International Review of Education (2023) 69:31–50
https://doi.org/10.1007/s11159-023-09990-0

ORIGINAL PAPER

Translanguaging as bona fide practice in a multilingual South African science classroom

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Published online: 13 March 2023

Abstract

The call for improving students' academic achievement in science education has increased in urgency in recent years. It has also increased in complexity in the face of the growing cultural and linguistic diversity of present-day classrooms following inter- and intra-state migration. Although *translanguaging* pedagogy, where languages of input and output are deliberately interchanged, remains a relatively young field of research, it has grown substantially in the past decade. The study presented in this article sought to explore the role language plays in the academic performance of multilingual students at a primary school in South Africa. Adopting an ethnographic research design, the author collected qualitative data through lesson observations video-recorded in a fifth-grade science class, supplemented with several interviews with the teacher. Data analysis involved a combination of both inductive and deductive methods, and the results affirm that translanguaging pedagogy is indispensable for effective learning in multilingual classrooms. The author's findings confirm insights from previous research that the ability and encouragement to use multiple languages in science class allows multilingual students to engage in a practice of generating and creating scientific explanations in their own voice, resulting in better academic performance.

Keywords Science education · Translanguaging · Multilingualism · Monolingualism · Language of instruction (LOI)

Résumé

Le translanguaging, une approche justifiée dans une classe de sciences multilingue en Afrique du Sud – L'appel à améliorer les résultats scolaires des élèves en sciences s'est fait de plus en plus pressant ces dernières années. Au regard de la diversité culturelle et linguistique des classes d'aujourd'hui, du fait des flux de migration

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à l'intérieur des pays et entre eux, sa complexité s'est accrue. Bien que l'approche pédagogique du *translanguaging*, qui repose délibérément sur des cours donnés dans une langue et des exercices rendus dans une autre, soit une discipline de recherche relativement jeune, elle s'est notablement développée cette dernière décennie. L'étude présentée dans cet article se proposait d'explorer le rôle de la langue dans les résultats scolaires des élèves multilingues d'une école primaire en Afrique du Sud. S'appuyant sur une conception ethnographique de la recherche, l'auteur a recueilli des données qualitatives en observant des cours enregistrés sur vidéo dans une classe de sciences de CM2, ce qu'il a complété avec plusieurs interviews de la maîtresse d'école. Pour l'analyse des données, il a recouru à un mélange de méthodes inductives et déductives, et les résultats permettent d'affirmer que l'approche pédagogique du translanguaging est indispensable pour que l'apprentissage dans les classes multilingues soit efficace. Les conclusions de l'auteur confirment les résultats de recherches antérieures selon lesquels permettre et encourager l'emploi de plusieurs langues dans les cours de sciences donne la possibilité aux élèves de s'exprimer avec leurs propres mots pour créer et élaborer des explications scientifiques, ce qui se traduit par de meilleurs résultats scolaires.

Linguistic landscapes and challenges in education

The increasing global migration of people for various reasons has led to a change in the linguistic landscape of our classrooms. This has resulted in the emergence of, and in some cases an increase in, the call for schools to cater for the academic needs of these multicultural and multilingual classrooms (Cenoz and Gorter 2015). The monolingual pedagogy still prevalent in most schools no longer corresponds to the sociolinguistic reality evident in many present-day global classrooms as large numbers of students arrive with a home language different from the school's language of instruction (LOI) (Hamman 2018; Kang and Ahn 2019).

This state of affairs negatively impacts students' learning outcomes. A body of recent research on the relationship between language and learning suggests that confinement to a single LOI – especially if it is not the students' home language – constitutes the major factor in their academic underachievement (see for example Cenoz and Gorter 2015; Hamman 2018; Holdway and Hitchcock 2018; Ramos and Martínez 2018; Somerville and Faltis 2019). South Africa, the focus of this article, is no exception (Msimanga et al. 2017). To mitigate the effects of this misalignment (between students' home language and the LOI), some educators have resorted to "smuggling" students' languages into their classrooms (Charamba 2020a).

Although Section 29(2) of the South African Constitution (RSA 1996a) stipulates that every student has the right to receive education in the language of their choice,[1] and notwithstanding the long-standing multilingual nature of South African classrooms, education in this country largely continues to follow a monolingual trajec-

[1] The Constitution of South Africa recognises eleven official languages. Two of them (Afrikaans and English) are colonial; the other nine (isiNdebele, siSwati, isiXhosa, isiZulu, seSotho, sePedi, seTswana, tshiVenda and xiTsonga) are Indigenous.

tory (Charamba and Zano 2019; RSA 1996a; Omidire 2019). What happens in most South African schools is that students in primary grades 1–3 are taught in their home language alongside English (Charamba 2019a).[2] In grade 4, they switch to either English or Afrikaans and continue using that language as the LOI until they complete their education (Omidire 2019). According to the Department of Basic Education, more than 80 per cent of the country's educational institutions use English as the LOI despite the fact that it is the home language of only about 9.6 per cent of the population (DBE 2010). African languages are taught as subjects and only spoken outside of the classrooms.

