# TEACHING TRIGONOMETRY IN A GRADE 11 MULTILINGUAL MATHEMATICS CLASS: A FOCUS ON TEACHER CODE SWITCHING PRACTICES

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**ABSTRACT–**Studies in and outside South Africa encourage teachers to take advantage of the presence of multilingualism in their classrooms and use it to the advancement of student learning. This study was aimed at identifying prevalent teacher code switching strategies, ascertain where and how teachers draw their mathematical vocabulary during teaching, and to understand how precise and consistent teacher code switching is with the established mathematics register. Data were obtained through document collection, observing and interviewing three grade 11 mathematics teachers purposively selected from three secondary schools in the Eastern Cape Province. Data were qualitatively and quantitatively analysed. Results showed that borrowing code switching strategy was prevalently done consistently across the participating teachers. Very little transparent code switching was observed. No grade 11 trigonometry terms in indigenous language were transparently and consistently code switched. Teachers consistently operated in the public domain. This study concludes that development of supporting mechanisms and best practices to encourage transparent, meaningful and beneficial code switching is required to support and promote conceptual understanding of strongly bounded sub-registers of secondary school mathematics such as trigonometry.

**Keywords:** Multilingual, Code Switching, Trigonometry, Language.

## 1. BACKGROUND OF THE STUDY

### 1.1. Teaching Trigonometry

Trigonometry is an important sub-register of the secondary school mathematics consisting of technical mathematics terms that are rarely or not used in everyday life of the teacher and the students. It comprises 50% of the grade 11 mathematics content in South Africa (DBE, 2011). Trigonometry uses a lot of symbols and condensed language, and is an important school subject not only for mathematics but also for some other fields. Trigonometry is a mathematically rich sub-register of the high school curriculum that links concepts in geometry (about shape and space) and other mathematics sub-registers such as arithmetic, mathematical proofs, analysis among others. Trigonometry has numerous situations where processes and concepts are embedded in a single object referred to by Gary & Tall (1994) as precept. Hence careful use of language by teachers during explanation is crucial in understanding the processes and concepts involved.

### 1.2. Teacher Language Practices

Majority of multilingual mathematics classrooms in South Africa are taught in the language that is not the first language of the students and/or the teacher. Students especially from township and rural schools have limited access to the language commonly chosen as language of learning and teaching (LOLT) in most schools. Adler (2001) posits that the teacher's classroom language practices must scaffold students' entry into mathematical discourse and for language (talk) to be a resource for mathematics teaching and learning, it needs to be transparent. The inner workings of the language used by the teacher to scaffold learning should be available for the learners' inspection (Lave & Wenger, 1991) for transparency to be ensured. It is argued that for teachers to become competent users of home language as a tool for teaching and learning trigonometry, there is need

for them to understand how, why and where this tool is utilized in the practice of teaching mathematics.

The use of languages other than the LOLT during teaching to provide learners with access to mathematical concepts is common in multilingual classrooms. This practice is prevalent in countries where teachers are teaching in the language that is not their first language nor the students' native language. One such practice is code switching defined as the alternate use of two or more languages within the same utterance or during the same conversation (Adler, 2001).

The perception that code-switching is a teaching and learning resource has had much attention in a range of mathematics education studies in and outside South Africa (Adler, 2001; Halai & Karuku, 2013; Jegede, 2012; Setati, 2008). These studies encourages teachers to take advantage of the presence of multilingualism in their classrooms and use it to the advancement of student learning. This study was aimed at addressing the following questions: What forms of teacher code switching strategies are prevalent in the mathematics teacher's language practices during teaching of trigonometry? Where do teachers draw their classroom vocabulary during teaching trigonometry? How precise and consistent is teacher code switching with the standardised trigonometry's sub-register?

## 2. CLASSROOM CODE SWITCHING

Teachers use code switching as a way of incorporating learners' first language in the teaching and learning process. Macaro (1997) argues that it is not only impractical to exclude the learners' first language from classroom teaching but that it is also likely to deprive learners of an important tool for conceptual learning. Setati & Adler (2001: 246) noted that most studies on code switching in mathematics classrooms "…have either demonstrated and/or argued for use of the learners' main language in teaching and learning mathematics as a support needed while the learners continue to develop proficiency in the language of learning and teaching (LOLT), at the same time as learning mathematics." While this is crucial and has benefits, clear teacher code switching guidelines needs to be developed and implemented in the classroom. Macaro (1997: 73) proposes the 'optimal' perspective to teacher code switching which considers the use of first language to have pedagogical value, where its role should be acknowledged and controlled, and that 'optimal' principles and guidelines of teacher code switching should be established. Halai (2009) concluded her study on Pakistan's mathematics multilingual classroom by advising that "… the prevalence of code switching in multilingual classrooms suggests that there is need for teachers, teacher educators and policy makers to look into ways of maximising the potential of code switching through appropriate policies, teaching practice or curriculum materials" (p. 61).

