Language Supportive Mathematics Textbooks and pedagogy with less loaded curriculum for sustainable mathematical literacy in Tanzania

ABSTRACT

There is robust research evidence demonstrating that an accelerated curriculum results into poor student learning outcomes, contrary to the curriculum’s very envisaged expectations. Tanzania’s mathematics curriculum is overloaded at both primary and secondary school levels. Although overloaded curricula, and consequently accelerated curricula, is a characteristic typical of most developing nations’ curricula, including Tanzania’s, Tanzania’s situation in the mathematics classrooms is further compounded by the fact that the big majority of secondary school students are not proficient in English, the language of instruction at that level of education. Furthermore, a recent study conducted by the language Supportive Teaching and Textbook (LSTT) project in Tanzania indicated that the English language level in the mathematics textbooks currently in use was too high for learners still struggling to learn the language. In fact, it was shown that even native speakers at the same age would read the textbooks with difficulty. For a more sustainable future of the country in a world driven by technology, mathematical literacy of her people is an indispensable tool that its citizens have to acquire. This is unfortunately, compromised by the overloaded curriculum and the language of instruction factors highlighted above. This paper therefore explores the literature that argues for both a lighter curriculum in mathematics coupled with language sensitive mathematics textbooks and pedagogy to ensure a more just, equitable and inclusive future for all.

Key word: mathematics textbooks; language supportive pedagogy; mathematical literacy; Tanzania.
Introduction

It has become commonplace in the contemporary world of the 21st century to have children, once they are of age, to be sent to school so that they can learn skills, acquire attitudes and gain knowledge that will help them to contain the challenges of their environment for their own good and that of the entire society in which they live. Education has become a matter of priority to a very large extent even in the so-called developing countries. Take for instance, African countries South of the Sahara, where not very long ago the government had to force parents to enroll children in school, UNESCO (2011) reported extremely encouraging high rates of school enrolments.

But high enrolment rate does not automatically translate into the children thus enrolled having access to quality education, the kind of education that would enable them to learn important skills that would ultimately prove to be tools with which to navigate with relative ease through the intricacies of the 21st century knowledge society; an education that would enable educants to acquire positive attitudes which would ensure that the world becomes a haven of peace where all peoples of this planet could co-habit and live harmoniously in spite of their cultural, racial or religious differences; and an education that would enable recipients gain knowledge of the forces that operate in their environment to be able to tame such forces and make them work for a sustainable future of the humankind. In other words, in addition to physical access to education, they need to have what Morrow (2007) has referred to as epistemological access to knowledge.

Over the years that Sub-Saharan Africa has recorded high enrolment rates in education, there has been a corresponding negative growth reported in the quality of education. A number of factors may be attributed to this unbecoming trend of things including poverty, malnutrition (UNESCO, 2011). There are several other silent contributors to this state of affairs, which have not been brought to the limelight. This paper aims at exploring how an overloaded mathematics curriculum in the case of the Tanzania education system coupled with mathematics textbooks that are written using difficult English language compared to the level of proficiency of the students at secondary school has significantly contributed to lowering the standards of mathematics learning. It further goes on to chart out ways of alleviating the gravity of the effects of such overloaded curriculum and demonstrating how language supportive textbooks and pedagogy could help get around the problem of difficult mathematics textbooks in a context where learners are not proficient in the language in which the textbooks are written.

Mathematics curriculum and textbooks: The current situation

Meena (2014) stated that the Tanzanian curriculum for both primary and secondary education was not only partitioned into discrete subjects, but also it was overloaded. He further reveals that the curriculum is so overloaded that the timetable is compactly filled up leaving no space for learning other skills (p.3). At primary school level, a total of twelve subjects are taught thus: standard one and two have a total of 32 lessons per week whilst standards III to VII have a total of 42 lessons per week. At secondary school level, a total of not less than thirteen subjects are taught (Meena, 2014, p. 4).

