit their full mastery of scientific concepts due to students' low proficiency in the language of instruction (Charamba 2020b; Duarte 2019).

Consequently, most students in the country, other than those involved in research, have not been exposed to pedagogy that emphasises the interconnectedness of their language practices and the possibilities inherent in their translanguaging (Charamba 2020a; Gort 2015). The present study suggests schools should make multilingual students aware that their ability to translanguage is integral both to their academic success in the science classroom (Wickman

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2013) and to their positioning as border thinkers who have the power to critique their English medium learning spaces (Holdway & Hitchcock 2018). Schools should encourage science students to draw from their rich, fluid linguistic repertoires, thereby moving away from the coloniality ways of languaging (Yuvayapan 2019), as posed to the current status quo where students are required to perform linguistically in the dominant language according to a standardized variety imposed by the majority language community (García 2015).

This study also suggests that teachers should adopt a translanguaging stance that cedes the control of students' languaging practices and allow these students' voices; however they emerge, to take centre stage (García et al 2017). The researcher believes that taking up a translanguaging lens can allow room for more insurgent *knowledges* to destabilise and subvert the *colonialities* of power (Yuvayapan 2019), knowledge, and being (Karlsson et al. 2018) inscribed in dominant literacy and science classrooms (Velasco & García 2014; Yuvayapan 2019).

CONCLUSION

A body of research in and outside the country continues to provide strong evidence of the effectiveness of multi-lingual approaches to science education. Low proficiency in the language of instruction, as highlighted earlier in this article, has been identified as one of the major causes of academic underperformance amongst science students whose home language and language of instruction differ. The present study joins a body of research which suggests that there is need to come up with alternative pedagogical approaches for multilingual science classes in South Africa which cater for the simultaneous use of more than one language for teaching and learning purposes (Charamba 2019a; García 2015; Karlsson et al. 2018; Yuvayapan 2019). Basing on classroom observations, questionnaire, and interview responses in the present study the pedagogical practice of translanguaging works both ways, from students' home language to English as well as from English into the home language.

Translanguaging uses all languages at the student's disposal, and in this way, it implies a deep understanding of meaning and can result in increased epistemic access in the science classroom as it does not recognise hard boundaries between languages. During the interviews, the majority of teachers indicated that the use of students' home language alongside the language of instruction (English) in the science classroom enabled their student to understand scientific concepts better. The present study, therefore, suggests that teachers challenge the linguistic rigidity in the form of monoglossic bias in language policies and practices through acknowledging multilingual science students' diverse linguistic repertoire which can be effectively used as a pedagogical tool in the classroom.

Further research on translanguaging in South African science classrooms will most likely go in different directions. One of these directions will be when translanguaging is used as a pedagogical tool to develop scientific knowledge and to expand the students' linguistic repertoires, it is essential to prove its effectiveness (Charamba 2020b). More research is therefore needed so as to see if translanguaging offers students with a better understanding of scientific concepts when different African languages are used. Further research is needed to determine if

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effectiveness of translanguaging pedagogy at different educational levels or for different types of South African students in the science classroom.

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REFERENCES

Arteagoitia, I., & Howard, L. (2015). The role of the native language in the literacy development of Latino students in the U.S. In J. Cenoz & D. Gorter (Eds.), *Multilingual education: Between language learning and translanguaging* (pp. 61–83). Cambridge: Cambridge University Press.

Bakhtin, M. M. (1981). "Discourse in the Novel." In Michael Holquist (Ed), *The Dialogic Imagination: Four Essays* (pp 269–434). Austin, TX: University of Texas Press.

Bakhtin, M. M. (1986). Speech Genres and Other Late Essays. Austin: University of Texas Press

Bonomi, M (2019). Mi(s) Lengua (s): educational paths for Hispanic students within Italian school, *Journal of Multilingual and Multicultural Development*, DOI: 10.1080/01434632.2019.1621875

Cenoz, J., Gorter, D & May, S. (Editors) (2017).Language Awareness and Multilingualism (Third Edition). Springer, Switzerland.

Charamba, E. (2020a). Translanguaging in a Multilingual Class: a study of the Relatio between students' languages and Epistemological access in Science, *International Journal of Science Education,* DOI: 10.1080/09500693.2020.1783019

Charamba, E. (2020b).Pushing linguistic boundaries: translanguaging in a bilingual Science and Technology classroom, *Journal of Multilingual and Multicultural Development* DOI:10.1080/01434632.2020.1783544

Charamba, E. (2019a). Translanguaging: developing scientific scholarship in a multilingual classroom, *Journal of Multilingual and Multicultural Development*, DOI: 10.1080/01434632.2019.1625907

Charamba, E. (2019b). Learning and language: towards a reconceptualization of their mutual interdependences in a multilingual science class, *Journal of Multilingual and Multicultural Development*, DOI: 10.1080/01434632.2019.1707837

Charamba, E & Zano, K. (2019). Effects of translanguaging as an intervention strategy in a South African Chemistry classroom, *Bilingual Research Journal*, DOI: 10.1080/15235882.2019.1631229

Charamba, E, Jisa. W, Matariro, M, &Zano, K. (2019). Subduing hegemony of Literacy Inadequacy by (Re) embracing multilingualism in a Deaf Science Classroom, *PONTE International Journal of Sciences and Research Vol. 75* | No. 8/1, 58- 85

Creese, A., & Blackledge, A. (2015). Translanguaging and identity in educational settings. *Annual review of Applied Linguistics*, 35, 20-35.