The decision to separate languages in the classroom has affected bilingual pedagogies all over the world since the 1970s. This decision was reinforced in other pedagogical approaches such as *audiolingualism* or the *communicative approach* (Cenoz and Gorter 2015; Duarte 2019; Larsen-Freeman 2000; Ramirez and Ross 2019; Zavala 2019).[3] Meanwhile, several local and international authorities in education have suggested that harnessing students' linguistic repertoire for instructional purposes has positive benefits in terms of improving academic performance in science (Barakos and Selleck 2019; Duarte 2019; Goossens 2019; Jang and Brutt-Griffler 2019; Kiramba and Smith 2019; Nehring 2019; Ollerhead 2019; Pacheco et al. 2019; Paquet and Levasseur 2019; Preece 2019).

In this article, I argue the case that research studies, sociolinguists' findings and classroom experiences of multilinguals in South Africa, and indeed all over the world, indicate that linguistically responsive teaching which acknowledges and sees multilingualism as a teaching and learning resource benefits students in various ways (Hamman 2018; Larsen-Freeman 2000; Li and Lin 2019; Lin 2019). In the context of multilingual classrooms, Ofelia García (2017) defines educational situations where all language resources are used in the same lesson to enhance science learning as a *translanguaging* practice.

Science education: Oscillation between everyday and scientific discourses through translanguaging

Several researchers around the globe (see for example Henderson and Ingram 2018; Kang and Ahn 2019; Miller et al. 2018; Nehring 2019; Torpsten 2018; Windschitl et al. 2018) and in South Africa (for example McKinney and Tyler 2019; Msimanga et al. 2017; Omidire 2019) suggest that teachers can only create understanding and engagement in the science classroom if all students are able to contextualise and relate abstract subject matter to their own concrete and practical everyday experiences (Cenoz and Gorter 2015). In most of the science classrooms around the world

[2] Children in South Africa join grade R (Reception Year) when they are five years old, and enter primary school (grades 1–6) the following year. This is followed by middle school (grades 7–9), with grade 9 marking the end of compulsory formal schooling. Secondary level (grades 10–12) is attributed to Further Education and Training (FET).

[3] In a nutshell, audiolingualism puts listening/speaking before reading/writing and promotes the repetition of correct spoken sentences. The communicative approach is based on the idea that learning a language successfully comes through having to communicate real meaning.

today, the LOI in use usually moves on a continuum ranging from everyday discourse to a more academic one (Bonomi 2019; Garza and Arreguín-Anderson 2018; Somerville and Faltis 2019).

This continuum constitutes a hybrid space (Karlsson et al. 2018) between two different ways of using the LOI, for example English, that constitute a kind of interlanguage discourse (Larsen-Freeman 2000; Ramirez and Ross 2019). In most multilingual science classrooms, the interlanguage discourse receives an additional dimension because the LOI in most schools is different from many – in some cases even the majority – of the students' home language (Hamman 2018; Ollerhead 2019), and South Africa is no exception (McKinney and Tyler 2019; Msimanga et al. 2017).

Qi Zhang et al. (2020) made classroom observations in five Chinese universities in southern, central and northern China and then interviewed the 43 course lecturers to gain an insight into their use of translanguaging pedagogy. The findings suggest that when lecturers (in this case teaching Chinese as a foreign language) did use translanguaging, they noted great improvement in their students' acquisition of the English language ("predominantly employed for explanatory and elicitation functions", ibid., p. 359) and course-specific knowledge. This suggests a close link between language use and knowledge-building (Cunningham 2019; Meyerhöffer and Dreesmann 2019).

For students to succeed in the science classroom, they must have satisfactory proficiency both in the LOI and the scientific language (Fránquiz and Ortiz 2018). This can only be achieved if science teachers accommodate students' prior knowledge as well as their linguistic repertoire (Bakhtin 1981; Menken and Sánchez 2019). The communication spaces thus created can then facilitate the integration of discourses from students' everyday life with the new, unfamiliar science discourse (Cenoz and Gorter 2015; Kamberelis and Wehunt 2012). This might result in greater concept comprehension as the scientific content being taught in the classroom is interwoven with the students' experience of their lives outside of school. Thus the students' sociolinguistic backgrounds enrich the science learning process since the relevance of their experiences and lives is foregrounded (Hamman 2018; Holdway and Hitchcock 2018; Tan et al. 2012). When students relate the scientific subject matter to their everyday experiences in their continuous reconstruction (Dewey 1902; Menken and Sánchez 2019) of the science content, they move between their everyday language and the scientific terminology they are introduced to in school (Henderson and Ingram 2018; Karlsson et al. 2018; Windschitl et al. 2018).

