Vol. 77 | No. 9/1 | Sep 2021
DOI: 10.21506/j.ponte.2021.9.1
PONTE Florence, Italy
International Journal of Sciences and Research

Mathematics lecturers and students views on the role of language in a multilingual classroom at TVET college level

Name of Author (Corresponding Author)
(Affiliation/University/Country/Email)
Antoinette Kahiya

Department of Mathematics (Newtech), Majuba TVET College, South Africa,
akahiya@yahoo.co

Deonarain Brijlall (corresponding author)

Department of Mathematics, Durban University of Technology, South Africa,
deonarainb@dut.ac.za

Abstract
This paper reports on a study exploring the teaching and learning of mathematics in a multilingual classroom at a Technical Vocational Education and Training College (TVET). A case study research method was used. Three N5 mathematics lecturers and 20 N5 students were purposefully selected from two campuses of a TVET college in South Africa. Data were collected using semi-structured interviews and through classroom observations. Lecturers were interviewed individually to find out the effects of the language of teaching and learning on student understanding, and to find out the teaching strategies they use to teach mathematics. Findings reveal that students know what they should do in order to understand mathematical concepts, although they do not always adhere to them, and they also know what they expect from lecturers. Lecturers also know the teaching strategies that could give them good results, but the students seem to not do their part. Findings also reveal that a common language between lecturers and students helps a lot in explaining some important mathematical facts and it also helps in improving participation during lessons.

KEYWORDS: multilingual classrooms, mathematics learning, mathematics teaching

INTRODUCTION

Linguistic diversity continues to grow in schools, colleges, and universities all over the world including South Africa , as students from diverse linguistical and cultural backgrounds enrol at these institutions (Turkan & de Jong, 2018). According to Zehler , Fleischman, Hopstock, Stephenson, Pendzick, 2003, teachers now have to work with students with a variety levels of linguistic proficiency. The world has become aware of the importance of language in the learning of Mathematics due to the economic migration and increasing focus on education for economic development, and widespread use of the English language. In South Africa TVET college students come from all over the country and from the neighbouring countries. The pedagogical and content knowledge of mathematics teachers and lecturers has to be strong. Attention to the role of language needs to be included when working with multilingual learners. South Africa has 11 official languages. The majority of students are taught in their first language (L1) in the first 3 years of their schooling. From 4th year there is a dramatic switch to the

language of learning and teaching (LoLT), which in most cases is not known or has not been mastered by the students. According to studies by Heugh (2017) and Collier and Thomas (2017), children take 6 to 8 years to become adequately proficient in an 'International' language L2, to use the language effectively for academic purposes.

TVET colleges use English as the LoLT . According to Sibanda and Graven (2018) access to mathematics learning and successful interpretation of assessments depends on the understanding of the language of teaching, learning and assessment. Poor performance in mathematics is therefore linked to poor language proficiency or lack of it (Reddy et al, 2016). Learning to communicate mathematically is central to grasping mathematical concepts (DoE, 1996; 1997). Accordingly, in most classrooms there is lack of effective communication due to the diversity of languages amongst the students and the lecturers. Lecturers, just like the students are also of diverse languages because they come from all over the country and others come from outside South Africa.

At most colleges, some of the lecturers cannot speak any of the South African indigenous languages. Through informed discussions with students, some indicated their belief that they fail because they do not understand English. From my teaching experience I noticed that students do not like solving word problems. They complain about not understanding the English language involved. The students switch off their brains at the sight of word problems. They want the lecturer to explain the problem in their mother tongue and write the equations for them. Very little to no participation takes place when the lecturer does not speak the indigenous language. Lack of a good foundation in mathematics is also another cause of poor performance at TVET colleges.

The purpose of this study was to explore the role of language in the teaching and learning of mathematics in a multilingual classroom at TVET college. To address this purpose we formulated the question: **What are lecturers' and students' views on the role of language in a multilingual mathematics classroom?**

LITERATURE REVIEW

Due to the growth of cultural and economic migration there has been wide use of English as a language of teaching and learning. Many studies have been done on the role of language in the teaching and learning of mathematics at primary and secondary school level, little has been done on multilingual and bilingual adults' learning of mathematics. More research on ways of

teaching such groups of learners have to be carried out as well. Studies focusing on teaching and learning of mathematics in multilingual classrooms at primary and secondary schools have indicated that the home languages of students are resources for learning (Adendorff, 1993; Adler, 1996, 1998, 2001; Setati, 1996, 1998). Use of students' home language is supported by these studies. Considering language as a resource challenges disadvantage assessment performance of students who are not proficient in the language of teaching. Robertson and Graven (2019) showed how use of English only in a grade 4 class of isiXhosa speaking students made it difficult for the teacher to encourage exploratory talk. Students could not deepen their conceptual understanding of mathematics. In South Africa, most students come from high schools where mathematics was taught and explained in their indigenous languages. Given the nonexistence of the mathematical register in these languages, misinterpretation takes place easily, and thus conceptual errors are taught. Students find it difficult to cope at TVET due to the English language used for teaching and learning.