Also researchers in this review have sought to refute the assumption that code switching in multilingual classrooms is a problem and hindrance to the acquisition of mathematics language and content. Studies have however, emphasized the need for well thought out, judicious and well-structured code switching practices in the classroom (Mafela, 2009; Neeta & Klu, 2013). Halai & Karuku (2013) found that teachers, in many cases, use a largely unplanned code switching strategy. Code switching should be systematic, skillfully done and consistent (Then and Ting, 2011) in mathematics classrooms. However, little is known about whether teacher code switching is consistent, systematic, structured and well planned in the mathematics classrooms in South Africa. Lack of consistency results in the haphazard use of code switching due to lack of recognized standards in terms of how and how much, and when code switching is to be used.

### 2.1. Consistency and Precision

Mathematics employs consistent words and symbols to ensure precision of expression as loss of precision is always risky and may cause difficulties during learning. Consistency in this study mean invariability in frequency of code switching into vernacular (IsiXhosa), uniformity of repeated use of terms, accuracy of translation into the vernacular and lack of ambiguities and contradictions in

translated terms. Precision mean the use of terms and symbols, consistent with mathematical definitions, in ways appropriate for students at particular grade levels (Ball et al, 2005).

### 2.2. Translation Strategies

Code switching involves teachers using words and phrases from other languages. This result in mathematics teachers whose first language is not the LOLT practicing translation of terms during code switching. Six forms of translation strategies relevant to this study as adapted from Gauton et al, (2003) are briefly explained in this section:

Transliteration (TLT) is where nativisation of existing English language mathematical terms (Makalela, 2007) occurs by giving a first language (IsiXhosa) spelling and pronunciation to second language (English) terms (Gauton et al, 2003). Loan word borrowing (LWB) is when teachers borrow from English language retaining the spelling, meaning and pronunciation of the word (Baker, 2011). Semantic Transfer (SST) is code switching where a new meaning, and/ or additional more technical meaning, is attached to existing words by modifying their semantic content.

Paraphrase (PAR) is code switching that is a short description or explanation of the word derived by putting together related words or unrelated words (Baker, 2011). Compounding (COM) is where a term is coined by combining existing words to form one word (Meaney et al, 2012). Ready Translated Equivalent (RTE) refers to all situations where there is no problem of non-equivalence at word and/or phrase level between source (English) and target language (IsiXhosa) because IsiXhosa already possessed a ready equivalent of the English term (Gauton et al, 2003).

## 3. THEORETICAL FRAMEWORK

This study is informed by the socio-cultural theory as envisaged by Vygotsky (1978), particularly the critical role of language in classroom communication and cognitive development. A socio-cultural perspective enhanced viewing language backgrounds of the teachers and pupils as a resource for teaching and learning trigonometric concepts (Moschkovich, 2007). The socio-cultural aspects of Vygotsky's theory illuminate the point that learning and development cannot be dissociated from their context. The social environment influences cognition through its "tools", that is, cultural objects, language, and social institutions. According to Vygotsky (1978), people think and perceive things in a way made possible by the vocabulary and phraseology of their language. Concepts that cannot be encoded in their language will not be accessible to them, or at least will prove very difficult (Durkin, 1991). Vygotsky's theory enables exploring issues of learners' first languages as used to teach trigonometry through code switching in the mathematics multilingual classroom.

## 4. SAMPLE AND RESEARCH PROCESS

This study used a case study approach which enabled the researcher to gain a detailed view of teacher code switching practices manifested during teaching trigonometry in multilingual classrooms. Data were obtained through document collection, observing and interviewing three grade 11 mathematics teachers purposively selected from three schools in the Eastern Cape Province. Each teacher was observed for five consecutive lessons in a week teaching trigonometry. The lessons were video recorded. At the end of each lesson, each teacher was interviewed.

