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Reflections on a research initiative aimed at enhancing the role of African languages in education in South Africa

A B S T R A C T In the South African educational domain, there are an increasing number of initiatives which attempt to address the inequities in the system by providing support in an African language at various levels. Many of these initiatives use translation of texts in various subject areas as a major method of support which necessarily involves terminology development. This article puts forward the argument that although linguistic and conceptual development are inextricably linked, provision of translations, terms and word lists may not be sufficient to encourage 'deep' learning of the key concepts in the disciplinary content areas. The challenges arising out of the present educational context in South Africa require a more holistic approach, including language provision and management, professional translation and back translation, more inclusive methods of terminology development with richer contextualization and the enrichment of teachers' pedagogic content knowledge. The argument arises out of a re-examination of the findings from research into the development of two multilingual resource books for use by teachers of mathematics and science at secondary school level. These resources were developed in order to facilitate understanding of key concepts in the mathematics and science disciplines and will undergo a re-appraisal of the extent of their effectiveness in meeting these aims.

1. Introduction

Weideman (2007:589) argues for a postmodernist definition of applied linguistics that identifies "social and political accountability as the critical feature of the endeavour" as opposed to a modernist definition, which emphasizes the scientific foundations of the discipline. This call is not untimely for the African context where a vast number of children are still obliged to learn their school subjects through the medium of an ex-colonial language. Applied linguistics as a discipline has come to be associated very strongly with English language teaching and with the

use of English as the language of learning and teaching for the school curriculum. This is partly as a result of South Africa's complex colonial and apartheid history, but also as a result of strong pressure from parents whose attitudes were formed during that period, and, of course, who want their children to be competitive in a globalizing, modern world. English for these parents has tremendous instrumental value. The result is, however, that the majority of South African learners have not been afforded the opportunity of drawing on their home language for learning. Various scholars have long been proclaiming the injudicious use of ex-colonial languages as languages of instruction (Bunyi, 1999; Burkett et al 2001; Dlodlo, 1999; Heugh, 2002) and the call for applied linguists and educationists to be more 'socially responsible' has been responded to by a number of initiatives in South Africa, particularly in the area of language in education. One such initiative, to be described in greater detail later, resulted in the creation of two Multilingual Resource Books in Mathematics and Science in four languages: English, Afrikaans, isiZulu and isiXhosa (Young et al 2005). The project aimed at facilitating both teachers' and learners' understanding of key concepts in mathematics and science at secondary school level by providing definitions and extended explanations in the other languages. The general findings from the first phase (GET) of this study have been reported on in Howie et al (2005). Research findings from the specific regions involved in the study have also been recorded in Wildsmith-Cromarty & Gordon (2009) for KwaZulu-Natal and Schafer (2005) and Thokwe and Schafer (2009) for the Eastern Cape. The study, together with the findings, will be briefly summarized later in this article in order to provide the context for a critical reflection on the extent of the usefulness and effectiveness of the products of the study, i.e. the resource books, insofar as they may facilitate conceptual understanding for the learners.

2. The status quo

South Africa has reached a crossroads in terms of whether or not it continues the downward trend in international tests assessing performance in both language and literacy proficiency levels, and knowledge of science and mathematics. Macdonald's (1990) findings in the well-known Threshold Project revealed that Grade 5 learners in South Africa were reading at Grade 3 levels and below. The Progress in International Reading Literacy Study (PIRLS) was carried out in South Africa with Grade 4 and 5 learners in all the official languages and not only in English. Notwithstanding, South African learners were at the bottom out of 45 countries (Howie et al, 2008). The KwaZulu-Natal Department of Education (2007) published a report on its systematic evaluations of grade 6 learners in the province, indicating that 75% of these learners are below the required benchmark for literacy competence. The results for mathematics were even poorer with 88% lacking in competence. In addition to low literacy and reading levels, South African learners' poor performance in the 1996 and 1999 Third International Mathematics and Science Surveys (TIMSS) assessment (Fleisch, 2008) bears testimony to the fact that these learners are not receiving much benefit from their education, and, as a corollary to that, do not seem to have the means to access subject matter or content in any meaningful way. In terms of the aims of Curriculum 2005 (and the more recent National Curriculum Statements), learners need to be able to "collect, analyze, organize and critically evaluate information" (No. 4), and "use science and technology effectively and critically" (No.6) with an emphasis on "problem-solving" (DoE, 1997:15). This is what learners need to be explicitly taught, but access to appropriate pedagogy, tasks, activities and resources in the home language of the learners