Role of language in a multilingual mathematics classroom

Language is a major learning medium used for communication and epistemic purposes in mathematics classrooms (Prediger, S., Erath, K., & Moser Opitz, E., (2019). In a mathematics class, students also learn the language together with the mathematics. Gorgorio' and Planas, (2001) noted that language and communication are essential elements of teaching and learning mathematics. Language facilitates many things including transmission of mathematical knowledge. It provides the tool for teacher-student, and student-student interaction. When students do not understand, they do not participate. According to Mahofa (2014), some mathematics terms cannot be translated into local indigenous languages. Students with little fluency in LoLT will see language as a barrier to their learning if the teachers do not have strategies to use the students' own linguistic resources.

Language plays an important role in the development of deep conceptual understanding of mathematical ideas (Durkin & Shire, 1991). Clarkson's model (2009) could help in improving students' learning.

Clarkson suggests the following four ideas 1) Teachers should encourage different types of language such as informal talk in students' first language leading to more formal mathematical talk in the language of teaching. 2) Tracing the language paths of students in the complex multilingual situations 3) Informal talk inevitably occurs in students' first languages. This can

lead to miscommunication when the teacher does speak the students' language. 4) Teachers need to use academic mathematical language and promote an expectation that students will come to use such language. According to Moschkovich, 2007; Setati & Adler, 2000; Webb & Webb; 2008, encouraging students to discuss ideas in their own language has proven to have a positive impact on students' conceptual understanding of mathematics.

Multilingualism in mathematics classrooms worldwide has made the world aware of the importance of language in learning mathematics. Sweden, America, Catalonia, and Cyprus, to mention only a few, have multilingual classrooms due to demographic changes and international migration.

Being able to shift between everyday language and subject specific language is regarded by some researchers to be the key to developing mathematical understanding (Australian Curriculum and Reporting Authority (ACARA), 2012; Barwell, 2012; Adoniou & Qing, 2014). Howie (2003), in particular advocates high competency in the language of instruction for the successful learning of mathematics. In South Africa, some of the lecturers struggle to construct a grammatically correct statement in English and this makes it very difficult for students who are trying to learn both the language of instruction and the language of mathematics. Students' lack of linguistic ability affects their performance in mathematical tasks. Of great concern is the teachers' lack of awareness of the challenges that the mathematics language causes for students (Gough, 2007). In a mathematics classroom, when language is routinely unpacked and scaffolded for the learner, learning outcomes improve (Fuchs, Fuchs, and Compton ,2012). Classroom discussions are also important in the development of cognitive competencies discussion improves the learner's ability to comprehend and communicate mathematical understandings and strengthens the development of their mathematical ideas, (Turner, Drake, McDuffie, Aguirre, Bartell & Foote ,2012).

Barwell (2008) argues that encouraging mathematical discussions based on the students' experiences, would help the students to develop their own understanding of mathematics and the mathematical language they encounter.

In Catalonia to solve the language problem all new students, attend language lessons for seven and half hours per week. Lack of understanding of the language of instruction reduces participation by the students. For example, when solving word problems most students cannot formulate correct equations from given real life problems due to misinterpretation of the language.

A common language between teachers and students, which they can turn to for common understandings would be of great help in the teaching and learning of some mathematical concepts and topics. Grouping students according to their languages during group discussions could help in improving the conceptual understanding. In

According to Anhalt and Rodriguez-Perez (2013) and Clarkson (2004), the teaching of mathematics in diverse classrooms is made complex and challenging by issues of language and culture.

Mathematics being a language of its own, with its own vocabulary or mathematical register does not make it easy for students. There are words which tend to have one meaning in everyday English and another meaning in mathematics, for example, volume, degree, operation just to mention a few.

This ambiguity in meaning affects mostly the solving of word problems. In this topic students are supposed to read the word problem and formulate appropriate equations and solve them.

Misunderstanding one word in a word problem can lead to misunderstanding the whole sentence and hence the problem at hand.

Student perceptions on Teaching and Learning Mathematics in English

In Malaysia, research on the effect of teaching mathematics and science in English revealed that students felt that it was not easy since English was not their first language. Those whose first language was English still struggled with understanding the mathematical language; and they could not grasp or comprehend the concepts and mathematical relationships. Before the introduction of English, non-English speakers used to learn in their local language, Malay. Teaching in English was not easy for the teachers as well since they were used to teaching in Malay (Tan & Lan, 2011). The new system that used English for teaching benefited only the academically and linguistically strong students. This is the same scenario we have in South Africa. The Nated (also known as Report 191) courses are 10-week courses but are usually taught in less than 8 weeks due to delays in registration. Time and language are most likely to impact on the performance of the students. Would those who fail to qualify perhaps do so if they had been given more attention to foster their understanding of the mathematical language and concepts? More research is needed to explore the situation.

