The Volatile Issue of Language(s) of Instruction in Foundation Phase Mathematics Teacher Education in a Multilingual Context

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Abstract

In multilingual countries, international and national studies indicate that issues around languages of instruction are challenging because of complex social, political and economic factors associated with language usage. However, the South African Language in Education Policy (1997) stipulates that foundation phase learners need to be taught in their mother tongue. Therefore, appropriate modules are required at higher education institutions to prepare foundation phase pre-service teachers for mother-tongue instruction. As mathematics teacher educator researchers, we acknowledge the challenges faced in teacher preparation for multilingual mathematics classrooms. Our findings indicate that some South African higher education institutions have responded to these challenges by using simultaneous translation methods or offering modules with an African language of instruction. We argue that it is important to identify these challenges but also to 'start with ourselves' to explore ways of improving foundation phase mathematics teacher preparation in our multilingual context.

Keywords: higher education, language of instruction, mathematics education, self-study

Introduction

When languages of instruction (LoIs) are debated in South Africa there is often tension about what is expected from an education system (De Klerk 2002). LoI expectations are often dependant on the particular intentions, demands and interests of the many stakeholders in the education system. Some of these stakeholders include the national education system, higher education institutions (HEIs), the schooling system, learners, learners' parents and learners' prospective employers.

Each of these stakeholders has different expectations and reasons for wanting a particular LoI, and these demands on the education system lead to tensions that have caused even violent responses (Mesthrie 2002). An example here is the 1976 Soweto uprising, when African learners rioted against use of Afrikaans as the LoI in African schools. More recently a newspaper article by Da Costa and Jansen (2012), titled, 'Afrikaans vs Zulu row brewing at schools', reported on similar tensions.

In order to explain the volatile issues related to LoIs some of the expectations and demands presented in policies governing national and teacher education systems need to be considered.

Education policies relating to LoIs are perceived as political instruments for particular political agendas. These political instruments are legislated for implementation in schools and/or HEIs. The South African policy documents directly relating to LoIs having a bearing on Foundation Phase (FP) teacher education include the Language in Education Policy (Department of Education (DoE) 1997), Language Policy Framework for South African Higher Education (CHE) 2001), and the Language in Higher Education Policy (DoE 2002).

Briefly, these policies legislate the following: maintenance of home languages and access to acquisition of an additional language in the FP (Grades 0-3); FP learners to be taught all subjects in their mother tongue; and promotion of all 11 official South African languages in HEIs. Although the aforementioned policies are conceived in the political arena, it is the schools, learners and their parents, and the HEIs who are expected to implement these policy decisions. This cascading of expectations from policy to practice in classrooms has many intersections of stakeholders with a variety of strongly held views about what is 'right' or 'best' for learners in relation to LoI. How

do these views on the LoI relate to Mathematics teaching and learning in HEIs?

There are numerous studies on the LoI in Mathematics in South Africa and elsewhere, which consider this issue from diverse perspectives. Most of the studies in South Africa focus on teaching and learning in multilingual Mathematics classrooms. For example, Adler's (1997) work focuses on the mediation of Mathematics knowledge in multilingual classrooms. In addition to researching Mathematics mediation in multilingual settings, Setati (1998a, 1998b, 2002**)** explores the use of code-switching (Vorster 2008) in the intermediate phase (IP) (Grades 4-6) or senior phase (SP) (Grades 7-9). Research by Naudé, Pretorius and Vandeyar (2003) in the area of FP learning programmes argues that there is a connection between the learners' proficiency in the LoI and readiness for FP Mathematics learning.

Other research related to language diversity, such as studies by Botes and Mji (2010), Van der Walt (2009), Vorster (2008) and Setati, Molefe, Duma, Nkambule, Mpalami and Langa (2007), pay attention to Mathematics vocabulary, code-switching, pedagogy for multilingual Mathematics classrooms and LoI of IP or SP learners. However, there is a dearth of research on FP Mathematics education using African languages as LoI (Green, Parker, Deacon & Hall 2011). Specifically, there is a scarcity of literature focusing on FP Mathematics teacher development where the LoI is an African language.

Furthermore, Essein (2010:33), who focuses on Mathematics teacher educators' awareness of teaching Mathematics in multilingual contexts, contends that there are:

> no structured courses that attend specifically to the needs of pre-service teachers who are being prepared for teaching mathematics in multilingual classrooms of learners who are not yet proficient in the language of instruction.

It is for these reasons that we explored how HEIs are preparing FP Mathematics teachers to teach English second-language learners in their mother tongue.

More precisely, we explored the volatile issue of LoIs in teaching at South African HEIs, to seek ways to improve and assess what we offer at our

HEI. In particular, the research questions that informed the study were:

- What are the LoIs in FP Mathematics teacher education programmes at selected South African HEIs?; and

- How are FP Mathematics education students taught in an African language?