In South Africa, recent research points to the efficacy of translanguaging in multilingual classrooms. For example, a study by Lizette de Jager (2021) reports on the efficacy of translanguaging and suggests that through this pedagogy, educators can build on science learners' diverse language practices and support them in expanding their linguistic repertoires to develop various literacies and scientific content knowledge, resulting in their performing well in academic environments.

In another study conducted in South Africa, Charlene du Toit-Brits and Henry Blignaut (2021) suggest that one of the reasons contributing to underachievement of multilingual learners who are taught through a single LOI different from their home language is the scarcity or non-existence of support to learn in their home language. The researchers suggest that provision of multilingual lessons and resources enhances academic performance, as learners may not have the language skills

required to comprehend subject-content successfully in English. This insight is also confirmed by another South African study conducted by Deborah Ali (2021), which suggests that learning challenges emerge in higher grades where English is the only LOI, as most students still lack the required competency in the LOI, and, in addition, have to learn the subject vocabulary. Their struggle with these challenges leads to their underachievement. To mitigate the problem, Ali (ibid.) recommends the use of translanguaging in science classrooms as it allows for better understanding and academic performance.

The use of students' linguistic repertoire allows multilingual science students to engage in a practice of generating and creating scientific explanations in a variety of ways, and this should be seen as a resource in appropriating scientific language and knowledge rather than a hindrance (Cenoz and Gorter 2015; Goossens 2019; Larsen-Freeman 2000; Meyerhöffer and Dreesmann 2019; Miller et al. 2018; Vogel and García 2017), allowing students to make use of different linguistic practices in the meaning-making process (Hamman 2018). Ofelia García and Li Wei (2014) use the term translanguaging to describe such a practice. According to Gwyn Lewis et al. (2012), the term has been used in Wales since the 1980s. It was coined in Welsh as "*trawsieithu*" by Cen Williams (1994) and his colleague Dafydd Whittall, and first translated into English as "translinguifying" (Lewis et al. 2012), and then later as "translanguaging". In the present study, translanguaging refers to the process whereby multilingual speakers use their linguistic repertoire as an integrated communication system (Cenoz and Gorter 2015; García and Wei 2014) for collaborative learning purposes.

Some modern scholars view translanguaging as a theory that postulates that rather than possessing multiple autonomous language systems, as has been traditionally thought (Pacheco et al. 2019), all users of language conveniently select and use relevant linguistic features from a single communicative repertoire in the meaning-making process (Iversen 2020; Vogel and García 2017). Through translanguaging, multilingual science students use their *idiolect*, that is, their individual full linguistic repertoire, without regard for socially and politically defined language labels or boundaries (Cook and Li 2016; Hamman 2018; Nehring 2019). Thus, these students make use of translingual practices of multilinguals to learn deeply, while also becoming enabled to recognise when to use what linguistic features for what purposes (Cenoz and Gorter 2015; Li 2018). Translanguaging entails going between and beyond linguistic systems and structures, including different modalities such as speaking, writing and signing inside or outside the science classroom (Lin 2019; Vogel and García 2017). In other words, translanguaging breaks the artificial and ideological divides between named languages.

In defining translanguaging, François Grosjean (2019) uses a sports-related analogy of hurdles, where two athletic skills, high jumping and sprinting, are involved together with other complementary processes such as breathing, sight and so forth. Hurdlers use these skills as an integrated whole to excel in their discipline in the same way multilinguals use their linguistic skills to communicate effectively. It is important to point out that translanguaging should not be conceived as an object or a linguistic structural phenomenon to describe and analyse, but rather as a practice and a process – a practice that involves dynamic and functionally integrated use of differ-

ent languages and language varieties (Cenoz and Gorter 2015; Somerville and Faltis 2019; Vogel and García 2017), and, even more importantly, a process of knowledge construction that goes beyond language(s). It takes us beyond the linguistics of systems and speakers to a linguistics of participation (Li 2018, p. 15).

The present study makes use of the theoretical underpinnings of the concepts of interlanguage and hybrid spaces found in *heteroglossia*, a term coined by Mikhail Bakhtin (1981) and translanguaging pedagogy (García 2009). Bakhtin's work on heteroglossia focuses on the situatedness of language, in its concretely historic and economic forms of use rather than as a universalised abstraction (Kiramba and Smith 2019; Menken and Sánchez 2019). This links language use by multilingual students to cultural, historical and institutional constraints and influences (Hamman 2018; Vogel and García 2017). Heteroglossia, according to Bakhtin (1986) identifies diversity in speechness (Somerville and Faltis 2019), languageness (Garza and Arreguín-Anderson 2018) and voicedness (Meyerhöffer and Dreesmann 2019) and supplies an umbrella term to forefront the socio-ideological aspect of languages, codes and voices (Madsen 2014). Most simply, this means that language is a public holding and that individual use is never solely idiosyncratic or free of social influences (Cenoz and Gorter 2015; Hamman 2018; Somerville and Faltis 2019).