A survey carried out in 2009-2010in Malaysian Universities showed that the students from other countries were ready to be taught in English, while the Malay students preferred to be

taught in their own Malay language (Majid et al. 2011). From informed discussions with some students at a TVET college in KZN they have the same sentiments.

In Northern Australia, most teachers do not speak the same languages as the students, and this makes it very difficult for learners to grasp mathematical concepts. Barwell, Barton and Setati (2007), concluded that teachers in such circumstances put emphasis on the language at the expense of developing mathematical concepts.

Limited language proficiency leads to difficulties in learning and to misconceptions (Riordain, Coben & Miller-Reilly, 2015). More research on language at TVET level is needed since the problem continues through to tertiary level, because of where the students are coming from.

Teachers' perceptions on Teaching and learning Maths in English.

In both urban and rural Malaysian schools, teachers believed that weaker students had to be supported in their learning by using their local languages (Tan and Lan, 2011). The Malaysian education system implemented a policy that made English the medium of instruction for Mathematics and the Sciences after using the local language for more than 30 years. This was a difficult time for both the teachers and the students. Only the academically and linguistically strong students benefited from this new system. Teachers used English throughout the lesson when teaching the best classes. When teaching the weaker classes teachers first used English, then translated into Malay. Other teachers used more Malay and less English. In South Africa we have almost a similar situation, lecturers still teach in local languages even though the classrooms are multilingual.

American student teachers in Tanzania realised that there were great improvements in participation when they learnt the local language and used it in their classrooms (Kasmer & Billings, 2017). Switching to the language of learners helps when students do not understand (Halai, 2011),

Code Switching

Code switching is the alternating of languages, dialects or of language styles in the speech of an individual, or the use of more than one language in the same conversation (Adler, 2001; Setati, 1998).Halai and Karuku (2013) believe that code switching should be recognised by education authorities as a valuable resource that can be adopted in multilingual mathematics classrooms to facilitate learning. They think that code switching could be crucial in improving the quality of classroom discussions and interactions, just as was discovered by the American student teachers in Tanzania (Kasmer & Billings, 2017).

Chikiwa & Schafer (2016) concluded that to promote code switching that is precise, consistent, transparent, and supportive of teaching, consensual understanding of best practices for code switching must exist.

Code switching promotes participation in class. From the researcher's experience in South Africa, when lecturers use only English when teaching, the students become passive, and few participate. When lecturers use the students' language together with English, more students participate. Maluleke (2019), concluded that code switching helps teachers to evaluate whether students understand the content being taught and it helps them to put emphasis on the concepts that are critical. Mixing or inter changing between English and the students' language helps to maintain the flow of information and improve the students' understanding. According to Jegede (2011) code switching serves as a communication strategy that bridges the gap of linguistic competence in two languages. Code switching enhances academic performance and encourages students to make meaningful contributions in class.

THEORETICAL FRAMEWORK

Cognitive Constructivism

Bruner (1966) attaches great importance to language in determining cognitive development. Vygotsky and Bruner investigated the nature of and relationship between language and thought. Language is inextricably linked with thought (Vygotsky, 1962). According to Bruner (1973), the use of language as an instrument of thinking is important together with its effect on cognitive processing.

Bruner's theory of learning development is clear about language and how this affects cognition. The constructivist teacher is a facilitator who monitors, guides and encourages critical thinking, including encouraging teamwork by allowing students to work in pairs or groups. Constructivism allows children to develop skills and confidence to analyse the world around them, create solutions and justify their words and actions. Bruner proposes a cognitive constructivist approach, in that learning is an active social process whereby new knowledge is constructed by students through exploration of their world and through the filter of their prior knowledge. His ideas on cognitive psychology examine the thoughts and reasoning of people in addition to how they respond to stimuli (Smith, 2002). His cognitive theory of instruction encourages educators to create instruction that leads the student through a sequence of statements until the student masters the content.

In a constructivist model, the teacher is involved in setting up conditions that enable students to discover relationships between concept and language plays a major role in this process. Bruner believes a learner can be encouraged and supported with assistance (Stapleton & Stefaniak, 2019). According to Stapleton and Stefaniak (2019), Bruner's form of discovery learning helps students to be creative and to remember.