has not been widely available. Such tasks and activities are equally important for building up an effective academic discourse for learning and achieving in school.

Although South Africa's Language-in-Education policy (DoE, 2002) proclaims the right of every child to basic education in the language of his/her choice, it would seem that African languages are still not being used for learning in educational contexts beyond the first four years of primary schooling. For rural children living in more or less monolingual areas where exposure to languages other than the home language is infrequent, the use of an ex-colonial language for instructional purposes could be, and often is, an alienating experience (Heugh, 2002; Macdonald, 1990:Taylor & Vinjevold, 1999). It is in these contexts that one tends to find fairly established code-switching practices as teachers try to mediate between the curriculum content in English and the learners' levels of proficiency and understanding in that language. The issue might be even more complicated for children living in multilingual, urban areas, where the language of instruction at the nearest primary school may not necessarily be their home language. In addition, many urban children grow up speaking a `mixed' form of language (Ntshangase, 2002; Rudwick, 2004; Slabbert & Finlayson, 2002) as their primary discourse so that a 'standard' form of their home language might not be familiar. Lafon (2005), at a workshop on the standardization of African languages, argued that the linguistic context of Gauteng, for example, which is multilingual, cannot be directly codified, as "isCamtho, or similar varieties, have not yet developed enough to warrant their extended use in writing" (134). He thus argues for an inclusive approach to standardizing isiZulu specifically (and the African languages in general) so that the process does not exclude regionally different forms or varieties. Notwithstanding the complexities in the implementation of such an approach, the best place to begin an initiative is on the ground, as it were, so that learning to use the home language as a medium of instruction becomes an organic process. In multilingual contexts such as Gauteng, the provision of a resource book which makes use of a number of different languages could encourage the use of multilingual pedagogies.

Another contributing factor to poor concept learning on the part of South African learners as evidenced in their performance in the surveys mentioned above, is that teachers themselves are not fully proficient in the medium of instruction, which has mainly been English (Taylor & Vinjevold 1999; Probyn 2002), and are thus unable to facilitate understanding of the relevant concepts for their learners in ways which would induce deep and lasting learning. In addition to this, many mathematics and science teachers are under-qualified in these fields and have difficulty in understanding and interpreting the basic concepts and related language forms themselves (Sanders 1993).They therefore resort to a reproductive `rote-rhythm' learning-teaching strategy (Macdonald 1990; Taylor & Vinjevold 1999) which narrowly circumscribes what will be learned. This also results in superficial learning of the subject matter on the learners' part (usually rote-memorization). For teachers to feel sufficiently competent in both language and content knowledge, they need to augment their own understanding of the relevant concepts in these fields, and have the tools to facilitate this understanding for their learners. The multilingual resource books are an attempt to enhance teachers' subject knowledge as well as affording them the opportunity to express this knowledge through the medium of the home language.

3. Language of learning and teaching

Arguments for the use of the mother tongue as a language of instruction (which is also referred to as the 'home language' in this article), especially in the early years, are now widely accepted both internationally and locally, i.e. on the African continent (Batibo 2009; Brock-Utne & Hopson 2005). According to Cummins & Swain (1986), it takes approximately two years to reach a level of proficiency in basic interpersonal communication skills (BICS) in a foreign/additional language, but at least seven years to build up cognitive academic language proficiency (CALP) in that language. Difficulties appear almost insurmountable if CALP has not initially been established in the mother tongue (or home language), and, furthermore, if the languages involved are non-cognate. Cummins' (2000) well-quoted `interdependence hypothesis' proposes that a solid cognitive academic language foundation needs to be established in the mother tongue before any viable transfer to a second language can take place. If this is the case, then what happens to learners who are required to learn through the medium of a second language *before* any cognitive academic language proficiency has been built up in their own language? What is there to transfer?