The videos were transcribed and analysed for consistency in the frequency of code switching into IsiXhosa across teachers, and, code switching strategies that emerged. Data was further analysed for consistency and precision across mathematical domains of practice (Dowling, 1998). These domains are:

- Esoteric domain, which is characterised by the use of highly specialized, formal and abstract mathematical language and content;
- Descriptive domain which uses specialized mathematical language imposed on non-mathematical content;

- Expressive domain which deploys non-mathematical language to refer to mathematical content;
- Public domain which is characterised by referring to forms of expressions and content expressed in entirely everyday terms.

### 4.1. Validity

The degree to which data collected in the research truly measures that which it was intended to measure is validity (Creswell, 2009). Multiple sources of evidence were used during data collection thereby increasing the validity of the data in this study. Data triangulation was also done. Themes were thus established based on several sources of data.

## 5. DATA ANALYSIS AND DISCUSSION

Two teacher code switching practises emerged, transparent code switching (TCS) and borrowing code switching (BCS). Data was analysed for consistency using these two emergent themes.

- Borrowing Code Switching Strategies (BCS)

This is where a teacher would borrow from the English language either by retaining the English spelling or by adapting the phonology of the borrowing language (Baker, 2011). Two forms of BCS were noted: Transliteration (TLT) and Loan word borrowing (LWB).

- Transparent Code Switching Strategies (TCS)

This refers to all code switching where meaning of terms was not concealed but noticeable, self-evident and transparent to students (Meaney et al, 2012). Four forms adapted from Gauton et al, (2003) emerged in this study; Semantic Transfer (SST), Paraphrase (PAR), Compounding (COM) and Ready Translated Equivalent (RTE).

In this paper, discussion focuses on

- Teacher code switching strategies
- Domains of mathematical practice
- Planning for code switching
- Teacher repetition

Data were analysed quantitatively and qualitatively.

### 5.1. Teacher Code Switching Strategies

Table 5.1 and Figure 5.1 showed that borrowing code switching strategy was prevalently employed consistently across all the participating teachers. During teaching trigonometry, teacher A was observed performing BCS 69.8%, teacher B 75.9% and teacher C 78.7%.

Table 5.1: Teacher Code Switching Strategies

| | | | Teacher A | Teacher B | Teacher C | Total |
|---|---|---|---|---|---|---|
| Strategy | BCS | TLT | 4.5 | 8.7 | 10.8 | 78.7 |
| | | LWB | 65.3 | 67.2 | 67.9 | |
| | TCS | SST | 5.5 | 3.7 | 5.1 | 21.3 |
| | | PAR | 1.5 | 0.6 | 0.4 | |
| | | COM | 2.8 | 0.9 | 2.4 | |
| | | RTE | 20.4 | 18.9 | 13.4 | |

Table 5.1 also indicates that teachers consistently used LWB (A-65.3; B-67.2; C-67.9) strategy throughout their teaching. Most of the mathematical talk in IsiXhosa was done through borrowing. All the teachers consistently used the borrowing strategy (A-69.8%; B-75.9%; C-88.7%) throughout the teaching of trigonometry, more than using the transparent code switching strategy (A-20.2%; B-24.1%; 11.3%). Teacher C borrowed 89% of mathematical terms from English and transparently code switched only 11% of the time.

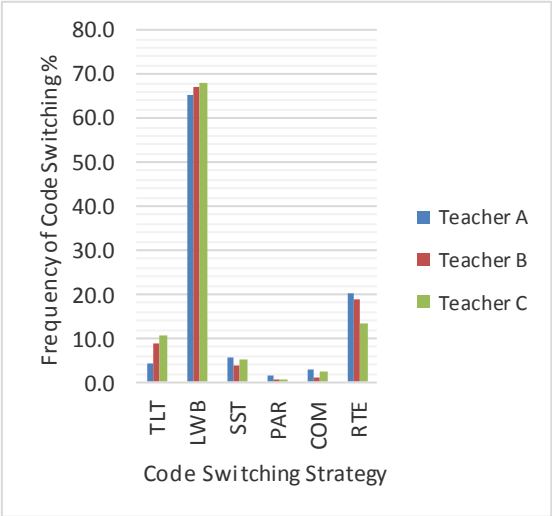


Figure 5.1: Comparison of Teacher Code Switching Strategies

Very little transparent code switching, which according to Meaney et al (2012), is critical for supporting students' understanding, thinking and conceptual growth in mathematics, was evident in teacher language. Such transparency was mainly from those mathematical terms commonly used in the foundation and the intermediate phases. No grade 11 trigonometry terms in indigenous language were transparently code switched, all such terms were consistently code switched through borrowing.