There are five sections in this article. First we review the literature that points to possible reasons why LoI is a volatile issue, and then we discuss the theoretical framework selected for this study. Thirdly, we describe our chosen methodology, and then present and discuss the findings of the study. Finally we draw conclusions after answering our research questions.

Literature Review

Why is LoI such a volatile issue? The literature points to politics, socio-economic status, culture and the hegemony of English as causing volatility (Alexander 2000; Balfour 2007; Parmegiani 2012; Setati 2005; Singh 2009; Skutnabb-Kangas & Phillipson 2010). According to Lee (2003), language, culture and identity are interconnected and it is in the early formative years that linguistic and cultural systems play an important role in socialising a child and shaping his/her perceptions and persona. Maintenance of a person's language can be considered to facilitate preservation of a person's culture. It is no wonder that Henning and Dampier (2012:102) point out that LoI literature in South Africa 'highlight the on-going conundrum of what could be reasonably considered as the optimal language for learning in early school education'.

As young children move from home to the FP school, their LoI is an important issue in the learner's burgeoning identity. The identity fostered and nurtured in the home environment may be starkly different from what is inculcated at the FP school – particularly if the home environment is dominated by a language different from that used at the school.

Wright (2012:112) points out that some African cultures – that are characteristic of communities in rural schools – do not want their languages

altered, as 'these languages carry traditions, values and sonorities of significant cultural importance, so that many rural speakers would prefer them to be respected and preserved just as they are'. Wright gives an example of the volatile nature of language issues in describing the so-called Nhlapo-Alexander proposal, where a harmonised Nguni and Sotho standardised national language was suggested. He notes that the 'harmonising' of the mentioned languages met with such violence from black academics that the proposal had to be abandoned. This study explores existing and potential possibilities for developing African languages as LoIs where academics are able to play a role in promoting the use of African languages at HEIs.

Not only do tensions around LoI exist for reasons based on preservation of cultural traditions, but also because English is associated with socio-economic benefit. In South Africa, English is identified as the only *lingua franca*. According to Balfour (2010), parents choose schools where the LoI is English so that their children can maintain their middle-class status or progress from working class to middle class. In other words, deliberate choices are made by parents for perceived socio-economic benefit and higher social status (Wright 2012). Thus parents choose English as the LoI for their children for reasons that are not based on educational grounds. This means that teaching and learning in such multilingual Mathematics classrooms, where the learners' home language is different from the school's LoI, becomes challenging (Botes & Mji 2010).

Furthermore, according to Skutnabb-Kangas and Dunbar (2010:11), imposing a dominant language such as English as the education medium often prevents access to education because of the 'linguistic, pedagogical and psychological barriers it creates'. This means learning in a dominant language hampers learners' education. For the teaching and learning of Mathematics in particular, the fact that Mathematics is considered to be a 'language' in its own right (Usiskin 1996) further complicates learning for English second-language speakers. According to Setati (2005:448), learning Mathematics includes 'acquiring fluency in the language of mathematics which includes words; phrases; symbols; abbreviations; and ways of speaking reading, writing, and arguing'. As a result, Botes and Mji (2010:125) state that Mathematics requires of learners yet another 'scientific manner of writing'.

When teaching Mathematics or Mathematics Education the second-language learner is thus introduced to mathematical concepts using two 'languages' simultaneously, as explanations are provided in a particular LoI to clarify the specific language used for mathematical terms and concepts (Botes & Mji 2010). However, Teferra and Altbach (2004:45) indicate that when an African language is used as the LoI, learning is hampered by 'poor vocabularies and grammatical conventions of indigenous languages that make it difficult to convey ideas and concepts'. However, the fact that indigenous languages do not have, for example, specific mathematics terms, cannot be used as a criterion to classify these languages as 'poor'. This study, where existing translations of Mathematics terms is explored, will shed light on the use of vocabularies and grammatical conventions of indigenous languages for translation of mathematical concepts.

It is not only schools which face LoI challenges but also HEIs, because 'English is, for better or worse, a hegemonic language' (Balfour 2011:2) in South Africa. After surveying African higher education for the new millennium, Teferra and Altbach (2004) indicate that LoI is one of the challenges in the 21st century: '[l]anguage remains a volatile social issue in many African countries' (45). As mentioned previously, these authors reiterate that in Africa there are 'perceived socioeconomic benefits' (45) that dictate the choice of LoI. Teferra and Altbach (2004) consider the development of African languages as an instructional medium in higher education to be faced with a variety of issues, listed as:

- the multiplicity of languages on the continent;
- the controversy surrounding the identification and delegation of a particular language as a medium of instruction;
- the developmental stages of languages for use in writing and publications;
- the paucity of published materials;
- a poor infrastructure for producing, publishing, translating, and developing teaching materials locally; and
- the pressures of globalization (45-46).

