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ETC4 Keynote

One country, many languages: Exploring a multilingual approach to mathematics teaching and learning in South Africa

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The articulation of a multilingual language-in-education policy in South Africa meets many challenges in practice. Research shows that despite what policy says, learners, families and teachers in historically disadvantaged black African schools in the country prefer English as the language of learning and teaching, and maintain the view of African languages as the languages of the home. In this plenary lecture, I comment on a multilingual approach to mathematics teaching and learning that I see as an alternative to constraining language practices in mathematics education. The two main principles of this approach are: the deliberate, proactive and strategic use of the learners' home language and the selection of real life, interesting and high cognitive demand mathematical tasks. The underpinnings are a holistic view of multilingual learners and a notion of language as resource for mathematics teaching and learning.

Keywords: Multilingualism, language-in-education policy, language of teaching and learning, mathematics classroom, language practices.

A context of eleven official languages

South Africa is a context of great language diversity with a progressive body of language rights in principle and on paper. Prior to 1996 and before the end of apartheid, English and Afrikaans were the two official languages. Since 1997, the language-in-education policy recognises these and nine more languages that are official. In line with the new constitution adopted in 1996, the current policy supports, encourages and values multilingualism as a resource. It is claimed the principle that no language should be introduced at the expense of another in society and particularly at school. The policy promotes but does not mandate the use of African languages alongside English, encouraging schools to maintain the languages of the home. Families are thus allowed to choose their preferred language of learning upon admission to a school. If the school uses that language and there is a place available, then it must admit the learner. Schools have to choose a language of learning and teaching mathematics as well, and school governing bodies – comprising parents, educators and non-educator members of staff – are required to state explicitly their plan and specific measures to promote multilingualism.

The articulation of a multilingual language-in-education policy for South Africa meets many challenges in practice. Research shows that despite what policy says, teachers in historically disadvantaged black African schools in the country prefer to teach mathematics in English (Setati, 2008). Moreover, research also shows that speakers of African languages in these schools prefer to be taught mathematics in English, a language that they are still learning (Setati, 2008). Their limited fluency in English does not reduce their desire and aspirations of mobility and access to social goods such as jobs and higher education. Overall, the struggle of African-language learners with English does not move them and their families away from choosing it as the language of

learning and teaching. At the same time, debates on language and mathematics teaching and learning tend to create abstract dichotomies that are not helpful by distinguishing between the language of the school and the languages of the home. Thus, policymakers and educators seem to think that only one language can and should be used during teaching and learning. Similarly, many black African families seem to think that their languages are sufficiently learned at home and are not adequate or necessary at school, often conceived of as almost useless for their children and an obstacle to wider communication.

Why the seeming disconnection between policy and practice?

The scenario in South Africa points to the disconnection between policy and practice, with a progressive language policy in education and a monolingual orientation that values one language over others. This phenomenon is not unique to the South African context. Other mathematics educators and mathematics education researchers have documented similar scenarios in other parts of the world (see, for instance, the early work by Barwell, 2003, with learners of English in mathematics classrooms of England, the work by Moschkovich, 2015, with Latino communities of learners in the United States, or the work by Planas, 2014, about well-established ‘minority’ languages in Catalonia). Given the hegemony of English as a world language and despite other languages may be involved in the construction of discourses of adequate language use across the world (Phakeng, Planas, Bose & Njurai, 2018), the perdurability, amplitude and pervasiveness of this phenomenon across the globe is not surprising.

There is more to it than a mere problem of disconnection. The reduced roles often attributed to language in mathematics learning and teaching remain behind and are called into question. Educational practice and research on language and mathematics learning is still framed by a cognitive perspective, which assumes the premise that language is benign and innocent, as well as the primary condition for interaction, mediation and experience (see the discussion in the introduction of the volume by Barwell et al., 2016, or the discussion in Barwell, Moschkovich & Setati Phakeng, 2017). Much has changed since the late seventies of the past century, when Austin and Howson (1979) published their survey on language and mathematics education, but the ascendancy of the cognitive perspective continues. In conversations with colleagues (Setati & Moschkovich, 2010), I have resisted to a captive area dominated by cognitive and deficit approaches from the seventies and to these days, marked by the idea that language issues are not salient to the entire mathematics education community. These are relevant considerations if we advocate for a broader understanding and conceptualization of mathematics education, and more importantly for an area that does not dismiss equity in the path towards the policy-practice nexus. By failing to view the politics of language, we do not only recreate inequity but drive mathematics education research into an illusion of precision and neutrality as well.

