PRINT: ISSN 0975-1122 ONLINE: 2456-6322
Int J Edu Sci, 10(2): 182-191 (2015)
DOI: 10.31901/24566322.2015/10.02.01

Exploring Some Teaching Strategies that Overcome Challenges Created by the Language of Instruction within Multilingual Mathematics Classrooms

Jayaluxmi Naidoo

Mathematics and Computer Science Cluster, School of Education, College of Humanities, University of KwaZulu-Natal, Private Bag X03, Ashwood, 3605 South Africa
Telephone: 031 260 1127, Mobile: 0744752938, Fax: 0866321410
E-mail: naidooj2@ukzn.ac.za

KEYWORDS Collaborative. Knowledge. Manipulatives. Mnemonics. Teachers

ABSTRACT This paper explores teaching strategies used by mathematics teachers to overcome challenges created by the language of instruction at selected multilingual schools. Participation was requested of forty-five teachers in KwaZulu-Natal, South Africa. The final sample comprised of six teachers. This paper encompassed the following methods of data collection: lesson observations, teacher interviews and focus group interviews with selected learners. All the data was analyzed qualitatively within an interpretive paradigm. The theory of teacher knowledge was used as a theoretical lens. The findings suggest that teachers incorporated supportive teaching strategies in their classrooms. Some of these strategies included collaborative learning and the use of mnemonics and manipulatives. It is argued that identifying strategies that could overcome challenges created by the language of instruction within multilingual mathematics classrooms could provide valuable insights for curriculum developers, as well as teachers both nationally and globally.

INTRODUCTION

South Africa is a vibrant multicultural and multilingual country (Naidoo 2006). A multilingual setting refers to a setting that embraces individuals who speak two or more languages (Poudel 2010). Since the majority of South Africans are multilingual (Barwell and Setati 2005) the challenge for a teacher within this setting is the teaching of abstract concepts (as in the case of mathematics teaching) in a language that is not the learners' main language (Gorgorio' and Planas 2001; Barwell et al. 2007; Anthony and Walshaw 2009).

Despite the fact that all South African learners are exposed to mathematics at an early age, research (Reddy 2005; Taylor 2008; Anthony and Walshaw 2009; Siyepu 2013) has demonstrated that learners in South Africa perform poorly in the subject. This poor performance may result in only a small percentage of learners acquiring the necessary mathematics competence to pursue mathematically based careers at tertiary institutions (Brijlall 2008). One possible reason for this poor performance is that the majority of learners in South Africa learn mathematics in a language in which they are not fluent or confident (Setati 2008). In order to perform well in schools, learners ought to be fluent in the language of instruction since these challenges plague many classrooms both nationally and internationally (Setati 2008; Clarkson 2009).

Thus, it is important for teachers to identify teaching strategies that may overcome challenges created by the language of instruction thereby improving performance and the mathematical ability of learners (Brijlall 2008). Hence, it was of interest to explore how experienced teachers used strategies to overcome challenges created by the language of instruction that emerged within their multilingual classrooms. The research question being addressed in this paper is: What strategies do teachers use to overcome challenges created by the language of instruction within multilingual mathematics classrooms?

Language and Mathematics

Today, teaching is more challenging than before, since globally learners are becoming pro-

Address for correspondence:
Jayaluxmi Naidoo
Private Bag X03, Ashwood,
3605 South Africa
Telephone: 031 260 1127
Mobile: 0744752938
Fax: 0866321410
E-mail: naidooj2@ukzn.ac.za

gressively diverse with regard to culture, language and learning needs (Islam 2012). The role of language in mathematics teaching is viewed as an essential component in order to promote mathematical success (Clarkson 2009). The teaching of mathematics in a language, which is neither the teacher's nor the learners' first or home language has been revealed to be a challenge for both teachers and learners alike (Kasule and Mapolelo 2013). Learners ought to be confident in their reading and literacy skills to ensure that their mathematical understanding is not affected by the issues associated with second language learning (Bohlmann and Pretorius 2008). Therefore, teachers cannot ignore issues of language and they ought to move beyond the belief that language will take care of itself (Lim 2007). Teachers are required to be sensitive about the way in which language is used to convey meanings and messages within mathematics since learners from different backgrounds will have different problems with the language of instruction (Tapson 2000; Poudel 2010).