The Language and Learning across the Curriculum Special Interest Group (LLACSIG: 1997) of the Southern African Applied Linguistics Association propose that there needs to be recognition of and support for the use of learners' home languages if they are to be used for thinking and the acquisition of knowledge. Their approach to the learning experience is one of social constructivism (Vygotsky 1978; Bruner 1985) whereby the process of creating meaning, developing thought and articulating this understanding through language are mediated by more knowledgeable adults through interaction. They continue:

> Expressing oneself in a process of coming to understand, requires one to organize one's experience – analyzing, synthesizing, categorizing, summarizing, comparing, sequencing, examining cause and effect relationships, etc. (LLACSIG 1997:46)

For the LLACSIG, the home languages should be considered the primary vehicles for meaningful learning as they provide the learner with the prior knowledge upon which to construct new knowledge. Mother tongue or home language medium of instruction is thus best for facilitating cognitive development. However, where educators (and parents) are unaware of the complex role played by language in the development of cognitive structures and the construction of knowledge, they assume that the requisite conceptual and linguistic conditions for the acquisition of literacy and numeracy skills can be met through the medium of an additional (foreign) language. However, learners have difficulty harnessing `new' knowledge presented in the foreign, additional language, to existing prior knowledge if the latter has not been developed in their home language:

> …the critical role of African language speakers' primary language in developing broader cognitive competencies and conceptual understanding continues to be undervalued and under-exploited in the teaching and learning situation. (LLACSIG 1997:53)

Brodie and Long (2004:136) make the point that "one of the few non-contestable principles in education is that new knowledge can only come about as old knowledge and experience is re-coordinated". For example, the LLACSIG (1997) argue that we build up mental *schemata* into which concepts are organized through our use of language and cognitive processes. This

construction of meaning is then communicated through language. The mental schemata or frameworks are built from prior knowledge and experience, and a more complete understanding of a concept represented by a particular term would include information about its concrete (texture, size, dimensions, shape, etc) and abstract features (genus, class, etc). Concept development is thus a gradual, complex process of accumulating knowledge about different aspects of a concept and what it means. This is more easily achieved through one's home language.

Much of the specialized vocabulary in the various content subjects, and especially mathematics and the natural sciences, does not fall within the learners' immediate experience. These terms create comprehension difficulties for learners who are unfamiliar with their subject-specific meanings. In a situation where the language of instruction is a non-indigenous language, even the teachers struggle to facilitate understanding of such concepts for their learners. For example, in a study examining teachers' difficulties in relation to the teaching of science and mathematics, Abrahams & Young (2002) found that teachers and learners experienced difficulty in interpreting word sums because of the complexity of the language used, such as rhetorical markers signaling `if-then' hypothetical clauses. In a separate study, Sanders (1993) found that teachers themselves are a major source of learners' misconceptions regarding science and mathematics concepts, as they are either unaware of the core meanings of these concepts, or they make *ad hoc* use of the indigenous language through code-switching in order to explain the English terms. Ambiguous terms which carry both everyday and scientific meanings pose further difficulties for teachers. For example, the English word *energy* has distinct scientific meanings depending on the context in which it is used and which are different to its everyday meaning. In isiZulu, the equivalent term for *energy* in its general, everyday use is *amandla, Matla* in SeSotho and *Maatla* in Setswana. However, the same terms also refer to *power, force and pressure* which reveals that some scientific terms are under-differentiated in the African languages in relation to the English terms. Teachers tend to use the general `cover' term *amandla* to signify *energy* in these contexts, which, in turn, dilutes the scientific meaning and results in inaccurate representations of the basic concepts

4. The Development of the Resource Books

The initiative originated at the University of Cape Town, and eventually expanded to the Eastern Cape (Rhodes University) and KwaZulu-Natal (University of KwaZulu-Natal). A team of applied linguists, subject specialists and teacher educators collaborated in the development of two multilingual resource books for understanding concepts in Mathematics and Science (Young et al, 2005). The resource books provide home language support for the learning and teaching of science and mathematics at both the general education and training (GET) and further education and training (FET) levels. The books are designed to supplement the existing textbooks (which are usually in English or Afrikaans), and to support the teaching activities which are carried out mainly through English with regular code-switching into an African language.