**5.2. Domains of Mathematical Practice**

It was observed that all the participating teachers operated mostly in the public domain (A-66%, B-46%, C-47%) as shown in Figure 5.2. Mathematical IsiXhosa terms in the esoteric domain were very few (A-5%, B-12%, C-6%). Operating mainly in the public domain implies that teachers predominantly taught in the everyday domain. This, according to Dowling (1998), does not promote sufficient formal mathematics teaching.

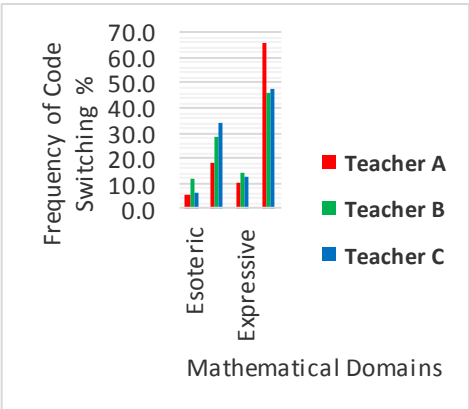


Figure 5.2: Comparison of Teacher Code Switching Across Mathematical Domains of Practice

Consistently speaking mostly in the public domain does not provide students with the competency they require to participate effectively as members of the greater mathematics community (Dowling, 1998). As encouraged by Mercer (1995, 83) "Teachers are expected to help their students develop ways of talking, writing and thinking which will enable them to travel on wider intellectual journeys, understanding and being understood by other members of wider communities of educational discourse." While some IsiXhosa teacher translations of mathematical terms were consistent and precise, some were not.

**5.3. Planning for Code Switching**

All participating teachers in this study indicated that they did not plan for code switching. While they agreed to its usefulness in the classroom, to them, it is something that happens spontaneously, unpremeditated and impetuously. This was revealed from their responses during interviews.

Researcher: When you plan for your classes, do you also plan for code switching?

Teacher A: Mh-h, no, when I do my planning, I don't even use isiXhosa when I'm doing my planning. I just code switch when I'm teaching, when I see that it is necessary to do code switching and then I just do code switching. Otherwise in my planning I don't even plan.

Researcher: Where do you get the IsiXhosa vocabulary? Do you plan for code switching?

Teacher B: No, no, it just comes out as I talk, because I speak IsiXhosa. IsiXhosa is my home language so it just comes out you know. Whenever I prepare, my preparation is only done in English. IsiXhosa just comes out whenever there is that learner that does not understand something, and then I can try and explain in IsiXhosa.

Researcher: Do you prepare for code switching?

Teacher C: Code switching yho! I don't plan because sometimes it happens automatically. For example, when you see the mood of the children like the one that I did today, where I just sang something… So you don't plan that. I don't plan it.

Researcher: Where do you get your IsiXhosa vocabulary?

Teacher C: No, you make your own, you modify things that will suit you. You can come up with an angle that is better known to a community. But once it becomes known, you use a little bit of that word and then you transfer it to the correct terminology of what it actually is all about. And also it works when you have relations and you mix with different teachers in workshops and so on.

Teachers' responses suggested that they assume that one does not need to plan to use a language that is one's mother tongue. It brings also the assumption that teachers may only plan when teaching in English probably because one is using an unfamiliar language. Another assumption that these teachers seem to have is that since they know the mathematics register in English, it will not be difficult for them to use their home language during teaching. Teachers used their impromptu judgements as to when and how they code switch. No prior thinking was deemed necessary by all the teachers.

Interviews revealed the lack of materials in IsiXhosa that teachers and students can use during teaching and learning. All the teachers professed lack of any material that they use to support and plan for code switching. The lack of materials together with lack of planning explains the prevalence of LWB.

The department of education insists on teachers planning before they go to teach. While classroom code switching is permitted, there is no insistence on planning for it. There is silence on how it is supposed to be done, when and how often among other things. In other words there is not visible teacher support on how to fruitfully use the home language during teaching. All teachers in this study were not trained to teach in indigenous languages, their planning thus focuses on the use of English. It was noted that all the materials available to teachers to help them prepare for teaching and to use during teaching were in English, which is the LOLT of all schools chosen for this study.