With 11 official languages[1] in South Africa, English serves as the language of instruction making the language a significant factor in academic achievement and subsequent social mobility (Dhillon and Wanjiru 2013). Once learners understand how information is being articulated, they can better understand what is being expressed, and thus, have a better chance of understanding why it is being conveyed (Jamison 2000). One aspect of language that may cause confusion is the vagueness of words that are diverse in meaning between the milieu outside school and within the mathematics classroom (Meiers 2010). Thus, understanding the nature of language used in mathematics classrooms and critical thinking about the mathematics concepts being taught enables teachers to support their learners in the classroom.

Multilingual Mathematics Classrooms

Mathematics teachers have used many strategies such as code switching, mathematics manipulatives and mathematics dictionaries to assist in making the meaning of complex or abstract words in mathematics easier to understand (Moyer 2001; Ncedo et al. 2002; Setati et al. 2002; Shaw 2002; Vorster 2008). Code switching may be described as the use of more than one language in a classroom; code switching enables learners to use their main language as a learning tool (Setati and Adler 2001) and may occur when a multilingual person is addressing another multilingual person and may consist of a single phrase or involve several sentences (Zazkis 2000). Research (Clarkson 2009) proposes that teachers ought to encourage informal discussions using the learner's first language before moving to more formal discussions in the language of instruction.

Mathematics manipulatives are concrete objects that are commonly used in teaching mathematics. They include plastic blocks, paper models, dynamic models, wooden structures and everyday objects (such as coins, beads, buttons, rubber bands, ice cream sticks, or bottle caps), which may be used as teaching tools for the subject (Naidoo 2011). The use of concrete objects in a mathematics classroom assists in catering for learners who have different learning styles (Brijlall 2014). The use of dictionaries may assist learners to acquire meanings of words that they are generally not exposed to on a regular basis. For example, Zevenbergen (2001) discusses how words such as *volume* could have diverse meanings outside the classroom (when adjusting the loudness of a television set), while in mathematics this word refers to the amount of space within an object.

Theoretical Framework

Shulman (1987) used seven categories to organize the different kinds of professional knowledge that a teacher ought to possess. Aspects pertaining to three of Shulman's (1987) categories were used in framing this paper. Thus, for the purpose of this paper the categories of content knowledge, pedagogical content knowledge and teachers' knowledge of learners and their characteristics were focused upon. Content knowledge refers to a teacher's knowledge of the subject matter that ought to be taught. A teacher's content knowledge of a subject is an indication of teacher quality, which in turn may influence learner achievement (Kanyongo and Brown 2013).

Pedagogical knowledge refers to a teacher's knowledge about techniques, processes and methods for teaching (Drijvers et al. 2010) and pedagogical content knowledge revolves around a teacher's ability to transform and teach (Brijlall and Isaac 2011) subject matter. This transformation is required for effective teaching and learning through the use of multiple ways of adapting and representing the subject matter in order to elude student misconceptions (Mishra and Koehler 2006). Pedagogical content knowledge in mathematics requires the merging of mathematics content and pedagogy since teachers are required to know mathematics content and know how to organize, teach (Brijlall and Isaac 2011) and explain this content adequately (Ball et al. 2008).

MATERIAL AND METHODS

Data Collection

Gatekeeper access was obtained from the KwaZulu-Natal Department of Education (KZN DoE). Once the research proposal and list of participating schools were approved by the KZN DoE, 45 KZN schools were invited to participate. Twenty schools accepted the invitation to participate in this study. The population for this paper comprised of mathematics teachers teaching within multilingual mathematics classrooms. All participants were provided with an informed consent form that provided a detailed description of what would be expected of the participants during the data collection phase. Ten of the twenty schools were selected at random to be a part of the pilot study and the remaining ten schools participated in the study. The pilot study assisted in ensuring the validity and reliability of each research instrument.

The final sample comprised six teachers teaching at six different schools, located within KZN. There was a need to ensure that all the participants taught within different social contexts. The final sample is depicted in Table 1. It must be noted that pseudonyms were used to protect the anonymity and identity of the schools and teachers in this paper.

Table 1: The main participants in the study

Secondary school (Pseudonyms are used)	*Teacher (Pseudonyms are used)*
Carnation	Sam
Daisy	Dean
Lily	Maggie
Orchid	Alan
Rose	Karyn
Tulip	Penny

Source: Adapted from Naidoo 2012 (Author)

Data Collection Tools

Data was collected through a multi-method approach using lesson observations, a semi-structured teacher interview and focus group interviews with learners. At least three Grade 11 mathematics lessons that were taught by each of the six teachers in the final sample were observed and video recorded. The focus of the observations was on how the teachers used specific teaching strategies to overcome the language challenges that emerged within their multilingual classrooms. The analysis of the observations involved reviewing each lesson observation and identifying critical moments in each lesson. Critical moments in this paper refer to those moments that were observed when the teaching of mathematics was hampered due to the challenges that the language of instruction created, by this the researcher means that at these moments it was evident that the learners could not understand the terminology or mathematics concepts being discussed because they were unable to understand the language of instruction. After analyzing the observations through the use of thematic coding, additional notes were made on the semi-structured interview schedule before the interviews with each teacher commenced.