In addition, these authors provide examples of where language is a volatile

social issue in a number of multilingual industrialised nations outside Africa. However, often the challenges in industrialised nations are because of the two (or a few) languages used in the country. In contrast to what occurs in most industrialised countries, the challenges are compounded in South Africa because there are 11 official languages (Afrikaans, English, isiZulu, isiXhosa, isiNdebele, siSwati, Sepedi, Sesotho, Setswana, Xitsonga and Tshivenda). Furthermore, according to South African language policy documents FP learners should be taught in their mother tongue. However, from IP until Grade 12 (and beyond into higher education), the LoI is usually Afrikaans or English. In addition to the large variety of mother tongue languages of the learners, their teachers might speak a different mother tongue from that of the learners. In this case the number of combinations of second-language speakers communicating with each other in Mathematics classrooms poses a minefield of potential challenges. This implies that in these multilingual classrooms a large number of combinations of second-language speakers will be communicating with each other, using mathematical terminology, to explain, understand, apply andsolve problems.

To assist learners in understanding the specific scientific language for Mathematics used in South African multilingual classrooms, a number of 'dictionaries' have been developed. For example, Botes (2008) recognises the need for a 'learner companion' for IP learners and provides diagrams and explanations of mathematical terminology in Afrikaans, English, isiZulu, isiXhosa, Setswana and Sesotho. In addition, Mathematics terminology required by Further Education and Training (FET) learners is available to assist them in understanding concepts in Mathematics if their mother tongue is Afrikaans, English, isiXhosa or isiZulu (Young, van der Vlugt, Qanya, Aldous *et al.* 2005; Young, van der Vlugt, Qanya, Abel *et al.* 2010). The Department of Arts and Culture (DAC) (2003) published a dictionary for multilingual FP and IP Mathematics classrooms in the 11 languages. In the literature, however, there appears to be limited published multilingual dictionaries available that provide mathematical terminology necessary for preparation of FP Mathematics teachers or for FP Mathematics classrooms.

Despite there being multilingual dictionaries available for school learners, translating mathematical concepts is not a quick or easy task. When some of the translations provided in the dictionaries developed for FET

learners were examined by African mother tongue Mathematics teacher educators, the translations were found to be inappropriate. For example, the isiZulu translation of 'function' is given as '*izinguqukoezincikile*' (Young, van der Vlugt, Qanya, Abel, *et al.* 2010:140; DAC 2003:68). The English description of the function concept is given as 'relation between variables' (DAC 2003:68). However, the isiZulu translation does not convey this meaning. The analysis of '*izinguqukoezincikile*' in terms of English meanings of the two words is: *izinguquko* meaning 'change' or 'turn around' and *ncika* meaning 'lean on' or 'rely on'. As a result, combining the meanings of the isiZulu words to understand the function concept in isiZulu translates as 'dependent change' in English, giving no sense of the relationship between numbers. However, the isiXhosa translation, '*isiphumosentsebenziswanoyamanani*' (DAC 2003:68), conveys the meaning of the function concept more accurately. The analysis of '*isiphumosentsebenziswanoyamanani*' in terms of English meanings is: *isiphumo* meaning 'results'; *sentsebenziswano* meaning 'working together'; *yamanani* meaning 'of values'.

Combining the meanings of the isiXhosa words to understand the function concept is closer to conveying the function meaning provided in English. Perhaps a better translation of the mathematical term 'function' into isiZulu would be similar to the isiXhosa translation. The isiZulu term would then be '*umphumelawokusebenzisanakwamanani*'. Otherwise the second option provided by Young, van der Vlugt, Qanya, Abel, *et al*. (2010:140) as an isiZulu translation, 'amafankishini', is sufficient. This translation keeps the root of the English word and does not create confusion in understanding the function concept. Furthermore, Mathematics teachers whose mother tongue is isiZulu usually speak of '*ama*-function' (or '*fankishini'* in isiZulu). These examples indicate that it is difficult to find accurate, universally acceptable translations of Mathematics terminology from English into an African language, and such translations need to be developed in consultation with mathematicians, Mathematics teachers, Mathematics teacher educators and linguists who are fluent in both languages.