Examining the primary mathematics syllabus, a physical count of the topics from standard one to seven shows that a total of 71 topics have to be covered over the seven years (The United Republic of Tanzania: Ministry of Education and vocational training., 2005). Whilst a total of 38 topics at lower secondary school level are covered over four years (The United Republic of Tanzania: Ministry of Education and Culture., 2005). Even after providing for some topic overlaps, these are still too many topics considering that there are only about 6 or 7 mathematics lessons per week. After one provides for school vacations and public holidays in a year, one can reasonably assume that on average about 1.75 topics have to be covered per week at primary school level and an average of one topic per week at secondary school level. This is an extremely fast pace; it cannot allow for thorough mastery of the content on the part of all learners, especially for secondary school
learners struggling to make meaning of mathematical concept in a language they can hardly articulate. It therefore forces teachers to accelerate the curriculum so that at the end of the day they are not accused of not having covered the syllabus. This is what the author of this article is calling the “accelerated curriculum.” It must not be confused with “accelerated learning programme (ALP)” as used by Longden (2013) in the background paper prepared for the Education for All Global monitoring report 2013/14, in which the focus of accelerated learning programme was identified, in line with Charlick’s (2004) idea, as not just faster learning, but also learning that is deeper and more effective. The acceptance of the term ‘accelerated curriculum’ in this paper is however, faster learning process, which is extremely superficial.

The accelerated pace of learning in Tanzanian secondary schools is moreover compounded by the fact that the mathematics textbooks are written in overly difficult English language for learners who have not as yet acquired that adequate language proficiency to be able to use it as a language of instruction. Barrett (2014), in the baseline study that was conducted in three regions in Tanzania for the Language supportive Textbook and Teaching (LSTT) project, found that the majority of the textbooks that were purportedly written to match the Tanzanian curriculum were more often than not too difficult for learners who were just transitioning form Kiswahili medium of instruction in primary schools to English language medium of instruction in secondary schools. This results into a complex learning environment on the part of the learner, a complexity that leaves the learner lagging behind the intended curriculum. This mismatch between the students’ English language level and that of the textbook was a point of concern by Heyneman (2006) when he argued that in order for a teacher to tell apart between an effective textbook from one that is superficial, the teacher will have to assess how the textbook “visualizes the feasibility of various class activities, and most importantly, the exigencies of second language classroom use” (p. 41). Consequently, if the textbook has paid little regard to the second language parameters in classroom context, like ignoring the level of students’ English language competence, as is the case in Tanzanian mathematics classrooms, then the textbook is straight away superficial. Superficiality definitely translates into minimal mathematics learning experiences.

Students’ level of proficiency in the Language of Instruction

Tanzania is one of the countries in Africa that have two different languages of instruction in schools. At primary school the language of instruction is Kiswahili, which is the national and official language of the country. After seven years of primary schooling, students are made to study in English when they now enter the next level of their education. All subjects, except Kiswahili, are now, and thereafter, supposed to be taught in English. This language of Instruction model comes with a number of challenges at the time of primary –to-secondary school transition (Marwa, 2014). The principal challenge however, is the fact that the majority of the students joining secondary school education after completion of their primary school are not proficient in English, the language of instruction at that level and that even the teachers who are supposed to facilitate learning at that level are also grossly, functionally speaking, handicapped in the use of the English language (Qorro, 2006). Lack of proficiency in the language of instruction on both the teacher’s end and that of the learner’s means that effective learning is to a very large extent stalled right from the word go.

Qorro (ibid) indicates that:

Only when teachers and students understand the language of instruction are they able to discuss, debate, ask and answer questions, ask for clarification and therefore construct and generate knowledge. These are activities that are a pre-requisite to learning and whose level determines the quality of education (p. 3)

Halliday (1993) had earlier on clearly demonstrated that ‘language is the essential condition of knowing, the process by which experience becomes knowledge’ (p. 94). Put differently, this then means that in order for students to transform their experiences, be they inside the classroom or
outside the classroom, students need language as a resource to process the experiential input and be able to fit that experience in relation to and among the other experiences already stored in the long-term memory. Processing the experiential input in a language that has not been internalized is therefore tantamount to, metaphorically put, using a worn out physical tool to mediate with the physical environment. For instance, using a claw hammer whose claws are broken to extract a nail from a wooden block would prove to be very taxing. There would be a lot of drudgery for very minimal gains. And therefore learning becomes an uphill task that makes the learner fearful of the classroom and ultimately fearful of school learning in general.

