

Processes of pedagogic change: integrating subject and language learning through teacher education

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Abstract

A considerable body of research evidences the power of multilingual education to transform classrooms and to strengthen subject learning. In many postcolonial contexts, large numbers of learners within mainstream basic education learn in a European language, which may be unfamiliar to them. An urgent question for research, therefore, is how multilingual education can be introduced and scaled up. We report on a project that developed an approach to integrating science and mathematics subject learning with language learning within one university and scaled it up across five teacher education institutions in Tanzania. Critical features of the process are identified. These point to the importance of collaborative professional learning for endogenous innovation that aim at expanding a community of practice rather than replicating an ideal practice.

Introduction

There is a substantial and growing body of research arguing for multilingual educational practices in multilingual societies (Wright et al., 2015). These arguments are evidenced by small to medium scale classroom research, involving qualitative observation of classrooms, interviews or larger surveys with teachers and, less frequently, consultation with learners (Cenoz, 2017). The research evidence has been collected from diverse multilingual contexts, ranging from the city states of East Asia (Lin and He, 2017), hyperdiverse cities of Europe (Duarte, 2018), and, pertinently for this edited book, diverse rural and urban landscapes of low- and middle-income countries within sub-Saharan African (Msimanga and Lelliot, 2014; Probyn, 2015; Terra 2018) and across the Global South (see for example contributions to Shoba and Chimbutane, 2013; Coleman, 2017). Taken individually, the studies are small and context-specific in their conclusions. Cumulatively, they provide a robust evidence base for the potential of bilingual or multilingual educational practices to promote socially just education, as this volume illustrates.

It is harder to find evidence on how to take multilingual education (MLE) to scale. Yet, in many formerly colonised countries that use a European language as the language of instruction within the state education system, this is precisely the challenge. Lack of evidence on scale-up is not specific to multilingual education (MLE). Samoff, Dembélé and Sebatane (2013) over many years developed a review of education reform scale-up of education initiatives in sub-Saharan Africa. They found very few examples of successful innovation going to scale. More often, projects which are extraordinarily successful at improving the quality of education in a specific place and time have faltered when ministries attempt to scale them. This does not bode well for using the evidence basis from numerous successful but mostly small-scale initiatives to influence national policy in the direction of MLE across an education system. National policy does matter as it may put a brake, or even a block, on pedagogic innovation. However, it is also critical to give attention to the processes of professional learning through which pedagogical change occurs are also critical:

pedagogical renewal does depend largely on teacher development But just as student learning is significantly determined by the quality of teaching (of teachers by extension), teacher development (conceived as teacher learning) is in part determined by the quality of the learning opportunities which teachers (prospective, beginning and experienced) engage in. The quality of such learning opportunities is, in turn, determined in part by the quality of the designers and facilitators, that is, teacher educators and trainers. (Dembélé and Lefoka, 2007: 547)

Teacher education should be regarded as a “fulcrum for change” (Stuart, 2002), particularly when it comes to strengthening pedagogy. Teacher educators are well-positioned to influence large numbers of student teachers at the start of their careers. They are expected to be pedagogic experts who engage in school-based research, particularly if based in university departments of education. Further, they are networked with a number of schools, where their students are posted for teaching practice placements.

The *Language Supportive Teaching and Textbooks* project in Tanzania, capitalised on these positional advantages of teacher educators to develop and disseminate a pedagogic approach which draws on bilingual strategies to strengthen science and mathematics teaching and learning at the lower secondary level. State primary education, which enrolls a large majority of pupils and is the only available provision in most rural areas, uses Kiswahili as the language of instruction, whereas English is used in all secondary schools (Sumra & Rajani, 2006). For most students, the transition in language of instruction is abrupt and challenging and this has been observed to impede science learning (Mwinsheikhe, 2009; Juma, 2015). Whilst language in education researchers have advocated a change in policy for four decades, the implemented policy has not changed. Meanwhile, in the last ten to fifteen years lower secondary education has expanded rapidly and Tanzania now has a policy of universal secondary education. The development and scale up of language supportive pedagogy was an attempt to mitigate the classroom consequences of a controversial but, so far, intransigent language policy. The project aimed to enhance the language proficiency of student teachers for subject teaching at the same time as introducing them to a bilingual pedagogical approach designed to address the language barrier.