Core concepts in mathematics, geography, physics, chemistry and biology were identified from the school curriculum and translated into isiXhosa and isiZulu, besides Afrikaans and English. Only the basic concepts and their definitions or descriptions were translated. Extended explanations and examples mostly remained in English, except in the FET book, where some extended explanations for complex concepts do appear in the home languages. The reason

for choosing these four languages was that they were the official languages of the provinces in which the research was carried out. The production of resource books in the other African languages is under consideration, especially if the initial resource books are successful in facilitating learning and teaching.

The initiative aimed to encourage teachers to use the African languages to introduce the concepts in the home languages in order to aid understanding in contexts where the language of instruction is English. Initial drafts of the books were extensively evaluated by in-service teachers through questionnaires, workshops and focus-group interviews for triangulation purposes. The tracer study involved classroom observation of mathematics and science lessons at intervals over a two-month period. The participant teachers of science and mathematics were drawn from local secondary schools in the regions and were regarded as representative of the end-users of the resource books. In this way, the initiative was an inclusive process that incorporated the feedback from these teachers from their experiences of using the books. For the research carried out in KwaZulu-Natal, a convenience sample of twenty-seven teachers was used, drawn from high schools from the greater Pietermaritzburg region. This sample included schools of varying socio-economic means, from well-resourced to poorly-resourced schools.

The research design was exploratory-descriptive-interpretive, yielding qualitative data which were analyzed according to themes. These included teachers' general responses to the book; code-switching practices generated by the book and difficulties experienced when attempting to use the African language translations supplied by the book. It was thus an empirical study, attempting to gauge teachers' attitudes to the book as a support for facilitating home language instruction, and their actual practices when using the book in the classroom. Data collected from the various research instruments such as questionnaires, workshops, observations and interviews were triangulated in order to gain a holistic evaluation of the role the home language might play in mathematics and science instruction.

The evaluation of the project as a whole, including the research methodology, instruments and final analysis was the responsibility of a unit from one of the collaborating universities (Howie et al. 2005). The other participating universities were responsible for implementing the research in their own contexts. Detailed descriptions of the processes and quality control measures used in the study, including the creation of the definitions by subject specialists and subsequent validation of content, translation and back translation of the definitions which necessarily involved terminology creation and development, and the workshops for teacher inputs and feedback can be found in Schafer (2005), Thokwe & Schafer (2009) and Wildsmith-Cromarty & Gordon 2009. The focus of the present article, instead, is on the extent to which the resource books did, in fact, encourage the deeper kind of learning described earlier and whether the provision of translated terminology in the home languages for key concepts in the various subjects is sufficient. An additional question is whether the resource books could be enhanced or modified in order to encourage such learning and if so, how? These questions will be addressed in relation to the findings from the study.

5. The research process

Although this article refers to the data collected from the KwaZulu-Natal region specifically, reference is also made to the findings from the other regions. What follows is a brief summary

of the research process. A more detailed description can be found in Wildsmith-Cromarty & Gordon (2009) and Schafer (2005).