The Effects of Bilingualism on Cognition

Bilingualism affects the development of attention and the effects of bilingualism on cognition are found across different sociolinguistic settings. To develop cognitive benefits, a certain level of bilingual proficiency is required (Marian and Shook, 2012). The following are found in bilingual people; enriched cognitive control, improved metalinguistic awareness, as well as better memory, visual-spatial skills, and creativity. The use of a second language should be increased both at home and in social contexts to enable the brain to deal with increased language control effectively (DeLuca, Rothman, Bialystok & Pliatsikas, 2020). According to DeLuca et al. (2020) , the increased use of a second language leads to more effective and efficient interference suppression processes and efficient language switching. If South African students would use English more, at college, home and in their social context they would benefit a lot. Most students do not speak English at home nor outside lessons, they use their mother tongue. DeLuca et al., (2020) alludes that the experience of learning and using an additional language leads to structural adaptations in the brain. Mastering English as a foreign language enhances two components of the executive function in human cognition: namely, cognitive flexibility and working memory (WM). In the learning of mathematics, the WM plays a crucial role in the retention of information while mental operations are being performed.

Bilinguals have a mechanism for controlling attention for their two language systems (DeLuca et al., 2020). Controlling one language while using the other exercises the neurological mechanisms that underpin attention control and enhances the bilinguals' abilities in the Executive function. Encouraging students to discuss ideas in both their mother language and the LoLT would also help in the control of language. Teaching strategies like Polya's problem solving and cooperative learning that give students a chance to discuss and clarify problems with one another help in improving academic performance and enhancing communication skills (Crandall, 1999).

In childhood bilinguals controlling their attention for two languages boosts the development of executive control (EC) processes and so sustains cognitive control advantages through to adulthood (Marian and Shook, 2012). Executive function (EF) regulates cognitive abilities and processes such as attention and inhibition. Inhibition allows bilinguals to resist interference and gain more vocabulary than would monolinguals, who are not skilled in inhibiting competing information. The use of these processes by bilinguals when speaking or listening strengthen the control mechanisms and so changes the associated brain regions. Thus, using teaching strategies that involve participation from the students can be effective in helping achieve academic proficiency. From informed observations, in the multilingual classrooms the students who are fluent in English participate more than those who are monolingual. This shows the importance of language in teaching and learning mathematics.

METHODOLOGY

This section explains the research design, participants and methodology that were used in the study.

Research design

In this study a qualitative case study design was used. According to Creswell (2014) a case study is an in-depth exploration of a bounded system like an activity, event, process, or individual based on extensive data collection. The case study design allows one to concentrate on a specific situation and attempts to identify the various interactive processes at work. This study focused on the use of language in teaching and learning of mathematics in a multilingual classroom.

Population

The participants were from a TVET college in Kwazulu-Natal in South Africa. The population consisted of three lecturers and 120 students. These were N5 mathematics lecturers and their students from 2 Campuses of the college. Students from both campuses spoke mainly IsiZulu, but there were others who spoke a variety of other languages. The majority of the students chosen for the Campus 2 group were mainly repeaters. These Campus 2 students were repeating the module due to having previously failed it. The researcherS, with the help of the lecturers, chose 10 students to form a focus group from each campus. Students were chosen according to their home languages. Three Xhosa speaking students, two Sotho speaking students, two Swati speaking students and three isiZulu speaking students, were chosen from Campus 1. From

Campus 2 the sample had six IsiZulu speaking students, three Swati speaking students, one Xhosa speaking student. Class observations were also done with the same three lecturers.

Interviews and Observations

Interviews were audio recorded and then transcribed. Participants were given the transcribed data to verify that it was an accurate reflection of the interview. The transcribed data were analysed thematically. Qualitative data analysis is a process of moving from specific data to general categories and patterns and relationships identified (McMillan and Schumacher, 2014). Meaning was sort from the data collected and themes and patterns were created from data that reflected common ideas.

For the observations, observation schedules were drawn which looked for the teaching methods, use of multilingualism during lessons, lecturer's knowledge of how students learn, effectiveness of the teaching strategy and students' success rate. The themes created from the interview data were also used for the observations.

Ethical Issues.

Ethical clearance was granted by Unisa and the Department of Higher Education and Training and the College Principal gave permission to conduct the study at the college.

For confidentiality, no real names were used, lecturers were referred to by $\{\{Li\}_{i=1}^{3}\ Cj\}_{j=1}^{2}$ where L stands for Lecturer and C for Campus. Students were referred to by $\left\{\{Cj\}_{j=1}^{2}\ Si\right\}_{i=1}^{10}$. Detailed consent forms were given to all participants. All participants were adults ages ranging from 20 years and above. All participants were told that participation was voluntary, and they could withdraw at any time.

RESULTS AND FINDINGS

What students think about the language of teaching and learning.

Language plays an important role in the development of deep conceptual understanding of mathematical ideas Durkin and Shire (1991). According to Anhalt and Rodrigues-Pérez (2013) students learning mathematics in a language that is not their home language need explicit and deliberate linguistic support.