In this chapter, we briefly outline the nature of the pedagogic innovation before explaining the process of collaborative professional inquiry through which it was scaled up. We finish by highlighting the essential elements of the process of professional learning and draw out implications for the design of scale up of MLE.

Language supportive pedagogy for secondary school science

In their vignette in this volume, Rubagumya et al. describe the essential features of language supportive pedagogy, as applied within teacher education. Here, we focus on the process through which this approach was developed and scaled up and only discuss briefly the features of the pedagogic approach. In borrowing techniques from modern foreign language teaching and integrating them into science and mathematics subjects, this approach has features in common with Content-Language Integrated Learning (CLIL) (Coyle, 2007). It has been developed through a collaboration between linguists, including those with language education expertise, and science educators. Language education in Tanzania is influenced by the cognitivist tradition that views second-language learning as a cognitive process of internalising the linguistic system of the second language with a target of native-like fluency (Valdés et al. 2015). It focuses on learning the grammatical rules and patterns of the language and hence, there is an emphasis on modelling syntax and correcting errors in grammar, syntax and pronunciation. This is grounded in a monoglossic view

of languages as fixed, homogeneous independent units. It assumes bilingualism to be a form of parallel monolingualism, whereby the bilingual person is either speaking in one language or the other (Flores and Beardsmore, 2015). A longstanding frustration for secondary school English teachers in Tanzania is that their efforts to model the rules and patterns of English are constantly undermined by colleagues teaching other subjects, who use non-standard English with inaccurate grammar, spelling and pronunciation (Qorro, 2009).

Science teacher educators within the project were influenced by constructivist theories of learning, which underpinned earlier science education projects in Tanzania (e.g. Ottevanger et al., 2005). Constructivist theories of learning recognise that learners build on pre-existing knowledge, making it important for teachers to elicit and challenge students' 'misconceptions' (Cakir, 2008). In other words, articulating prior understanding is part of the process of making sense of and learning to articulate new concepts. Social constructivism, influenced by Vygotsky, emphasises the role of language and social interaction in mediating the learning process and hence learning science involves learning the formal scientific language of scientists (Scott et al., 2007). Within secondary schools, science teachers share a broad-based consensus that good teaching engages learners in dialogue, discussion, observation of the natural world around them and laboratory demonstrations and practicals. However, science educators in many schools serving disadvantaged areas are just as frustrated as their English teaching colleagues, because their students do not respond to attempts to engage them in discussion through the medium of the English (Mwinsheikhe, 2009). Students do, of course, have prior knowledge of school science and the natural world, knowledge that during their primary education they articulated and heard expressed in Kiswahili, which is the language of instruction in all government primary schools. They may also be used to discuss their informal observations of the natural world in a community language, which in the many rural areas is different from Kiswahili. In the terminology of Rubagumya et al. (this volume), familiar knowledge is encoded in a familiar language. To work around this, science teachers commonly improvise bilingual strategies, translating key points and instructions into Kiswahili, or more simply, default to teaching entirely in Kiswahili (Barrett et al., 2014). This can leave teachers with a sense that their practice is illegitimate because it contravenes Tanzania's monoglossic language policy. Whilst these approaches may well build on students' understanding of the science curriculum, it does not develop their ability to talk and write about scientific ideas in English. As research on assessment and language in Zanzibar has shown, secondary school students frequently cannot demonstrate their knowledge of science in national examinations, which are conducted in English (Rea-Dickins et al., 2009).

