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Challenges in Using African Languages as the Language of Learning and Teaching (LoLT) for Mathematics in Rural Schools: Foundation Phase Teachers' Perspectives

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ABSTRACT The South African Language in Education Policy (LiEP) advocates using African languages in the Foundation Phase (FP) which is the first phase of formal schooling in South Africa. This paper seeks to identify the challenges in implementing the language provisions prescribed in the LiEP in South Africa and within the region. Using the challenge-based learning (CBL) approach, this paper provides a glimpse into the challenges that 50 FP teachers based in six rural schools in South Africa face when using African languages as LoLT when teaching mathematics. Data collected through questionnaires, focus-group interviews, and observations in mathematics classrooms were used to illuminate these challenges. The results indicate that teachers experienced three main challenges: multilingual learners and learners who were taught in English in pre-school, English scripted lesson plans, and teacher training that was only provided in English. Importantly this paper identified a language disjuncture between policy and practice where the policy requires teachers to teach in African languages while the teaching material is written in English.

KEYWORDS *African languages, challenge-based learning, mathematics teaching, language of learning and teaching, rural schools*

Introduction

This paper draws on community-engaged research conducted from 2018 to 2020 by academics in an open and distance learning university, the University of South Africa (UNISA), in the rural communities of three provinces of South Africa: North West (NW), Limpopo, and KwaZulu-Natal (KZN). These three provinces were selected for this study because most of the population residing in these provinces is located in rural settlements, and the pre-service teachers trained in this ODL university are employed in rural schools. Some of the academic responsibilities in an ODL university are to engage with communities to develop strong relationships and share resources while advancing and enhancing scholarship in what is usually called community engagement. In response to UNISA's community engagement mandate, this study aims to identify challenges experienced when using African languages as a language of learning and teaching (LoLT) for mathematics as well as sharing reading and mathematics resources with identified schools in rural communities.

Permission to collaborate with the schools was requested from the three District Directors, who, together with their team members, granted us permission and selected two schools in each province to participate in this community engagement project. Furthermore, ethical clearance was granted from UNISA, followed by the research request application at each provincial office of education. We conducted a needs analysis using an open-ended questionnaire to set up specific, measurable, and relevant deliverables for the selected schools, many of which

focused on challenges teachers faced when using African languages to teach mathematics. Based on these initial findings, we, together with the beneficiaries and district officials, jointly decided to undertake a study to explore the challenges experienced by teachers when teaching mathematics using African Languages and to uncover possible solutions.

Naziev (2018) highlights that mathematics requires language to build, discover, understand, teach, and learn. However, there are different views about the specific language that needs to be used. Evidence from the literature suggests a significant relationship between language use and mathematics learning (Smith, 2017). Peng, Lin, Unal, and Lee (2020) argue that African languages as the LoLT of mathematics leads to high quality teaching and learning. Peng, et al., conducted a meta-analysis of 344 studies involving 393 independent samples to determine correlations between using LoLT in mathematics and its success in the mathematics classroom. The main finding from Peng et al.'s (2020) study suggests that language should be used to communicate, represent, and retrieve mathematics knowledge as well as to facilitate working memory and reasoning during mathematics performance and learning. They further established that the use of language to retrieve mathematics knowledge may be more important for foundational mathematics skills.

The South African Language in Education Policy (LiEP) (Department of Education, 1997) advocates the use of African languages in the Foundation Phase (FP) in accordance with Section 6 of the Constitution of the Republic of South Africa which promotes the use of all 11 official languages that were historically neglected in the Apartheid era. Section 29 (2) of the Constitution states that everyone has the right to receive education in the official language or languages of their choice in public educational institutions where such education is reasonably practicable. This background is supported by Stoop (2017), who encourages teaching learners in their preferred language, usually their mother tongue. FP is the first phase of formal schooling in South Africa. It involves teaching from the Reception Year, which is called Grade R (for children between 5-6 years of age). The phase ends with Grade 3 teaching children up to the age of 9 years.