Vol. 17. No.7 (2020), 117-132. ISSN: 1823-884x

Creswell, J.W. (2014). Research Design: Qualitative, Quantitative, and Mixed Methods Approaches (4th edition). London: Sage.

Dewey, J. (1902). The child and the curriculum. Chicago, IL: The University of Chicago Press.

Duarte, D. (2019) Translanguaging in mainstream education: a sociocultural approach. *International Journal of Bilingual Education and Bilingualism*, *22*(2), 150-164,

Fogle, Lyn & King, Kendall. (2017). Bi- and Multilingual Family Language Socialization. 10.1007/978-3-319-02255-0_7.

García, O. (2015). Translanguaging and abecedariosilegales. In T. M. Kalmar (Ed.), *Illegal alphabets and adult biliteracy*: *Latino migrants crossing the linguistic border* (pp. 131–136). New York: Routledge.

García, O., & Wei, L. (2014). Translanguaging: Language, bilingualism and education. Basingstoke: Palgrave Macmillan.

García, o., Johnson, s., & seltzer, K. (2017). The translanguaging classroom: Leveraging student bilingualism for learning. Philadelphia: Caslon.

Garza, E. &Arreguín-Anderson, M. G. (2018). Translanguaging: Developing scientific inquiry in a dual language classroom, *Bilingual Research Journal*, *41*:2, 101-116

Glăser, J& Laudel, G. (2010). Life with or Without Coding: Two Methods for Early Stage Data Analysis in Qualitative Research Aiming at Casual Explanations. *Qualitative social research,Volume 14*, No 2, Art.5.

Gort, M. (2015). Transforming literacy learning and teaching through translanguaging and other typical practices associated with "doing being bilingual". *International Multilingual Research Journal*, *9*(1), 1–6.

Gorter, D. (2015). Multilingual interaction and minority languages: Proficiency and language practices in education and society. *Language Teaching*, *48* (1) 82 –98.

Gorter, D., Zenotz, V., & Cenoz, J. (Eds.). (2014). Minority languages and multilingual education. Berlin: Springer.

Grinker, D. (2014). Inside Soweto: Memoir of an Official 1960s-1980s. Johannesburg: Eastern Enterprises.

Grinker, D &Gorelik, B (Eds). (2014). Inside Soweto: Memoir of an Official 1960s-1980s. Johannesburg: Eastern Enterprises.

Henderson, K. I., &Ingram, M. (2018). "Mister, you're writing in Spanglish": Fostering spaces for meaning making and metalinguistic connections through teacher translanguaging shifts in the bilingual classroom, *Bilingual Research Journal*, *41*:3, 253-271

Holdway, J., & Hitchcock, C. H. (2018). Exploring ideological becoming in professional development for teachers of multilingual learners: Perspectives on translanguaging in the classroom. *Teaching and Teacher Education*, *75*, 60-70.

Kamberelis, G., & Wehunt, M. D. (2012). Hybrid discourse practice and science learning. *Cultural Studies of Science Education*, *7*(3), 505–534.

Karlsson, A., Nygård Larsson, P., & Jakobsson, A. (2016). Flerspråkighet somenresursi NO-klassrummet [Multilingualism as a resource in the science classroom]. *Pedagogisk ForskningiSverige,21*(1–2), 30–55.

Vol. 17. No.7 (2020), 117-132. ISSN: 1823-884x

Karlsson, A, Nygård Larsson,P & Jakobsson, A (2018). Multilingual students' use of translanguaging in science classrooms. *International Journal of Science Education,* DOI: 10.1080/09500693.2018.147726

Kiramba, L. K. (2016) Heteroglossic practices in a multilingual science classroom. *International Journal of Bilingual Education and Bilingualism*. DOI: 10.1080/13670050.2016.1267695

Lewis, G., Jones, B., & Baker, C. (2012). Translanguaging: Origins and development from school to street and beyond. Educational Research and Evaluation: *An International Journal onTheory and Practice*, *18*(7), 641–654.

Lewis, G., Jones, B., & Baker, C. (2013). 100 bilingual lessons: Distributing two languages in classrooms. In C. Abello-Contesse & R. Chacón Beltrán (Eds.), *Bilingualism in a school setting* (pp. 107–135). Bristol: Multilingual Matters.