Language is not benign or innocent. It is not a neutral or docile tool of expression, representation and communication. It is a product and carrier of power (Bourdieu & Wacquant, 1992). Language choices of teachers and learners who prefer English are informed by a socio-political perspective, which considers the political nature of language and the power of English in particular. I have largely exposed the fact that language is political (Setati, 2005, 2008) and that not all languages are equally ‘powerful’ and do not serve the same functions. Language in the mathematics classrooms is not used for the sake of the teaching and learning of mathematics only. Language has implications for how social goods are or ought to be distributed (Gee, 2005). Social goods are anything that a group of people believes to be a source of power, status and capital. English and school mathematics are, for example, social goods whose access implies in turn access to other social goods such as higher education, jobs and international opportunities. Nonetheless, this question of access is not easy and needs to be explained in the context of many dilemmas and contradictions. More than twenty years ago, Lodge (1997) referred to the paradox of access as a

double-edged sword. Access to powerful knowledge increases and entrenches power at the same time. On the one hand, if the school system favors access to the language of power, the marginalization of home languages is perpetuated. On the other hand, if the school system favors the home African languages, learners are denied the access to social goods available in English. Moreover, enforcing purist home language or English only monolingual teaching at any level of education is not consistent with multilingual policy and can be seen as discriminatory. In the case of home language monolingual teaching (e.g., recent policy in the Gauteng Province of South Africa), it suggests that those who have capital can buy access to English. In the case of English only monolingual teaching, it suggests that learners are not allowed to be who they are.

How does the language-in-education policy play out in multilingual classrooms?

Today the South African language-in-education policy is manifested in a diversity of classroom settings in which multilingualism is apparent. Some typified examples of these settings are:

- Township classrooms with South African learners only and a shared main language (low cognitive demand mathematics tasks are common; English accompanied by procedural discourse prevail in mathematical lessons; and there are limited occurrences of code-switching accompanied by conceptual discourse).
- Township classrooms with immigrant learners and a main language not shared (low cognitive level demand mathematics tasks are common; there is no code-switching; procedural discourse prevails in mathematical lessons; and most learners refuse to be identified as migrants).
- Urban classrooms with immigrant learners and French as a shared main language (high cognitive level demand mathematics tasks are common; teaching happens in both English and French, however, writing is in English only; conceptual discourse prevails in mathematical lessons; and learners tend to be open and proud of their migrant identity).
- Rural classroom with immigrant learners and a main language not shared (low cognitive level demand mathematics tasks are common; there is no code-switching; procedural discourse prevails in mathematical lessons; and most learners are open but not proud of their migrant identity).

Why these language practices and why embedded in these distinguishable ways? Are these practices and their variations mere responses to 'practical' pedagogic matters? Are they related to who the mathematics teacher is, and hence her social identity? Are they related to which the shared main language is and the socio-economic background and capital attributed to its speaking community? Are these language practices about the culture of the school and its treatment of the learners of mathematics, especially immigrant learners? If so, is the culture of the school overt and clear about what an immigrant is and which learners are called immigrants? Are participants of this culture aware of the multiple layers of language represented in multilingual classrooms such as minority/human rights, race, socio-economic class or culture? What renders being multilingual irrelevant in mathematics teaching and learning? Level of fluency in the language of learning and teaching? Level of mathematics performance? Level of socio-economic class?

The development, by either teachers or learners, of language practices of code-switching, procedural and conceptual discourse, etc., cannot be simplified to one or two decontextualized reasons in isolation. Exploring language practices in specific multilingual mathematics classrooms of immigrant learners, for instance, provides a different gaze into teaching and learning mathematics in multilingual classrooms in South Africa. Moreover, it is different the situation in township schools, where the majority of the teachers are multilingual and many speak

at least two African languages in addition to English and Afrikaans. Learners in these schools are also likely to speak more than one African language and will have ranging levels of English language proficiency. Beyond these relevant specificities and based on my research, what I claim is the existence of a network of connected reasons some of which are political. Our aim as researchers is not only to identify the practices but also to question how and why these practices have been embedded the way they have, as well as how and why their politics and implications remain under-researched. In the next section, I comment on a multilingual approach to mathematics teaching and learning that I see as an alternative to constraining language, teaching and learning practices in classrooms. Such multilingual approach is in line with the argument in Planas and Setati Phakeng (2014) about “the right of using the students’ languages because it is itself more than an intrinsic human right; it is an option that potentially benefits the creation of mathematics learning opportunities (p. 883).