Theoretical Framework

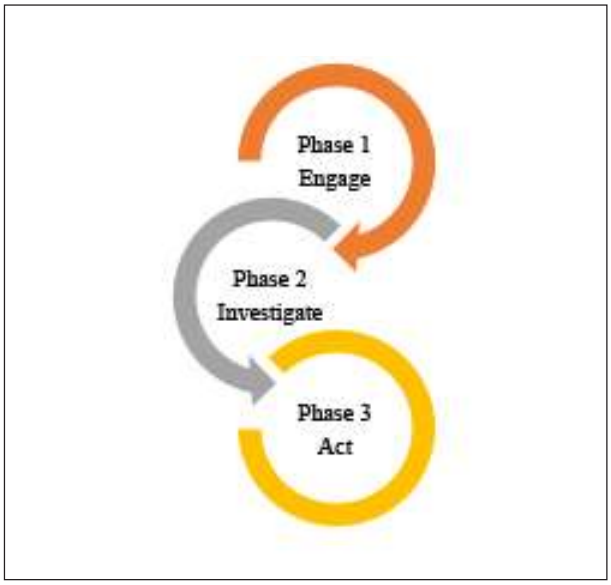
This study is underpinned by the challenge-based learning (CBL) framework adapted from Nichols et al. (2016). According to Nichols et al. (2016), the CBL framework emerged from the 'Apple Classrooms of Tomorrow Today' project initiated in 2008 to identify the essential design principles of a twenty-first-century learning environment. We found CBL to be a suitable theoretical framework for this paper because it is used in universities, schools and institutions worldwide to empower learners, pre-service teachers, administrators and community members to address local and global challenges.

As highlighted by Johnson et al. (2009), considering problems of global importance is a defining characteristic of challenge-based learning. Thus, this paper's literature review reflects on studies conducted nationally and globally. Another reason for identifying CBL as the relevant theoretical framework for this paper is that it frequently utilizes collaborative learning experiences. In this study, university academics, teachers and department officials worked together to learn about challenges experienced by teachers when using African languages as LoLT in a rural school and proposed solutions. Nichols et al. (2016) expanded on implementing CBL on challenge activities using the three phases illustrated in Figure 1.

We used these three interconnected phases for the CBL framework in Figure 1, developed by Nichols et al. (2016), to establish a community engagement project, collect data and design intervention strategies.

Figure 1

Challenge-Based Learning Phases



Literature Review

The literature reviewed in this section focuses on studies aimed at promoting the use of African languages in teaching mathematics. We include studies that are focused on promoting the use of Indigenous languages in teaching mathematics to align the current study to international trends.

Experiences of using Indigenous Languages as the LoLT for Mathematics in Africa

Nkonde et al. (2018) used a case study in Zambia's primary schools to do a preliminary evaluation of the impact of using African languages as the LoLT for mathematics. Surveys, interviews, and focus-group discussions were used to gather data from 30 primary school teachers in one of Zambia's provinces. Despite the challenges associated with using African languages as the LoLT for mathematics, the teachers were still in favor of this practice (Nkonde et al., 2018).

Nahole and Haimbodi (2022) conducted a study to explore challenges that pre-service teachers faced in teaching mathematics using indigenous languages. They administered a questionnaire to 90 pre-service teachers from the Rundu campus of the University of Namibia. Their findings revealed that pre-service teachers faced difficulties teaching some mathematical concepts that were literally translated from English to indigenous languages. Nahole and Haimbodi (2022) recommended that further studies be undertaken to explore how teachers teach mathematical concepts with no corresponding words in indigenous languages.

International Views on the Use of Indigenous Languages as LoLT for Mathematics

Turning now to the international context, Edmonds-Wathen, Owens, and Bino (2019) report on a Papua New Guinea project whose purpose was to support elementary teachers in integrating i ndigenous cultural practices and learners' home language in the implementation of the mathematics syllabus. Through a one-week workshop, Edmond-Wathen et al. (2019) found that teachers responded positively to the language resources and showed a willingness to use their own knowledge of indigenous culture and language to develop and teach mathematics curriculum. These findings become relevant in this study as the participating schools are in rural communities.