### 5.4. Forms of Teacher Code Switching Practices: Repetition

In this study, various teacher code switching practices were observed. One of the emerging practices that was prevalently evident from all teacher language practices was their use of repetition during teaching.

Throughout the teaching of trigonometry, all the three teachers used repetition when asking questions and also when explaining concepts. Code switching for repeating information or questions previously asked in English or vice-versa took various patterns that include ;English first then repeating in IsiXhosa, IsiXhosa then English, English to IsiXhosa to IsiXhosa, IsiXhosa to English to IsiXhosa, IsiXhosa to IsiXhosa to English and IsiXhosa to IsiXhosa to IsiXhosa. This paper was interested in exploring and understanding code switching consistency and precision during the teaching of trigonometry in a grade 11 class.

#### 5.4.1. Consistent and Precise Repetition

Teachers' code switching was noted to be either consistent without being precise, or precise without being used consistently, or the terms were both precisely and consistently used.

Teacher B: Can you find the value of A there? Yes *sizawuyifumana njani i-value ka-A* there?

Teacher C: How did you get 66? *Umfumene njani u-66*?

Teacher A: What have you done in order to get 3? *Wenze ntoni ukuze ufumane u-3*? (what did you do to get 3?)

Teacher A: Then you find D *kengoku* using *zonke eza-values ungakhange uzi-roundishe* (Find D using all the values before rounding them off).

The teacher uses English to IsiXhosa form of repetition. The key words in these questions are 'find' and 'value'. The word 'find' was precisely and consistently translated to IsiXhosa as *fumana* in both questions during repetition. But the word 'value' is borrowed using *i-value or eza-values*. *Fumana* is used more oftenly in daily life referring to various acts that involves finding, looking for something, to uncover or obtain. It is also commonly used in early primary school education. Conversely, 'value' is not as common though it is used as well in everyday life. This explains why teachers in this study consistently repeated borrowed version of the term value, that is, *i-value, eza-values, la-value* in all cases. On the other hand *fumana* has two English equivalents according to statements above, find and get. Borrowing was consistently done by all the three teachers as they repeat information.

For Teacher C, key mathematical words were borrowed and the meanings of these terms are maintained. The three key words are all being borrowed using the prefixes only (LWB) as in the first extract below.

Teacher C: So *apha apha kwezi* (here with these) triangles we do not use *i*-trig ratio, can you see *apha sisebenzisa ntoni i*-Sin (here what do we use, sine?)

Teacher C: Then I've been given an angle and *aku specifaywanga* (it has not been specified), *akuthwanga phaya* (it has not been indicated there that), an included angle, *kuthwe* (it states) two sides and an angle.

In the second extract above, Teacher C repeats information during explanation using a TLT phrase *aku specifaywanga* (not specified) and repeats it with the RTE term *akuthwanga* (not indicated). The terms specify (to identify clearly and definitely) and indicate (to point out) are used interchangeably by Teacher C.

#### 5.4.2. Inconsistent and Imprecise Repetition

In this section focus was on scenarios where teacher language used to repeat information was inconsistent, imprecise or both.

Teacher B: what we want was the relationship between AC and these two values that we are given, can you see that? *U-AC uyintoni phaya* (what is AC there)

Teacher A: What is the relationship of BC to C, the relationship of BC to C? *Uyintoni u-BC* to C?

Teacher A: AD, *u-AD u-opposite* to what, *yintoni u-AD?* (What is AD?)

Teachers were observed repeating statements in IsiXhosa and leaving out key words. For Teacher B key word is 'relationship', in IsiXhosa he just asks for AC yet in English the teacher used the term relationship. For Teacher A, the word relation is inadequately represented in IsiXhosa for connecting BC and C. In the third extract above, the word 'opposite' which is a guiding term has been omitted in IsiXhosa. The IsiXhosa version is now open to a number of interpretations and solutions. Thus there is lack of precision in the translation. This could be because the teachers do not have ready translations for these key words such as 'relationship' and 'opposite' which are crucial in these questions. Also such words are not commonly used in lower primary school grades.

Teacher B's three statements given below shows how he repeated in IsiXhosa with the intent of elaborating. The teacher is explaining and using the meaning of the term 'isolate'.

Teacher B: How do you solve, *besithe senza njani kanene? Apha sifuna u-AD abe yedwa nhe?* (By the way how did we say we do this? Here we want AD to be alone right?)