Luk, G. N. Y., & Lin, A. M. Y. (2015). L1 as a pedagogical resource in building students' L2 academic literacy: Pedagogical innovation in a science classroom in a Hong Kong school. In J. Cenoz & D. Gorter (Eds.), *Multilingual education: Between language learning and translanguaging* (pp. 16–34). Cambridge: Cambridge University Press.

Madiba, M.(2014). Promoting Concept Literacy through Multilingual Glossaries: A Translanguaging Approach In C. Van der Walt and L. Hibbert (Editors), *Multilingual Teaching and Learning in Higher Education in South Africa (pp* 68- 87). Clevedon: Multilingual Matters.

Madsen, L M (2014). "Heteroglossia, Voicing and Social Categorisation." In A. Blackledge and A. Creese (Editors), *Heteroglossia as Practice and Pedagogy (pp 41-58)*. Heidelberg: Springer.

McKinney, C & Tyler, R (2019). Disinventing and reconstituting language for learning in school *Science, Language and Education, 33* (2) 141-158.

Meyerhöffer, N & Dreesmann, D.C (2019). Let's Talk Biology – Developing a Model for Incorporating English-Speaking Experts into the (Bilingual) Science Classroom *The American Biology Teacher, Vol.81* No. 3, March 2019; (pp. 152-159).

Miller, E., Manz, E., Russ, R., Stroupe, D., &Berland, L. (2018).Addressing the epistemic elephant in the room: Epistemic agency and the Next Generation Science Standards. *Journal of Research in Science Teaching*, *55*(7), 1053–1075.

Msimanga, A., Denley, P. &Gumede, N (2017). The Pedagogical Role of Language in Science Teaching and Learning in South Africa: A Review of Research 1990–2015, *African Journal of Research in Mathematics, Science and Technology Education, 21* (3) 245-255.

Olander, C. (2010). Towards an interlanguage of biological evolution: Exploring students' talk and writing as an arena for sense-making. Göteborg: Department of Education, Göteborg University.

Phajane, M.H. (2019). Play and Teaching in Early Childhood Classrooms: Perspectives and Practices of Teachers and Children in South Africa. *Journal of Social Sciences and Humanities, 16* (4), 1-14

Portoles, L. & Marti, O. (2017). Translanguaging as a teaching resource in early language learning of English as an additional language. *Bellaterra Journal Teaching & Leaning Language& Literature, 10*(1), 61-77.

Vol. 17. No.7 (2020), 117-132. ISSN: 1823-884x

Seah, L. H., & Yore, L. D. (2017). The roles of teachers' science talk in revealing language demands within diverse elementary school classrooms: A study of teaching heat and temperature in Singapore. *International Journal of Science Education, 39*(2), 135–157.

Serder, M., & Jakobsson, A. (2016). Language games and meaning as used in student encounters with scientific literacy test items. *Science Education*, *100*(2), 321–343.

Silver, R. E. & Bokhorst-Heng, W. D. (2016). Overarching themes, bilingual dreams and multilingual landscapes: Quadrilingual education in Singapore. In Silver, R. E. & Bokhorst-Heng, W. D. (Eds.), *Quadrilingual education in Singapore* (pp 3-19). Singapore: Springer.

Somerville, J &Faltis, C (2019). Dual Languaging as Strategy and Translanguaging as Tactic in Two-Way Dual Language Programs, *Theory into Practice*, 58:2, 164-175.

Statistics SA: Census (2011). *Main Place: Soweto Census 2011*. Adrain.com. Retrieved 14 January, 2019.

Tan, E., Barton Calabrese, A., Turner, E., & Gutiérrez, M. V. (2012). Empowering science and mathematics education in urban schools. Chicago, IL: University of Chicago Press.

UNESCO, (2018). Reshaping cultural Policies. 2018, Global Report, UNESCO

Velasco, P., & García, O. (2014) Translanguaging and the writing of bilingual learners. *Bilingual Research Journal, 37*, 6-23.

Wickman, P. (2013). Aesthetic experience in science education: Learning and meaning-making as situated talk and action. New York and London: Routledge.

Windschitl, M., Thompson, M., &Braaten, M. (2018).Ambitious Science Teaching. Cambridge: Harvard Education Press.

Yuvayapan , F. (2019). Translanguaging in EFL classrooms: Teachers' perceptions and practices. *Journal of Language and Linguistic Studies*, 15(2), 678-694.

Zavala, V. (2019). Translanguaging pedagogies and power: a view from the South, *Language and Education,33* (2), 174-177

ABOUT THE AUTHOR

ERASMOS CHARAMBA
School of Education
University of the Witwatersrand, Johannesburg
erasmuscharamba@live.com