International Journal of Research
Available at https://pen2print.org/index.php/ijr/
e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 05 Issue 20
SEPTEMBER 2018

The role of translanguaging in building Science knowledge: Exploring the relational dimension of epistemological development.

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Declaration by authors

We undertake that this article has not been published in same or similar form elsewhere and that all work is original and where applicable scholarly references have been acknowledged. We also agree that this article may be referred to another Chief Editor in our group if better suited to that journal.

Abstract

The mantle of language in the generation and development of concepts is incontrovertible . Science at school level is grossly regarded as a practical subject, but its effective teaching and learning requires language proficiency, be it written or shared orally during tutelage. This demonstrates therefore that both the learners' and teacher's language and scientific language all play an entwined but salient role in the effective dissemination and maximum comprehension of science concepts. The current study involves a group of grade 11 learners (n= 40; 25 girls and 15 boys) aged between 15 and 17 whose home language is Southern Sesotho and are all taking science as a full time subject. The learners were taught in both English and their home language, and were given academic materials written in their home language on the topic taught. A post- test was

e-ISSN: 2348-6848
p-ISSN: 2348-795X
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given and interviews conducted with the students with results highlighting the important role played by one's home language in the science classroom.

Key words: science education, translanguaging, multilingualism, home language.

Introduction

"Ha o bua le motho ka puo a e utwisisang, sena se ya hlohong ya hae. Empa ha o bua le yena ka puo ya hae, sena se ya pelong ya hae" Nelson Mandela (2010).

"If you talk to a man in a language he understands, that goes to his head. If you talk to him in his language, that goes to his heart," Nelson Mandela (2010).

Language and learning are enmeshed because all teaching is done through linguistic channels. Language is therefore considered both a prerequisite for conception and a bearer of perception (Fortanet-Gomez, 2013; Miller, 2008) and therefore influences the extent to which a learner understands the tutorials. This is because language is indispensable in communication and education as it can bestow bridges to new opportunities, or build barriers to equality. Language connects, disconnects, creates unity, and can cause conflict depending on how it is used.

The predominant challenge in the present day classroom is to meet the needs of learners from linguistically diverse backgrounds who have a limited proficiency in the language of instruction (Lemmer, 2010). In South African schools Science education is administered through either English or Afrikaans language which are the home languages for less than 20% of the total population in the country (Statistics SA, 2017).

Recent studies suggest that one of the major causes of learners' academic underachievement is the use of a language of instruction different from the learners' home language (Baker, 2011; Childs, 2016; van Laere, Aesaert and van Braak, 2014). This justifies the deduction by educational analysts that both languages are a major cause for the current learners' underachievement in Science

e-ISSN: 2348-6848
p-ISSN: 2348-795X
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education as they are used as the languages of instruction in respective schools (National Senior Certificate School Subject Report, 2017).

As alluded to earlier on, according to Statistics SA (2017) about 80% of the country's population are 'black Africans', leaving 20% to be shared among whites, coloureds, and Indians/Asians. This therefore evidently means that in the majority of Science classrooms in the country the two languages used for instructional purposes (English and Afrikaans) are neither the home language of the teacher nor the learner.

South Africa boasts of 11 official languages but teaching in 89% of the schools remains in English, especially for subjects such as Mathematics and Science (Deacon, as quoted by The Citizen 2017). In view of this, Umalusi South Africa's quality assurance body on education concurs that it remains verifiable that learners studying in a language other than their home language continue to experience great difficulty in interpreting questions, drawing up responses, hence definitely more should be done with regards to the languages of instruction (National Treasury Report on South African Education, 2016).

The director for the Centre for Unity in Diversity, Dawood (2017) commenting on the 2017 South African grade 12 results said quality education with concomitant outcomes form the bedrock of vibrant, cohesive and growing societies and its converse entrenches inequality and social discontent. The latter well describes South Africa 23 years into democracy. Straight up global measures and local findings confirm that in terms of science and literacy the trends have moved backwards with a 2016 study revealing that at least 78% of Grade 4 learners in the country are functionally illiterate (Dawood, 2017).