Teacher B: Isolate AD, *samshiya njani u-AD abe yedwa phayana* (how do we isolate AD)?

Teacher B: You need to isolate *u-C nhe, la-AC funeka abeyedwa* (we want to isolate AC)

The use of an everyday phrase '*abe yedwa'* for 'isolate' is consistent in IsiXhosa here though a more mathematically precise term could have been used here, for example, make the subject of formula or transposing the formula. Use of more standard terms would help students become competent participants of the wider mathematics community. It would prepare them for future and wider use of mathematics during and after high school. Such phrases which are more mathematical and esoteric in nature are not easy to translate to IsiXhosa. Hence even if the teacher is to use them, he would still use them in a borrowed form and not their translated form. In the classroom,

> *"The teacher has the responsibility for building contextual foundations for the future learning of the students, and for creating continuity in the educational activities that the students engage in" (Mercer, 1995, p. 83).*

Teacher's use of his or her localised terms will only serve temporary and very short term purposes and inadequately prepare students for lifelong meaningful participation in mathematics related activities and forums.

Teacher B: So *u-AD izawuba ngubani?* (What will it be), what will be the value of AD there?

Here there is repetition from IsiXhosa to English. In the IsiXhosa statement, the word 'value' is not included as is the case in English. Note that also the word *'value'* is referred to as *i-value* in many cases when teacher code switches. This could be the reason why the teacher has omitted it in IsiXhosa. The question in English is more amplified and exact than in its IsiXhosa equivalent. This then provides a more accurate question in English.

Teacher B: How do you find the angle in the fourth quadrant, *sayifumana njani* (how do we find it)? How do we express the angles in the fourth quadrant?

Teacher B uses the English- IsiXhosa-English form of repetition. The IsiXhosa translation leaves out the phrase 4th quadrant. This again could be attributed to lack of IsiXhosa equivalent for 'quadrant' and the teacher assuming it would not be necessary to repeat that phrase. But repeating it in the third statement implies strongly that the teacher did not use it because it does not have an IsiXhosa immediate translation. Teacher used it again showing how important the term is to his question. Again in the third statement, the teacher used the word 'express', which is not the same as 'find'. Hence while there is consistency from first to second statement, there is neither consistency nor precision in the third statement.

Teacher C: Now what has changed is that we no long write on our lines all of the x-axis, *asibhali ngoku* (we do not write) u 1, 2, 3.

Teacher A: *U-AD u-opposite* to what, y*intoni* (what is) u-AD?

Teacher C: Let's talk about your answers, PQR what is your missing angle, *ibingubani i-angle yenu.*

Teacher C is repeating the same information in IsiXhosa in a summarised manner. Repetition leaves out some information. Key guiding words 'opposite' and 'missing' are lacking in IsiXhosa. The

translation tries to compress information supplied in English resulting in lack of precision. This is an assumption that pupils would link with the English version of the question. The problem could be with those students who 'tune-out' or switch-off and wait for the IsiXhosa translation. Research has shown that one of the major disadvantages of code switching during teaching is it leading to students 'tuning out' their weaker language and wait for the information in their stronger language (Reyes & Kleyn, 2010; Thompson, 2012). The chances are high for such students to miss crucial information resulting in misinterpretation of the question and hence struggling to solve it. The question posed above by Teacher C is more explicit in English that in IsiXhosa. The reduction of ideas in IsiXhosa translation might cause problems associated with misinterpreting the question as a result of student 'tune-out'. This is therefore an inconsistency in teacher code switching resulting from the teacher leaving out some information in the translated version.

**5.5. Use of LWB and TLT in One Sentence**

Both forms of borrowing, Loan word borrowing (LWB) and Transliteration (TLT), were common among teachers. They were practiced precisely and consistently throughout their teaching.

Teacher B: And then here we want to find u-AB so *nantsi i*-Sin rule *sesiyi-deduci-le nhe* (so here is the Sin rule we have already deduced it).

Teacher B: then you find D *kengoku* using *zonke eza*-values *ungakhange uzi-roundishe* (find D using all the values before rounding them off).

Teacher A: AD *then siya*-cross multiplyer AD Sin 500 is equal to 12.