Each of the six teachers selected for the final sample were interviewed using a semi-structured interview schedule, with each interview recorded. Selections of video clips were provided for the teachers to view. The video clips showcased the critical moments during each lesson and the various strategies the participants used to overcome the challenge that the language of instruction created. The teachers were interviewed regarding their use of different strategies at these critical moments in their lessons. The teachers' responses were probed to ensure that there were no misinterpretations or misunderstandings on the part of the researcher.

A small group of between six to ten learners from each participating school (N= 48) was purposively selected for focus group interviews. These learners were selected based on the level of interaction with their teacher and peers in the classroom. This interaction was determined during lesson observations at each school. The focus group comprised learners who interacted frequently, with an average frequency or no interaction at all during the mathematics lessons.

A semi-structured focus group interview schedule was used and all focus group interviews were recorded. The focus groups were provided with the opportunity to view the selected video clips highlighting critical moments that were shown to their teachers. During the focus group interviews, the learners were asked questions about the value of the teaching strategies used in their classrooms during these critical moments. Through the use of this method, issues that were not captured or noticed previously, emerged hence providing additional data and triangulation of evidence (Creswell 2007). Excerpts taken from the teacher interview transcripts and learner focus group interview transcripts are used to support the discussions that follow.

RESULTS

Based on the lesson observations, it was apparent that the teachers in this paper understood their learners and used this knowledge to reflect on and to adapt their lessons in order to ensure maximum benefit for their learners. In order for the teachers to do this, they needed to have a good command over the content being taught, as well as adequate pedagogical content knowledge. This pedagogical content knowledge enabled the participants to convert their own mathematics content knowledge into a form that was comprehensible for their learners. The participants were skilled at using resources available to them to support their teaching of mathematical concepts successfully (Bukova-Güzel et al. 2013).

Each multilingual learning community in this paper used their own symbols and teaching strategies to make mathematics more accessible to members of the learning community. For example, in the more resourced classroom at Rose Secondary, Karyn, the teacher, used the smart board, think-pair-share method of collaborative learning and video clips to overcome the language challenges that emerged while she was teaching. Karyn's multilingual classroom comprised a small percentage (30%) of learners who spoke English as a second or third language. So, for example when she used collaborative teaching strategies she grouped her learners into small strategic groups, the learners were grouped according to mathematical ability and language proficiency. Small groups provide second language learners with a chance to use their second language skills in a non-threatening manner. Based on the lesson observations, it was evident that each group was equitably representative of both mathematical ability and language proficiency.

Participating learners were from different racial backgrounds and spoke different home languages. This caused additional conflict and challenges within the classrooms. Moreover, due to the differences between the dominant language at home and the language of instruction (English) at school, certain mathematics concepts (for example, concepts such as *table, difference, improper, face, figure, mode* and *function*) and rules had to be revisited. This revisiting of mathematics concepts took away from the time allocated for syllabus coverage. Regardless of this external conflict, the syllabus had to be completed in time for the national tests and examinations. To overcome this conflict, the teachers needed to be reflective and resourceful in the classroom. The teachers in this paper all taught at secondary schools and used supportive strategies. While analyzing the lesson observations and interviews, key teaching strategies emerged including, collaborative learning and the use of mnemonics and manipulatives. These teaching strategies are discussed in the subsequent section.

DISCUSSION

Collaborative Learning

Collaborative learning refers to a teaching method in which learners at various ability levels work together in small groups towards a common goal. Collaborative learning promotes communication skills while allowing learners to think critically (Brijlall 2015). In this paper, communication was hampered because the language of instruction affected the way in which the rules and instructions were understood within each multilingual learning environment. At times these differences in the language learners were accustomed to created challenges within the classroom.