Effects of accelerated curriculum and language of instruction proficiency

In discussing the effects of the accelerated curriculum and language of instruction a link will foremost be made between overloaded curriculum and an accelerated curriculum in that when the curriculum is overloaded teachers more often than not tend to accelerate the pace of their teaching so as to be able to cover all that is intended. The two expressions, accelerated curriculum and overloaded curriculum, will therefore be used synonymously and hence interchangeably.

Curriculum has been defined in a number of ways that, when carefully studied, may help us to understand the evolution which this important concept has undergone and hence be able to historically situate it. Lunenburg (2011) highlights some important ways in which curriculum has been construed in the history of education. It has included looking at curriculum as a formal course of study putting emphasis on the content to be studied; it has also included the conception of curriculum as the sum total of all the learners’ experiences with weight put on how the given content is learnt by translating it into learning experiences during the teaching and learning process; and there are yet those who have construed curriculum in nontechnical and more philosophical, social, and personal approach. Although these conceptions clearly indicate what the intended meanings are, the great majority of them fall short of specifying how much time should be allocated for the given content to be optimally covered by learners of different learning capabilities. Would those who may learn the given content in less time be obligated to wait for those who can not learn the same content at the same fast pace? Or would those two categories be allowed to take two different learning trajectories although in the same classroom?

Pritchett and Beatty (2015) have amply demonstrated how; when the curriculum is overloaded the majority of the children do not learn the intended curriculum. They further posit that:

If the official school curriculum covers too much, goes too fast and is too hard compared to the initial skill of the students and the ability of the schools to teach this can produce disastrous results. An overambitious curriculum causes more and more students get left behind early and stay behind forever. If children do not acquire reading and writing skills early, then textually based teaching in higher grades is pointless. If children do not acquire simple arithmetic concepts – like place and common denominator – then more sophisticated operations like adding fractions are impossible. If children do not acquire basic reasoning skills – like filling in a word to complete a meaningful sentence – then asking for creativity or critical analysis later is impossible (p. 280).

In short the authors in this quote have underscored, in the context of mathematics learning, the fact that overloaded mathematics curriculum makes meaningful and in-depth learning an impossible task especially if early years learning is compromised; for this is then passed on to later years. This keeps on accumulating the aggregated effects of overloaded curriculum as initial inputs for subsequent topics and subsequent years of learning. The situation then produces an effect similar to the butterfly effect in weather whereby a butterfly’s flap of wings in Brazil may purportedly cause a tornado in Texas in the USA (Lorenz, 1972). This scenario perfectly reflects the situation in Tanzania education system today. As has been underscored above by Meena (ibid.), the curriculum is overloaded at both levels of basic education. If the curriculum is overloaded at primary school
level, the content at that level that was supposed to be thoroughly understood so that that content may latter on have acted as the foundation on which to build further learning would simply be rushed over. The effect of these apparently ‘small’ omissions as a result of accelerating the curriculum would definitely impact the learning of several more concepts at a multiplicity of levels of the victim’s education.

Furthermore, the fact that the acceleration of the curriculum is not a one off thing, but rather a culture that has become so ingrained in the teachers’ practices that the entire primary school learning trajectory is permeated with overloaded curriculum, these ‘small and sometimes big’ omissions and transgressions in fast-paced curriculum implementation are so numerous and regular that the sum total of their effect may amount to several ‘tornadoes’ of misrepresentations of mathematics concepts in subsequent years.

**Exigencies of the knowledge society of the 21st century**

About 15 years ago, on the eve of the 21st century, Morin (1999) shared his views about the kind of education that would be appropriate for the twenty first century, a century that was to be characterized with rapid changes. He advanced his views in form of seven lessons, which in his opinion, were lessons of essential knowledge that ‘should be covered, without exclusivity or exclusion, in education for the future in all societies in every culture, according to the means and rules appropriate to those societies and cultures.’ (p. 1). The key learning that he envisioned was to include learning how to detect errors and illusions; acquiring competencies in confronting the uncertainties; learning the principles of pertinent knowledge, the human condition, understanding our human identity, mutual understanding of the humankind, and knowing the ethics of the human genre.