Data collection for the GET resource book was carried out in two phases.The first phase involved the presentation of the book to the teachers in a series of workshops with intervals between each workshop in order to give the teachers time to use the book in class. The book was presented to the teachers for their feedback on the concepts, explanations and translations and specifically on the use of isiZulu. After a trial period of four weeks, teachers reconvened for a second workshop in which they were required to design a lesson in their subject (mathematics or science) with the assistance of the multilingual resource book. It was important to monitor the extent to which teachers engaged with the isiZulu translations and incorporated these into their lessons. It was this phase of the workshop process that many of the teachers found difficult and which points to the need for something more than the provision of subject-specific terminology in the home language – a point which will be revisited later. The third workshop consisted of an exercise in which teachers were asked to reflect on the usefulness of the book for their teaching and whether they were comfortable with the translations. The fourth workshop required teachers to complete an evaluation questionnaire which included their responses to the use of isiZulu as a language of instruction. The final research activity for the presentation phase was a focus group interview which probed the answers to the questionnaire more deeply in smaller groups.

The second phase of the study involved observation of teachers using the book in their classrooms. In KwaZulu-Natal, four lessons were observed taught by four different teachers, two for mathematics and two for science, from four different schools. The research team wished to monitor the nature of the code-switching that resulted from using the book – if any. The findings from the observations provided an opportunity for triangulation with the questionnaire and interview data. The lessons were recorded on video which were later used in a stimulated recall exercise in semi-structured interviews with the teachers in order to probe their teaching practices more deeply. Narratives for each lesson were then constructed from the various research instruments and included as part of the final report on the project (Howie et al 2005).

6. The findings revisited

The following discussion re-examines findings from the study in the light of fresh insights into the various issues that they raised. These include teachers' preparedness for using an African language for instructional purposes in ways that extended beyond code-switching for explanatory purposes, the development and use of terminology in the African languages, and teachers' content and pedagogic content knowledge. It is, however, acknowledged that the teachers had only experienced using the resource books for a few months during which the data was collected. The findings might have been very different had they used the book for a longer period.

6.1 Code-switching

The data from the observations revealed that the availability of translations in the African language tended to enhance the use of code-switching for explanatory purposes, a practice

with which teachers were already familiar – although the explanations of the concepts provided in the book were in English. Possibly due to the unfamiliarity of the terminology and of using the home language for instructional purposes, teachers resorted to their traditional practice of using English for presenting the technical/specialist terms, (although the isiZulu translations were available to them), and using isiZulu to explain the terms (although the explanations provided were in English). In other words, they did the opposite to what the book was intending them to do, i.e. present the concepts and the related terms in isiZulu. In Thokwe & Schafer's study (2009) on the other hand, teachers use of code-switching for instructing and presenting content, explaining and asking questions increased markedly after exposure to the resource book.

In KwaZulu-Natal, teachers requested that the English explanations of the concepts be translated into isiZulu, and not merely the definitions. This is a valid request, as extended explanations in the home language would be a significant step towards building academic knowledge in the language in general, and accurate scientific and mathematical conceptions in particular. Such knowledge, developed in the home language first, would then be more easily transferred to the additional language, i.e. English.

6.2 Development and use of terminology

In the KwaZulu-Natal study, the data revealed teachers' uncertainties regarding the use of the home language for teaching mathematical and scientific concepts, particularly in relation to word-coinage and lexical choices by the translators. The unfamiliarity of some of the terminology in isiZulu raised the question of a standard variety and what that would consist of. This is not uncontroversial in South Africa – something which became very clear at the workshop on standardization of the African languages held in Pretoria (Webb et al 2005). At this workshop, the emerging urban varieties of the African languages and their role in the standardization process were highlighted (Webb & Deumert 2005). There was also a call for community-driven development of the African languages towards standardization. Lafon (2005) proposed further that standards might also be based on urban varieties rather than on the `deep' often rural varieties, in the common drive towards modernization.

The problem with terminology also extended to the translation process itself. Although the translations into isiXhosa and isiZulu were done by specialists who had extensive experience in translation work across various disciplines, not all of the translators had been or were involved in the teaching of mathematics and science at school level, hence they could have chosen terms for concepts that were not familiar to the teachers or their learners. This limitation was addressed in the development of the second resource book for the FET level, where back-translators were used to validate the process. Some of these back-translators however were practicing mathematics and science teachers, some of whom were also unfamiliar with the technical terms used by the primary translators. They thus tended to query these terms, preferring to use more general, colloquial ones or even selecting an inappropriate meaning for polysemous terms from various lexical choices in the dictionary. An example of this is the equivalent for 'bonding' in chemistry, which, in isiZulu, would be *–hlobana*. The dictionary offers two definitions for *–hlobana*: 'related to one another' or 'bonding'. Some back-translators chose the former, which revealed their lack of knowledge of the appropriate term in isiZulu. In the subsequent validation process, the team reverted to the technical term.