Within her classroom, Penny used many differing strategies for example, manipulatives, mnemonics, pictures and code switching, to compensate for the differing backgrounds of her learners. She also used a combination of collaborative learning (group work) and individual work during her lessons. In this way, Penny used her experience and teacher knowledge (Shulman 1987) to accommodate for language challenges in her classroom. Penny did this with the aim of improving the teaching and learning of mathematics. This is evident in the excerpt that follows:

Penny: *…the aspect of group work helps those that are not picking up the concepts easily…so they help each other [learners]*[2] *and they [learners] prefer to indicate what they understand rather than what is confusing…we restate, rephrase and review all the time…*

Maggie also used collaborative learning strategies within her classroom. She relied on this strategy especially when starting a new section. A teacher's attitude towards a learner's home language also determines their interactions (Poudel 2010). Maggie was aware that some of her learners struggled with communicating and understanding the language of instruction. So she used group work to ensure that there was communication around the mathematics concepts, additionally, learners could be assisted by their peers to achieve a common understanding. The use of collaboration also motivates learners to become less dependent on the teacher (Brijlall 2008). This is evident in the excerpts that follow:

Maggie: *…I know they [the learners] find it difficult when I talk about new concepts…so I introduce and explain… I ask them to get into groups and talk about what the concepts mean…we solve problems in groups first they get to talk and discuss…until it makes sense…*

LFGL3[3]: *…it helps when we talk in groups…we were talking about mode and I was thinking about mowed…like cutting the grass…no one laughed when I was confused…they [the rest of the group] wrote it out and explained it…I don't feel bad I don't talk like them…they make me feel like part of them…it makes sense when we talk in groups first…*

Learners also worked collaboratively through peer tutoring. Peer tutoring is an important strategy for teachers to implement because it allows learners who have grasped concepts, to help learners who have not. This collaboration between the learners benefits both the learners (Brijlall 2008), because it allows the academically stronger learner to reinforce the skills he/she has developed, as well as, this collaboration introduces the skills on a more basic level to the low attaining learner. Penny, for example, followed the following steps to ensure that peer tutoring and the tutor were successful within her classrooms.

She trained her learners on the process of peer tutoring and strategies for fulfilling their role of a tutor or tutee. She grouped her learners into pairs. Allowing learners to work in pairs reinforces their enthusiasm and conceptual understanding (Nyamupangedengu and Lelliott 2012). While students were working in pairs, Penny walked around her classroom providing useful insights and tips on the exercises to be completed. In this way, Penny monitored the peer tutoring and provided feedback. This is evident from the excerpt that follows:

Penny: *…peer learning... I try to do this as much as possible…it depends on the lesson as well…they work well together…especially if one learner can support the other with defining mathematics concepts and instructions.... I use that quite often…*

Karyn also used group work and peer tutoring in her classroom. She believes that her learners enjoyed and benefitted from the use of this teaching strategy in the classroom. Additionally, the use of group work encouraged learner participation and enhanced learner understanding (Brijlall 2015). This is evident from the excerpt that follows:

Karyn: *…you can see that you have their attention and they are just more involved...even when they are struggling with understanding concepts…they discuss within their groups…they support each other…*

From the lesson observations and field notes gathered it was also noted that in some instances learner tutors used code switching to ensure that their tutees understood what was being discussed. The teachers in this paper also used code switching. Code switching was evident in Sam's classroom. Sam believed that using code switching was beneficial in his classroom. This is evident from the excerpt that follows:

Sam: *…sometimes it is easy to use words they understand and then use the actual mathematics concept name…*

The Use of Mnemonics and Manipulatives

Mnemonics were used by teachers to assist learners with remembering formulae, rules or new concepts. In this paper, mnemonics are defined as a strategy that provides a visual or verbal clue to learners who may have difficulty retaining mathematical information (DeLashmutt 2007). The use of mnemonics in the teaching and learning of mathematics is beneficial because this allows learners to link the sequencing steps for mathematics problems, by using simple phrases. This helps learners classify and group each step, thus allowing them to break mathematics problems into smaller parts. The learners are then able to bring these smaller parts of the mathematics problem into the bigger picture. Penny used the mnemonic BODMAS[4] when learners were asked to solve problems using the order of operations.

Additionally, Penny provided chart paper with equations already written on it for learners to solve in groups. While the learners worked on the examples, Penny walked around the classroom providing encouragement and support to her learners. She also used the mnemonic SOH CAH TOA (Oranges Have Segments Apples Have Cores, Oranges Are Tangy) when teaching learners formulas in trigonometry. While the use of this mnemonic may be used to address other challenges that may not necessarily be associated with language, Penny used this mnemonic because her learners struggled with understanding concepts such as *adjacent* and *hypotenuse*. Penny believed that allowing her learners to interact with each other created a favorable learning environment for learners to discuss their challenges freely, additionally by using chart paper the lesson became more interesting and creative for her learners. This is evident in the following excerpt:

Penny: …*I have often asked them to make charts and you would see a beautiful response…especially when we incorporate definitions of mathematics concepts with a diagram depicting what the concept looks like…*

The use of mnemonics assisted learners in recalling and remembering important aspects in mathematics. While this may not be a novel idea, this mnemonic assisted the learners when language became a challenge to learning and understanding trigonometry functions and ratios.

