Scaffolding STEM education through translanguaging[1]

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ABSTRACT

Incorporating Science, Technology, Engineering and Mathematics (STEM) education in various African countries is increasingly viewed as a response to the demands of the Fourth Industrial Revolution (4IR). Most students engaging with STEM disciplines in Africa are English as a second language (ESL) speakers, while the medium of instruction remains English. This paper critically examines translanguaging as a potential pedagogical strategy for the effective teaching and learning of STEM subjects within ESL contexts in Zimbabwean secondary schools. Data were gathered through semi-structured interviews with 16 science and mathematics teachers who were equitably drawn through purposeful sampling from two rural and two urban secondary schools in Zimbabwe. Two non-participant lesson observations were also conducted at each of the four selected schools. The findings reveal that the incorporation of learners' first language (L1) in STEM instruction correlates with improved outcomes. Translanguaging serves as a beneficial instructional approach in bilingual and multilingual educational environments as it recognises and leverages the coexistence of multiple languages and represents a significant advancement towards the intellectualisation of African languages. The government, through the Ministry of Education, should integrate translanguaging in its language-in-education policy.

Keywords: co-existence of languages; dynamic bilingualism; science and mathematics; STEM education; translanguaging

INTRODUCTION AND BACKGROUND

The instruction of STEM subjects, specifically science and mathematics, has historically been conducted in the English language within the educational systems of Anglophone Africa (Brock-Utne, 2016; Nhongo & Tshotsho, 2019, 2020). African languages have often been perceived as inadequate for facilitating the teaching and learning of STEM subjects (Brock-Utne, 2016; Nhongo & Tshotsho, 2020) because of their perceived inadequacy in terminology. Consequently, the instruction of science and mathematics exclusively in English places many

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learners who are English as a second language (ESL) users at a disadvantage. This, however, does not take away the fact that there are many other ESL learners who prefer to learn science and mathematics in English (Makupe & Machaba, 2024). The linguistic terrain in Africa is either bilingual or multilingual but this scenario has not been given serious attention when it comes to the educational environment (Bamgbose, 2015; Brock-Utne, 2016; Kamwangamalu, 2019). The paper explores ways in which translanguaging as a teaching and learning strategy can be used in incorporating African languages in STEM instruction.

Chumak-Horbatsch (2012: 56) observes that in the process of translanguaging, bilinguals 'make use of multiple communicative possibilities, practices, and choices. They use their language flexibly, shifting, mixing, and blending linguistic features'. As they translanguage, 'they go back and forth from one language to the other, combining elements from each language to convey their language and social skills and their cultural knowledge and understanding' (Chumak-Horbatsch, 2012: 56). Translanguaging acknowledges linguistic diversity in multilingual educational settings giving students the liberty to shuttle between languages without necessarily adhering to the rules of languages that are co-existing within a linguistic ecology. The exploration of language as a key resource in teaching STEM subjects in multilingual settings is essential (Bamgbose, 2015; Brock-Utne, 2026). African languages have been deemed insufficient for teaching and learning STEM subjects due to the perceived inadequacy of their technical terminologies (Bamgbose, 2015; Nhongo & Tshotsho, 2020). This paper argues that translanguaging is a promising instructional strategy, especially in bilingual and multilingual educational settings. Despite coexisting with African languages in Zimbabwe and other Anglophone African countries for two centuries, English remains isolated and privileged as the predominant instructional language. The paper challenges the notion of English as a monolithic and autonomous language in multilingual educational settings and further contests the treatment of African languages as separate tools of communication, arguing for their interconnectedness.

Kamwangamalu (2019), Davydova and Ilg (2023) and Mirhosseini and de Costa (2024) argue that considering the form and functions of English in Africa, it should as well be seen as an African language. He explains:

> In terms of functions, perhaps more than any native African language, English plays a pivotal role in virtually all state institutions, including government and administration, the media, the formal economy, and education, and it serves as a link language between speakers of various languages (Kamwangamalu, 2019: 115).