The interviews conducted brought about different views from the students. Some of them think that the language is not the problem behind their failure to understand mathematical concepts. C1S5 says *"... Does not affect me. Since primary I have been using English…"*. C1S6 said

"*Somewhere somehow it does affect me...*" Then he immediately changes his mind and says "*The thing, it's not the language. I think the way the lecturer teaches us….*" This sudden turn within the same sentence makes the researcher think that the student was not exactly clear where his problem lay.

Similarly, C1S7 says "*The language does not affect me, but somewhere, somehow it affects my peers……Some of us are not like good speaking people but we learn as we go. So, sometimes they just explain huge words which we do not understand, whereby he needs to go back on the vocabulary to find out what it means*." A bit of contradiction here. He thinks he has no problem with the language but then he mentions that they do not understand the meaning of big unfamiliar words used by the lecturer. Here it is not sure if the student grasps the mathematical concepts being taught or not.

C2S2 says "*If we are being taught in English it's better for us to understand during the examinations to read the questions and understand them*". This student is aware of the benefits of learning in English, but again it is not clear whether the student grasps the concepts taught.

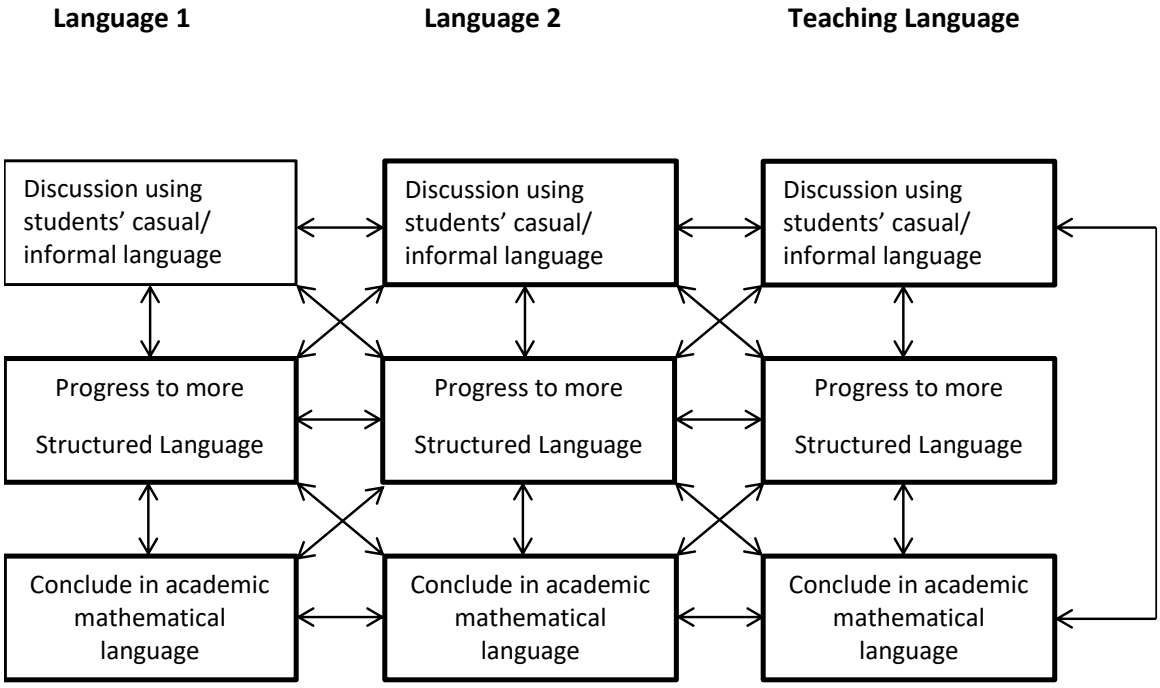

Figure 1: Adaptation of the language use model for multilingual students

Source: Clarkson P.C (2009)**:** Potential Lessons for Teaching mathematics in Multilingual Classrooms in Australia and Southeast Asia.

C2S4 says "*It depends on the teacher. The language does not really matter a lot. The teaching technique is the one that matters*". This one thing the language is not the problem but the teaching method.

C2S3 says in IsiZulu "*It kills us to be taught in English*". He says this in his mother tongue. By using his mother tongue, this student indicates how difficult he finds the English language. If one cannot express himself in English, how much of the lesson taught in English will he grasp?

These responses from the students show the different opinions regarding the language of teaching. This shows that language affects students differently and lecturers should take note of this when they teach. According to de Jong and Harper (2005) teachers teaching English language learners should pay attention to the role of language and to the role culture plays. Besides having strong content knowledge, the teachers should have knowledge about language, second language and literacy development. Clarkson (2009) in Figure 1 describes a language model suitable for primary schools, to ensure that the students have a good foundation for secondary school and tertiary level studies.