Vincent and Stacey (2008) have noted that having adequate teaching and learning resources has become significant in improving the teaching and learning of mathematics, since mathematical concepts and skills cannot be learnt in isolation. These teaching and learning resources may include mathematics manipulatives. A manipulative also provides a technique for learners to see what is being taught when they cannot understand concepts because of issues with the language of instruction. This is supported by the excerpts that follow. Karyn used the smart board to explain concepts and ideas while teaching transformation geometry.

Karyn: …*it's just so much easier when the learners visualize what you try to explain... especially when they do not know what the terminology you are using means…*

RFGL6[5]: …*if someone had to tell you this is the hypotenuse, and if you had not of heard it before you would not know what it is but if you like show it on the actual triangle it is the longest side; it's easier to understand so you kind of link everything together.*

At Dean's school many of his learners were second language learners and the use of mathematical terms became problematic. Dean resorted to the use of manipulatives to teach the rotation of points that he wanted his learners to attempt. Dean used a simple manipulative made up of a stick and colored rubber bands to demonstrate to his learners the rotation of points on a Cartesian plane. Dean's explanation for his use of this manipulative is as follows:

Dean: …*if you ask them [the learners] to rotate…or give them the rule…they are not going to understand the terms clockwise and anticlockwise... But by showing them the rotation using the stick, we can see exactly how the position changes and I wanted them to see that initially…*

Through the use of this simple self-constructed manipulative, Dean showed evidence of understanding the content being taught, additionally, Dean showed evidence of knowing how to organize and teach this content adequately (Ball et al. 2008). Dean had the appropriate content and pedagogical content knowledge necessary to achieve success in his classroom. After being exposed to this manipulative, based on evidence from the lesson observations and the focus group interviews, the learners were able to answer the classwork exercise with minimal support from Dean. This is collaborated by excerpts from the focus group interview with Dean's learners that follow:

DFGL2[6]: *Yes rotation, we like actually saw the movement …clockwise…*

DFGL3: *…it was clear…I understood it [the rotation of the point…it was easy to do the exercise afterwards…*

DFGL6: *Keep the thing [rubber band] on the spot and just rotate it…the rubber band will go onto the angle…clearly as we did, because we could see it.*

From her experience, Penny was aware that her learners struggled with learning mathematics in English, which was their second or third language. She relied on her well-founded pedagogical content knowledge and devised supportive ways of teaching her learners problem solving techniques in mathematics. Penny used mnemonics and manipulatives. Learners require mathematics manipulatives, which may assist them in constructing meaning from what they have been taught. Interpreting learner errors and evaluating alternative procedures is not all that teachers do; teaching also involves explaining processes (Ball et al. 2008). For example, when Penny was teaching, she used a manipulative (a clock face she had constructed out of cardboard plate) to explain to her learners the meaning of clockwise and anticlockwise while discussing the term direction of the rotation. She used this manipulative to probe learner responses—both correct and incorrect—until learners constructed the correct conceptual meaning of the terms clockwise and anticlockwise. She asked learners to discuss in groups as well as write down what they understood by these definitions. By asking learners to both speak and write she probed their thinking (Jamison 2000).

Penny believes that it was important for learners to see what she was teaching, in order to understand the mathematical concepts being taught. This is evident from the following excerpt:

Penny: *…I believe that is how children internalize concepts by seeing it. So diagrams and visuals do that for children especially when language is a barrier...*

In Alan's classroom, he recognized that working with fractions in trigonometry was becoming an obstacle to his teaching. He realized that many learners had not grasped foundational knowledge and terminology when working with fractions. In order to teach for success, teachers are required to know what the source of their learner errors or misconceptions are (Ball et al. 2008). Working from a basis of what knowledge learners have plays an important role is teaching for success (Brijlall 2014). Alan understood why his learners were having difficulty when working with fractions. His learners had a problem differentiating terminology like, *numerator*, *denominator*, *less than* and *greater than*. Since conceptual development and instruction in mathematics is dependent on the understanding and use of mathematical language, this mathematical language needs to be taught by the teacher (Clarkson 2009). Alan resorted to using manipulatives to express basic fractions and terminology to assist his learners in grasping foundation knowledge for fractions, and to allow them to have a visual understanding of what this knowledge meant. He constructed a fraction wall using a transparency and fraction tower squares using cardboard (he used an old calendar to construct fraction tower squares). He used an overhead projector to model equivalent fractions using the fraction wall. Alan used a combination of his content and pedagogical content knowledge to construct a manipulative that was powerful in supporting his learners' understanding (Ball et al. 2008).