A multilingual approach to mathematics teaching and learning

How can we teach mathematics in multilingual classrooms to ensure that learners are challenged mathematically and interested in learning mathematics? How can we draw on the diversity of languages present in South African mathematics classrooms (English and the learners’ home languages) to provide the language support that learners need? How can we draw on the learners’ home languages to ensure a focus on developing mathematical proficiency while learners are still developing fluency in English? All these questions are very timely in a world in which the continuing domination of some language groups and their privileged speakers over others damages the identities, futures and learning opportunities of children of these other groups.

A holistic view of multilingual learners theoretically underpins a multilingual approach to mathematics teaching and learning. It is holistic because it relies on the fundamental interconnectedness of all the languages of learners and all their uses in practice. From this view, a multilingual is not a sum of two or more complete or incomplete monolinguals, nor a bilingual with an additional language. A multilingual is like a high hurdler who blends two types of competencies, that of high jumping and that of sprinting, in her fluid and advantageous use of language. When compared individually with the sprinter or the high jumper, the hurdler meets neither level of competence, and yet when taken as a whole, the hurdler is an athlete in his or her own right. No expert in track and field would ever compare a high hurdler to a sprinter or to a high jumper, even though the former blends certain characteristics of the latter two. In many ways the bilingual is like the high hurdler. The constant interaction of the many languages in the multilingual learner has produced a different but complete dynamic language system.




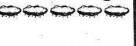
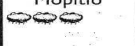
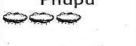
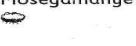
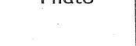

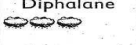






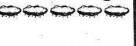
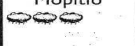
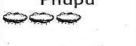
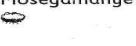
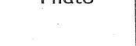

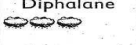





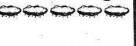
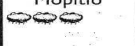
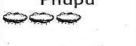
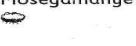
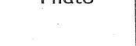

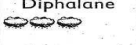


Importantly, a multilingual approach to mathematics teaching and learning draws on the understanding of language as resource. For a resource to be useful, it needs to be both visible and invisible in its functioning (Adler, 2001). *Visibility* is in its presence and the form of extended access to mathematics it provides, while *invisibility* or *transparency* is in the form of unproblematic interpretation and integration of the language(s) used. This reasoning does not apply only to language in the classroom. For example, the instrumental use of technology in mathematics teaching and learning becomes effective when it is both visible and invisible or transparent. When technology becomes so visible that remains the focus, instead of the material environment for orchestration of the mathematical lesson, this occurs at the expense of the focus on the teaching and learning of mathematics. What typically happens in many multilingual mathematics classrooms is that language becomes visible to the teacher almost exclusively when being spotlighted for some learners using ‘wrong’ words and ‘wrong’ grammars. It is, however, largely invisible to the teacher and the class when conversations develop in fluid ways.

Two major principles should guide a multilingual approach to mathematics education, so that teachers take advantage of the home languages and experiences of learners rather than disregard them. These principles are as follows (Setati, 2008):

1. The *deliberate*, *strategic* and *proactive* use of the learners' home languages.
 - Unlike code-switching, which is spontaneous and reactive.
 - English and the learners' home languages operating together and not in opposition.
 - All written texts are given to learners in two languages (home language and English).
 - Learners are explicitly encouraged to interact in any language they feel comfortable with.
2. The use of real life, interesting and challenging mathematical tasks.
 - Through this, learners would develop a different orientation towards mathematics and would be more motivated to study and use it.

While learners communicate in their home language, simultaneously or not with English, they develop mathematical meanings and in this context, such meanings can be accepted, questioned and negotiated. The deliberate, proactive and strategic use of the learners' home languages in the discussion of interesting mathematical tasks ensures that language functions both as a transparent resource and as a facilitator of mathematical learning opportunities. However, it is a challenge for some –if not many– mathematics teachers to switch languages in the classroom as a flexible strategy of teaching and learning, as well as to think of posing interesting high-demanding mathematical tasks to learners who are in the process of gaining fluency in English. I have largely argued that there are practical ways and strategies of facilitating the work.