Although all these area of knowledge that Morin (ibid) promoted are by all means very pertinent in our contemporary world, Jerald (2009) however underscored the overwhelming importance of mathematics in ensuring personal success on the labour market and in life in general. Jerald (ibid) pointed out that ‘Math test score has a greater effect on postsecondary enrollment, completion of a bachelor’s degree, and earnings than any other competency.’ (p. 32). Despite the fact that this proposition was made with regards to the American population, it is nonetheless true of any developing country like Tanzania considering that the world has become a global village and some life realities in any one country are to a large extent replicated in many other countries in the world.

The importance of mathematical literacy, also known as quantitative literacy or numeracy has, for instance, been earmarked as one of the most crucial aspects that transcend careers. Mathematical literacy’s applicability is found not only in mathematics careers but also in “virtually every major public issue—from health care to social security, from international economics to welfare reform—depends on data, projections, inferences, and the kind of systematic thinking that is at the heart of quantitative literacy.” (Steen, L. A. (Ed.) (2001) in Jerald, 2009, p. 39). This assertion, though once again given in the American context, its truth can be extended to the Tanzanian context without much modification.

But what does quantitative literatecy really entail? A very enlightening response to this question has come from Ojose (2011) who, has argued that mathematical literacy entails competencies such as mathematical thinking and reasoning, mathematical argumentation and proof, mathematical communication (my emphasis), modeling, problem posing and solving, representation, symbols and tools and technology. To be mathematically literate is to be able to comfortably use all these competences in one’s daily activities. Ojose (ibid) then goes on to propose strategies that could be used to support the development of mathematical literacy. Teaching of mathematics should promote conceptual understanding, should always demonstrate the relevance of mathematics to their daily life in society. Citing Steen (1990), Ojose (ibid) argues further for mathematics curricula that were ‘grounded in appropriate childhood experiences, the collective effect would be to develop among children diverse mathematical insight into the many different
roots of mathematics.’ (p. 94). Still citing Steen (1990), Ojose (ibid) urges mathematics educators to draw inspiration from the developmental power of five deep mathematical ideas: those of dimension, quantity, uncertainty, shape, and change (p. 97).

The nature of mathematical literacy as described above clearly shows how necessary communication between the learners and the teachers is. Mathematical thinking, mathematical argumentation and proof, problem solving, mathematical representation etc., are all activities that require the learner’s communication with one’s inner-self, student –student communication and learner- teacher communication. As observed above, communication is a human activity for which human beings have invented a tool. That tool is language, which for a given community is part of their common cultural identity.

In the mathematics classroom context, both students and teachers could only assure all these communication instances through a language that is well understood among themselves. The lack of English language proficiency on the part of both students and teachers in the Tanzanian context therefore means that this communication (important though it might be for developing mathematical competencies) is, for most of the pedagogical interaction time, absent.

Furthermore, the proposed strategies highlighted above do indicate that an accelerated curriculum would end up not giving adequate time for establishing connections among mathematical concepts; it would deny learners opportunities for problem solving as a strategy for mathematics learning; development of mathematical competencies can not be achieved by learners who, due to exigencies of syllabus completion, are made to rush over the mathematical content. For competency development requires that tasks of a given nature, tasks that ultimately ensure a certain competency, be consistently and regularly assigned to learners so that they can internalize the patterns and sequence of events that the tasks present and eventually those patterns and sequence of events become ingrained as habits of the mind (a competence).

We therefore notice that both accelerated curriculum (resulting from an overloaded curriculum) and the lack of English language proficiency in the Tanzania education system are impediments to development of mathematical literacy. As it has already been indicated, lack of mathematical literacy translates into many pitfalls in terms of the growth of the national economy.