During the translation and validation process, it thus became obvious that terms needed to be richly contextualized with lots of examples for the teachers to feel confident in using them. It also pointed to the need in this country for professional translators specialized in various subject areas, although translation work in specialized subject areas would best be carried out collaboratively involving translators and subject specialists. This is what the research and development of the resource books attempted to achieve.

It would appear from the above that terms need extensive description in the African language in order to cover the various meanings carried by the English equivalent, which is preferable to coining a new term that might be unfamiliar to the end-users. Such a description would also serve to construct the concept for the learner in the home language. Once the concept has been understood, a more specialized term could then be created as part of the process. One of the ways of providing such contextualization is through the development of corpus-based, multilingual glossaries. Madiba (2010) argues for definitions of terms based on concordances as these provide a richer contextualization of the terms. For Madiba, definitions are not sufficient for bringing about the deeper kind of learning required for the development of scientific concepts. Such learning also involves understanding the extent to which concepts are related to each other – in any language. Thus, for example, understanding the concept 'triangle' should also involve being able to relate the shape to that of the pyramids, and to identify subordinate relationships by subdividing polygons into triangles. What is important for students is 'how they are made to engage with the different concepts in ways that promote the development of higher order thinking skills' (2012:15). Such understanding could optimally be achieved through the use of teaching strategies which form part of a teacher's pedagogic content knowledge. Madiba (2010) goes on to argue that processes such as decontextualization (from exposure to multiple meanings of a term in different contexts) are part of deeper learning processes crucial for developing scientific concepts. He cautions, however, that this makes the translation of such terms and their concordances a much more complex task.

Madiba's (2010) argument for corpus-based glossaries counters Mesthrie's (2008) skepticism of the pedagogic value of glossaries and terminology lists. Mesthrie proposes that word lists or glossaries are a necessary but not *sufficient* condition for the use of indigenous languages at university level as discipline-specific knowledge does not only involve the learning of terminology but also involves the mastery of an entire register in the discipline. For Mesthrie, terms need to be developed through use by experts and specialists in communities of practice. Such communities of practice have been increasingly in evidence at universities who have begun to provide materials in the African languages. Maseko (2011) reports on collaborative efforts to develop terminology in Pharmacy, Education and Political Philosophy at Rhodes University. Terms were also richly contextualized in the production of course materials. The teams included linguists, translators, subject specialists and students and the terms developed through such a participatory process were then subjected to verification processes by external bodies. Similar processes were followed by Engelbrecht et al (2010) for the disciplines of nursing and midwifery at the University of KwaZulu-Natal. Health specialists, senior students, translators, linguists and nursing educators held workshops in order to collaboratively develop and refine online glossaries in the African home language for their students. There has subsequently been a call to include clinical practitioners in such workshops which would go some of the way towards creating what Mesthrie refers to as a community of practice.

6.3 Teachers' content and pedagogic content knowledge

Finally, it seemed that although teachers responded well to the book and seemed to find it useful for enhancing their own understanding of the subject content, not all the teachers observed in the classrooms used the book in the way it had been intended. For example, some teachers started using it as a textbook, copying whole sections from it for the learners. Instead of trying to mediate the scientific or mathematical explanations pedagogically, through various tasks and activities that might help learners grasp the concepts more easily in their home language, they used it as a crutch, believing that this would be sufficient for learning. This could well indicate a lack of pedagogic content knowledge, apart from the language issue.