The different views on how the English language affects the students' learning of mathematics relates in a way to Clarkson's model. C2S3 prefers using his home language. Clarkson advocates the use of causal or informal language first. In this case the lecturer needs to know the student's language so that he can bridge the gap to arrive to the formal language. Knowledge of the students' language helps to move gradually to the language of learning. This move would make the understanding of the subject better and thus students would have a better chance to understand the examination as expressed by C2S2. Dash, Berroir, Joanette & Ansaldo (2019), believe that the use of different languages enhances the students' subcomponent of attention responsible for establishing a state of alertness for incoming stimuli. Prochazkova (2013), says learning mathematics in a different language provides students with a different perspective on the content area.

What Lecturers think about the language of Teaching and Learning:

The lecturers think that students fail to grasp mathematical concepts due to lack of understanding of the language of teaching and learning. In response to the question "How does it (medium of instruction) fit in with the language of your students?", lecturer L2C1says, "*It does in some way disadvantage the students because sometimes the students they cannot*

communicate properly in English". Student C1S7 also says "...*Some of us are like not good speaking people...".* This show us that both lecturers and students are aware of the problem of language difficulties amongst the students. The lecturer L2C1 proceeded to say "*Some of the sections it's fine, but especially with word problems, solving and understanding the textbook. The word problems they find difficult because some of them ehh mainly communicate in Zulu…".* This suggests that if the students put more effort in communicating in English, they might improve their understanding and interpretation of word problems. Some of the lecturers indicated that most students prefer that the lecturers use IsiZulu when teaching Mathematics.

The three lecturers agreed that language is a barrier to the understanding of mathematics, yet most students claim they do not have a problem with the language. To solve this language problem, the students should accept that they have a problem, and this might motivate the lecturers to take language into consideration when they are planning their lectures. Students' struggle with the word problems means that they will not come up with the correct mathematical interpretation of the problems and hence will not be able to solve the given problem. Bruner (1966) suggests that teachers and parents should help in scaffolding the method of communication to simplify tasks within learning. Adopting the Clarkson (2009) model in Figure 1 would help enhance the success of students in the learning of mathematics. Shifting between the causal language and the subject specific language and mastering this is the key to success (ACARA, 2012; Barwell, 2012). Some countries like Germany, China and the Catalan region of Spain, students spend time learning the language of instruction first before embarking on a study course. To improve the understanding of the language of Teaching and learning, it might help if TVET colleges in South Africa think of introducing a bridging course in English before students start N1 or Level 2.

CONCLUSIONS

This study explored the role of language in the teaching and learning of mathematics in a multilingual classroom. From the responses of the students, it is clear that a variety of languages play a role in the teaching and learning of mathematics. Students in a multilingual class prefer different "types" of languages. In this study it was noticed that some students preferred to communicate through their mother tongue and others thought intermittent use of the English language before an academic mathematical language would be more beneficial. Students thought that this would help them to gain better interpretation of the assessment tasks in examinations. Howie (2003) and Sibanda and Graven

(2018) allude that high competencies in the language of instruction are necessary for successfully learning mathematics. The researcher found that having a common language between lecturers and students is crucial. It helps in clarifying questions and promoting progress from causal language to structured language and thence to the mathematical language. This concurs with Barwell (2012). Lecturers who allowed use of the mother tongue had better participation from the students than the lecturer who could not speak the same language as the majority of the students. There were improvements when the lecturers first explained in the mother tongue and then reexplained in English. There is however need for further study on the role of language in multilingual classrooms at TVET colleges.

REFERENCES

.Adendorff, R. (1993). Code-switching amongst Zulu-speaking teachers and their pupils. *Language and Education*, 7:141-162

Adler, J. (1996). Secondary School Teachers' Knowledge of the Dynamics of Teaching and Learning Mathematics in Multilingual Classrooms, unpublished Ph.D. thesis, Johannesburg, University of the Witwatersrand.

Adler, J. (1997). A participatory inquiry approach and the mediation of mathematical knowledge in a multilingual classroom. *Educational Studies in Mathematics*, 33(3), 235- 258.

Adler, J. (1998). A Language of teaching dilemmas: Unlocking the complex multilingual mathematics classroom. *For the Learning of Mathematics*, 18(1), 24-33.

Adler, J. (2001). *Teaching mathematics in multilingual classrooms.* Dordrecht, The Netherlands: Kluwer.

Adoniou, M., & Qing, Y. (2014). Language, mathematics, and English language learners. *The Australian Mathematics Teacher*, 70(3), 3-12.