In the context of the Philippines, Perez and Alieto (2018) determined the correlation between mother tongue proficiency and mathematics success. A descriptive, correlational, non-experimental, cross-sectional research design was used with 71 Grade 2 Filipino learners. They found that learners with high mother tongue proficiency also achieved high scores in mathematics. Perez and Alieto (2018) concluded that learners taught in their mother tongue can make sense of mathematical concepts discussed in the classroom. This evidence suggests that there is no need to promote the English language as a LoLT of mathematics over the mother tongue.

Challenges Experienced when using African Languages in Teaching and Learning of Mathematics

In the South African context, the LiEP encourages the use of the African languages (mother tongue in other contexts), in FP teaching. Essien (2018) undertook a study to review the role of language in the early years in Kenya, Malawi, and South Africa. The study aimed to evaluate research conducted over 10 years on using African languages as the LoLT of mathematics and the findings pointed to the following challenges:

- No source of reference when using African languages as LoLT for mathematics due to the lack of longitudinal studies that investigate the impact of language on the teaching and learning of mathematics
- Many African languages lack the mathematical vocabulary necessary to teach mathematics
- Teachers' preference for using English over African languages when teaching mathematics due to a need to translate most of the mathematical concepts from English to an African language and the fact that they were trained to teach in English.

These challenges strengthen the need to explore the use of African languages as the LoLT of mathematics in primary school, which is the focus of this study.

Strategies for Teaching Mathematics using African Languages

In Kenya (Njoroge (2017) used a pre-and post-test to measure the efficacy of using an African language in mathematics and science teaching. He divided Grade 1 learners into two groups: one group was taught in Gĩkũyũ (Kenya's predominant home language), and the other group was taught in English. The findings indicated that using an African language as the LoLT for mathematics and science was effective. The group taught in Gĩkũyũ recorded better performance. The mean score obtained in the post test examination is higher than that in the pretest on the experimental group in the two subjects than the group taught in English (Njoroge, 2017). These findings imply that in Kenya, using African languages in mathematics teaching has the potential to improve learner performance. However, Njoroge

recommended the following strategies to realize that potential:

- Avoiding the use of English as a sole language to improve classroom engagement and discussion.
- Using and adopting the African language as a legitimate language of mathematical and scientific communication to create opportunities for learning.
- Using home language (which is African language) as the LoLT.

Lastly Njoroge (2017, p. 142) calls for "a deliberate, proactive and strategic use of the learners' home languages as a transparent resource in the teaching and learning of Mathematics and Science in multilingual environments."

Method

This study employed a qualitative exploratory case study design which is described by Turner (2019). This process requires researchers to embed themselves in the study context for a long period. Turner further asserts that the exploratory case study design enables the researcher to thoroughly observe the participant and the research sites in order to learn about them. Teachers' views and experiences were collected through questionnaires, focus group discussions and classroom observations in community-engaged research, which adapted the CBL's three phases illustrated in Figure 1 by Nichols et al. (2016). Permission was obtained from the Provincial Departments of Education, teachers, and parents of learners for classroom observation (Engagement phase). Data was collected during the investigation phase from the 50 teachers who were purposefully sampled from the six schools using questionnaires, focus-group discussions, and observations while sharing knowledge, expertise, and resources to develop support strategies/material to address the identified needs. In the last phase (Act phase), we conducted workshops to support the FP teachers. Data from the questionnaire were teachers' perspectives, and focus group interviews were used to gather their views on the challenges they experience when teaching mathematics in African languages as the LoLT. Observations were used to confirm the views and perceptions gathered from the teachers.

Data Analysis

All the data collected were prepared and grouped according to the methods used in collecting the data: questionnaire, focus group discussions and observations. From the questionnaire, the first part of the data analysis focused on the participants' profile which is presented in Figure 2. Secondly, we identified challenges to determine similar and different challenges across the schools. Data from focus-group discussions were transcribed, and the transcriptions were combined with classroom observation reports and loaded into Atlas.ti for analysis. We coded all challenges we identified in the data and afterwards categorized them according to their sources. Example categories are challenges emanating from LoLT, teacher training, lesson preparation and presentation. From the categories, the following themes emerged: the LoLT of mathematics, English scripted lesson plans, and teacher training.