Theoretical Framework

The theory framing this study is using the concept of 'lingocide' (Singh

2009). According to Singh (2009:133) lingocide is 'a gradual process of avoidance by the affected ethnic group and of wanton and deliberate erosion of a language in favour of the language/s of domination by hegemonic forces'. Similar concepts of language erosion are described by Skutnabb-Kangas and Dunbar (2010) as 'linguistic genocide'. In particular, Skutnabb-Kangas and Phillipson (2010) equate 'linguicide' to genocide. In other words, indigenous languages are 'eradicated' in a process that is akin to genocide. In this manner, English is viewed as a 'killer language' (Skutnabb-Kangas & Phillipson 2010), eroding the indigenous languages that are often seen to be of less value than English.

Several authors trace the persistent hegemony of English in post-apartheid South Africa to the 'power of liberation and empowerment' afforded to the English language (Singh 2009; Parmegiani 2012). In South Africa middle-class parents whose children are English second- language speakers usually prefer to send their children to English medium schools. These parents consider the ability to speak English fluently, with the 'correct' accent, to be important for future social and economic reasons (Balfour 2007). As Singh (2009) points out, it is these middle-class parents who contribute to the lingocide of indigenous languages. Furthermore, Parmegiani (2012) refers to this abandoning of an indigenous language and increased use of English as 'colonisation of the mind'.

However, the promotion of indigenous languages need not be construed as an attempt at promoting domination of these languages over English. Parmegiani (2012) warns against the reversal or replacement of one dominant language by another. Instead a balanced approach is necessary, where promotion of all languages occurs. In the spirit of trying to promote African languages some HEIs have actively sought ways of counteracting the hegemony of English. These HEIs have moved from merely developing language policies for inclusion of indigenous languages in their curriculum to implementing these policies. For example, since 2010 the University of KwaZulu-Natal (UKZN) (Vithal 2013) has offered 56 modules in isiZulu across a variety of programmes. Moreover, as from 2014 UKZN intends registering all undergraduate students for a compulsory isiZulu module which they need to pass before graduating. However, this is not to say that isiZulu will be the main LoI at UKZN, it but will be developed alongside English as an academic language.

To this end, we frame our article based on the concept that English should not be a 'killer language' but should be promoted alongside African languages at HEIs. This development of African languages is of particular importance in preparation of teachers for the FP in multilingual contexts in South Africa.

Methodology

As a research team we wanted to know more about what other South African HEIs offer in terms of LoIs for preparation of FP Mathematics Education modules, so that we could learn more about how to prepare teachers in our province. In other words, we wanted to gain knowledge about existing possibilities in South Africa so that we can improve what is offered in pre-service teacher development, specifically for mother tongue instruction required of FP Mathematics teachers. We saw the need to interrogate the volatile language issues around teaching Mathematics through the medium of an African language, so that our HEI teacher preparation can be more appropriate for the context in our province.

For these reasons we selected a self-study methodology as we want to make a difference in the way we prepare FP Mathematics teachers. In selecting self-study we were able to identify both the phenomenon and the method. Self-study operates as a phenomenon because of its orientation based on reflective practice and operation as a method for documentation and social action. The method we chose to use to answer our research questions involved making comparisons of what LoIs are offered at four South African HEIs and how pre-service teachers are prepared for mother tongue instruction in Mathematics.

Self-study

For the past two decades self-study has been successfully used in educational research as a means for improving teaching and discovering knowledge (Louie, Drevdahl, Purdy & Stackman 2003:151). The underlying principles of self-study methodology have particular characteristics, procedures and guidelines that have been developed by self-study leaders such as Loughran

(2004), LaBoskey (2004) and Samaras (2011). Even though there are particular procedures and characteristics that define self-study methodology, the methods or strategies that are available to the self-study researcher can be adapted to suit the context in which he/she wishes to achieve the major goal of self-study research. This goal is to gain pragmatic knowledge to improve and assess teaching (Samaras 2011). Furthermore, when making use of self-study to seek ways of improving teaching offered at an HEI, benefits beyond those that accrue to individual researchers are facilitated (Louie *et al.* 2003).

Often self-study research is criticised for being a 'navel gazing' activity where the knowledge gained through research only benefits the researcher by only allowing for changes in the researcher's practice. To address this concern the benefits of collaborative self-study, where a research team undertakes a study, have been well documented (see, e.g. Coia & Taylor 2009; Lunenberg & Samaras 2011; Pithouse-Morgan & Van Laren 2012). According to Louie *et al.* (2003) there are many benefits to collaborative self-study, including the social support permitted by collaborative self-study through dialogue between researchers that allows for critiquing findings in a constructive manner. In addition, collaborative self-study enhances 'validation of self-study research' (Louie *et al*. 2003:157) as various interpretations and actions to improve teaching can be continuously negotiated before, during and after the research process.