To explore the potential of translanguaging pedagogy for improving science students' academic achievement in a case-study approach, I embarked on my study with the following research question:

> *What are the translanguaging practices within a multilingual fifth-grade classroom and how do they shape students' opportunities for learning science?*

Research context

The school I chose for my case study was Thuto primary school (pseudonym) in Jabulani Township, South Africa, where I followed one fifth-grade science class ($n=36$) taught by Miss Mmabatho Mokoena (pseudonym). I obtained ethical clearance from the Free State provincial Department of Basic Education, and informed written consent concerning participation in this study from the teacher and the students' parents.

A township is an area formerly reserved for black people during the colonial era (Grinker 2014) when they were moved to an area separated from White suburbs by a so-called *cordon sanitaire* (or sanitary corridor). Thuto primary school falls under Section 21 of the South African Schools Act (RSA 1996b), which means it qualifies for government subsidy as most of the parents fall in the low-income bracket (Charamba 2019b). Like all schools across the township, this school has a 100 per cent black student enrolment whose home language is isiZulu, one of the country's eleven African official languages mentioned in footnote 1 above.

The school's official LOI is English. In accordance with the South African Language-in-Education policy (RSA 1997), the students in Mmabatho Mokoena's class had received bilingual education through English and isiZulu from grade R to grade

3, which meant that they had used both languages as a resource in all class meaning-making situations (Charamba and Zano 2019). At the beginning of grade 4, the students had been introduced to monolingual pedagogy, with teaching and learning strictly confined to English LOI. Under this monolingual approach, all instructions, learning materials and academic activities are provided in English only (Charamba 2019a). The home language of all members of Mmabatho Mokoena's class was isiZulu, and most students were from low-income families. Although students were permitted to use the language of their choice during lunch, recess, and end-of-day free time the reality was that English dominated throughout much of the school day (Cenoz and Gorter 2015; Karlsson et al. 2018).

In the classroom, isiZulu was only spoken during isiZulu lessons and the teacher would tell the class that it was time to switch to isiZulu language. During her first five years as a teacher at Thuto primary, Mmabatho Mokoena adhered faithfully to the policy of language separation and expected her science students to do the same. However, during the academic year of this study (2019), she had decided to allow her students more linguistic flexibility in their science classroom activities. She told me that she had taken this decision after

> "having attended an International Conference on Languages and Literacies at a local university and learned of the benefits of translanguaging pedagogy from various researchers who presented during the 3-day conference" (Interview, 16 July 2019).

Mmabatho Mokoena went on to explain that:

> "When a student is bilingual it means they are able to communicate in the two languages with varying proficiency. With my students, I noticed that one might be better at reading in one language and speaking in another. Some struggle to express their ideas in one language. As a result, I then took it upon myself to allow my students to use both English and isiZulu in the classroom during science activities" (Interview, 16 July 2019).

Even though Mmabatho Mokoena did not always model dynamic bilingualism (García et al. 2017), as she almost always communicated with students in the LOI, she permitted and encouraged flexibility with student language use in all her science lessons (Cenoz and Gorter 2015; Hamman 2018; Li 2018). She allowed her students to share their responses, and to work with their classmates in the language of their choosing, thereby sustaining a pedagogy of translanguaging in her science classroom (Cenoz and Gorter 2015; Hamman 2018; Li and Lin 2019; Vogel and García 2017).

Data collection and methods

Multilingual classrooms are complex, power-laden spaces (Li 2018), and research seeking to deeply understand student language use in these settings requires in-depth and sustained analysis. Therefore, over the course of four months (July–October

2019), I spent one morning each week in the fifth-grade science classroom at Thuto primary school, resulting in approximately 20 hours of videoed observational data. Each observation was one hour in length and included instructional time in which both English and isiZulu were used in the classroom. Video recording happened in a variety of participation patterns such as whole-class, and small group. The focus of the video recording was to document translanguaging practices (Lemke 2012).

The science teacher (Miss Mmabatho Mokoena) was interviewed formally at the beginning and end of the study to better understand her role in shaping classroom language use. I also interviewed her informally at several points throughout the study using video-elicitation techniques (Creswell 2014). At such points, I showed Mmabatho Mokoena video footage from classroom observations where her science students were actively translanguaging and asked her to share her interpretations and reflections with me (Meyerhöffer and Dreesmann 2019). I used her responses to triangulate my interpretations of the data (Lemke 2012). This also gave me the opportunity to ensure that I was considering multiple perspectives of the same classroom interactions (Charamba 2019b; Hamman 2018). I video-recorded both the two formal and the six informal interviews (all of which were conducted in English) and transcribed them for subsequent analysis.