The fifty teacher educators in the LSTT project were already influenced by constructivist view of learning and the sociocultural view that learning is not just an individual process but a socially and historically situated one (Farnsworth et al., 2016). It was not difficult for them to appreciate and accept a sociolinguistic description of learning in a second language as an iterative process of shifting back and forth between the informal registers of students' 'thinking language' the formal, or in Halliday's (1993) terms 'scientific' registers, of the target language. 'Code switching' between an African and European language is a feature of Tanzanian science and mathematics classrooms, as it is in other African schools (Clegg and Afitska, 2011; Msimanga and Lelliot, 2014; Probyn, 2015). However, as Setati et al. (2002) observed in rural South African schools, the transition from expressing prior knowledge in a familiar language to articulating scientific concepts accurately (both scientifically and linguistically) in formal English is for many learners a broken incomplete learning journeys.

The pedagogic approach developed by the Language Supportive Teaching and Textbooks project drew on insights both from constructivism and the cognitivist approach. Students are given time to

process new scientific concepts in their familiar language and encouraged to relate them to their pre-existing knowledge through various strategies that range from giving the Kiswahili translation of key subject specific pedagogy (a quick way to orientate students by signalling the relevant previous learning from primary school) through to explorative practical activities. Allowing time for students to express and discuss their ideas in a familiar language is also key (Probyn, 2015; Barrett and Bainton, 2016). Most commonly the 'familiar language' used is Kiswahili. However, students are free to use a community language or translanguage (García and Wei, 2015) across languages. Being non-prescriptive about the language students used in their classroom discussion and tolerant of stumbling English that is "hesitant and incomplete" (Barne 2008:5, quoted in Moate 2010:41) increased their confidence to start talking and expressing their ideas in class. At the same time, the approach provides structured support for developing the vocabulary and practicing the grammatical rules and patterns associated with secondary school science through using strategies that are commonplace in modern foreign language classrooms such as role play, fill the blank, sentence starters and vocabulary lists. In this way science teaching reinforces the learning of grammar covered primarily in English lessons, whilst building subject specific vocabulary and supporting students to gain proficiency in the subject specific genres of writing used in secondary school science. Explicit attention to pronunciation is also a feature of language supportive pedagogy through consistent correction of mispronunciations. This all requires creating an affirmative classroom climate, where students feel safe to take risks, practice speaking in English without fear of humiliation and share their ideas about science in whichever language they are most comfortable. At the same time teachers need to practice a degree of consistency in correcting linguistic errors, particularly recurring errors, without slipping into pedanticism that distracts from rather than supports science learning.

Implementing language supportive pedagogy in teacher education

We first developed language supportive pedagogy through developing teaching and learning materials that were both much easier to read than existing textbooks and provided activities that developed reading, writing and talking about science in English. By mid-2016 we had texts prepared that demonstrated our distinctive approach to teaching Biology and Mathematics to second language learners living in disadvantaged rural and urban contexts. The team, which developed the approach, were mostly teacher educators at the University of Dodoma. It was tempting, at this point, to start introducing schoolteachers to the approach. We were mindful, however, that teachers are a pragmatic audience, who are rightly sceptical of experts offering silver bullet solutions to their longstanding classroom dilemmas. One of the surest ways to convince teachers to change their practice is to go into their classroom and demonstrate the approach with their own students. Before we could communicate language supportive pedagogy with any degree of authority, we had to be thoroughly practiced in the approach ourselves. For teacher educators, practicing what we preached meant adapting the language supportive pedagogy for implementation in teacher education programmes. At this point, the researchers at the University of Dodoma reached out to teacher educators in a neighbouring University, St. John's University of Tanzania, and three Teachers Colleges, Butimba, Morogoro and Mpwapwa to join them in this second stage of development. Including the three Teachers Colleges was considered key because of their extensive and nuanced practice-based expertise in pedagogy for secondary education.

