

ENGLISH SECOND LANGUAGE LEARNERS' CHALLENGES IN COMPREHENDING PHYSICAL SCIENCES CONCEPTS

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Abstract

Physical Sciences is a complex subject with many abstract concepts. This complexity is magnified by the learners' lack of the linguistic capacity to comprehend the concepts and engage actively in the teaching and learning process. Previous studies have alluded to the fact that science is a language on its own, which therefore makes it even more difficult for learners whose home language is different from the medium of learning and teaching. Previous research indicated that learners who are English second language speakers perform poorly in Physical Sciences because the majority of learners particularly from townships and rural areas are only exposed to English in the classroom, and once they get out of the classroom, they start communicating in their home languages. It is against this background that the current study sought to determine challenges English second language speakers face in comprehending Physical Sciences concepts. In a quantitative and qualitative methodology, five grade 12 Physical Sciences teachers and 51 learners in their Physical Sciences classrooms were randomly selected from public schools in Johannesburg. To establish English second language learners' challenges in comprehending Physical Sciences concepts, a questionnaire was administered to the selected learners. The teachers were interviewed using a structured interview schedule to explore how they assisted English second language learners to overcome language challenges when learning Physical Sciences. Quantitative data was analysed and descriptive statistics were obtained and a regression analysis was done to find the correlation between these learners' marks in the subject English First Additional Language and their Physical Sciences marks. Qualitative data from teachers' interviews were analysed using content analysis. Findings from the learner questionnaire showed that 78% of the learners indicated that language plays an important role in them understanding high school Physical Sciences concepts and as such they failed to meaningfully understand the Physical Sciences terminologies and jargon used for each specific topic. They also indicated that they perform badly in Physical Sciences assessments as they struggle to engage in meaningful classroom discussions due to their poor proficiency in English, the medium of instruction. The analysis showed a positive correlation between learners marks in English as a subject and their Physical Sciences marks. Amongst others teachers indicated that they mostly used code switching as a strategy to assist learners understand concepts. The findings have implications on South African education policy makers to consider the use of home languages in teaching and learning.

Keywords: *Code switching, English second language, language challenges, physical sciences.*

1. Introduction

Scientific language is not understood by everyone because it is not the same as the language used in everyday communication. Sullenger (2005) posits that some of the things that contribute to the difficulty in learning the scientific language is the childhood language that has already being imputed into the learner's minds. Indeed there are words in science that do not mean the same thing when communicated in the learners' home languages, which learners have come to understand as the right meanings. This difference complicates the process of teaching and learning science considering that the teacher needs to be aware of those different meanings and should find a way of eliciting those misconceptions in learners before introducing the new knowledge. These language challenges have been attributed to the poor performance of South African (SA) learners in science for example there has been a drop in the pass rate of Physical Sciences from 75.5 % in 2019 to 65.8% in 2020 (Bhaw & Kriek, 2020). Of note is that learners in Physical Sciences subject perform poorly compared to other subjects due to the complex language used in the subject, which is technical and very academic. Though there are other contributing factors towards poor performance in Physical Sciences, language has been found to be one of the many causes (Department of Basic Education, 2020).

1.1. Problem statement

Language is a central factor to all learning (Rollnick, 1998). In South Africa, English is the language of learning and teaching (LoLT) despite it being a second or third language to most learners (Fook & Gurnam, 2015). Because of the lack in proficiency in the LoLT learners in SA continue to disappoint in performance at school level in both science and mathematics (Gudula, 2017) despite the nation grappling with the shortage of skills in science such as engineering. As a Physical Sciences teacher, the first author of the current study noted how his students struggled to understand the technical expressions used in the topic mechanics where terms such as ‘a body at rest’ or ‘uniform motion’, are used. Learners have developed their own understanding different from the scientific meaning (Sullenger, 2005). The argument is how can science, literacy and language be linked in the classrooms (Boyle, Rizzo, & Jonte, 2020). In concurrence as early as 1998, Rollnick indicated that the learner’s success in learning science is dependent on the knowledge of learning English language. In the SA context, most learners from township or rural schools are only exposed to English when they are in the classrooms and once outside, they immediately switch to their home languages, which leave them with little exposure to the LoLT (Probyn, 2006). To compound the problem, some teachers teach science and mathematics using their own home languages (Mokiwa & Msila, 2013; Motloun, Mavuru & McNaught, 2021) yet examinations are conducted in the LoLT.