Alan used a demonstration of horizontal and vertical arrangements of the fraction tower squares and allowed his learners to experiment with their own fraction towers in small groups. This exercise allowed learners to experiment with concrete manipulatives and through discussion and group work they gained foundational understanding of fractions, terminology and the relationship of fractions with other concepts, for example, percentages. They could then apply their knowledge to the lesson on working with trigonometry ratios. Alan rationalized his use of manipulatives and mnemonics as follows:

Alan: *…the learner can see exactly what you are doing…because in a way sometimes you are saying certain things and the kid is thinking of something totally different, and if you don't show them what is happening, you are making the assumption that they know what is happening but if he thinks of something else his entire trig would suffer…*

His learners also felt that these teaching strategies were useful to them as is evident in the excerpts that follow:

OFGL1[7]: *It becomes again easier to understand because you are doing it for yourself…it is better than listening to someone say to* *you…especially when we don't understand the words…we have learnt through that...*

OFGL2: *It also creates a more interactive feel between the teacher and the learners as such; he doesn't become like monotonous in a sense…especially when the mathematics words are hard to understand…*

OFGL3: *…well, it [fraction towers activity] makes it better for us to understand because if we just have a bunch of numbers like in trigonometry if they just give us y and r…it is not easy for us to see what they are actually talking about…*

OFGL5: *…it helps when we work in groups… I feel comfortable talking to them [group members] first…I want to make sure I know what I must do…*

Maggie also believed that learners needed to see through the use of manipulatives to understand what is being taught as is evident from the excerpt that follows:

Maggie: *…yes… if you are doing a section in geometry…you go to the visual in front of you…so that really helps…especially when they do not understand the term or concept we are using… So certain aspects we need to use visual stimulation…*

It was evident that in these instances that the teachers valued the use of visuals in assisting learners with understanding certain concepts in mathematics especially when the language of instruction created a challenge in the classroom. As can be seen, teachers must possess unpacked mathematical knowledge because they are required to make mathematics content visible to learners when necessary (Ball et al. 2008). Similarly, Sam used his resourcefulness and knowledge as an experienced teacher to scaffold the teaching and learning of mathematics in his classroom. This was evident in the following excerpt:

Sam: *…I start from the concrete, something they can see…it's just in front of them…they can see the pattern in bricks…I think it makes things easier if you are talking about something they can see, they can understand what you are teaching if they see...the words don't confuse them…*

CONCLUSION

The challenges created by the language of instruction within multilingual mathematics classrooms are not unique to South Africa. These challenges are revealed in studies conducted in other classrooms worldwide. The teachers in this paper used various teaching strategies and teaching manipulatives to overcome the challenges that the language of instruction created. They used mnemonics, manipulatives and collaborative work while teaching their lessons. The teachers revisited certain mathematics terms (such as *function*, *face*, and *figure*) that had diverse meanings outside the classroom. The teachers used collaborative work so that learners could understand these key concepts and recognize what they meant within the mathematics context. The teachers showed evidence of adequate pedagogical content knowledge because they were adept at using appropriate teaching strategies to teach the mathematics content.

Also of importance was that the teachers in this paper interacted with their learners throughout the lessons and the teaching strategies that were used were not confined to the traditional 'chalk and talk' method. The manipulatives that were selected by each participant to overcome the challenges created by the language of instruction were inexpensive and easily accessible or constructed. The teachers were aware that not overcoming the challenges created by the language of instruction might impede their learners' mathematical ability and performance in school.

Through discussing the manner in which each teacher in this paper used strategies to overcome the challenges that the language of instruction created, other teachers could be exposed to possible supportive teaching strategies for their own multilingual classrooms. It is important for teachers to be exposed to helpful teaching strategies in mathematics, as this could be one way of improving the mathematics performance and ability of learners globally.

RECOMMENDATIONS FOR FUTURE STUDIES

The conclusions of this paper while not generalizable indicate that the sharing of good practice may enhance mathematic learners' understanding and performance. While the strategies used by the participants may not be novel, the discussions in this paper could provide ideas to curriculum developers and teacher educators for their planning of methodology modules and lectures for prospective mathematics teachers.