Once again, drawing inspiration from a previous research within Tanzania (Eriksson and Osaki, 2018), we adapted the lesson study methodology for collaborative professional development. Lesson study originated in Japan, where in large schools the same lesson will be delivered several times to different class groups. A team of teachers collaboratively design a lesson plan for the first lesson and

then progressively refine this each time the lesson is taught. Improvements are based on feedback from observers in the team and data collected from a small number, typically around three, case study students, whose classroom interactions are observed and who may be interviewed immediately after the lesson. Lesson study has since been adapted for various contexts. In our adaptation a single lesson was not immediately repeated. However, we did borrow collaborative planning and evaluation of lessons and data collection from case study students through the academic semester.

Subject teaching methods courses were the obvious starting point for introducing the theory and practice of language supportive pedagogy. These units of study are taken mid-way through the undergraduate and diploma level teacher education programmes. They focus on subject specific pedagogy for one subject, so the Mathematics Teaching Methods course, for example, includes learning theories, lesson planning, assessment design specific to Mathematics. The courses typically end with two sessions of microteaching, in which small groups of students take turns to demonstrate to their peers a short lesson they have planned. The lesson study teams were made up of science or mathematics teacher educators and language specialists from within one institution. However, they would occasionally be joined by an observer from one of the other institutions in the partnership. In this way, the University of Dodoma shared its expertise, developed over the previous three years, with the partner institutions and the universities benefited from the various interactive strategies that teacher educators in Teachers Colleges had developed through their involvement in recent national quality improvement programmes. As different institutions delivered very similar courses at different times in the year, insights that developed out of lesson study of a course in one institution could inform its implementation in another.

Typically, each teaching session would be interactive, involving group discussion and presentations from groups of students or micro-teaching. The lesson would close with feedback from a language specialist on language use, which frequently focused on explicit correction of grammatical errors and mispronunciations that had recurred in the lesson. Explicit attention to pronunciation, grammar and vocabulary became the established and accepted norm within the lessons. In their own micro-teaching, student teachers also explicitly addressed vocabulary and, in some sessions, provided structured support for reading and writing. In the first year, participating teacher educators reported that collaboration through lesson study was demanding on their time but the cooperative approach to problem-solving and sharing of expertise across subject and language specialists generated an enthusiasm around their teaching that had not existed previously. Colleagues were regularly talking with each other about their teaching and in so doing, became reflexive with respect to the design and delivery of their courses.

The adapted lesson study approach was dynamic. It transformed our two-dimensional plans for scaling up the implementation of language supportive pedagogy into a multidimensional open-ended process of pedagogic development conducted by an expanding cross-institutional community of practice (Farnsworth et al., 2016). Teams tended to start with basic ideas about language supportive pedagogy. These focused on the strategic use of Kiswahili in student discussion combined with attention to language through ensuring understanding subject specialist vocabulary, modelling use of simple accessible grammatically accurate English and consistent affirmative correction of grammatical errors and mispronunciation (see Rubagumya et al.'s vignette for further detail). From this basis, however, lesson study teams took their investigations in different directions. The Chemistry Teaching Methods group at the University of Dodoma in their second cycle, explored the relationship between conceptual learning and language proficiency. The Physics team developed an interest in how practical demonstrations and experiments support conceptual learning and

subgenres of writing used in laboratory reports and scientific inquiry. The Biology group, which was contending with large class sizes of 260, experimented with using micro-teaching to deliver nearly all components of the course. This involved them providing coaching to teams of two or three students, who collaboratively prepared a microteaching demonstration, and then engaging the rest of the class in critical discussion. Hence, they turned microteaching into a strategy to simultaneously develop students' language proficiency for teaching, subject knowledge and pedagogical knowledge and skills. Their initiative inspired other teams, who also started making more extensive use of microteaching, extending to language teachers implementing the approach in Kiswahili Teaching Methods courses. During this stage, team members' understanding of what LSP meant in practice deepened considerably as over two years of repeated lesson study cycles, they became comfortable with theory behind language supportive pedagogy and its implementation became increasingly routine.