1.2. Purpose of study

The study sought to answer two research questions: What are English second language learners’ challenges in comprehending Physical Sciences concepts? and how do teachers assist learners who are English second language speakers to overcome the language challenges when learning Physical Sciences concepts?

2. Literature review

Learning science is the same as learning a foreign language (Henderson & Wellington, 1998). The language of science is difficult to the learners because they lack the appropriate vocabulary to express themselves when communicating or writing science (Sullenger, 2005). Because of its academic nature, Derewianka (2014) argues that all learners whether second or first speakers of the English language need a lot of scaffolding in the science classrooms, which Lo, Lin, and Cheung (2018) and Motloun et al. (2021) indicated could be difficult for teachers who are English second language speakers to implement. As such, learners fail to bridge the gap from everyday language to scientific language and to acquire the cognitive academic language proficiency required for learning and meaningful engagement with the curriculum (Probyn, 2006).

Learners face a myriad of challenges when they learn science in a language different from their home language. These challenges include the obvious ones which are failure to comprehend words as well as spelling and pronouncing the scientific terms and processes (Henderson & Wellington, 1998). It therefore means that in tests or examinations, learners grapple with understanding both the content being asked and let alone the instructions which guide them on how to answer the asked questions. Because when speaking in a particular language, one communicates the traditions, customs, morals and values of the people who own that language (Masondo, 2013), one of the challenges is that science then becomes divorced from the culture of the learners which in a way demotivates them to continue studying science or to strive to perform better in the subject. Because of these challenges, some learners may be disadvantaged as a result of the lack of cognitive academic language proficiency and Mavuru and Ramnarain (2020) lamented when they said, “In this context, English prevails as a language of access and power for the majority of Black learners particularly in township and rural schools, who lack English language proficiency to fully engage with curriculum in the classroom” (p. 2473).

Teachers have been found using code switching as a strategy to help learners understand science concepts (Meyer & Crawford, 2011), which among other problems Nomlomo (2010) indicated could be challenging task in a class of learners from diverse linguistic backgrounds. Some teachers have utilised transliteration which Mphahlele (2004) described as a method where one learner fluent in both the home language and English helps by interpreting and explaining to other learners during the teaching and learning process. Such a practice has however been viewed as propagating misconceptions, confusion and misunderstandings in the science classrooms (Msimanga & Lelliot, 2014).

3. Methodology

For this study both qualitative and quantitative methods were used. Using random sampling technique (Patton, 2002) five grade 12 Physical Sciences teachers and 51 learners in their Physical Sciences classes were randomly selected from five public high schools in Johannesburg. A 5-point Likert scale questionnaire was administered to all the selected learners to establish the learners’ challenges in

comprehending Physical Sciences concepts since they were all English second language speakers. These learners did English First Additional Language as a subject and for the current study their test scores obtained from term 2 end of term tests were also analysed and compared to the Physical Sciences term 2 test scores. Each of the five teachers were interviewed once using a semi-structured interview schedule to explore how they assisted English second language learners to overcome language challenges when learning Physical Sciences.

Quantitative data from questionnaires was analysed and descriptive statistics were obtained. A regression analysis was done to find the correlation between these learners' marks in the subject English First Additional Language and their Physical Sciences marks. Qualitative data from teachers' interviews was subjected to content analysis (Bowen, 2009) where categories on the different strategies teachers used to mitigate language challenges were obtained.