This is attributed to TLT code switching's nature which permits maintenance of the English root of the word, giving it IsiXhosa pronunciation, for example *uzi-roundishe, sesiyi-deduci-le, siya-cross multiplyer.* Thus it is argued that the prevalent use of BCS was due to lack of readily available IsiXhosa terms for these trigonometrical concepts. The researcher considered this practice as the teacher's way of reducing the risk of losing meaning of the word if a pure IsiXhosa word is to be used. Thus teachers were operating in the 'safe code switching mode' where they are consciously reducing the risk of losing meaning in the process of switching. This is supported by what these teachers said during interviews. Consider Teacher B's explanation below:

Researcher: What is calculate in IsiXhosa?

Teacher B: If you want to say find, *ufuna* and then calculate it's the same thing as *ufuna* because you want to find the answer there, you are calculating for the answer, so in IsiXhosa, *ufuna* the answer. So you will find that calculating and finding they are very close you. So that is why I was saying using mostly venac [vernacular], it would be difficult, I mean there would be misconceptions or maybe you would find that there are words that will make it difficult for you to separate them.

The teacher is linking 'calculate' and 'find' using their isiXhosa equivalents. The teacher agrees that certain translations may cause more harm than good and its better they be avoided. Teacher conceded that it would be difficult to use pure IsiXhosa precisely and comfortably. This according to him is because there are terms that are different in English but are treated as synonyms in IsiXhosa like find (*funa, fumana*) and calculate (*bala*). Thus Teacher B would rather use LWB to avoid misconceptions and reduce associated difficulties.

Teacher C was asked about the IsiXhosa word for 'quadrilateral' during interviews and his response reveals some key aspects to this study that are discussed below.

Researcher: If one says quadrilateral, the child might not quickly pick, but what if you say *macala mane?*

Teacher C: Ja it makes sense because when you talk about laterals it means sides, it means *icala,* so that's a lateral. So it's a quadrilateral which means four; now it should be quad and laterals. Quad is four to them and laterals are sides, so it makes sense to them *ngamacala amane* and they can quickly understand. But I never

use *amacala amane* because ja! I think it can make sense to them, knowing the meaning of what you want to say.

The teacher agrees that use of certain terms in IsiXhosa makes understanding of concepts easier. Especially when the translation is more of a description of the word rather than just a word. For example, the word for quadrilateral in IsiXhosa actually describes the kind of shape we are referring to and in that sense it makes the concepts clearer, reachable, accessible and transparent to listeners. Teacher C agrees with the transparency of the IsiXhosa term but acknowledges that he never uses that transparent form. The reasons why words like *i-quadrilateral* instead of *umacala-mane* which is clear and transparent would be preferred by the teachers include ; hegemony of English, teacher's lack of consciousness to such clear terms, lack of planning for code switching, lack of mathematics register and lack of materials in IsiXhosa.

## 6. RECOMMENDATIONS

### 6.1. Planning for Code Switching

Planning is an integral part of successful teaching. Mathematics teachers in multilingual classrooms need to be encouraged to plan and think about how, when and where they would need to use pupils' first language during teaching. Prior proper planning for code switching is required as opposed to impromptu, inconsistent and ad hoc code switching which is a current phenomenon in many mathematics secondary school classrooms. Planning will curb student 'tune out' and its associated problems. It will also restrain prevalent use of 'safe code switching modes' (LWB and TLT) which do not give students access to the concepts and vocabulary needed for understanding the subject. For teachers' code switching to provide explicit, meaningful and well-timed support to students, prior planning needs to be done. Such planning for code switching should be systematic, regular and well-informed.

### 6.2. Teaching Materials and Best Practices

The presence of consistent and precise use of some translated terms within and across teachers and lessons suggests that trigonometrical words exist in indigenous languages. However, most of such words observed in this study are those that are introduced in primary school. Development of teaching materials in IsiXhosa that would aid the teaching of mathematics at all phases is crucial. Concerted efforts are important for development and use of best practices and guidelines for code switching. Best practices in this paper mean all those efforts, strategies and initiatives that will narrow the gap between every day, informal and unspecialised teacher's spoken language and the variety selected for academic purposes (Wildsmith-Cromarty, 2012). Best practices are all those strategies that will ensure systematic, planned and calculated use of pupils' home language when code switching during teaching.

## 7. CONCLUSION

This study concludes that development of supporting mechanisms to encourage transparent, meaningful and beneficial code switching by mathematics teachers is required. This paper also propose that institution of best practices for code switching is required to guide and promote code switching that is precise, consistent, transparent and supportive of the conceptual understanding of strongly bounded sub-registers of Mathematics such as trigonometry in secondary schools.

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