In Africa, and particularly in Zimbabwe, English has long been treated as a foreign language, which has created numerous challenges in the education sector. However, English has been present in Zimbabwe for over a century, nearly as long as other African languages such as isiXhosa, Chichewa, and isiNdebele. Given Zimbabwe's linguistic history, it is inappropriate to continue viewing English as a foreign language or the sole language capable of addressing STEM issues.

Some sections of society believe that African languages cannot be used in the teaching and learning of STEM subjects. Bamgbose (2015) argues that science cannot be taught in African languages because the terminology for African languages is not yet developed. On the other

hand, Nhongo (2024) suggests that the most realistic way to develop discipline-specific terms in African languages is to use these languages so that the terms can emerge through use. That process can also lead to the intellectualization of African languages (Nhongo & Siziba, 2022; Siziba & Nhongo, 2024). One implicit premise is that for African languages to be used as instructional tools, they must be used alongside English through a process of translanguaging. This approach would also facilitate the development of terminologies for STEM subjects. STEM terminologies will likely emerge as African languages are utilized through translanguaging, serving as a scaffolding process. All languages that are present in the learning environment should be considered valuable resources. These languages, English included, do not necessarily need to be separated but are supposed to be used together through a process of translanguaging. Selecting a specific African language as the sole medium of instruction for STEM subjects presents the ongoing challenge of terminology. Simultaneous use of all available languages, including English, through translanguaging can facilitate teaching and learning, potentially enhancing cognition. Research suggests that using multiple languages in teaching and learning environments can positively impact cognitive development (Chumak-Horbatsch, 2012; García, 2011; Vygotsky, 1962). A promising approach to incorporating African languages into STEM education involves leveraging the linguistic diversity of the classroom by utilizing all available languages, including those that coexist with English. STEM has been defined by Tsupros, Kohler and Hallinen (2009: 10) as follows:

> STEM education is an interdisciplinary approach to learning where rigorous academic concepts are coupled with real-world lessons as students apply science, technology, engineering, and mathematics in contexts that make connections between school, community, work, and the global enterprise enabling development of STEM literacy and with it the ability to compete in the new economy.

STEM education is primarily focused on teaching and learning of science in the fields of technology, engineering and mathematics. Its goal is to enhance economic growth and improve livelihoods by fostering technological advancements. STEM education aligns with the goals of Fourth Industrial Revolution (4IR). Rosa and Orey (2018: 222) observe that 'In many modern economies with a high demand for qualified researchers and technicians, STEM is a major thematic domain'. Lee and Tan (2013: 2) note that Southern African countries are enthusiastic consumers of the kind of STEM subjects that are taught in Singapore. Kim, Chu and Lim (2015: 209) state that 'STEM has been emphasized in East Asian countries for the past few decades'. The Southern African countries have been motivated to adopt STEM education because of its success in the Asian countries.

In 2016, Zimbabwe adopted STEM education. In 2017, the then Minister of Higher Education, Science, and Technology Development, along with the vice chancellors of Zimbabwe's state universities, toured several Asian countries to consult on STEM education. They were advised to integrate the arts into STEM, which led to its immediate transformation into STEAM. The minister then encouraged all state universities to emphasize the arts and to establish departments of African languages at each institution. As language became a component of STEM, this paper examines the inclusion of African languages in the teaching of STEM subjects. Debates on STEM education have since centred on the idea that science and mathematics should be taught in African languages. In response, the Ministry of Primary and Secondary Education (MoPSE) initiated the development of science and mathematics teaching materials for Early Childhood

Education. However, teaching STEM subjects in African languages has been hindered by the lack of developed terminologies for those subjects. This paper argues that translanguaging can address the shortage of specialized terminologies in African languages.