4. Research findings

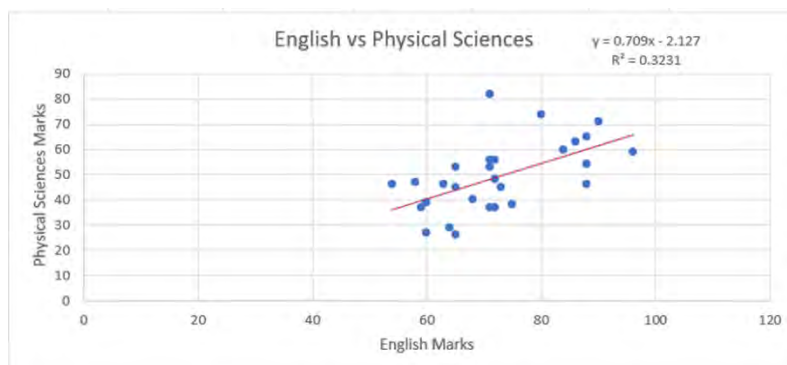
From the analysis of the interview data, it showed that most of the teachers did not assess the suitability of the teaching strategies they employed in reducing the language challenges learners face in the Physical Sciences classroom. As such, their choice of teaching strategies had no regard for teaching learners for understanding of the concepts. This is so because no meaningful response was given to the question: What influences your choice of the teaching method and activities? One would have expected that teachers could have raised the complexity of the topic, engagement of learners, and the need to scaffold learning to ensure learner understanding. The teachers did not regard the mitigation of language challenges in the Physical Sciences classroom as their responsibility but rather they insisted that it was the responsibility of the English teacher not science teacher to equip learners with skills to discern meaning from the Physical Sciences text and also make sure that learners acquire cognitive academic language proficiency. None of the interviewed teachers indicated that they may have language challenges themselves which could impact negatively on how they explain Physical Sciences concepts to the learners. This was despite that the researcher could deduce that some of the teachers were not articulate during the interviews showing their lack of fluency in English.

Two of the teachers suggested that the problem with learners' poor performance in Physical Sciences emanated from learners' failure to understand the concepts and did not directly attribute it to language. One of the teachers however pointed out that the content of English taught at high school was not relatable to the Physical Sciences in the sense that it was taught in a general manner to cater for all the subjects. The teacher's argument was that the teaching was not specialised to include science, technology, engineering and mathematics (STEM) jargon. In this case the teacher advocated for the teaching of English specific to learners who study STEM subjects.

When asked about the possibility of introducing home language in the teaching of Physical Sciences to solve the problem of learners' failure to understand, explain or even write scientific terms, all the interviewed teachers did not believe that introducing home languages as the language of learning and teaching of science would be a good development. They believed that learners would be disadvantaged and the South African education standard would be considered lower at international level. The teachers suggested that the government should rather introduce a subject called English for Physical Sciences where in this class learners would be taught the scientific jargon concurrently with the Physical Sciences as another subject.

From the 51 learners who took part in the survey, 78% believed that language plays an important role in understanding of high school Physical Sciences and that those that do not understand English and the Physical Sciences jargon, would not perform well in Physical Sciences examinations. To check the validity of these learners' assertion, a scatter plot was drawn (Figure 1) to show the relationship between the learners' scores in an English test and their scores in the Physical Sciences test scores.

Figure 1. Scatter plot of the English vs Physical Sciences marks for grade 12 learners.



The graph shows that there was a positive relationship between these marks indicating that the learners that performed well in English were most likely to perform well in Physical Sciences and the reverse is true. An explanation to this trend could be that if learners understand English, then they do not find it difficult to read the material that is written in English, while those that do not understand English, struggle with understanding the concepts written in English. An equation for the trend line was obtained as $y = 0.709x - 2.127$ and the coefficient determination $R^2 = 0.3231$. Linear regression analysis was done on these learners' marks to determine the relationship between learners' performance in Physical Sciences and English from a quantitative perspective. The coefficient determination and the trend line equation match. For the sake of regression analysis, the confidence level of 95% was used as a default in excel.