A crucial study was published in November 2017 proffering a detailed understanding of the nexus between access to quality education and the advancement of social mobility for the country's most vulnerable citizens who learn in a language different from their mother tongue. *A Society Divided - How unequal education quality limits social mobility in South Africa*, by the Department of Economics at the University of Stellenbosch, makes the critical point that:

"The majority of South African learners essentially follow a learning trajectory that ultimately leads to poor access to tertiary education and poor labour market outcomes, which in turn perpetuate a cycle of desperation for generations to come that is almost impossible to escape from

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through the education system in its current state. The persistence of deep inequality two decades after apartheid is a powerful indictment of the South African education system's failure to overcome past injustices, despite considerable shifts in government spending to poor schools. It is therefore of utmost importance that South Africa addresses inequalities in educational opportunity as early as possible to promote social mobility for all learners irrespective of race, culture or language" (Eldridge, van der Berg and Rich 2017).

There is the extensive consent across the country's education researchers and analysts that for a government that spends the largest chunk of its budget on basic education, the current Science results are deplorable (van der Berg, Taylor, Gustafsson, Spaull and Armstrong 2011). An alert, educated, curious and economically robust population of young people is a vital tendon to realising the dream of a country that prizes human dignity, equality through diversity, freedom, tolerance and national unity (Eldridge et.al 2017).

Methodology

The study was motivated by the minimal proficiency of most Science learners in the district under study.

The sampling frame for this research was Grade 11 Physical Sciences learners in Fezile- Dabi district. From this sampling frame, 40 learners from two high schools took part in the research. The two schools are situated in a farming area and are referred to as "farm schools". The schools attract learners from the farming community as well as the surrounding "black townships".

The home language for most of the learners at the two schools, according to information provided by the respective principals, is Southern Sesotho whereas the language of instruction at both schools is English. Simple random sampling was used in this research to give an equal opportunity to all learners and do away with sampling bias. The sample comprised 25 girls and 15 boys. 16 participants were aged 15, 19 of them were 16 years old and the remaining 5 were aged 17. Since the research was on the effect of language on Science education, this justifies the choice of learners who were taking Science as a full time subject and the home language for all 40 participating learners was Southern Sesotho.

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Empirical data was first obtained by giving all Grade 11 Science learners in the two schools an English language proficiency test (referred to as test 1) to determine their proficiency in the language of instruction. The top 40 achievers were then invited to participate in the study. The 40 participants were then given a Science pre-test (referred to as Test 2) based on a topic they had been taught in English language. After the intervention the learners wrote a post-test.

Syntax language data were collected through an interview schedule at the end of the research. The aim of the interviews was to engage learners in a reflective exercise to look back at the learning episodes in which they had been given Science lessons in their home language (Southern Sesotho) and given an English- Southern Sesotho Physics dictionary to use as an intervention strategy.

This was an eight-paged dictionary with commonly used Science terms and expressions found under the topic *Mechanics* translated into Southern Sesotho. During the phenomenological interviews the researcher asked the interview questions in the same order and using the same wording. The use of this type of in- depth interview enabled the researcher to establish meanings or essence of a lived experience among the participants, how they experienced the lessons, and, lastly, the meanings that they (interviewees) attached to the learning experience.

The responses were written and tape- recorded by the researcher ensuring data was captured accurately for analysis. The responses were then transcribed and analysed. The interview process lasted for five days with each session taking approximately 20- 30 minutes.

Results

The results of the study divulged learners' positive feedback that validates the use of translanguaging approach in the Science classroom. The main themes that emerged from the analysis of learners' interview responses were:

Theme 1: Impact of language in academic performance in Science.

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p-ISSN: 2348-795X
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Theme 2: Academic benefits of printed Science learning materials.