TRANSLANGUAGING IN TEACHING AND LEARNING

'Translanguaging', a term used in linguistics to refer to a communicative approach by bilinguals and multilinguals to shuttle between languages was initially introduced by Cen Williams, who coined the Welsh term *trawsieithu* to refer to a teaching strategy employed in Welsh-English bilingual classrooms. This approach aims to enhance and develop children's listening, speaking, reading, and writing skills in both languages (Chumak-Horbatsch, 2012). It has been observed that 'Translanguaging builds on research conducted by Moll and his colleagues in 1962, stressing the importance of historically accumulated and culturally developed bodies of knowledge and skills essential for functioning' (Lubliner & Grisham, 2017: 1). Translanguaging is 'the deployment of a speaker's full linguistic repertoire without regard for watchful adherence to the socially and politically defined boundaries of named and usually national and state languages' (Otheguy, García & Reid, 2015: 283). On the other hand, Poza (2017: 101) says that 'language classification has been a construct to control variety and difference and thus it excludes mixed language practices', and other ways of using languages in multilingual networks. Translanguaging is argued to be the solution as to how language should be used for pedagogics in multilingual educational settings. Translanguaging is a realistic approach to the description of language use in multilingual and bilingual settings where all existing languages are afforded opportunity to function freely without observing the grammatical rules of each language involved. Lubliner and Grisham (2017: 1) argue that 'Translanguaging is reality-based; it is the way bilingual children and adults use a full repertoire of linguistic resources to communicate with one another'. García (2011), Chumak-Horbatsch (2012) and Childs (2016) note that translanguaging has become a common communicative practice in many parts of the world. Since translanguaging has positively been argued to be the most effective communication strategy, it is therefore prudent to adopt it as an instructional method of scaffolding STEM education in bilingual and multilingual African educational contexts.

Jayathilaka, Jeong and Ryu (2024: 1706) argue that translanguaging 'acknowledges and values students' linguistic resources, thus allowing multilinguals to draw upon their entire linguistic repertoire to comprehend and express ideas'. Lubliner and Grisham (2017: 1) are of the view that 'the movement toward translanguaging reflects a tremendous change in perspective and practice regarding the education of children who enter schools speaking languages other than English'. The importance of translanguaging is critical to learners in that the 'opportunity to use home languages in the classroom gives them a voice and builds and capitalises on their home language practices, allowing them to take ownership of their home language' (Chumak-Horbatsch, 2012: 56). Childs (2016) says that the languages that learners already have are crucial resources for enhancing cognition. Translanguaging as a language process is most ideal in multilingual educational contexts especially where the learners and their instructor share familiar languages (Mwinda & van der Walt, 2015; García, 2016). This does not mean that translanguaging would not work where the teacher has a different L1 from that of the learners. However, García (2016) suggests that the teacher should be prepared to learn

the learners' L1 in situations where they are unfamiliar with the learners' home language. It should be noted that where translanguaging takes place it is not mandatory that the teacher should learn the learners' L1.

The research done by Mbirimi-Hungwe and Hungwe (2018) suggests that translanguaging is an important intervention strategy for teaching computer science and should be adopted by the wider multilingual university community. Similarly, Wildsmith-Cromarty (2018) in her study that looked at how isiZulu naturally interacted with English in a classroom situation concluded that translanguaging has cognitive benefits. Other research on translanguaging in teaching and learning includes studies by Makalela (2015); Ngcobo et al. (2016); Ngcobo (2018), and Hungwe (2019) among others, all of which focused on the context of South Africa. In the Zimbabwean context, Nhongo and Tshotsho (2019) explored the ways in which translanguaging can be used an instructional method in science and mathematics classrooms. They suggested that the language-in-education policies need to be explicit on how translanguaging can be adopted as an instructional strategy in situations where languages coexist.