College or university-based courses are just the first step in student teachers' training. Very quickly tutors became concerned with how to support their students during the crucial period of teaching practice, when over a six-week period they are placed in a school. Across the three institutions well over 4000 trainee teachers were scattered to schools around the whole country, where they would attempt to implement in school classrooms the teaching methods they had learned in university and college lecture halls. Two weeks after the students' departure, their tutors were likewise scattered around the country, visiting their students in schools for a half day of supervision and observation. These visits became an opportunity to explain to school leaders, the logic behind the language supportive pedagogy, which the students were using. In some instances, this led to requests from schools for workshops. One Teachers College invited teachers from the partner schools with which it worked most closely to workshops, where their students demonstrated language supportive pedagogy.

The lesson study collaborative approach made every participant in the project a leader of the initiative in their own lecture hall or classroom. With leadership came a sense of ownership and a commitment to promote and disseminate the approach. In total around 50 teacher educators from the five participating institutions were involved in lesson study teams. However, the reach of the project went further as those participants shared their new-found expertise with colleagues within their institution, insisting that all teacher educators should be exposed to language supportive pedagogy. Members of the core team of 50 also conducted workshops with secondary school teachers in collaboration with four separate secondary education quality improvement projects in Tanzania. The teacher educators participating in the Language Supportive project had become champions for language supportive pedagogy spreading the theory and classroom strategies through their existing networks.

The authors of this chapter have in common a background in science education. None of us claimed expertise in language education before engaging in the project and so we count ourselves amongst the participants, who have come to fuller understanding of how language is inextricably intertwined with science and mathematics learning. When teaching second language learners, who are navigating a change in the language of instruction midway through their basic education, the interdependencies of language and science learning have their own dynamic. Sometimes it involves eliciting and making connections to common sense knowledge articulated in a familiar language. However, eliciting and connecting to scientific knowledge expressed in the registers of primary school science is equally important. We have expanded our repertoire of strategies for supporting students to read, write and articulate their ideas about science in English and have a strong appreciation of the value of learning resources matched to students' language ability and subject

language demand being placed in the hands of teachers and learners. One of the most significant steps we have taken as a community of professionals is to switch from viewing language in education as an insoluble policy problem beyond our domain of expertise to viewing it as also a pedagogic problem that, with some help from language education experts, we can address, at least partially, through strengthening our practice. We do not yet know to what the extent the enthusiasm generated in the last three years will sustain or whether the spread of the innovation through networks that link teacher education institutions and schools will continue. However, the practice has been institutionalised within the five participating teacher education institutions. On this basis therefore in the next section we identify some of the reasons for the project's success.

Reflecting on successes of language supportive pedagogy

After three years of implementing language supportive pedagogy in teacher education, we have established a community of practice, a form of learning partnership within which science and language educators collaboratively negotiate subject-language integrated practice (Farnsworth et al., 2016). There is within the partnership an enthusiasm to continue the process of professional learning and to expand the membership of the community of practice into schools. There are individuals, who have taken the lead in the continued development of the language supportive pedagogy as a practice, extending the repertoire of teaching and learning activities. As illustrated by the examples of lesson study team innovations above, the direction of change has been towards greater participation by student teachers and the democratisation of classrooms. Hence, tutors on the subject methods courses have found attention to language to be liberating as it opens up to them new pedagogic possibilities.

Others have focused on dissemination, taking a lead in designing training for in-service teachers, introducing language supportive pedagogy to schools and projects concerned with professional development. Their efforts, still in the early stages, raise critical questions around processes of scale-up. Language supportive pedagogy has spread across the five partner teacher education institutions not as a static recipe for classroom practice, which is to be replicated, but through an open-ended process of collaborative inquiry, which expands a repertoire of practice in tandem with developing a more nuanced theoretical understanding. So far, initiatives to spread language supportive pedagogy into schools have been conducted as one-off workshops, which combine theory, demonstration and opportunities to experiment with the pedagogy through designing teaching and learning activities and lesson plans. However, based on our experience of professional learning within the project a more promising approach would be to communicate our innovation through nurturing communities of practice that conduct interlinked inquiries into language and learning.