Theme 1: Impact of language in academic performance in Physics

The majority of the learners indicated that they did badly in the Science pre- test due to their inability to infer the language used in the test. The test was in English language and based on a topic they had been taught in the same language as it was the language of instruction. The learners hinted that English was their second or third language hence they had limited use of the language outside the classroom. They only use the language in the classroom and once they are outside revert to their home language. Below are examples of such responses:

Excerpt 1

It was the second test [referring to the pre- test] that gave me problems. It was too complicated and I couldn't understand the language. English is not my mother tongue. It was difficult for sure. I understand Sotho and Tswana only.

Research alluded to earlier in this article underscores the close relationship that exists between the language of instruction and academic achievement in Science. The significance of language for efficacious learning becomes conspicuous if we consider that the ability to use language dictates not only the nature of a person's relationship with others and the ability to communicate, but also the capability to think, since language is the medium of much of human thought (Nieman & Monyai, 2013). Because of the evident close linkage between language and thinking, the learners' ability to think and learn depends on their aptness to utilise and comprehend the language in use.

According to a respected researcher in language development and learning, Cummins, cognitive skills are developed by speaking, reading, and writing in a person's own language. Cummins (2008) states that where a language of instruction is concerned, one should accept, by and large, that the home language which developed within the context of social interaction and which is culture bound is foundational to the thinking, learning and identity of learners.

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Researchers investigating the possible causes of underachievement among learners taught in a language different from their home language have distinguished between the use of language in natural daily set-ups and language used in academic situations (Aarts et al., 2011; Hornberger & Link, 2012; Madiba, 2014; Makalela, 2015). The authorities argue that reading printed matter or writing a class activity makes quite different demands on a learner compared to talking to a friend. On the playground learners translanguage on an inter- and intra-sentential level with their peers, something forbidden in most Science classrooms.

Research further detected that although language minority learners were able to discourse in peer-appropriate ways, in face-to-face situations in a language different from their home language, they encountered problems in utilising language in decontextualized academic situations (Baumann and Graves, 2010; Janks and Makalela, 2013). This discrepancy in what has come to be called basic interpersonal communicative skills (BICS) and cognitive academic language proficiency (CALP) by Cummins is a useful distinction for today's Science teachers and learners.

Interview responses affirmed that learners had proficiency and comprehension problems with regards to the language of instruction leading to only13.3% of them passing the proficiency test. Consequently, if 13.3% are relatively proficient in the language of instruction, how then can learners be expected to do wonders in a subject taught through a language they have limited proficiency? Evidently, in order for learners to perform well in Science they should be proficient in the language of instruction.

Theme 2: Academic benefits of printed learning materials

Science textbooks used by learners in the study are written in English language. The lessons and assessments are also in the same language as well as any additional learning resources availed to them. Predictably, according to the learners' responses these educational materials are not fulfilling their intended purpose because of the language in which they are written. Below is a direct quote from one of the respondents:

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p-ISSN: 2348-795X
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Excerpt 2

For difficulty words I kept on checking them up in the Sesotho dictionary the teacher gave me [laughs]. That helped me a lot and made me score high marks in the last test. My marks for the first two tests were low because I didn't have anything to help me and the teacher had taught us in English only and the textbook is also in a language I struggle with.

Only a few learners saluted the use of textbooks not written in their language with the majority denouncing them. Those who were negative about the textbook use are literally not so much concerned about the quality of the textbook, but rather with the way educators use them and other printed material during lessons.

Previously- and in some current scenarios- an educator may have asked the learners to open their textbooks to a particular page and then go through each paragraph or selected paragraphs explaining the concepts to the learners. In such cases the learners were or are passive listeners- not the ideal learning situation (Nieman and Monyai, 2013). Such practices render the printed material meaningless to most learners unless written in a language comprehensible to the reader. Excerpt 4 above and 5 below affirm this position:

Excerpt 3

My feeling is that the department [DoE] must give us dictionaries in our mother tongue for all subjects. They help us understand the work better. This one was very, very useful. We can also have work sheets for those difficult topics written in our language for better understanding.