Based on the learners' responses in the survey teachers seemed not to understand English enough to explain the concepts meaningfully when teaching Physical Sciences. The majority of the learners (65%) indicated that teachers tend to use their home languages more often to explain concepts in the classrooms which made the learners understand Physical Sciences concepts much better. Some of the learners (47%) however indicated that the use of home languages tends to bring confusion and elements of being marginalised when a teacher explains the concepts in a home language different from that of particular group of learners. The findings also revealed that, while learners prefer that teachers explain the concepts in their home languages, 14.6% even preferred that their study materials be written and printed in their home languages. Most of the learners that participated in this study, indicated that the reason they performed poorly in Physical Sciences in the previous grades was because they could not participate in class discussions due to language challenges. The reason learners could not participate was that they were not confident to make discussion in English and 22% believed they could have performed better had they participated in class discussions. As such 43% of the learners indicated that if they had grasped terminology of the content from lower grades, they could have performed better in the subject at the higher grades.

In the interviews the teachers indicated that because of language barrier the learners' parents, siblings or guardians do not understand English as such most learners do not get any help on the activities they are tasked to do at home. On the other hand only 4.3% of the learners indicated that they get help from their parent/guardians or siblings when doing home work. The majority of the learners (78.1%) believed that if their learning materials were presented in their home language, they could have been helped at home. On the other hand the teachers felt that because of the diversity in languages in South Africa, it becomes difficult to officially teach using learners' home languages, the reason they attributed to the ineffectiveness of code switching in the classrooms.

5. Discussion

The findings of the study showed that learners who are English second language speakers struggled to access Physical Sciences concepts due to their lack of academic language proficiency. The learners viewed English as an impediment in their learning which confirms previous studies such as Ferreira (2011), Mavuru and Ramnarain (2020) and Motlounge et al. (2021) who inferred that in such contexts English prevails as a language of access and power for the majority of English second language speakers. This is evident in that there were learners who pointed out that had their learning materials been written in their home languages, they could have performed much better and also got help from their siblings, parents or guardians at home. Of concern is the lack of opportunities to learn or be taught on how to master the complex terminologies associated with STEM subjects even from lower grades. To this Derewianka (2014) called for the need for teachers to extensively scaffold when teaching science to learners, which Lo, Lin, and Cheung (2018) and Motlounge et al. (2021) indicate could be problematic because the teachers are also English second language speakers whose proficiency in the LoLT is also questionable. Though some learners and the teachers were opposed to the use of home languages in the teaching and learning of Physical Sciences, previous studies (e.g. Farmer & Anthonissen, 2010) found that SA learners taught in their home language (Afrikaans), performed much better than those taught in English, a second language.

6. Conclusion and implications

The paper reports on a study to determine challenges English second language speakers face in comprehending Physical Sciences concepts. Important issues were raised which show that both learners and teachers who are English second language speakers face challenges in learning and teaching Physical Sciences in English (respectively). An important issue that arose from the study is that teachers tend to trivialise the difficulty their learners face in the classrooms when they struggle to understand scientific

concepts and processes due to lack of academic language proficiency. As a result of this downplay, they do not make meaningful efforts to scaffold the learning process when teaching.

Whilst the study would not suggest a drastic change by advocating for the teaching of STEM subjects in learners' home languages, it however brings out the need to develop teachers' proficiency in the language of learning and teaching. This has implications on both pre-service and in-service teacher professional development providers to incorporate language aspects when teaching science. In particular the teachers advocated for a special subject, English for STEM subjects, which has curriculum implications. Such a subject would equip learners with the linguistic capacity to comprehend Physical Sciences concepts easily and could improve the learners' performance in examinations.

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