Results

To maintain the teachers' and the schools' anonymity, we used letters of the alphabet to name the schools, for example, Schools A to F. For the teachers, they created pseudonyms with reference to the schools they come from; for example, SAT1 stands for Teacher Number 1 from School A. Figure 1 presents the number of participants per school. The pseudonyms are outlined in Table 1.

Figure 2 shows that the schools with the highest number of participants were in NW with 18 teachers (seven in School E and eleven in school F). KZN came second with 17 teachers (six in School A and 11 in School B). Limpopo schools had the lowest number of participants (nine in school C and six in school D).

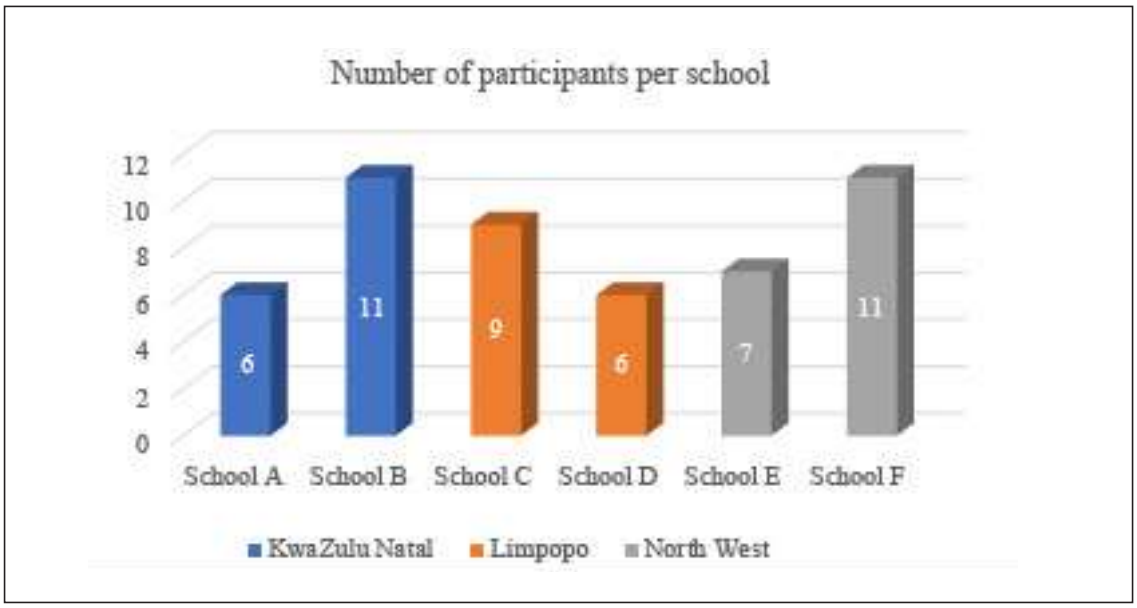
Table 1

Pseudonyms

Pseudonym	Whom does it represent?
SAT1	Teacher Number 1 from School A
SAT5	Teacher number 5 from school A
SAT4	Teacher number 4 from school A
SBT1	Teacher number 1 from school B
SCT1	Teacher number 1 from school C
SCT3	Teacher number 3 from school C
SCT4	Teacher number 4 from school C
SET1	Teacher number 1 from school E
SET2	Teacher number 2 from school E
SET4	Teacher number 4 from school E
SET5	Teacher number 5 from school E
SFT1	Teacher number 1 from school F

Figure 2

Number of participants per school



The first set of questions aimed to profile the languages of the schools; we looked at the home languages of teachers and their learners and the LoLT of each school. Schools E and F's LoLT is Setswana; Schools C and D's LoLT is Tshivenda, and Schools A and B's LoLT is isiZulu. It was evident that in KZN both teachers' and learners' Home Language (HL) is isiZulu, and they use isiZulu as LoLT. A similar finding was apparent in Limpopo schools where both teachers' and learners' HL is Tshivenda and the LoLT is Tshivenda. The findings in Northwest schools were different, as evidenced by the fact that both teachers and students spoke 5 specific languages.