Data analysis for the present study involved a combination of both inductive and deductive analysis (Bryman 2015). I drew deductive codes for all materials from the literature I reviewed and included: translanguaging, multilingualism; meaning-making, and epistemological access (Charamba 2019a; Karlsson et al. 2018). Inductive codes were derived from an analysis of my own field notes, interview transcripts and videos of classroom interactions (McMillan and Schumacher 2010), paying particular attention to sections where students were actively translanguaging. I identified, transcribed and analysed these sections with the goal of understanding the translanguaging practices within this multilingual fifth-grade classroom and how they shaped students' opportunities for learning science (Vogel and García 2017). After identifying recurring patterns, I was able to construct two emergent conceptual themes (Lemke 2012; Meyerhöffer and Dreesmann 2019): (1) students' translingual practices in the multilingual classroom; and (2) the teacher's use of these practices to actively scaffold language and learning. In the last phase, I selected representative samples of classroom discourse to exemplify each of the two themes emerging from the study. All participant names used in the study are psuedonyms.

Results

In this section, I present examples of how the students and their teacher engaged in translingual practices for meaning-making in the science classroom. I make use of verbatim excerpts to triangulate my analysis and interpretations of the data collected (Karlsson et al. 2018; Meyerhöffer and Dreesmann 2019). During the course of the study, Mmabatho Mokoena proved to be an advocate of translanguaging, believing the pedagogy to be "a way of equating and integrating students from different linguistic and cultural backgrounds, and, as is the case in our school, varying proficiency in the language of instruction" (Interview, 23 July 2019).

Mmabatho Mokoena also expressed her concerns with the school's language policy:

> "The use of English is a challenge in our school. According to a recent study by the Department of Basic Education, most of our fifth-grade students operate at third-grade reading and writing levels. There's no way we can use English only and expect them to fully comprehend scientific concepts. The only way to bridge the linguistic gap is by allowing the practice of translanguaging in my classroom" (Interview, 16 July 2019).

This statement reveals the teacher's critical view of the ways in which the school's language policy reinforces language hierarchies and puts English language learners at a disadvantage through the complication of prescribing English as the sole LOI (Cenoz and Gorter 2015; Hamman 2018; Meyerhöffer and Dreesmann 2019).

Translingual practices in the multilingual science classroom

The classroom observations revealed that besides being a strategic tool for teaching and learning, translanguaging was the authentic way how these fifth-grade science students communicated with one another (Cenoz and Gorter 2015; Hamman 2018; Karlsson et al. 2018). They frequently used their linguistic repertoire as they negotiated meaning and shared ideas in the science classroom (Hamman 2018; Vogel and García 2017). For example, during one class activity on *Cells and Batteries*, Kea asked a peer, "it says *amandla* can be stored?" The explanation from Mmabatho Mokoena was that Kea was inquiring if the question asked whether energy could be stored or not. In using the isiZulu term for energy, Kea wanted to verify the actual meaning of the term "energy", a way of making sure that was used by many of the students during the science classes I observed. Another interesting example, presented in Excerpt 1, is a conversation between four students during a group activity:

> Excerpt 1
> Mpho reads the instruction: Write 3 forms of energy.
> Moses: "We write 3 *izinhlobo zamandla*?" [… forms of energy].
> Simphiwe: "Yes, 'forms' means *izinhlobo.*"
> Lebo: "'Energy' is *mandla.*"

Here, Moses wants to know if he has got the meaning of "forms of energy" correct by translating the term into isiZulu. Simphiwe, one of the few who exhibited satisfactory proficiency in English, confirmed the meaning to Moses, and Lebo chipped in to reaffirm the meaning of "energy". Such practices were common during the study. The existence of a fluid language space in Mmabatho Mokoena's classroom enabled this sort of linguistic experimentation, where her science students could make use of their linguistic repertoire in the science classroom (Hamman 2018; Kiramba and Smith 2019; Vogel and García 2017).

In another example, when Dineo was demonstrating how an electric circuit works, she used isiZulu to discuss the connections of cells and English to make an evaluative statement:

> Excerpt 2
> "*Uxhuma amaseli usebenzisa izintambo* [you connect cells using wires]. *Bese uxhuma iswitch* [You then connect a switch]. Switch is for open and close."

Dineo used *iswitch* referring to "a switch". This, according to the teacher, was because there is no isiZulu word for a switch. Sharing what they had discovered in their group, Boitumelo stated:

> Excerpt 3
> *"Uma amaseli ebhekene nokuqondisa ngendlela engafanele umjikelezo ngeke usebenze"* [If the cells are facing in the wrong direction, current will not flow].

Here, Boitumelo says "*uma amaseli ebhekene nokuqondisa ngendlela engafanele umjikelezo ngeke usebenze*". This is a scientific fact that if cells are facing the wrong way, electrical current will not flow. The fact that it is presented in isiZulu does not compromise the correctness of the response.