Other studies have also explored the use of translanguaging in the teaching of STEM subjects. Han and Zhang (2014) explored the use of translanguaging as a method for communicating science fiction and developing the plot in a literary text entitled '*Story of your Life*'. Charamba (2022) argues that the decreasing pass rate in science subjects in South Africa is as a result of the difference between the language of instruction used in schools and the learners' home language. Charamba (2022) observed that monolingual pedagogies in science subjects remain the major problem although the language-in-education policy of South Africa puts emphasis on multilingualism. Charamba (2022) suggest that there is need for the adoption of translanguaging as an instructional strategy in multilingual African science classrooms. Ndhlovana and Charamba (2023) conducted a systematic literature review of studies conducted the use of translanguaging as an instructional tool in the fourth to sixth grade Natural Sciences classrooms in South Africa. From their study, they concluded that translanguaging has become a culturally socially just pedagogy that enhances cognition and as such they recommended the use of translanguaging pedagogy in Natural Sciences classrooms.

THEORETICAL FRAMEWORK

The arguments presented in this paper are grounded in the theory of dynamic bilingualism. Dynamic bilingualism 'refers to the development of different language practices to varying degrees in order to interact with increasingly multilingual communities and bilinguals along all points of the bilingual continuum' (García & Kleifgen, 2018: 57). It challenges the autonomy of coexisting languages in a bilingual educational context and emphasizes on the idea that speakers draw from a range of linguistic features and practices. According to García (2011: 144), dynamic bilingualism refers to 'language practices that are multiple and ever adjusting to the multilingual multimodal terrain of the communicative act'. It has been observed that García's proposal of dynamic bilingualism was a reaction to new dimensions in communication resulting from globalisation (Chumak-Horbatsch, 2012: 54). García and Kleifgen (2018: 57) note that dynamic bilingualism does not entail adding another language, but it relates to 'developing complex language practices that encompass several social contexts'. García (2011:

43) confirms that dynamic bilingualism is synonymous with plurilingualism. This is because dynamic bilingualism exhibits the translanguaging practices of bilingual learners in the process utilising languages in their immediate environment (García & Li Wei, 2014; Baker & Wright, 2021;). García and Kleifgen (2018: 57) note that

> within a bilingual perspective, languages are not simply perceived as autonomous and separate systems that people 'have', but rather as linguistic and multimodal features of a semiotic meaning-making repertoire from which people select and 'do'.

Dynamic bilingualism is 'a theory that focuses on languages that speakers use rather than on separate languages they have' (Chumak-Horbatsch, 2012: 53). Speakers of African languages become bilingual as soon as they enter school because of exposure to English as an L2. Some become bilingual even before entering school through exposure to English or any other African language. Failure to involve the learner's L1 in learning or making exclusive use of their L1 hinders effective communication during learning. These learners alternate between languages, demonstrating that they are dynamic bilinguals, which makes translanguaging an important instructional strategy. Dynamic bilingualism, as a theory, is significant in this paper as it highlights the resourcefulness of all available languages in a classroom context, advocating for their utilization due to the substantial cognitive benefits they offer to learners.

METHODOLOGICAL PATH

This study adopted a qualitative approach for data collection, presentation, and analysis. By emphasizing narrative and descriptive methods, the approach was well-suited to exploring and understanding the nuanced practices and experiences of translanguaging within science and mathematics classrooms. Schools where the study was conducted and teachers who participated in the study were selected through purposeful sampling. Data were collected using four secondary schools as case studies, where two of those schools are in Bulawayo urban and the other two in Matobo rural District. Two non-participant lesson observations were conducted at each of the four selected schools where one was done in mathematics and the other in science. The researcher did not interfere with or contribute to the lessons but was present only to observe how language was used during instruction. The study focused on Forms 3 and 4 which constitute Ordinary Level according to the education standards of Zimbabwe. A pass or fail is determined at this level and an individual is expected to attain at least five subjects in order to be considered as having succeeded. Form 3 represents the 10th year of schooling while Form 4 is the 11th. The researchers used double-period lessons for observations which took a duration of 70 minutes on average. The main interest was on understanding how communication occurred between teachers and learners, as well as among learners, in these bilingual settings.