From the data in Figure 3, it is apparent that NW schools are multilingual. The most striking result from

Figure 3

NW Schools Various Languages

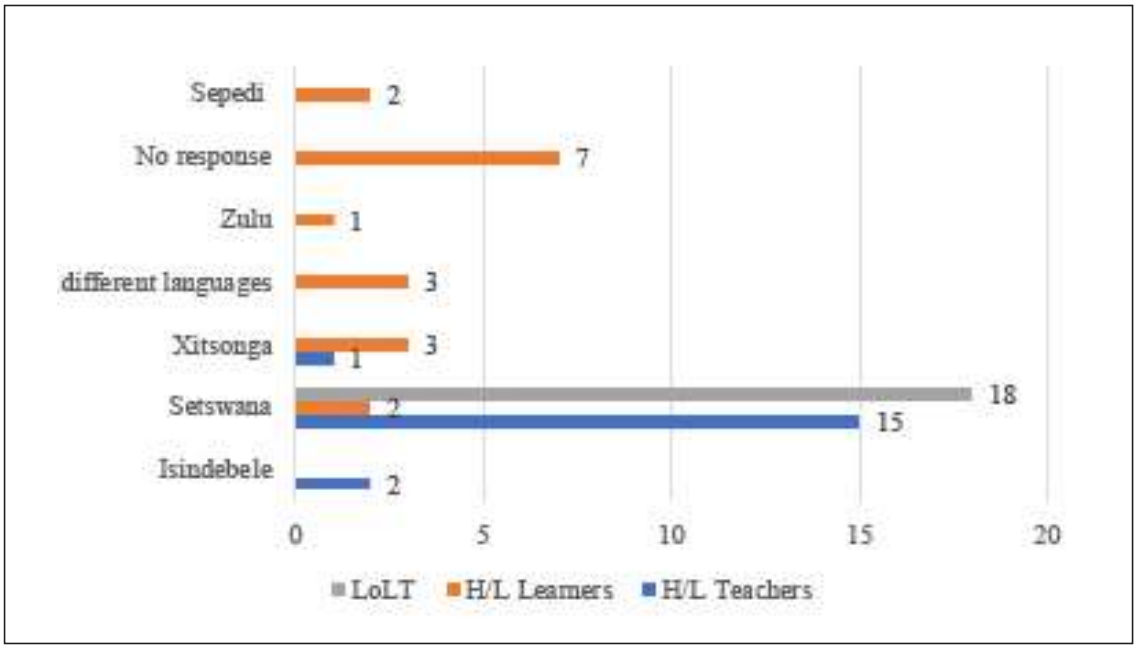


Table 2

Competency to Use LoLT to Teach Mathematics in FP

Province	EXCELLENT Use LoLT through the lesson	GOOD Use LoLT but switch to English	FAIR Use a bit of LoLT and English dominantly	INCOMPETENT Use English throughout the lesson	NO RESPONSE
KZN	2	13	1	0	0
Limpopo	0	15	0	0	0
NW	0	5	9	0	1

the data in Figure 3 is that only two participants indicated that the learners' home language was the same as LoLT which translates to only 11% of learners. However, most teachers are Setswana speaking (15 out of 18). There are 7 teachers who did not specify their HL, that could be because their HL was not listed in the questionnaire, or they omitted the question by mistake. The single most striking observation to emerge from the data is the NW language profile which links to Rivera and Ward's (2017) conclusion that learners in these schools tend to have difficulty in understanding mathematical concepts as they are presented in African languages other than their own.

After profiling the schools' languages, we focused on this question: "How would you describe your competency in using the LoLT for teaching mathematics?" The responses to this question are summarized in Table 1.

Table 2 shows a positive relationship between Figures 3 and Table 1. From Table 1, NW teachers seem not to be confident using the LoLT to teach mathematics even though 15 out of 18 were Setswana-speaking.

The questionnaire, focus group interviews, and classroom observations data presented the following key challenges affecting FP teachers in the six rural schools when teaching mathematics using African languages: the LoLT of mathematics, English scripted lesson plans and teacher training. These are described in more detail in the following section.