ACKNOWLEDGEMENTS

The researcher would like to thank the University of KwaZulu-Natal for partially funding this paper. The opinions expressed here are those of the researcher, and do not necessarily reflect the position, policies or endorsements of the university.

NOTES

1 The 11 official languages recognised include English, Afrikaans and nine African languages: IsiZulu, IsiXhosa, Setswana, Tshivenda, Xitsonga, Sesotho, IsiNdebele, SiSwati and Sepedi.
2 The words in square brackets have been added by the researcher to assist the reader in understanding the transcript excerpt.
3 The code used for Lily Focus Group interview with learners is LFGL. The number next to the code refers to the learner being interviewed for example: LFGL3 – refers to Learner number 3 in the focus group.
4 BODMAS: This mnemonic is used when working with equations involving a number of operations. The mnemonic alerts the learner to look for the various operations and solve them based on the order in which they appear in the mnemonic. For example: B: Brackets, O: Off, D: Division, M: Multiplication, A: Addition, S: Subtraction. Thus if an equation had two operations multiplication and subtraction, the learner would solve the multiplication aspect of the operation before solving the subtraction aspect of the equation.
5 The code used for Rose Focus Group interview with learners is RFGL. The number next to the code refers to the learner being interviewed for example: RFGL6 – refers to Learner number 6 in the focus group.
6 The code for Daisy Focus Group Interview with Learners is DFGL.
7 Code used for Orchid focus group interview with learners is OFGL.

REFERENCES

Anthony G, Walshaw M 2009. Characteristics of effective teaching of mathematics: A view from the West. *Journal of Mathematics Education*, 2(2): 147-164.

Ball DL, Thames MH, Phelps G 2008. Content Knowledge for Teaching: What makes it special? *Journal of Teacher Education*, 59(5): 389-407.

Barwell R, Barton B, Setati M 2007. Multilingual issues in mathematics education: Introduction. *Educational Studies in Mathematics,* 64(2): 113-119.

Barwell R, Setati M 2005. Multilingualism in Mathematics education: A conversation between the North and the South. *For the Learning of Mathematics,* 25.

Bohlmann C, Pretorius E 2008. Relationships between mathematics and literacy: Exploring some underlying factors. *Pythagoras,* 67: 42-55.

Brijlall D 2015. Exploring the Gurteen Knowledge Café approach as an innovative teaching for learning strategy with first-year engineering students. *Groupwork,* 24(3): 26-45.

Brijlall D 2014. Exploring the pedagogical content knowledge for teaching probability in middle school: A South African case study. *International Journal of Educational Sciences,* 7(3): 719-726.

Brijlall D, Isaac V 2011. Links between content knowledge and practice in a mathematics teacher education course: A case study. *South African Journal of Higher Education,* 25(4): 680-699.

Brijlall D 2008. Collaborative learning in a multilingual class. *Pythagoras,* 68: 52-61.

Bukova-Güzel E, Cantürk-Günhan B, Kula S, Özgür Z, Nüket Elçí A 2013. Scale development for pre-service mathematics teachers' perceptions related to their pedagogical content knowledge. *South African Journal of Education,* 33(2): 1-21.

Clarkson P 2009. Potential lessons for teaching in multilingual mathematics classrooms in Australia and Southeast Asia. *Journal of Science and Mathematics Education in Southeast Asia,* 32(1): 1-17.

Creswell JW 2007. *Qualitative Inquiry and Research Design: Choosing Among Five Approaches*. London: Sage.

DeLashmutt K 2007. *A Study of the Role of Mnemonics in Learning Mathematics*. MA Thesis, Unpublished. Hastings: Nebraska. University of Nebraska-Lincoln.

Dhillon KJ, Wanjiru J 2013. Challenges and strategies for teachers and learners of English as a second language: The case of an urban primary school in Kenya. *International Journal of English Linguistics,* 3(2): 14-24.

Drijvers P, Doorman M, Boon P, Reed H, Gravemeijer K 2010. The teacher and the tool: Instrumental orchestrations in the technology-rich mathematics. *Educational Studies in Mathematics,* 75(1): 213-234.

Gorgorio' N, Planas N 2001. Teaching mathematics in multilingual classrooms. *Educational Studies in Mathematics*, 47(1): 7-33.

Islam F 2012. Understanding pre-service teacher education discourses in Communities of Practice: A reflection from an intervention in rural South Africa. *Perspectives in Education,* 30(1): 19-29.