It is not a static idea of language supportive pedagogy that should be scaled up but the process of professional learning that created and developed the idea in the first place. Neither is it helpful to be prescriptive about the form and organisation of the process of professional learning. The adaptation of lesson study that worked well in teacher education institutions may not work so well in schools. We identify six features of the process as central to its success so far. The first two relate to the readiness and ability of teacher educators to engage with a process of pedagogic change. First, language supportive pedagogy built upon and extended teacher educators' theories of learning. Participating teacher educators already had a well-developed understanding of pedagogy and a commitment to participative pedagogies based in social constructivist theories of learning. They both recognised the need to address language learning explicitly in their courses and were sympathetic to the theoretical precepts of the language supportive approach. Second, teacher

educators were able to change their practice. They had the autonomy, particularly within universities, and professional expertise to digest new ideas and make changes to their practice. Taken together these two reasons suggest that an approach to nurturing communities of practice should take into account and build upon teachers' theories of learning and expertise as practitioners. The next two reasons for success derive from the organisation and membership of the lesson study teams. So third, cross-disciplinary collaboration, bringing together science or mathematics educators with language experts, created the potential to innovate and provided collegial support for changing practice that individual lecturers, might have resisted implementing independently. Fourth, whilst teams were based within institutions there was also networking across institutions, including engaging with the two UK-based researchers and with research literature. Sharing of ideas across institutions can help to inspire and sustain the energy for change within institutions.

The last two reasons relate to the lesson study design. The fifth reason is to do with allowing time for professional learning. Understandings of language supportive pedagogy were more restricted in the first year and practices more fragile. It was only with continued inquiry and practice over a second, and in some instances a third annual cycle, that teacher educators become secure in the approach. Cycling over successive years, also allowed team to move from replication to innovation, an essential step in internalising an innovation. In the first year, teams were more dependent on guidance and more uniform in how they conducted their inquiry and the changes they introduced into their practice. In the second year, teams embedded these changes. Some teams also began to explore aspects of their students' learning in more depth following tutors' own research interests or focusing on learning areas that tutors regarded as important for their subject. Sixth, the lesson study design directed attention to student learning, so changes to the curriculum and learning activities were focused on strengthening student teachers' development as teachers. The attention to student learning ensured the relevance and effectiveness of innovations introduced.

Conclusion

Taken together, the six reasons for LSTT's success, allowed for endogenous development of a multilingual education. Endogenous knowledge, Hountondji (1997: 17) explains, is "an internal product drawn from a given cultural background," and is to be contrasted with imported knowledge drawn from elsewhere. Endogenous knowledge can, however, be inspired by interaction with ideas from outside. Borrowed ideas are assimilated to the point of being "fully mastered and integrated" (*Ibid.*: 17). Hountondji goes on to characterise endogenous innovation as a dynamic, "never ending process of interiorisation" (*Ibid.*: 18). Pedagogies for multilingual education may share much in common but need to be developed and adapted for specific contexts. This includes adaptations responding to the language proficiencies of learners, the languages in which learners are accustomed to talk, write and read about science as well as the common pedagogic practices, expertise, versatility and professional freedoms of teachers. It may seem to those with long experience and depth of expertise in multilingual education that within our project, we have moved slowly to grasp and implement ideas that are already well known in the field. However, it matters who holds knowledge and how that knowledge is adapted and connected to practice. Patience with the pace of professional learning as a situated process may in the long term prove more sustainable than the common approach of cascade training of an innovation neatly designed by external experts. For us, learning about language in science education continues to be an ongoing open inquiry. What we have learned so far raises just as many questions as have already been answered and opens up as many new pedagogic possibilities as we have already explored in practice. The gradual expansion of a community of practice through a process of professional learning travelling along pre-existing networks within education systems is not an all-encompassing solution to the longstanding problem

of the language barrier in secondary education in Tanzania. It does however hold out promise for embedding aspects of multilingual education that strengthen secondary school subject teaching even within the constraints imposed by a longstanding and seemingly intransigent monolingual policy environment.

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