Key Challenges Affecting FP Teachers

The LoLT in Mathematics

The findings indicated that classes consisted of multilingual learners and learners who were taught in English in pre-school. Data from the questionnaire revealed that in School A, where the LoLT was Setswana, the learners could not read Setswana, and the teacher read and interpreted for them. "Not easy, for learners, they cannot read, they understand when interpreted by the teacher". "Some speak isiZulu, Xitsonga, and Sepedi at home and at school they use Setswana to learn" (SBT1). In Schools C and D, teachers were competent in teaching mathematics in Tshivenda; however, they found it difficult to teach certain mathematical concepts in the African languages. "Some of the mathematics concepts do not have terminology in Venda" (SCT3). In Schools E and F, the LoLT was isiZulu. Most teachers from school F indicated that teaching mathematics in isiZulu was confusing. Furthermore, teachers from School E explained that lesson plans for mathematics were written in English while the LoLT was isiZulu.

We tried to clarify some of the questionnaire responses, such as "teaching mathematics in isiZulu is confusing, during the focus-group interviews. The teachers provided additional context and confirmed that using African languages as the LoLT for mathematics posed challenges, such as translating some mathematical concepts because they did not have the vocabulary to teach in the LoLT "Learners understand English math terminology better than isiZulu" (SCT1). "Our main challenge is that children do not know Setswana because they are taught in English in the pre-school. They know numbers and colors in English" (SAT1). In School A, teachers said, "Translation often causes confusion (how to teach shapes because they change sekwere [square] or khutlonne [rectangle] also confuses khutlonnetsepa [rectangular])" (SAT4). "Translation causes arner dependency on teachers" (SAT5). In School B, they indicated that it is difficult to translate some of the terminologies, leading to a delay

when a teacher stops and thinks. Apart from the challenges raised regarding African languages as LoLT, the School F teachers felt that it would be better to teach in English. "English terms are simple and straightforward" (SFT1).

When we carried out classroom observations, they observed that the teachers tried to make sure that the materials displayed on the walls (e.g. posters) were written in African languages to enrich the learners' vocabulary (see Figure 4).

Figure 4

Posters Displayed in the Classrooms

English Scripted Lesson Plans

Schools E and F teachers explained that the scripted lesson plans they received from the Department of Basic Education and the non-government organizations that supported them were written in English. "Lesson plans for mathematics is written in English while teaching and learning is in isiZulu" (SET1). SFT3 further explained, "The curriculum is supplied in English, yet we teach math in isiZulu." The teachers wrote in the questionnaire that teaching materials were in English and African languages. SET2 stated, "Learners … confuse the language if it is written in English and isiZulu."

During the focus group interviews, all teachers explained that translating the lesson plans into African languages was time-consuming and prevented them from completing the syllabus. This is confirmed in the following excerpt: "… this exercise is not only difficult but time-consuming" (SBT1). In School C, teachers mentioned that some concepts only had English terminology and they needed pictures to explain those concepts. "We struggle to understand terminologies in English, let alone translating it into isiZulu" (SET1). The language used in the policy and lesson plans for mathematics is difficult and confusing. When asked to elaborate, SCT4 explained: "Terminology in the policy is different from lesson plans. They use different terminology for one concept."

Teacher Training

Teacher training also contributed to a lack of understanding of some of the mathematical concepts in their African languages as it was done in English. "I was trained to teach mathematics in mother tongue, and learners are struggling in writing number names and other concepts in isiZulu" (SET5). During the interviews, some of the responses indicated that the lack of constant use of African languages hindered them from effective teaching, especially when they had to use concepts that were not familiar to them. "The language used in lesson plans and policy to teach mathematics is difficult and confusing" (SET4).

Discussion

Under Results, beginning on page 22, we used the three interconnected phases for the CBL framework, namely: engage, investigate, and act. In this section, we detail how we used the CBL framework phases to discuss the findings of this study.