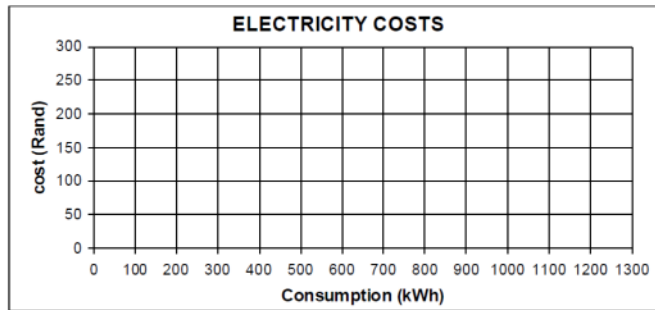
Table 1. Three examples of rich mathematical tasks

<p>Mandla's cinema hall can accommodate at most 150 people for one show.</p> <ol style="list-style-type: none"> a) Rewrite the sentence above without using the words "at most". b) If there were 39 people who bought tickets for the first show, will the show go on? c) Peter argued that if there are 39 people with tickets then Mandla should not allow the show to go on because he will make a loss. Do you agree? Why do you agree? d) What expenses do you think Mandla incurs for one show? e) Use restrictions to modify the statement above in order to make sure that Mandla does not make a loss. f) If Mary was number 151 in the queue to buy a ticket for the show, will they accommodate her in the show? Explain your answer. 												
<p>Look at the calendar with the days of rain and answer the questions.</p> <ol style="list-style-type: none"> 1. Which month has the most rain? 2. Which month has the least rain? 3. Which months have the same amount of rain? 4. How many more days does it rain in February than March? 5. How many days does it rain in September and October altogether? 6. Which month has 20 days of rain? <div style="text-align: center;"> <table border="1" style="margin: auto; border-collapse: collapse;"> <tr> <td style="padding: 5px;">Pherekong </td> <td style="padding: 5px;">Dibokwane </td> <td style="padding: 5px;">Hiakola </td> <td style="padding: 5px;">Moranang </td> </tr> <tr> <td style="padding: 5px;">Mopitlo </td> <td style="padding: 5px;">Phupu </td> <td style="padding: 5px;">Mosegamanye </td> <td style="padding: 5px;">Phato </td> </tr> <tr> <td style="padding: 5px;">Lewedi </td> <td style="padding: 5px;">Diphilane </td> <td style="padding: 5px;">Dibatsela </td> <td style="padding: 5px;">Manthole </td> </tr> </table> <p style="text-align: right; margin-top: 5px;"> = Matšatši a pula</p> </div>	Pherekong 	Dibokwane 	Hiakola 	Moranang 	Mopitlo 	Phupu 	Mosegamanye 	Phato 	Lewedi 	Diphilane 	Dibatsela 	Manthole 
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<p>The Brahm Park electricity department charges R40,00 monthly service fees then an additional 20c per kilowatt-hour (kWh). A kilowatt-hour is the amount of electricity in 1 hour at a constant power of 1 kilowatt.</p>												

- 1- The estimated monthly electricity consumption of a family home is 560 kWh. Predict what the monthly account would be for electricity.
- 2- Three people live in a townhouse. Their monthly electricity account is approximately R180,00. How many kilowatt-hours per month do they usually use?
- 3- In winter the average electricity consumption increases by 20%, what would the monthly bills be for the family home in (1) above and for the townhouse?
- 4- In your opinion, what may be the reason for the increase in the average electricity consumption in (3)?
- 5- Determine a formula to assist the electricity department to calculate the monthly electricity bill for any household. State clearly what your variables represent and the units used.
- 6- a) Complete the table showing the cost of electricity in Rand for differing amounts of electricity used:

Consumption (kWh)	0	100	200	300	400	500	600	700	800	900
Cost (in Rand)										

- 6- b) Draw a graph on the set of axes below to illustrate the cost of different units of electricity at the rate charged by the Brahm Park electricity department.



After careful consideration, the electricity department decided to alter their costing structure. They decide that there will no longer be a monthly service fee of R40,00 but now each kilowatt-hour will cost 25c.

- 7- What would be the new monthly electricity accounts for the family home and the townhouse?
- 8- a) Complete the following table showing the cost of electricity in Rand for differing amounts of electricity used using the new costing structure:

Consumption (kWh)	0	100	200	300	400	500	600	700	800	900
Cost (in Rand)										

- 8- b) Draw a graph on the same set of axes in question to illustrate the cost of electricity for different units of electricity using the new costing structure.
- 9- Do both the family home and the townhouse benefit from this new costing structure? Explain.
- 10- If people using the electricity had the option of choosing either of the two costing structures, which would you recommend? Clearly explain your answer using tables you have completed and graphs drawn in questions 6 a) and 6 b) and 8 a) and 8 b).