Jamison RE 2000. Learning the language of mathematics. *Language and Learning Across the Disciplines,* 4(1): 45-54.

Kanyongo GY, Brown LI 2013. Relationship between pedagogical strategies and teachers' content knowledge of mathematics. *African Journal of Research in Mathematics, Science and Technology Education,* 17(1-2): 106-112.

Kasule D, Mapolelo D 2013. Prospective teachers' perspectives on the use of English in the solving and teaching of Mathematics word problems-a brief cross-country survey. *African Journal of Research in Mathematics, Science and Technology Education,* 17(3): 265-274.

Lim TSK 2007. Language development strategies for the teaching of science in English *Learning Science and Mathematics,* (2): 47-60.

Meiers M 2010. Language in the mathematics classroom. *The Digest*, 2(1): 1-16.

Mishra P, Koehler MJ 2006. Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers College Record,* 106(6): 1017-1054.

Moyer PS 2001. Are we having fun yet? How teachers use manipulatives to teach mathematics. *Educational Studies in Mathematics,* 47(2): 175-197.

Naidoo J 2006. *The Effect of Social Class on Visualisation in Geometry in Two KwaZulu-Natal Schools, South Africa*. MPhil Thesis, Unpublished. Nottingham: University of Nottingham

Naidoo J 2011. *Exploring Master Teachers' Use of Visuals as Tools in Mathematics Classrooms*. PhD Thesis, Unpublished. Durban: University of KwaZulu-Natal.

Naidoo J 2012. Teacher reflection: The use of visual tools in mathematics classrooms. *Pythagoras,* 33(1): 1-9.

Ncedo N, Peires M, Morar T 2002. Code Switching Revisited: The Use of Languages in Primary School Science and Mathematics Classrooms. *Paper presented at the Tenth Annual Conference of the South African Association for Research in Mathematics, Science and Technology Education* in University of Natal, Durban, January 22-26, 2002.

Nyamupangedengu E, Lelliott A 2012. An exploration of learners' use of worksheets during a science museum visit. *African Journal of Research in Mathematics, Science and Technology Education,* 16(1): 82-99.

Poudel PP 2010. Teaching English in multilingual classrooms of Higher Education: The present scenario. *Journal of NELTA,* 15(1-2):121-133.

Reddy V 2005. State of mathematics and science education: Schools are not equal. *Perspectives in Education,* 23(3): 125-138.

Setati M 2008. Access to mathematics versus access to the language of power: The struggle in multilingual mathematics classrooms. *South African Journal of Education,* 28: 103-116.

Setati M, Adler J 2001. Between languages and discourses: Language practices in primary multilingual mathematics classrooms in South Africa. *Educational Studies in Mathematics,* 43: 243-269.

Setati M, Adler J, Reed Y, Bapoo A 2002. Incomplete journeys: Code-switching and other language practices in mathematics, science and English language classrooms in South Africa. *Language and Education*, 1: 128-149.

Shaw JM 2002. Manipulatives Enhance the Learning of Mathematics, 1-4. From <www.eduplace.com/state/pdf/author/shaw.pdf> (Retrieved on 6 May 2015).

Shulman L 1987. Knowledge and teaching: Foundations of the new reform. *Harvard Educational Review,* 57(1): 1-22.

Siyepu S 2013. The zone of proximal development in the learning of mathematics. *South African Journal of Education*, 33(2): 1-13.

Tapson F 2000. The Language of Mathematics. International Journal for Mathematics Teaching and Learning. From <http://www.cimt.plymouth.ac.uk/journal/ftlangm.pdf>_(Retrieved on 16 March 2015).

Taylor N 2008. *What's Wrong with South African Schools?* Johannesburg: JET Education Services.

Vincent J, Stacey K 2008. Do mathematics textbooks cultivate shallow teaching? Applying the TIMSS Video Study criteria to Australian Eighth-grade mathematics textbooks. *Mathematics Education Research Journal*, 20(1): 82-107.

Vorster H 2008. Investigating a scaffold to code-switching as strategy in multilingual classrooms. *Pythagoras,* 67: 33-41.

Zazkis R 2000. Using code-switching as a tool for learning mathematical language. *For the Learning of Mathematics,* 20(3): 38-43.

Zevenbergen R 2001. Mathematics, social class and linguistic capital: An analysis of mathematics classroom interactions. In: B Atweh, H Forgasz, B Nebres (Eds.): *Sociocultural Research on Mathematics Education.* Mahwah, New Jersey: Lawrence Erlbaum Associates Publishers, pp. 201-215.