Instances of translanguaging were observed, although neither the teachers nor the learners appeared to be aware that they were engaging in translanguaging. While translanguaging refers to the fluid integration of multiple languages (García, 2009), code-switching entails the combination of two discrete name languages (Balam, 2021). The most common strategy was switching between languages, which was considered part of the translanguaging process. The lesson observations were followed by semi-structured interviews which were conducted with 16 mathematics and science teachers to explore how language is used in their daily teaching. Four teachers, two for mathematics and two for science, were interviewed from each of the four case

study schools. Each interview lasted approximately 20 minutes. The idea was to explore how teachers engaged learners in multilingual classrooms. A descriptive approach which took the form of narrating how language was used during the non-participant lesson observations was adopted in presenting data. The descriptive approach also incorporated additional insights from the semi-structured interviews. The analysis was conducted through the lens of dynamic bilingualism, examining how translanguaging occurred.

In compliance with research ethics, the researchers obtained clearance from the MoPSE before engaging with school heads, who granted permission to collect data from their schools. The researchers did not interact directly or engage the learners during the study. Any questions regarding the learners' use of language in the classroom were directed to the teachers through interviews conducted after the lesson observations. The researchers did not coerce the teachers into participating in the study or conducting observations in their classrooms; participation was entirely voluntary. Explanation regarding the purpose of the study was provided to the teachers who participated in the study, and the teachers, in turn, informed the learners about the researchers' presence.

RESULTS

Various languages were involved in the teaching and learning processes in both Bulawayo and Matobo. In Bulawayo, the languages observed in the classrooms were English, Shona, and Ndebele. In Matobo, Ndebele, English, and Kalanga were the predominant languages, although three of the eight teachers involved in the study were Shona L1 speakers. These Shona L1 teachers mentioned that they had no difficulty with Kalanga, as Shona and Kalanga are mutually intelligible. The non-participant observations revealed that translanguaging was occurring during teaching and learning, even though both teachers and learners appeared unaware of this. The language practices that were observed to be taking place during the lesson observations included alternating between languages, code-mixing and code-switching. There were also instances where both learners and teachers mixed languages without adhering to specific grammatical rules. For example, some African language terms were inflected with English morphemes. While learners' L1 were incorporated as instructional languages, teachers expressed conflicting opinions about whether the Ministry permitted the use of these languages in science and mathematics lessons. Four teachers from an urban school, who also identified themselves as subject examiners of science and mathematics, explained that it is provided in the new curriculum that the language that learners understand better can be used to enhance their cognition although such use should be minimised as much as possible, as English is the official language of teaching and learning (LoTL). According to the curriculum, English is to be the primary LoTL, whereas learners' L1 should only come as a resource to scaffold cognition (Ministry of Primary and Secondary Education, 2014: 34). The teachers from both urban and rural schools acknowledged that they were aware the MoPSE does not allow them to use the learners' L1 as the sole LoTL. They all concurred that it was necessary to incorporate the learners L1 in teaching mathematics and science despite the MoPSE's stipulation that instruction should be in English. One science teacher from a rural school said:

> I am not very sure about the position of the Ministry in teaching the learners in isiNdebele but the head is very strict on that as he does not want learners to be taught in isiNdebele at all. We sometimes explain to him that this is a rural school and learners have no

> exposure to English, they don't even understand simple grammatical constructions but the head has always advised us to simplify the language that is used in science because once learners are aware that we also explain in Ndebele they will never at all put an effort to make themselves proficient in the English language.

Eleven of the 16 teachers interviewed were unclear about the MoPSE's position regarding the inclusion of the learners' L1 as LoTL. All the 16 research participants, however, concurred that the MoPSE should come up with a curriculum policy that provides for the inclusion of the learners' L1 in teaching and learning.