Anhalt, C. O. & Rodriguez-Perez (2013). K-8 Teachers' Concerns about Teaching Latino/a Students: *Journal of Urban Mathematics Education*: 6(2): 42-61

Australian Curriculum, Assessment and Reporting Authority (ACARA). (2012). *Australian Curriculum*. Retrieved 20 January 2019 from http: www.australian curriculum.edu.au

Barwell, R. (2008). Empowerment, EAL and the national numeracy strategy. *International Journal of Bilingual Education and Bilingualism, 8(4), 313-327.*

Barwell, R. (2012). The academic and the everyday in mathematics' talk: The case of the hyper-bagel. *Language and Education*, 27(3), 207-222.

Barwell, R., Barton, B., & Setati, M. (2007). Multilingual issues in mathematics education: Introduction. *Educational Studies in Mathematics*, 64(2), 113-119. Doi:10.1007/s10649-006-9065-x.

Bruner, J. S. (1973). *Beyond the Information given.* New York. Norton.

Bruner, J. S. (1960). *The Process of Education.* Cambridge: Harvard University Press.

Bruner, J. S. (1966). *Toward a Theory of Instruction.* Cambridge MA: Harvard University Press, 49-53.

Chikiwa, C., & Schafer, M (2016). Teacher Code Switching Consistency and Precision in a multilingual Mathematics Classroom. *African Journal of Research in Mathematics, Science and Technology Education*, 20(3), 244-255.

Clarkson, P. C. (2004). Teaching mathematics in multilingual classrooms: The global importance of contexts. In I.P. Cheong, H.S. Dhindsa, I. J. Kyeleve, & O. Chukwu (Eds.) *Globalisation trends in Science, Mathematics and Technical education:* 9-23. Brunei Darussalam: Universiti Brunei Darussalam.

Clarkson, P. C. (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.*

Collier, V. P., & Thomas, W. P. (2017). Validating the power of bilingual schooling: Thirty-two years of large scale, longitudinal research. Annual Review of Applied Linguistics, 37, 203-217.

Crandall, J. A. (1999). Cooperative language learning and affective factors. In J. Arnold (Ed.), *Affective Language Learning* (pp. 226-245). Cambridge, England: Cambridge University Press.

Creswell, J.W. (2014). *Research design: Qualitative, Quantitative, and Mixed methods Approaches.*(4th edition). Thousand Oaks, CA: SAGE.

Dash, T., Berroir, P., Joanette, Y., & Ansaldo, A. I., (2019). Alerting, orienting and executive control: The effect of bilingualism and age on the subcomponents of attention. *Frontiers in Neurology*, 10:1122. Doi:10.3389/fneur.2019.01122.

Dash, T., Berroir, P., Joanette, Y., & Ansaldo, A. I., (2019). Alerting, orienting and executive control: The effect of bilingualism and age on the subcomponents of attention. *Frontiers in Neurology*, 10:1122. Doi:10.3389/fneur.2019.01122.

DeLuca, V., Rothman, J., Bialystok, E., & Pliatsikas, C., (2020). Duration and extent of bilingual experience modulate neurocognitive outcomes. *NeuroImage* 204(2020) 116222. Doi: 10.1016/j.neuroimage.2019.116222.

Department of Education (1996). *Language in Education Policy.* Pretoria: Government Printers.

Department of Education (1997). *Education white paper 3: A programme for the Transformation of Higher Education.* Pretoria: Government Printers.

Dicker, A. (2015). Teaching mathematics in foundation phase multilingual classrooms: Teachers' challenges and innovations. *International Journal of Educational Sciences*, 8(1): 65-73.

Durkin, K., & Shire, B. (1991). Primary school children's interpretations of lexical ambiguity in mathematical descriptions. *Journal of Research in Reading*, 14(1):46-55.

Fuchs, L., Fuchs, D., & Compton, D. (2012). The early prevention of mathematics difficulty: Its power and limitations. *Journal of Learning Disabilities*, 45(3), 257-269.

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

Gough, J. (2007). Conceptual complexity and apparent contradictions in mathematics language. *The Australian Mathematics Teacher*, 63(2), 8-16.

Halai, A., & Karuku, S. (2013). Implementing Language-in-education Policy in Multilingual Mathematics Classrooms Pedagogical Implication*: Eurasia Journal of Mathematics, Science and Technology Education*, 9(1), 23-32.

Halai, N. (2011). Understanding a Pakistani Science Teacher's Practice through a Life History Study. *The Qualitative Report*, 16(4) 1034-1062.

Heugh, K. (2017). 'Lessons from Africa prove the incredible value of mother tongue learning', *The Conversation* (Australian edition), 27/02/2017.

Howie, S. (2003). Language and other background factors affecting secondary pupils' performance in Mathematics in South Africa. *African Journal of Research in Mathematics, Science and Technology Education*, 7, 1-20.

Jegede, O., (2011). Code switching and its implications for teaching Mathematics in primary schools in IIe-Ife, Nigeria. *Journal of Education and Practice*, 2(10):41-52.