**Less loaded curriculum and Language supportive textbooks and pedagogy**

In spite of embracing the learner-centred approach to education at all levels of basic education, the Tanzanian classroom reality on all counts promotes the content-centred approach; for coverage of the curriculum/syllabus seems to background any attempt to put the learner at the centre of the teaching and learning process. It would therefore be judicious on the part of policy makers to seriously think about including less in the curriculum in form of content to be covered, but including more of mathematical competencies to be acquired by the learners. It would also mean creating more time for learners to learn through problem solving and relating the mathematics they learn to the environment they live in. The issue of diminishing the curriculum load in terms of content at both primary school and secondary school levels is a matter that can very easily be negotiated among all educational stakeholders.

The issue of language of instruction however is more complex. Looking at the current language of instruction scenario in the Tanzanian context, one would be wondering why Kiswahili isn’t the medium of instruction at secondary school, which would have saved both teachers and learners the trouble of engaging in the teaching and learning process in a language they both don’t understand well. After all, UNESCO (1953), more than half a century ago, observed that education is best when offered in the mother tongue (or a language that is more familiar). Kiswahili, though not the mother tongue of the majority of Tanzanian, is a language that most Tanzanians are familiar with than they are with English. It would therefore be more favorable, more convenient and would make more sense to have Kiswahili as the medium of education at all levels of education.

However, the majority of educational stakeholders, especially students, parents, and teachers who still believe that it would not be judicious to do away with English as the language of
instruction, will not buy into making Kiswahili the sole medium of instruction. Some stakeholders mistakenly imagine that students learn more English if they learn all other subjects in English (Qorro, 2006). Even with the knowledge that both teachers and students have not mastered English adequately to be able to learn it, a good number of education stakeholders would still insist on learning all subjects in English.

Just recently, Godfrey (2014) conducted a study to explore the perceptions of Tanzania educational stakeholders regarding the use of English and Kiswahili as language of instruction. The results were not very different from what was found by earlier researchers; it was generally found that the majority of stakeholders not only wanted to maintain English as the medium of instruction at secondary school but also wanted it introduced at primary school level. The ambiguity of the current education and training policy (Jamhuri ya muungano wa Tanzania, Wizara ya elimu na mafunzo ya ufundi, 2014) on which language is now going to be the language of instruction is a tacit positive response to the voice of the majority of educational stakeholders in Tanzania.

Promoting Kiswahili to language of instruction status would seem to be inappropriate at this point in time as it would not be acceptable among many Tanzanian education stakeholders. An alternative would then have to be sought that would strike a balance between the stakeholders needs (though misguided) and the need for learners to benefit from the schooling career. Studying in English, a language they don’t understanding, makes their schooling career meaningless. This alternative would be to allow students to freely use both languages, that is Kiswahili and English, in their secondary school education.

Contemporary knowledge has pointed to more benefits than challenges in using a familiar language to scaffold the learning of content (e.g. mathematics) and the learning of the unfamiliar language (e.g. English language). Cross and Gearon (2013) argued that the use of the content and language-integrated learning (CLIL) has the advantage of increasing interaction among the learners themselves and between the learners and the teacher. It also has proved to bring about better scores in the target content area.

Barrett (2014) in the language supportive Teaching and Textbooks (LSTT) project, along with colleagues from several institutions in Tanzania, have written mathematics draft chapters which use Kiswahili-English Translations and glossaries. During piloting of the draft textbooks, both teachers and students applauded the move as it endorsed what most of them were ‘illegally’ doing; that is having talk-in-Kiswahili activities and talk in English activities. The draft book chapters are philosophically underpinned by the principles of the (CLIL)

**Conclusion and way forward**

Considering the evidence from the literature demonstrating how disastrous an overloaded mathematics curriculum can be to the development of mathematical literacy, it follows that a reasonably less loaded mathematics curriculum may allow mathematics learners to interact with mathematical activities that would make them more mathematically literate, thus boosting their employability potential. Allowing learners enough time to learn mathematics through problem solving, through involvement in mathematizing, will enhance the learners’ ability to use mathematics in their professional and social settings.

Additionally, a less loaded curriculum coupled with the widespread use of Kiswahili-English bilingual textbooks written in simple English language, would further solidify the students’ learning of mathematical literacy.
References