The resource books did not explicitly cater for teachers' pedagogical content knowledge (Brodie & Long 2004). This is different from either knowledge of the subject, eg. science or mathematics, or pedagogic knowledge, which refers to general techniques and strategies that teachers use to teach their subjects. It refers to the teachers' knowledge of their subject which is specifically related to teaching. For Brodie & Long (2004: 138), this includes "knowledge of how to represent topics to learners, what common misconceptions might be, and what counts as a worthwhile task to develop particular (mathematical) ideas". One of the most effective ways to do this would be to 'unpack' the concept in the home language, through appropriate problem-solving tasks. This, again, would imply transforming the extended explanations already provided in the resource books into activities that would promote conceptual understanding. This approach involves gradually encouraging teachers to systematically increase their use of the home language to introduce scientific concepts to their learners. Such an intervention provides support to teachers, whilst simultaneously supplementing both their content knowledge and their pedagogic content knowledge. This, in turn, enables teachers to facilitate their learners' reading, understanding and use of mathematics and science concepts and their related language forms. A further advantage of the multilingual resource books is that translations of basic scientific and mathematics concepts are provided in three languages, which means that teachers may refer to the translations in the other languages if the terms in their own languages are unfamiliar, or if they are uncertain of the core meanings of concepts. This occurred with some of the teachers n the current study, particularly where the languages are mutually intelligible, such as isiXhosa and isiZulu, which belong to the Nguni branch of sub-Saharan Bantu languages.

7. Challenges to the use of the mother tongue for instructional purposes

In the South African context, there are a number of challenges to face when using the mother tongue for instructional purposes.

Results from this study and others (Setati et al 2002) show that code switching for the purposes of clarification and explanation in science and mathematics classrooms appears to be an already established practice. The challenge is, therefore, to understand how to harness this code-switching practice in a systematic way in order to enhance conceptual development in the mother tongue or primary language. We need further research in order to ascertain whether the type of codeswitching used by teachers truly builds an academic understanding of a concept, or whether it dilutes scientific meanings through the use of colloquial examples.

The resource books already provide extended explanations of complex concepts. Many of these, especially in the FET book, are in the African languages. Teachers could tap into these for presenting concepts to their learners, building up academic and specialized discourses in the process. They could also transform these explanations into problem-solving activities.

Secondly, most teachers did not acquire their scientific or mathematical knowledge through the medium of isiZulu (or any other African language) because it was not available as a language of instruction during their period of training, which makes it difficult for them to transfer such knowledge from English to another language. Teacher training needs to be conducted in a bilingual instructional context to enable teachers to use the African languages for instructional purposes.

Finally, the problem does not lie solely with language, but rather with the way the language is used to develop concepts. Removing language barriers from learning and assessment does not necessarily compensate for a severe lack of content knowledge, which leads to the final issue of pedagogy.

Teachers' pedagogic content knowledge needs to be developed in the home language if the resource books are to be truly effective. One recommendation is that the resource books include various problem-solving tasks and activities that will help deepen teachers' understandings of mathematics and science and help them to use the African languages to teach them to their pupils. Such additions could either supplement or replace the extended descriptions in English.

8. Conclusion

Given the increasing number of research studies focusing on the development and promotion of the African languages in education, it is possible that South Africa finds itself in a transitional stage between the dominant use of a non-indigenous language as language of instruction and a more complementary approach with the increasing use of an African language. To ease this transition, we need to challenge the preference for English as medium, especially in the primary school years, with a fuller valorization of the African languages and their potential to function as academic languages. Once this occurs, we need to narrow the gap between the learners' (and teachers') informal, everyday use of the indigenous language and the variety selected for academic purposes. Perhaps a useful way of approaching this would be to encourage the perception of the different varieties as discourses (Gee 1996). The primary discourse is the informal (often mixed) variety used in the home and community, whereas the secondary discourse is that used for instruction in the educational domain. This would be no different from English learners distinguishing between their primary and secondary discourses. However, African learners would have the added advantage of a second secondary discourse, i.e.the additional (non-indigenous) language used as a medium of instruction in the more senior years. If their secondary discourse in the African language is sufficiently developed, it would not be as difficult to develop such a discourse in the other language.

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