Non-participant observations of eight mathematics and science lessons, averaging 70 minutes each, revealed that learners were more engaged when isiNdebele, their dominant L1 in Bulawayo and Matobo, was used. In many cases, teachers would provide initial explanations in English, followed by clarifications or emphasis in isiNdebele. The following is an example of one of the verbatim excepts as laid out by one science teacher during observation where the content being taught was focused on energy chain:

> As you can see at the top we have the sun, followed by vegetation - trees and grass, then grazers and herbivores impala, *ondlovu, amadube, lenkonkoni* (impala, elephants, zebras and wild beasts), then carnivores right below. So *liyabona ukuthi ilanga liqakathekile ngoba yilo eliletha impilo. Yonke lenergy isukela elangeni kusiya kusehla yikho abadala babengadli inyamazana ezidla inyama ngoba azila kudla okuqakathekileyo emzimbeni*. (So you see that the sun is important in bringing life. All the energy in foods comes from the sun that is the reason why our elders never ate animals that feed on meat because they are not rich in nutrients that are required by the body).

In this excerpt, the teacher is not merely translating but is shuttling between English and isiNdebele and at the same time putting emphasis and trying to make clarification on some key points of the matter being taught.

In some instances, the Kalanga language was used in the rural setting of Matobo, although its inclusion was initiated by the teacher. When TjiKalanga was incorporated, it initially seemed as though the teacher was joking with the learners, and they responded in TjiKalanga as if they were joking too. However, it was observed that effective teaching and learning were actually taking place. The classroom atmosphere became more relaxed when English, isiNdebele, and TjiKalanga were used together. TjiKalanga has not been used in education for a long time, and the way the teacher incorporated it during the science lesson increased learner participation. In the other three lessons, one science and two mathematics, isiNdebele and English were dominant. TjiKalanga only emerged when learners were emphasizing points in isiNdebele and would naturally include TjiKalanga, as it was the language they spoke at home. During interviews, the eight teachers from these rural schools noted that many of the learners primarily used TjiKalanga as their first language at home, and some concepts made more sense to them when explained in TjiKalanga.

In a Form 3 science classroom in a rural setting, where the lesson focused on ecosystems, the teacher initially used English throughout the session. This was followed by the teacher asking a

question in English where only one learner raised his hand and provided a correct answer but ungrammatically constructed. The teacher went on to explain the same concept in isiNdebele and subsequently asked the same question that was asked before while mixing English and isiNdebele. Unsurprisingly, this time around more than three quarters of the class raised their hands a sign that the incorporation of isiNdebele aided the learners understanding of the concepts of ecosystem. All the 16 research participants who were interviewed strongly agreed that the learners L1 need to be incorporated as LoTL in science and mathematics lessons as this increases learner participation and understanding of concepts. The teachers' sentiments were clear that the inclusion of the learners L1 in teaching and learning did not entail dislodging English language. One mathematics teacher from a rural school raised the following sentiments:

> Some of the concepts cannot be easily explained in English especially here in rural areas. If you don't use vernacular, you cannot meet the set objectives of the lesson.

Due to its limitations that imply that vernacular is a language that is inferior, primitive and less developed, it is not formally used in this paper. However, vernacular can be defined as an everyday language that is used by ordinary people in a particular community. A science teacher from one urban school said:

> Using Ndebele would make learners understand better. For the teacher to flow together with the learners, use the language that they understand better. It is proper for Ndebele to be used for delivering concepts, but teachers should also use English because it is the language that is used for assessment.

A mathematics teacher from an urban school who was also an examiner pointed out:

> Use of vernacular cannot be ruled out. When solving word problem maths learners lose out when these are given in English. A teacher has to make explanations in English at the same time throwing in vernacular here and there. Where they don't understand then vernacular only can be used but mindful of the fact that they will at the end be assessed in English.

From the class observations it was apparent that code-switching as part of translanguaging dominated as a linguistic repertoire in the science and mathematics classrooms.