During the collaborative group work, I also observed that language use was dependent on the task at hand or the participants in the group (Gibbons 2006). These less structured instructional strategies were punctuated with translanguaging practices, as students moved fluidly between linguistic practices to negotiate science tasks (Charamba 2019b; Hamman 2018; Lin 2019; Vogel and García 2017). It is possible that some students used their repertoire because they were unaware of how to say certain scientific terms in English (Hamman 2018). Although these students might have had various reasons for translanguaging, it was clear that they fluidly moved across languages (Charamba 2017; Cenoz and Gorter 2015; García et al. 2017; Vogel and García 2017) as they negotiated answers to questions or procedures for carrying out a science experiment (Hamman 2018; Meyerhöffer and Dreesmann 2019). Commenting on this, Mmabatho Mokoena stated:

> "By using monolingual pedagogy in multilingual settings, not only does that create the death of other languages but it also contributes to the academic underachievement of some students. In the science classroom I should assess students' knowledge of science and not their proficiency in English language" (Interview, 13 August 2019).

In an earlier study (Charamba 2019a) where I compared two groups of learners, I also found that participants who were allowed to use their entire linguistic repertoire performed better academically in the chemistry class than the monolingual (English-

only) group. Monolingual bias, the findings of that study suggest, leads to *linguicide* and *academicide* (Skutnabb-Kangas 2000).[4]

Translanguaging to actively scaffold language and learning

During whole-class interactions in Mmabatho Mokoena' science classroom, translanguaging provided an avenue for the fifth-graders to scaffold their language and scientific knowledge simultaneously (Li and Lin 2019). For example, Excerpt 1 shows how translingual practices helped them to understand the instruction given by the teacher (Vogel and García 2017). Excerpt 2 shows how Dineo used translanguaging to discuss connections in a circuit. In following up on Boitumelo's response (Excerpt 3), Mmabatho Mokoena asked the class the following question:

> Excerpt 4
> Teacher: "Boitumelo says if cells face the wrong direction, the circuit will not work. Why is that so?"
> She pauses, looks around the class and, on seeing no hand up, she continues:
> Teacher: "What do you think will be the problem *uma amaseli abhekene nokuqondisa okufanayo*, Thapelo?" [… if the cells are facing the same direction].
> Thapelo: "*Amandla kagesi ngeke ageleze ngoba* it's negative to negative" [The voltage will not flow because the negative terminal is connected to the other negative terminal].
> Teacher: "So how should we connect the cells?"
> Thapelo: "*Xhuma* negative *uye* positive *zikhathi zonke"* [always connect the negative terminal to the positive one].
> Teacher: "So you are saying we should always connect the negative terminal to the positive one?"
> Thapelo: "Yes."
> Teacher: "But the cells are facing in the same direction. What will happen?"

In explaining this excerpt during an interview session (Interview, 13 August 2019), Mmabatho Mokoena said:

> "Thapelo is one of my shy students and he finds it difficult to communicate in the English language. He hardly talks in class unless we translanguage. Translanguaging helps him make contributions during class and group discussions. Several of my students are like Thapelo, they use several languages for meaning-making and find it difficult to communicate in English."

Excerpt 4 shows how Thapelo was able to make a meaningful contribution to the class conversation. This excerpt, along with several other observations made dur-

[4] In a nutshell, linguicide refers to the forced loss of proficiency in a language, resulting in a reduction of the number of its fluent speakers, and the eventual death of that language. Academicide refers to a situation where little or no learning takes place resulting in poor academic performance.

ing the study, illustrates how translanguaging facilitates students' participation in the science classroom as they draw on their linguistic repertoire (Cenoz and Gorter 2015; Hamman 2018). During the reported lesson (Excerpt 5), Mmabatho Mokoena and Thapelo continue to make use of their linguistic repertoire as they share their thoughts (Charamba 2019a; Vogel and García 2017), a practice used by the rest of the class as the lesson progressed. Mmabatho Mokoena also drew students' attention to specific scientific academic vocabulary and checked their understanding across languages (Cenoz and Gorter 2015; Hamman 2018; Karlsson et al. 2018). In Excerpt 5, she stops to check her students' understanding of the lesson's key concepts.

Excerpt 5
Teacher: "*Uyini* 'electrical circuit'?" [What is an 'electrical circuit'?].
Sabelo: "*Umjikelezo kagesi* [electrical circuit]."
Teacher: "What do you understand by electrical energy?"
Simphiwe: "*Amandla kagesi* [electrical power]."
Teacher: "Correct. Electrical energy flows through an electrical circuit. In an electrical circuit, charges move along the wire. *Umjikelezo kumele uqhubeke njalo"* [The circuit must be continuous].

In this interaction, Mmabatho Mokoena not only validates the students' translation but also builds upon their contributions by providing other ways of expressing the concepts in English (Hamman 2018; Jang and Brutt-Griffler 2019; Karlsson et al. 2018). She supports student learning by accepting translingual responses. Through translanguaging Mmabatho Mokoena afforded her multilingual students the chance to simultaneously acquire scientific knowledge and improve their English language proficiency (Charamba and Zano 2019; Hamman 2018; Lin 2019). The teacher also created an ongoing English–isiZulu bilingual chart with students that they contributed to throughout the school term (see Excerpt 6), documenting both academic content vocabulary and everyday language (Cummins 2008) as terms arose during the lessons (Hamman 2018).