As highlighted earlier in this article, the majority of Science educators in South Africa also have a home language different from the language of instruction used by their employers. Interestingly this point was also raised by one of the learners who complained that:

Excerpt 4

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p-ISSN: 2348-795X
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"*... I don't see the reason why we should be taught in English by our own Sesotho speaking teachers. These same teachers speak to us in Sesotho outside classes, so why not in class also? In any case some of them are not better than us in English."*

The use of printed educational material can only be justified and effectual if it is penned in a language the learners are fully proficient in. From the responses it is evident learners make minimal use of these materials as long as they are written in a language they are not fully conversant with.

Patently, from the responses, learners learning Science in a language different from their home language, can perform better academically if materials and lessons are availed in their home language, unlike the present set-up which rather tests the learners' mastery of the language of instruction.

The current academic arrangement impedes second language learners since it entails complex linguistic demands which the learners do not possess from fully comprehending scientific concepts and also from demonstrating their scientific ability, undoubtedly prompting underperformance on the part of the learners. Science assessments involve reading sentences and/or lengthy paragraphs written in the language of instruction.

Discussion

Most of the learners indicated that the use of more than one language in the Science classroom equipped them with reasoning and interactive powers which are not realized in typical monolingual classrooms proof that translanguaging is an asset to individuals, families, and the entire society as it leads to improved academic performance. Current research shows that people who use more than one language appear better at blocking out irrelevant information, a benefit that may exist as early as seven months of age (Pandey, 2013).

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p-ISSN: 2348-795X
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In the same vein, Wei (2011) has found that the use of more than one language in a lesson involves 'going between different linguistic structures and systems, including different modalities and going beyond them' leading to better comprehension and assimilation of learned concepts. Creativity and criticality represent distinct elements of a translanguaging approach to Science education, which can also help sustain heritage languages and promote the co-construction of new identities and scientific knowledge. Through translanguaging the home language of the learner would be seen not as a threat, but as a resource to assist in the acquisition of new scientific knowledge throughout the learner's schooling years.

The advantages of translanguaging extend beyond the recognition of language and include recognition and acceptance of learner identities. In present day South African Science classrooms, this would imply making more provision for learners' native languages in various activities through allowing learners to use their home language as well as giving them academic resources written in learners' vernacular. This could be facilitated through the use of multilingual materials such as multilingual glossaries and work sheets (Madiba, 2014) thus assisting learners in accessing and comprehending content knowledge.

Permitting, encouraging and making place for the linguistic diversity and amplitudes of learners via translanguaging is a means of enacting transformational and humanising practice in Science classrooms. When learners fully participate during academic interactions there appears a shift from the image of an educator as a powerful knowledge holder and "bank clerk" to that of a problem poser. The educator is no longer one who merely deposits knowledge. The learner moves from "receiving, filing and storing the deposits" (Freire, 1972:72; Huerta, 2011) to a more active role resulting in a shift of the power balance prompting effective engagement and boosting academic achievement.

Schools in South Africa could deviate from the current tendency of switching to English in Grade 4 and instead maintain the home language throughout the schooling years as this would assist in

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developing and consolidating the home language and scientific concepts learnt (Alexander, 2012; Heugh, 2015).

From research cited and the present study it is evident that excluding the home language in learning activities positions many learners at a disadvantage. In such monolingual classrooms, the message of the hidden curriculum is that minority language learners do not belong, and are not as welcome as native language learners are leading to them being demotivated, having a low self-esteem, demoralized, lack of confidence, and underperform in assessments as the exclusion of their culture and language is a dehumanizing experience (Childs, 2016; Probyn, 2015).

In the present study it was this going between languages that provided a reasoning power for the learners accounting for their improved academic performance in the post- test. The results from the post- test showed positive effects of using learners' home language and academic resources written in the learners' home language in the classroom by reinforcing plural identities, bridging linguistic and cultural boundaries and increasing reasoning power through integrated multilingual practices (Garcia, 2011).