Engage

In this study, the 'Engage' phase was used to understand the FP teachers' challenges when teaching mathematics using African languages. We identified the FP teachers' challenges in using African languages when teaching mathematics through the questionnaire, focus-group interviews and classroom observations. Apart from collecting data from FP teachers, we consulted the literature focusing on teaching and learning mathematics using African languages. The challenges found in the literature linked with the findings are the African terminology for mathematical concepts, multilingual learners, and teacher training. Essien (2018) revealed the disadvantage of translating English mathematical concepts into African languages in that some concepts can only be in a phrasal form, not single words. The participants also raised concerns regarding translating mathematical concepts in African languages, leading to a delay in completing their teaching and learning activities.

Teachers from Schools A and B highlighted the challenge of having multilingual learners in one classroom, resulting in difficulty for other learners to understand mathematical concepts presented in different African languages. This challenge was also confirmed by Rivera and Ward (2017) and Umar (2018). In some instances, teachers code-switched for learners to understand what was being taught, but some teachers could not speak children's home languages in the classroom. Chitera et al. (2016) established that a lack of understanding of the mathematical concepts in other African languages while teaching affected the teachers' self-confidence.

Essien (2018) pointed out the challenge of some African languages that lack mathematics vocabulary. This challenge is seen as a contributing factor to the limitations of how teachers should be trained to teach mathematics using the African language in the FP. From the variety of challenges experienced in Schools A to F and those in the literature review, it seems that the LiEP advises schools to choose a LoLT, as per Section 8 of the LiEP (DoE, 1997) to redress the neglect of the historically disadvantaged languages in school education. However, based on the provincial government's failure to provide alternative language maintenance programs as mentioned earlier in this section and the South African government's provision of materials that are written in English only, one may conclude that the LiEP policy was implemented without a proper support mechanism and plan.

Investigate

In this phase, we and the participants explored the benefits of using African languages in mathematics teaching. Teachers did not mention any benefits of using African languages as the LoLT for mathematics. They described challenges they experienced in the classrooms, frustrations when translating, and fears of learner dependency. The benefits of using African languages in teaching mathematics were gathered from the literature. Some of the benefits identified by Nkonde et al. (2018) included improved participation and learner confidence. Since learners use the languages they understand, there will be no need to memorize the mathematical concepts. Teachers will have more time to focus on teaching and learning activities. Chitera et al. (2016) confirmed the benefit of using languages that both teachers and learners understand, emphasizing that there will be a flow of communication in the classroom leading to improved learner participation.

Act

The "Act phase" was used to solve the challenges for this study. There is some evidence to suggest that the teachers from the six schools tried to solve the challenges faced when using African languages during mathematics teaching. After realizing that learners did not understand mathematical concepts in African languages, the teachers tried to solve this challenge by translating the concepts using both English and African languages. Although the translation solved part of the challenge, it created other difficulties that brought frustrations to the teachers, such as time constraints in covering the curriculum. In School C, they solved the challenge of translating specific terms by using pictures to simplify the concepts for the learners.

Conclusion

This paper found significant implications for understanding the challenges experienced by FP teachers when using African languages as LoLT for mathematics. The following conclusions can be drawn from the findings:

- Some FP teachers' home languages are not the LoLT at the schools where they teach.
- Some FP learners are taught in their second or third languages.
- There is a language disjuncture between policy and practice where the policy requires teachers to teach in African languages while the teaching material is written in English.
- The language used in the training of teachers in institutions of higher education, namely English, contributes to the language disjuncture.

Although this study focused on challenges experienced by FP teachers, the findings may well have a bearing on mathematics learners' performance which is assessed by the Trends in International Mathematics and Science Study (TIMSS) every four years. TIMMS is a study that compares reliable and timely trend data on the mathematics and science achievements of different countries including South Africa. Even though the FP teachers in the six schools attempted to tackle some of the challenges they experienced, their interventions did not fully address the challenges.

Recommendations

The findings from the literature review and empirical data informed the following recommendations:

- Provincial departments of education should provide alternative language maintenance programs through in-service training.
- A participatory approach should be used where teachers develop African language mathematical guides.
- A mathematics language laboratory should be established in each school where community volunteers can support and enrich learners' mathematics vocabulary of the African languages.

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