Research Design, Data Selection and Analysis

The data presented in this article came from a larger research project supported by the Department of Higher Education and Training and the European Union as part of the Primary Education Sector Policy Support programme. The methods selected for our self-study consisted of exploring what is offered at four HEIs. As a collaborative research team we acknowledge that our analysis of the data is influenced by our own lived experiences as second-language Mathematics teacher educators. Our mother tongues are not English, but for more than 20 years each of us has been a Mathematics teacher educator or Mathematics teacher. Thus we are interested and keen to make a difference in the area of LoIs in the teaching and learning of Mathematics.

We selected faculties/schools of education at HEIs where we could locate FP Mathematics Education lecturers who were willing to be interviewed at their respective campuses. Each of the four HEIs is situated in a different province in South Africa and serves a community where the main languages of the pre-service teachers comprise a different selection of the 11 official languages. We collected data at these HEIs in 2011. We conducted face-to-face semi-structured interviews with academics at three of the HEIs and at the fourth HEI we conducted focus group interviews with 16 pre-service teachers registered for the Mathematics Education module that was offered through the medium of isiZulu. These participants were purposefully selected from the cohort of 58 pre-service teachers who completed the Postgraduate Certificate in Education (PCGE) Numeracy module. Of the 58 students, 25 were taught through the medium of isiZulu and 33 in English. These twenty five students gained their undergraduate degrees at South African HEIs where the LoI is English, but registered to study for a pre-service qualification where the LoI was isiZulu. The focus group discussions were conducted mainly in isiZulu but the participants could, according to their preference, respond in isiZulu or English. Table 1 provides a summary of the participants selected for this study.

Table 1: Participants interviewed at the four HEIs

HEI	Academics	Pre-service teachers
A	2	
B		16
C	2	
D	2	

Before we conducted any interviews with Mathematics teacher educators or students during focus group discussions, we obtained ethical clearance for our research. In addition, consent was requested from each participant to audio-record and to use his/her responses for research purposes.

The focus group discussions were transcribed verbatim and, where necessary, an isiZulu translator translated the transcriptions into English. We were guided by the research questions and the reviewed literature to gain knowledge that would assist us in attaining the goal of our self-study. Our

research focused on exploring how preparation of FP pre-service Mathematics teachers could be improved in the South African multilingual context. Specifically we looked at how our self-initiated, self-focused research that used multiple qualitative methods (LaBoskey 2004) could assist in responding to volatile issues related to LoIs at HEIs.

Analysis of the Data: Answering our Research Questions

We address the question 'What are the LoIs in FP mathematics teacher education programmes at selected South African HEIs?' by analysing the interview data from the four selected HEIs. In order to understand the LoI in teaching FP Mathematics Education modules in these HEIs we discuss the language(s) used in the lectures, assessment activities, and learning materials. First we describe the main languages spoken in the area where each HEI is situated.

Languages of Instruction, Assessment Activities and Learning Materials at HEI A

The main languages spoken by the students at HEI A are Afrikaans, English and Setswana. This HEI's language policy 'acknowledges the use of English, Afrikaans and Setswana as official languages for the institution as a whole' (CHE 2010:20). The LoI in the FP Mathematics Education modules is generally Afrikaans. However, while the LoI is Afrikaans, there are translators in the lecture venue translating simultaneously into English and Setswana. The translators whisper interpretations using interpreting equipment which students listen to using earphones. The choice of using the simultaneous interpreting system facility during lectures rests with the student. If the student chooses to use this facility, he/she selects the earphones tuned to the relevant Setswana or English channel at the commencement of the lecture. This participant at HEI A explained how simultaneous interpreting is facilitated during lectures:

> Interviewee 2: …what we do is that the lecture just continues in Afrikaans and in that class we have the simultaneous interpreting. We use the whispering microphone and the students have the headsets (HEI A:55).

Simultaneous interpreting is not code-switching, where the lecturer explains concepts in two different languages while teaching. Instead, the lecturer teaches in one language (English or Afrikaans) while interpreters simultaneously translate into Setswana, English or Afrikaans depending on the students' academic needs. According to the Council for Higher Education (CHE) (2010:20) audited report for HEI A, 'the interpreting services are well researched, training is offered and implementation is monitored'. In addition, the languages used for assessment in the FP Mathematics Education modules are Afrikaans and English, whereas the printed teaching and learning materials used in these modules are translated into the three acknowledged languages used at HEI A. One of the academic participants, Interviewee 1, indicated that:

> In the foundation phase [the simultaneous interpreters] also translate the study guides into Setswana (HEI A:13).

To summarise, at HEI A all pre-service teachers registered for FP Mathematics Education modules are accommodated in one venue but opportunities to learn in any one of the three acknowledged languages are provided during lectures. Languages used for assessment are Afrikaans and English, and translated materials are provided in Setswana, English and Afrikaans.