In a collaborative study with mathematics teachers in South African schools (see, e.g., Setati, Molefe & Langa, 2008) we grouped learners according to their home languages and gave them all written tasks, including tests and exams, in two languages: English and the learners' home language. Learners were explicitly encouraged to communicate in any language they feel comfortable with as they were tackling the tasks. In this way, not only did the learners remain focused on the mathematics of the task but the flexible use of languages also facilitated active participation by all learners. While the home languages were visible in the sense that the learners were for the first time given written mathematical texts in their home languages, they were also

invisible in that they were not distracting the learners' attention from the tasks they were doing. The learners were not focusing on the languages but on the mathematics of the task. Not only was the use of their home languages not perceived as a distracter or constraint, but some learners explained that having their home language versions was helpful.

In any multilingual approach to mathematics teaching and learning, the selection of high-demanding tasks rather than more routines classroom activities is key. Since mathematical tasks are central drivers to mathematics learning, they need to be seriously considered, diversified and chosen. The tasks in which learners engage provide the contexts in which they learn. Thus, tasks must be focused on what the teacher wants learners to know and do, be of varying cognitive demand, as well as allow the thinking of real world contexts that interest learners and engage them in mathematical discussions. Table 1 shows three examples of tasks for different grade levels. A cinema hall, a calendar and the electricity fees are the three real contexts adapted into texts and taken from the physical and social worlds around learners to communicate the message that mathematics is relevant and practical. The level of cognitive mathematical demand is high in many senses. Even the second task that could seem more about 'context' and less about 'mathematics' is a good example of integration between mathematics and context for rich mathematical discussion and learning. The number of meanings for phrases like "the most" and "the least" in "which month has the most/least rain" is mathematically relevant. It needs to be decided whether the total of days with rain (which is the information given in the task) can be a measure of the quantity of rain in a month (which is the information required in the question).

Opportunities and concluding remarks

The reflections presented above provide arguments for a multilingual approach to mathematics teaching and learning. There are several pedagogic but also ethical and political arguments involved in moving mathematics education toward a multilingual approach. Janks (2010) discusses the complexity of the work in education that considers questions of access (without recognition of diversity) and of diversity (without access to power). In her theorization, she moves 'beyond reason' to 'desire'. Desire for what one is excluded from, particularly mathematics and language, has material consequences. Both school mathematics and English in South Africa open and close doors to higher education and employment. Desire is thus a double-edged sword for us as teachers with a concern for the other: "As educators, changing people is our work –work that should not be done without a profound respect for the otherness of our students. Desiring what one is not should not entail giving up what one is" (Janks, 2010, p. 153)

Enabling others to access mathematics/become mathematical is our work but doing this involves more than just mathematics. The language choices of teachers and learners who prefer English are informed by the political nature of language. While language is a resource that can help advance mathematics learning, it can also be a stumbling block for successful mathematics learning. Many learners in South Africa do not have the level of fluency that enables them to engage in mathematical tasks set in English. One major challenge is bringing together the need for access to English and the need for access to mathematical knowledge. To address this, we need to be aware of the teaching and learning opportunities that a multilingual approach to mathematics education create:

- It recognizes the political role of language and thus also the inequality of languages
- More focus on mathematics rather than just ordinary language
 - Language functioning as a transparent resource (visible and invisible)
- Engagement with high cognitive level demand mathematics tasks, which some teachers overlook because of their learners' limited proficiency in the LoLT.

- Learner participation and interest in mathematics.

As explained in this report, the strategy for using language as a transparent resource in the teaching and learning of mathematics in multilingual classrooms is guided by two main principles: the deliberate, proactive and strategic use of the learners' home language and the selection of real life, interesting and high cognitive demand mathematical tasks. I have alluded earlier in this report to research that argues that to facilitate multilingual learners' participation and success in mathematics, teachers should recognise home languages as legitimate languages of mathematical communication. More particularly, research shows that with this approach, language becomes a resource in the multilingual mathematics classroom. While the political nature of English is recognized, the learners' home languages are not presented in opposition to English but as working together with English to make mathematics more accessible to the learners. Translating tasks into multiple languages is at the core of the multilingual approach. Translation is never a straight-forward enterprise, it is complex in many ways. As multilingual speakers of languages from different conceptual worlds we know from experience of living in language, what monolinguals know theoretically from training, that much loss and distortion of meaning can occur in translation. Yet translation is part of how meaning is transferred, made and re-negotiated; therefore, this aspect of linguistic activity remains an important consideration. The consequences of all this in terms of quality mathematics education and equity are far reaching.

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