The researchers also aimed to understand the sequence teachers followed in using the available languages during instruction. They wanted to determine whether teachers introduced new concepts in English before explaining in the learners' first language (L1), or if they began with the learners' L1 and then explained in English, used both languages concurrently, and used the languages fluidly without strict boundaries based on each language's linguistic repertoire. Of the sixteen teachers interviewed, nine stated that they start by delivering instructions in English and then switch to the learners'L1 when explaining concepts. Two science teachers mentioned that they begin with the vernacular before switching to English, while seven indicated that they use code-mixing English throughout the lesson utilising the available languages. Five of those nine who indicated that they begin with English also said that they incorporate code-mixing in the process if the concepts being taught are complex or unfamiliar to the learners. The way teachers operate in the science and mathematics classrooms demonstrate the use of

translanguaging in classes that are characterised by learners who are dynamic bilinguals. It is important to recognize that all four of these approaches, where teachers incorporate the learners' home language in teaching STEM subjects, are valuable. These methods are crucial because using the learners' L1 is a valuable resource for understanding concepts, rather than relying solely on English as a second language (ESL), in which the learners may have limited proficiency.

The research participants also mentioned that the learners' L1 is a valuable instructional resource. Seven teachers who participated in the study and were well versed with science and mathematics content said that the learners' L1 alone as a resource is not enough but there is need to ground content within the physical and social environment of the learners so that they understand what they are being taught. In linking this idea with the curriculum, one mathematics teacher from an urban school highlighted that

> Locally available resources should be used and the learners' local language is one of those resources. Indigenous knowledge systems should be used together with any other tools that are available in the learners' environment.

From this assertion it is therefore evident that translanguaging becomes an effective strategy when learners are introduced to concepts that fall within their physical environment and also communicated in both their L1 and L2. Bangura (2014: 12) argues that 'children in Africa should be taught African-centred Mathematics as such an approach would lead to development'.

The teachers emphasised that assessments are, and should continue to be, conducted in English. They noted that incorporating learners' L1 during instruction is more beneficial than totally excluding them. While all the 16 teachers interviewed agreed that the learners' L1 should constitute part of science and mathematics instruction, they however, pointed out that assessments should remain exclusively in English to ensure that learners are not disconnected from the broader global context. The teachers also pointed out that, although African languages are used in the classroom, the textbooks are written in English, and therefore English should remain the primary language of instruction, with the learners' L1 incorporated to aid in the understanding of concepts. One of the teachers from an urban school said:

> While vernacular is important in teaching, learners need to also master English so that there they use in in examinations because it can be confusing to have many languages being used when it comes to national examinations as some markers may not be knowledgeable when it comes to some languages that we have in Zimbabwe. Let me point out that the Ministry is very strict when it comes to the language of assessment because the only recognized language is English. As teachers we are allowed to use vernacular here and there during teaching but it must not be used throughout. I can tell you that this other year I used English throughout in my teaching and the learners failed dismally and the following year I would make emphasis in Ndebele and the pass rate improved. From there on I rely on vernacular where I realise that the learners are finding it hard to understand the maths problems in English.

The learners L1 as instructional language appears to be the most favoured and there is evidence from the research participants' sentiments that these languages are invaluable instructional resources. It is also clear from the teachers views and from the lesson observations that translanguaging is an important method of scaffolding science and mathematics instruction in multilingual and bilingual classroom contexts.

DISCUSSION

Translanguaging has proven to facilitate effective learning in STEM classrooms in ESL contexts. The fact that more three quarters of the class showed interest in providing the answer when questions were asked in their L1, compared to only one response when only English was used, underscores the importance of translanguaging in such settings. Instances where both the learners' L1 and English were used simultaneously, while still maintaining a clear message, demonstrated that dynamic bilinguals can easily grasp the content, even when code-switching is involved. Both learners and teachers were able to navigate between two languages, highlighting their ability as dynamic bilinguals. This suggests that there is need for translanguaging to be adopted as an instructional method for scaffolding STEM education. Choi (2024), García (2009) and Nehra (2024) put emphasis on translanguaging as an invaluable method for bilingual learners, as it allows them to use their L1. Including the learners' L1 is crucial for making concepts more realistic and relevant, thus boosting curiosity and cognition among learners.