Languages of Instruction, Assessment Activities and Learning Materials at HEI B

The students' main spoken languages at HEI B are English and isiZulu. The School of Education chose to offer the PGCE FP Mathematics Education modules in two separate groups: one where the LoI is English, and another where the LoI is isiZulu. Contrary to HEI A, these two groups are segregated

and their assessments are in English and isiZulu respectively. The same lecturer, who is an isiZulu mother tongue speaker, taught each group during different timetabled lectures. There was an attempt at providing students with learning materials in isiZulu.

However, the PGCE students felt that the materials were only partly translated into isiZulu. For example, in the focus group discussion the following information about the learning materials was shared:

> Participant 1: …we found it very useful; we had sufficient notes in IsiZulu although we would get some parts written in English. For example, we would get some of the methods written in English … (HEI B:16).
>
> Participant 2: … more content should be added to what we already have (HEI B:12).
>
> Participant 3: …we have not received some of our materials. (HEI B:7).

To summarise, at HEI B the students registered for FP Mathematics Education modules are separated into two groups according to the LoI. Languages used for assessment are either isiZulu or English, depending on the LoI. Translated materials are provided in English and partly in isiZulu.

Languages of Instruction, Assessment Activities and Learning Materials at HEI C

The main spoken languages at HEI C are Afrikaans, English and Sesotho. However, LoIs for the FP Mathematics Education modules are Afrikaans and English. Students are offered FP Mathematics Education modules in two separate groups, one where the LoI is Afrikaans and another where the LoI is English. Assessments for the one group are in Afrikaans, while in the other they are in English. If a student is required to repeat an FP Mathematics Education module then he/she is required to attend the module in the LoI offered at the particular time – either Afrikaans or English. HEI C offers

translation services to its academic community to facilitate translations between the two LoIs.

To summarise, at HEI C the students registered for FP Mathematics Education modules are separated into two groups according to the LoI. Languages used for assessment are either Afrikaans or English, depending on the LoI. Translated materials are provided in Afrikaans and English.

Languages of Instruction, Assessment Activities and Learning Materials at HEI D

The student population at HEI D is from diverse language backgrounds that include Tshivenda, Xitsonga, Sepedi and siSwati. However, the LoI in FP Mathematics Education modules is English – but during teaching practice at local schools the students are expected to teach learners in their mother tongue. The participants indicated that they struggled to choose an appropriate LoI because of the diverse languages spoken by the students and the lecturers.

Table 2 summarises the spectrum of LoIs of FP Mathematics Education modules offered at the four HEIs.

Table 2. Summary of the LoIs at the four HEIs

HEI	A	B	C	D
Main languages of students	Afrikaans, English, Setswana	English, isiZulu	Afrikaans, English, Sesotho	Tshivenda, Xitsonga, Sepedi, siSwati
LoIs in FP Mathematics module	Afrikaans, English, Setswana	English, isiZulu	Afrikaans, English	English
Strategies implemented	Teaching one group simultaneously interpreting from Afrikaans to Setswana and English	Teaching two separate groups in English and isiZulu	Teaching two separate groups in Afrikaans and English	Teaching one group in English

We answered the second research question, 'How are FP Mathematics Education students taught in an African language?', by analysing the interview data and other documents provided by participants from HEI A and HEI B. We chose these two HEIs because the Mathematics Education modules were taught in an African language. Our analysis focused on how communication occurred in the FP Mathematics Education modules. We also explored translations of selected Mathematics academic concepts into African languages. The data set used was the interview data from HEI A and HEI B as well as documents obtained during HEI visits.

The LoI at HEI A, as discussed previously, is Afrikaans with simultaneous interpreting of Afrikaans into English and Setswana. Setting up the simultaneous interpreting system does not take up any of the lecture time allocated to Mathematics Education. When Interviewee 1 was asked 'does it not affect the amount of work you need to cover in a particular module?' she responded:

Sometimes it does but not in general. I think here at the university we are so in it that it does not take much time. Because when I walk into the lecture theatre I unlock it- the lecture venues are locked because of all the equipment. So I will go and fetch the key and I will unlock it and the simultaneous translator will walk with me and she will go and set up her equipment. The students will come in and those who would like to make use of the interpreter will just pick up an earphone. (HEI A: 31)

The simultaneous interpreting system is costly for HEI A but the participants considered it to be important for the students to be taught in their mother tongue since the students are required to teach in their mother tongue. Interviewee 1 noted the financial implications as follows:

> We always have a translator. It costs the university a lot of money but it is very good if the [students make use of this facility]. They know the English terminology but it is translated for them in the students' mother tongue because our foundation phase teachers go back to the rural [homeland] and they teach Grades R to 3 in Setswana. (HEI A: 6)

According to a participant at HEI A, most students attended schools where the LoI was English. As a result some students are not familiar with

Mathematics terminology in Setswana. Learning FP Mathematics Education modules in Setswana assists in preparing the students for teaching practice in schools where Setswana is the LoI. The reason for using Setswana in Mathematics Education is provided by Interviewee 2 as follows:

> Some of the students want to go to rural areas to teach in Setswana again – so that is why we have to promote their own Setswana during lectures. As you might know, a lot of these students come from private schools or ex-Model C schools and their Setswana is almost gone (HEI A: 56).