Excerpt 6

English	**isiZulu**
Always	*Zikhathi zonke*
Cell	*Iseli*
Chemical energy	*Amandla amakhemikhali*
Circuit	*Umjikelezo*
Discuss	*Xoxa*
Electrical energy	*Amandla kagesi*
Electricity	*Ugesi*
Movement	*Ukunyakaza*

As shown in Excerpts 1 to 5, the flexible, fluid language space within Mmabatho Mokoena's classroom often increased students' opportunities for learning (García et al. 2017; Holdway and Hitchcock 2018). From this perspective, linguistic practices

and language speakers are not fixed or neutral (Bonomi 2019; García 2009; Vogel and García 2017); rather, they evolve and struggle within interrelated layers of historically formed, socio-ideological voices (Charamba 2019a; Bakhtin 1981; Cenoz and Gorter 2015; Hamman 2018; Karlsson et al. 2018).

Discussion

The present study affirms findings from previous research that translanguaging practices and pedagogies within multilingual science classrooms provide students with increased opportunities for meaning-making (Cenoz and Gorter 2015; Hamman 2018; Li and Lin 2019). In Mmabatho Mokoena's science classroom, translanguaging practices supported students in sharing the entirety of their ideas during the lessons (Hamman 2018). This worked well even if the students did not yet have full proficiency in the LOI (Li 2018). Mmabatho Mokoena was able to strategically bridge English and isiZulu, in ways that were both planned and organic (Preece 2019; Vogel and García 2017), for example when she continually made efforts to build upon her students' responses in Excerpts 4 and 5 and pushed their language and scientific content learning further.

During the study, I noted translanguaging was an authentic communicative practice within this multilingual learning space: regardless of the artificial boundaries of language separation (Cenoz and Gorter 2015; Preece 2019), students in this classroom were actively translanguaging for both social and academic purposes (Charamba 2019a; Hamman 2018; Jang and Brutt-Griffler 2019; Vogel and García 2017). During the lessons I observed, the fifth-grade students shifted between linguistic practices in response to situations such as a peer's dominant language, exhibiting *ubuntu*, the spirit of oneness or the language through which the teacher would have communicated, or the complexity of the task at hand (Charamba 2019a; Vogel and García 2017). I also noted an absence of linguistic boundaries, which enabled a flow of linguistic current across the science classroom (Cenoz and Gorter 2015; Hamman 2018; Vogel and García 2017). Through translanguaging, these students were able to comprehend and make sense of new scientific knowledge while at the same time developing their proficiency in English (Hamman 2018; Meyerhöffer and Dreesmann 2019). This was revealed by Mmabatho Mokoena when she said:

> "I have also noticed that besides mastery of scientific concepts, most of my students' spoken and written English has improved. They are now more conversant in English than they were before I opened up the linguistic space. Yes, translanguaging does help content mastery and language learning" (Interview, 24 September 2019).

Mmabatho Mokoena's response demonstrates the potential of translanguaging in fostering opportunities for science learning while at the same time suggesting how fluid language spaces can facilitate students' mastery of the LOI (Charamba 2019a ; Cenoz and Gorter 2015; Kiramba and Smith 2019). These findings suggest that science teachers in multilingual settings should foster a translanguaging space that

encourages science students to draw upon their entire linguistic repertoire for meaning-making in the classroom (Hamman 2018; Preece 2019; Vogel and García 2017). Translanguaging theory has provided teachers with a useful framework for understanding the lived linguistic practices of multilingual students and to find ways of scaffolding science learning in these multilingual spaces prevalent in the 21st century (Cenoz and Gorter 2015; Hamman 2018; Kiramba and Smith 2019; Vogel and García 2017). Within the field of education, García (2009) has introduced translanguaging as a way of representing the fluid discursive practices of multilingual students.

Based on the perspective of Ofelia García and Tatyana Kleyn (2016), translanguaging in this study represented a shift from viewing the multilingual brain as multiple monolinguals in one person to considering the multilingual mind as a single system with diverse linguistic features (Charamba 2019a; Meyerhöffer and Dreesmann 2019). In Mmabatho Mokoena's science classroom, the students transcended boundaries of the named languages, thereby suggesting we should think of multilingual science students as individuals with a single linguistic system (the inside view) which society (the outside view) separates into two or more named languages (Charamba and Zano 2019; Cenoz and Gorter 2015; Hamman 2018; Paquet and Levasseur 2019; Vogel and García 2017).

The present study joins the body of research on translanguaging pedagogies pointing to their beneficial use in the science classroom. For example, Joana Duarte (2019) examined how 15-year-old students applied their various linguistic repertoires to tackle tasks in content-matter classrooms. Her analysis of speech acts suggests that students resorted to using multiple languages, especially the home language, in cognitively challenging task-talk activities (Charamba 2020b; Cenoz and Gorter 2015; Li and Lin 2019). In peer action talks, the 15-year olds moved between languages to clearly present their ideas and to construct new content knowledge.