The fact that teachers were unaware of what the language-in-education policy stipulates regarding the learners' L1 in STEM classrooms highlights the need for the MoPSE to clearly communicate its position on using languages as resources in teaching and learning. Although the curriculum specifies that English should be the primary medium of instruction, with learners' L1 also available as a resource (Ministry of Primary and Secondary Education, 2014: 34), school authorities must ensure that teachers are informed and aware of this policy.

One of the key concerns that arises is the question of how learners would write assessments without translanguaging when they are already used to this practice. This concern can be addressed through understanding that purpose of translanguaging is to help learners towards developing proficiency in their L2 while gaining a deeper understanding of concepts and being able to express this knowledge in L2. As a strategy for teaching STEM subjects, translanguaging is not intended to produce learners who lack proficiency in their ESL, but rather to ensure they fully grasp the concepts. Once learners understand the concepts through translanguaging, it becomes easier for them to express these ideas in ESL. Translanguaging not only helps learners comprehend STEM concepts but also contributes to their development of ESL proficiency. By enhancing their ESL skills through translanguaging, learners are better equipped to perform well during assessments, both in communicating subject knowledge and in using improved English language skills.

CONCLUSION

The inclusion of African languages as learners' first languages (L1) in the teaching and learning of STEM subjects in Zimbabwe has proven to be a more practical and effective approach. Teachers and learners often revert to African languages during science and mathematics

lessons to facilitate clearer instruction. The use of African languages for clarification during lessons demonstrates that incorporating learners' L1 in teaching is essential. It is difficult to conduct science and mathematics lessons effectively in ESL classrooms without also utilizing African languages. Even though learners in their 10th and 11th year of schooling were introduced to ESL upon entering school, the continued inclusion of African languages at this level has shown positive results. This suggests that leveraging learners' dynamic bilingual abilities is crucial for success. It became evident that these learners can draw on multiple languages to facilitate effective communication during science and mathematics lessons. Translanguaging has been shown to be an effective instructional strategy in bilingual and multilingual contexts, particularly in science and mathematics. Code-switching, as part of translanguaging, emerged as the most frequently used strategy.

There was a general consensus among all science and mathematics teachers that incorporating learners' L1 in teaching and learning leads to positive outcomes for the learners. The use of learners' L1 was found to enhance classroom participation, enabling teachers to assess whether students understood the concepts. Relying solely on English tends to silence learners, resulting in poor performance in STEM subjects. While the use of learners' L1 through translanguaging has proven to be beneficial, there remains confusion about how African languages should be effectively utilised as resources in the classroom. Some in the education sector believe that incorporating African languages into science and mathematics instruction means abandoning English altogether. Others are concerned about the language used in assessments and the potential impact on learners' English proficiency due to the inclusion of African languages in STEM education. A clearly defined policy from the MoPSE is needed to provide guidance on how African languages can be utilized as valuable resources in teaching and learning. There is no reason why the languages learners use in their daily lives should be excluded from schooling, as these languages can facilitate effective communication and improve cognition.

In Zimbabwe, all reading materials for STEM subjects in secondary schools are written in English, necessitating English-language assessments. The incorporation of African languages is not intended to replace English but to enhance understanding, a crucial aspect of learning. The inclusion of African languages not only facilitates comprehension of STEM subject matter but also leads to improved English language proficiency. Therefore, there is no reason to be concerned about the language of assessment, as these learners will ultimately be capable of being assessed in English. The coexistence of ESL and African languages as learners' first languages should not be seen as a problem but rather as an advantage for both teachers and students. The MoPSE needs to develop a clear strategy for how learners' L1 should be used in the classroom, as current practices vary widely among teachers. The language-in-education policy should redefine multilingualism to move away from the belief that it means exclusively using a particular African language at the expense of English and other African languages. Multilingualism should recognize the coexistence of languages in a specific linguistic context and incorporate these languages through translanguaging. If translanguaging is effectively utilized, African languages will eventually become intellectualized, ESL learners will begin to appreciate STEM subjects, STEM subject pass rates will improve, learners' English proficiency will increase, and the goals of the Fourth Industrial Revolution will be achieved.

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