Kasmer, L.A., & Billings, E. (2017). Teaching Mathematics in Multilingual Classrooms: Developing Intercultural Competence via a Study Abroad Program. *The Interdisciplinary Journal of Study Abroad*, 26(2):1-17.

Mahofa, E., 2014. Code Switching in the learning of mathematics word problems in grade 10. Unpublished M.Ed. thesis, Cape Peninsula University of Technology, Cape Town.

Majid, N., Jaaman, S.F., Darus, M., Nazar, R.M., Ramli, S.N.M., Suradi, N.R.M., …. & Hashim, I. (2011). The Readiness of Mathematics and Science Lecturers to Teach in English from Students' Perspective. *Procedia Social and Behavioural Sciences*, 18, 342-347

Maluleke, M.J. (2019). Using code-switching as an empowerment strategy in teaching Mathematics to learners with limited proficiency in English in South African schools. *South African Journal of Education*, 39(3).

Marian, V., & Shook, A. (2012). The cognitive benefits of being bilingual. *Cerebrum: The dana forum on brain science.* 2012, 13 http://www.researchgate.net/publication/235751035

Moschkovich, J. (2007). Using two languages when learning mathematics. *Educational Studies in Mathematics, 64(2), 121-144.*

Prediger, S., Erath, K., & Moser Opitz, E. (2019). Language challenges for students with mathematics difficulties: An overview on research results and instructional approaches. In A. fritz, V. Haase, & P. R s nen (Eds.), *International handbook of math learning difficulties: From the laboratory to the classroom (*pp. 437-455). Cham: Springer.

Prochazkova, L., T. (2013). Mathematics for language, Language for mathematics. *European Journal of Science and Mathematics Education*, 1(1):23-27.

Reddy, V., Visser, M., Winnaar, L., Arends, F., Juan, A., Prinsloo, C.H., & Isdale, K. (2016). TIMSS 2015: highlights of mathematics and science achievement of grade 9 South African learners. Pretoria: Department of Basic Education/ Human Sciences Research Council.

Riordain, M.N., Coben, D., & Miller-Reilly, B. (2015). What Do WE Know about Mathematics Teaching and Learning of Multilingual Adults and Why does it matter? *Adults Learning Mathematics: An International Journal*, 10(1),8-23.

Setati, M. (1996). Code switching and mathematical meaning in a senior primary class of second language learners. M.Ed. research report, University of Witwatersrand, Johannesburg.

Setati, M. (1998). Code switching in a senior primary class of second language mathematics learners. *For the Learning of Mathematics*, 18. 34-40.

Setati, M., & Adler, J. (2000). Between languages and discourses: Language practices in primary multilingual mathematics classrooms in South Africa. *Educational Studies in Mathematics*, 43, 243-269.

Sibanda, L. & Graven, M., 2018, 'Can mathematics assessments be considered valid if learners fail to access what is asked of them?', South African Journal of Childhood Education 8(1), a505. https://doi.org/10.4102/sajce.v8i1.505

Smith, M.K.(2002). '*Jerome Bruner and the process of education'*. The encyclopaedia of pedagogy and informal education. http://infed.org/mobi/Jerome-bruner-and-the-process-of-education/Retrieved: October2019.

Stapleton, L., & Stefaniak, J. (2019). Cognitive Constructivism: Revisiting Jerome Bruner's Influence on Instructional Design Practices. *TechTrends* 63, 4–5. https://doi.org/10.1007/s11528-018-0356-8

Tan, M., & Lan, O. S. (2011). Teaching mathematics and science in English in Malaysian classrooms: The impact of teacher beliefs on classroom practices and student learning. *Journal of English for Academic Purposes*, 10(2011)5-18.

Turkan, S., & De Jong, E. (2018). An Exploration of Preservice Teachers' Reasoning About Teaching Mathematics to English Language Learners. *Teacher Education Quarterly, 45*(2), 37-60. doi:10.2307/90020314

Turner, E. E., Drake, C., McDuffie, A. R., Aguirre, J., Bartell, T. G., & Foote, M.Q. (2012). Promoting equity in mathematics teacher preparation: A framework for advancing teacher learning of children's multiple mathematics knowledge bases. Journal of *Mathematics Teacher Education,* 15(1), 67-82.

Vygotsky, L. S. (1962). Thought and Language. Cambridge, MA: MIT Press. https://doi.org/10.1037/11193-000

Webb, L., & Webb, P. (2008). Introducing discussion into multilingual mathematics classrooms: An issue of code switching? *Pythagoras, 67, 26-32.*

Zehler, A., Fleischman, H., Hopstock, P., Stephenson, T., Pendzick, M., & Sapru, S. (2003). Descriptive Study of Services to LEP Students and LEP Students with Disabilities: Policy report: Summary of findings related to LEP and SPED-LEP students. Washington, DC: Development Associates.