The results of using one's home language as a language of instruction corroborate with the dependable findings from varied research on translanguaging that the use of multiple languages and, principally, the languages of the learners in class validates their social identities and provides a humanising, emotionally safe environment to be themselves and gain positive schooling experience resulting in improved academic performance (Wei, 2011). Translanguaging therefore plays a catalytic role in the development of multilingual identities, which are typically muted by monolingual proscriptions (Makalela, 2014a; Makalela, 2015), resulting in improved comprehension of concepts learnt leading to improved academic performance in Science.

In moving away from 'linguistic tribes' of the colonial era, the use of African languages in the Science classroom can be aligned with the African cultural and epistemological conception of being, *ubuntu,* which propagates a communal orientation and continuum of social, linguistic and

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cultural resources and denotes the interconnectedness of all human existence (Makalela, 2014a; Makalela, 2014b; Msimanga and Lelliott, 2014). Translanguaging, basing on the responses from the learners and their performance in the post- test proves how effective one's language can be in the classroom situation.

Conclusion

Over the last couple of years, there has been remarkable progress in education in many developing countries, where millions of children have gained the opportunity to attend school. In spite of the tremendous progress, obstacles and challenges remain in attaining quality education for all children universally. Language is without a doubt one of the most dominant factors in the learning process, and the language factor emerges strongly as one of the most salient determinants of quality in education (UNESCO, 2016).

Unfortunately, most of the linguistic minorities go to school every day with a great burden because they do not speak or understand the language of instruction at school. For many children, being forced to drop out of school is not due to physical or monetary barriers, but to the decision for them to be taught in a language that they do not understand (UNESCO, 2016).

The results presented in this study show both the amount and degree of the mismatch between the languages at home and at school, as reported by the respondents. Compared to the eleven official languages in the country, only English is used as the language of instruction. The results from the study illustrate the fallacy of assuming that English placidly operates as the *lingua franca* for intercultural communication in South Africa and as an effective language of instruction. Basing on the results of the present study, low proficiency in language of instruction and underachievement in Physics results in loss of self-esteem and of a dignifying self-image, something which is fatal.

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p-ISSN: 2348-795X
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Despite several affirmative action programmes, African languages are still being used as languages of instruction only during the first three or four years of initial schooling, and are then dropped. Hardly any materials in African languages exist beyond the third or fourth grade, or if they do they are of poor quality. As soon as English becomes the predominant language in the classroom, most teachers are not proficient enough to use it adequately as a medium of instruction. The result is that black children's literacy in their home language and in English at the end of schooling is often poorly developed and found wanting. This has a ripple effect to other content areas across the curriculum, Science inclusive.

Results from the current study indicate that the education of the majority of South African Physics learners is negatively affected by language inequality. Translanguaging is offered as an appropriate post-apartheid approach that can counter the disadvantage of having to use a second language as a medium of instruction. It involves the purposeful use of two languages for learning (a common medium plus every learner's home language), irrespective of the number of language groups in the class. Learners collaborate in same language groups for task-based activities within a framework of sound teaching methodologies.

Conclusively, translanguaging improves thinking skills, creativity and flexibility of the learners and also allows parents to be actively involved in their children's learning. This study featured a mixed approach design that focused on a small number of participants in a South African set up. In this paper I strongly advocate more firmly established planning steps in order to realise the ambitions of the constitution, regional and local action programmes to enhance the value, visibility and status of African languages in Physics education, better Physics teacher training programmes, and initiatives to encourage the creation of Physics texts and literature in the African languages which can be used in the classroom.

Acknowledgements

The authors would like to acknowledge the Free State Department of Education, South Africa for allowing us to carry out the research in the two high schools, the school principals, participants and their parents.

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e-ISSN: 2348-6848
p-ISSN: 2348-795X
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