It is interesting to note how HEI A developed Mathematics terminology for concepts in Setswana. According to the participants mathematical concepts in Setswana were developed by working with the practising Mathematics teachers, using the DAC (2003) dictionaries in conjunction with relevant websites. One of the interviewees at HEI A is a simultaneous interpreter, and he explained that at HEI A they,

> do group work to coin some of the [mathematics] terms … if [he] cannot find it in any of the available material, then [he] has to coin a word for that (HEI A:57).

Table 3 shows examples of terminology developed through this process for mathematical content and pedagogical concepts.

Table 3. Examples of terminology developed by HEI A academics with practising teachers

Concepts	English	Setswana
Mathematical pedagogy	Inductive reasoning	*Go batlamabakakakakanyo*
	Levels of reasoning/thinking	*Dikgatotsakakanyo*
	Investigation	*Batlisisa*
	Proof	*Bopaki*
	Theory	*Tiori*

Mathematical concepts	Circle	*Sediko*
	Triangle	*Khutlotharo*
	Equilateral triangle	*Dikhutlotharotekano*
	Rectangle	*Khutlonnetsepa*
	Square	*Sekwere*

When reading through the list of translated words, there is evidence of an effort to coin words in Setswana rather than keeping the English root for the Setswana word. An example of keeping the English root is in translation of the English word 'theory' as '*tiori*' in Setswana. Another example of such a translation is '*sekwere*', that is directly translated from the English word 'square'. If one compares the translation of 'rectangle' ('*khutlonnetsepa*'), this fits more accurately than the translation provided for a 'square'. Analysis of the word '*khutlonnetsepa*' in terms of English meanings is *khutlo* meaning 'shape'; *nne* meaning 'four' and *tsepa* meaning 'equal'. Combining these words would then mean 'a shape with four equal sides'. However, the rectangle does not have four equal sides, but rather two pairs of opposite sides that are equal. Instead a rectangle should be translated as *khutlonne*. Yet this too is an incorrect translation, as it does not exclude other regular or irregular quadrilaterals. Nonetheless, these translations are a starting point for exploring possible translations of mathematical terms into Setswana.

In addition, the academics at HEI A encourage students and other academics to publish research articles in an African language. This is a bold move, as English is the *lingua franca* worldwide. Students and academics who publish Mathematics Education research in an African language run the risk of not having their articles accepted for journal publication. When asked 'How do you write a whole paper in Setswana?', Interviewee 2 responded:

> … we are telling them to publish papers in an African language because some people think you cannot write scientifically in African languages. So we want to prove that you can actually do that. And we want to be published as proof that it can be done …. When you write in the local language, the journal generally says you will have to write a long abstract in English to accompany and explain what the article in Setswana is about so that people understand …. The

> [HEI A]'s language directorate want to prove to the public that is can be done – you can publish in an African language and that African languages can become scientific media for writing and researching. Just recently we published an article on Computer Science in Setswana (HEI A:59–60).

At HEI B the LoI for the FP Mathematics Education module in the PGCE programme is English or isiZulu. In 2011, 25 students were registered for the module where isiZulu was the LoI. The LoI was mainly isiZulu and included some English words that did not have isiZulu equivalent translations. The students had mixed feelings about learning FP Mathematics modules in isiZulu. On the one hand, it was beneficial for them to improve their vocabulary of mathematical concepts in isiZulu in preparation for teaching practice and for better understanding. On the other hand, the students struggled with reading both English and isiZulu materials and being assessed in isiZulu. One of the participants indicated the difficulties experienced when translating from English into isiZulu, as follows:

> … we do end up trying to translate the books from English to isiZulu but when we now have to write on paper I would completely lose the meaning because now I am trying to translate and end up not getting the meaning … For example, ... when I write ... for instance I have to write the word 'improve' I end up writing '*impuruve*' when I have to write it in isiZulu because I don't remember the actual isiZulu word and because we normally use English words while speaking isiZulu, for example, we say: '*haw ngizo-improve'*. You use it like that but it does not fit in correctly (HEI B:3).

The participant probably realised that a translation of 'improve' exists; '*thuthuka/ enzangcono*' is the isiZulu translation of 'improve', but is infrequently used. This means that much time and effort is required on the part of the students when they need to complete assignments and tests in isiZulu, because the everyday isiZulu language spoken often makes use of words where the English root is 'translated' into isiZulu, and the correct isiZulu translation is not used frequently in everyday conversations.