In another study, Laura Portoles and Otilia Martí (2017) investigated the simultaneous use of multiple languages in early language learning. Their findings suggest that the monolingual approach does not facilitate effective teaching and learning. In my own previous research (Charamba 2017, 2019a, 2019b, 2020a, 2020b, 2020c), I have demonstrated how science students and teachers in multilingual classrooms achieve voice and agency by challenging discourses otherwise framed in monolingual perspectives. The participants in the present study used their full linguistic repertoires in flexible ways and drew on several languages as linguistic resources to gain epistemic access in the science classroom (Cenoz and Gorter 2015; Hamman 2018; Vogel and García 2017). Therefore, based on the present and other similar studies, it seems viable to state that translanguaging pedagogies have moved beyond Cen Williams' initial idea (Williams 1994) and could be leveraged as a useful pedagogical tool in the science classroom (Charamba 2019a; Meyerhöffer and Dreesmann 2019).

However, when it comes to African languages, for example isiZulu in this case, some words can either facilitate or pose challenges regarding the understanding of scientific concepts. For example in Excerpts 3 and 4, the word "*-qondisa*" in isiZulu can, apart from "direction" be glossed as "enlighten, explain, instruct, direct, put on the correct way, straighten, correct" – but in the context of the lesson, it clearly means "direction". In Except 4, where the word is followed by "*okufanayo*", meaning "same/similar", the meaning of the sentence comes across quite unequivocally as

"in the same direction", implying that the cells are facing the same direction. In this case, it is the word *okufanayo* that was extremely helpful to any science learner trying to understand the explanation of a circuit. The English word "same" is not nearly as helpful to a second language speaker as "*okufanayo*" in isiZulu.

In Excerpts 1 and 4, we have the word "*amandla*" which in isiZulu has several meanings, including "force", "power" and "strength". This creates the possibility of misunderstanding if the word is presented on its own. However, the presence of "*kagesi ngeke ageleze ngoba*", [electricity will not flow because], would help the science learner understand that here reference is being made to voltage (*amandla kagesi*). The development of a bilingual dictionary during the lessons also contextualises the usage of words and defines respective meanings, thus reducing challenges presented by the multiple meanings of some words, for example *umjikelezo* [circuit]. Building their own bilingual table, as shown in Excerpt 6, can be more conducive to the students' learning than using ready-made dictionaries. For example, authors of one isiZulu-English bilingual dictionary urge the discontinuity of the word "*ugesi"* to mean electricity and rather advance the usage of "*i(li)lektrisithi"* (Doke et al. 2006). However, in real life some people still use *ugesi* referring to electricity. Therefore, misunderstanding can only be dealt with through contextual corpus development, such as the one developed during the current study.

Conclusion

In the study presented here, I sought to explore translanguaging practices within a multilingual fifth-grade classroom and find out how these practices shape students' opportunities for learning science. The observations I made during the science classes and the teacher's interview responses indicate that allowing translanguaging in the classroom provides support for scientific knowledge acquisition (Li and Lin 2019) while simultaneously developing students' proficiency in the LOI (Charamba 2019a; Cenoz and Gorter 2015; Hamman 2018; Somerville and Faltis 2019). During the lessons I observed, in their conversation about the scientific content, students and the teacher moved in linguistic loops (Karlsson et al. 2018), making use of their entire linguistic repertoire in a pragmatic and functional way for epistemological access (Vogel and García 2017). Translanguaging is a practice that disregards "language boundaries" (Cenoz and Gorter 2015; Windschitl et al. 2018) and does not treat them as isolated means of communication. The concept of translanguaging is dynamic and implies speakers' activity across a linguistic spectrum rather than the interaction of closed systems (Charamba 2019a; Hamman 2018; Li 2018; Vogel and García 2017).

In the present study, the classroom observations and interview responses showed that the participants used their linguistic repertoire to clarify and review the scientific content (Charamba 2019a), Meyerhöffer and Dreesmann 2019), to construct rapport and to increase their participation in the lesson (Bonomi 2019; Vogel and García 2017). Given the fluid nature of a translanguaging approach, teachers can acknowledge students' linguistic repertoire and implement translanguaging pedagogy in multilingual science classrooms for epistemic access (Charamba 2019a; 2019b; Cenoz and Gorter 2015; Hamman 2018; Holdway and Hitchcock 2018; Vogel and García

2017). However, in applying this concept, more research is needed to explore – within particular sociolinguistic contexts – how translanguaging would be best implemented so that we can move towards developing more equitable multilingual classrooms for all students the world over (Charamba 2019a; Charamba and Zano 2019; Cenoz and Gorter 2015; Cunningham 2019; Goossens 2019; Hamman 2018; Li and Lin 2019; Lin 2019; Vogel and García 2017).

Funding Open access funding provided by University of the Witwatersrand.

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