Discussion and Conclusion

How do the findings presented in this study add to the volatile issue of LoI? First, two of the four HEIs visited are working towards a 'starting with themselves' approach in making a difference to the way in which FP Mathematics teachers are developed through the programme structures they designed in their BEd or PGCE programmes. These HEIs have implemented approaches where cognizance is taken of the LoI required for their particular South African multilingual context. It must be noted, however, that all of the academics interviewed at the four HEIs were interested and keen to learn more about possibilities for taking on the issue of LoI for FP Mathematics teachers at their respective HEIs.

Secondly, initiatives implemented by the two HEIs that use an African language as a LoI required substantial additional funding and commitment from the institutions. These resources are costly if one takes into account the current worldwide financial meltdown. For example, the use of simultaneous translators employed at HEIs requires additional funding for one or more translators for each venue in which Mathematics Education modules are offered. In addition, equipment for the translation process to be facilitated is essential.

Furthermore, the availability of quick, efficient translation facilities at an HEI appears to be a factor in promoting the use of an African language as a LoI. This too, however, requires setting up of appropriate HEI structures that can be effectively managed across disciplines and campuses. If, for example, Mathematics Education modules are offered in separate venues in isiZulu as well as in English, then additional, appropriately qualified Mathematics teacher educators also need to be appointed, and this too has financial implications for the HEI.

Thirdly, the securing of the services of appropriately qualified Mathematics teacher educators and simultaneous translators also requires careful consideration. The translation of many mathematical terms provided in 'dictionaries' currently available needs to be scrutinised by African language linguists in conjunction with teachers, Mathematics teacher educators and mathematicians. The definitions of mathematical terms are particularly important in Mathematics. For example, in Geometry one cannot define a square as a shape with four equal sides; both squares and rhombuses satisfy this condition. Sometimes linguists may be unaware of the specific

requirements of mathematical definitions, and need to consult with mathematicians.

Fourthly, there is a general shortage of Mathematics teachers in South Africa, and they are generally qualified to teach Mathematics in English as their Mathematics qualifications are gained through the medium of English. The high status of FET Mathematics teachers, who mainly use English as the LoI, would make it difficult to convince students to take up an FP Mathematics teacher education qualification offered in an African language. The canvassing of able, interested FP Mathematics teachers would require a concerted effort and possible incentive funding for these candidates to be secured for the important task of teaching Mathematics to young learners. This implies further costs to HEIs, as at present they are not preparing enough FP Mathematics teachers. This means that urgent interventions are necessary if FP teaching and learning of Mathematics is to be prioritised.

Fifthly, the separation of students into two separate groups according to LoI for teaching Mathematics Education may be construed as yet another way of dividing or separating people on the basis of a language. Perhaps this could be likened to what occurred in the Apartheid era? The fact that English is the *lingua franca* in South Africa cannot be ignored, so the Mathematics Education students who opt for an African LoI may not be considered for more lucrative teaching posts where English is the LoI. They may be required to teach in less affluent rural and township areas.

Sixthly, the publication possibilities in peer-reviewed Mathematics Education journals in African languages are limiting. The fact that terminology in Mathematics is not available cannot be seen as a deterrent for publishing in an African language. New terms and words are constantly being incorporated into all languages worldwide. For example, in recent years a whole new set of terminology has been developed around computer and other digital communication systems. By agreeing on particular mathematical terminology in an African language it should be possible to contribute to knowledge production in Mathematics Education through the medium of an African language.

Despite all the volatile issues relating to financial constraints, availability of qualified Mathematics teacher educators and separation of students according to their LoI, there are academics at HEIs that are

passionate about implementing the South African language policy requirements. Furthermore, there are sound educational reasons offered for the need to teach young learners in their mother tongue.

Two HEIs described in this study took the initiative in starting with themselves to support promotion of mother tongue teaching in FP Mathematics classrooms. These HEIs have employed strategies that seek to achieve a balanced approach in developing teaching and learning of an African language and English/Afrikaans to counteract the 'killing' (Parmegiani 2012; Singh 2009, Skutnabb-Kangas & Phillipson 2010) of one language by another. This development of African languages is of particular importance in the preparation of teachers for the multilingual FP contexts in South Africa.

The methods employed by these HEIs to promote the use of African languages have provided models that can be mimicked and improved upon at any HEI. No doubt the two HEIs will continue to extend their expertise in the area of mother tongue instruction, but it is up to each HEI to start with themselves to seek and design appropriate strategies that recognise the critical need to prepare FP teachers for teaching Mathematics in our South African multilingual context.

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