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Immaculate Kizito Namukasa
The University of Western Ontario, inamukas@uwo.ca

Madge Quinn
Formerly, Kyambogo University Uganda

Janet Kaahwa
School of Education, Makerere University, Uganda

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School Mathematics Education in Uganda: Its Successes and its Failures

Immaculate K Namukasa[a] *, Madge Quinn[b], Janet Kaahwa[c]

[a]*Faculty of Education, 1137 Western Road, N6G1G7The University of Western Ontario, London, Ontario*

[b] *Formerly, Kyambogo UniversityUganda*

[c] *School of Education, DOSATE, Makerere University, Uganda, P. O. Box 7062,Kampala*

Abstract

This paper examines the character of school mathematics education in Uganda. It focuses on its successes, failures and its history. The methodology involved analyzing Ugandan curriculum documents and teaching resources. The analysis is through a comparative and post-colonial approach. The analysis reveals that Ugandan mathematics education is largely not influenced by recent international reforms; it purely essentialist; and it focuses on the gifted and students. To be sure this study is relevant for curriculum development in developing countries. From a post-colonial perspective the study is relevant to mathematics education of indigenous and marginalized populations in developed countries.

Keywords: Curriculum; developing countries; comparative analysis; post-colonial framework; mathematics.

Objectives or purposes of the Study

The Ugandan school system, although small, is highly organized. As is the case with many other African school systems, its character was inherited; in Uganda's case, it was inherited from Britain in 1962 when self-government was established. In the 1960's, 70's and 80's, the country adapted curricula and curriculum materials from USA and Britain. But due to political and economic turmoil of the 1970's and 80's and recent emphasis to the building of local capacity and the development of partnerships there has been minimal curriculum reform and research (Nsibambi, 2000). This has left the country with a school curriculum that more or less reflects modern mathematics combined with traditional mathematics of the 1970's.

This curricula and textual examination of the character of school mathematics education in Uganda, is put into the context of Ugandan education generally, the context of Ugandan history and the context of school mathematics education in a globalized world. The examination is framed by critical and post modern mathematics education. Such an examination might offer useful information needed for the Ugandan curriculum renewal process. The basis of this examination in critical mathematics education implies that the paper is relevant for mathematics education of indigenous, marginalized and immigrant populations in developed countries such as Canada, New Zealand, the United States of America and Australia. Vithal and Volmik (2005) echo the need for system wide research on curriculum and policy in specific subject areas, especially if research is to inform policy.

Perspective(s)

Cultural, critical and political education frameworks have been adopted in research on education systems of former colonies and for marginalized populations (D'ambrosio, 2001; Namukasa, 2004; Apple, 1992; Vithal & Volmik, 2005; Skovsmose, 2007). In the case of Africa, scholars among other things argue for post-colonial, indigenous mathematics education and the

Africanization mathematics content and pedagogy (Gerdes, 1998; Zaslavsky, 1973). Woolman (2001) maintains that: “Curriculum content has considerable influence on educational reconstruction in African countries” (p. 41) and that Post-colonial African countries have made some advances in Africanising their curricula. Kanu (2003), speaking about a curriculum that is more responsive to the demands of education in today’s cultures and contexts, draws from a cultural and post modern framework. She recognizes that African cultures and contexts are not unlike minority and indigenous populations in Western countries. She calls for construing curriculum reform as postcolonial imagination which is grounded in the reality of hybridization between local and global, developed and developing, colonial and colonized, the third spaces that allow for the influences of culture, history, internationalization and global migration. Since the authors have both Western and African learning and teaching experiences and that any examination of indigenous education must take into consideration of global trends, the examination of the character of school mathematics education in an African country begs for a globalized post colonial framework.

Methods and modes of inquiry: Textual Analysis

To analyze the character of mathematics education in Uganda a textual analysis of the curricula and textbooks was carried out. Data for the analysis was gathered from a textual analysis of the primary and secondary school curricula and selected textbooks used in Ugandan schools. Textbook analyses have been commonly used to get to the tacit character of mathematics (Crawford & Snider, 2000; Dowling, 1996; Flanders, 1994; Mauch & Mc Dermot; 2007). This tacit character is at many times not visible in national curriculum documents.

Muhwezi (2003) identified more than 20 textbooks used at the primary school level in Uganda. The National Curriculum document (NCDC, 1991) outlines four students’ texts and

three reference textbooks for lower secondary school, but there are certainly more in use today. Textbook publication was recently liberalized and so many primary school books are now locally published in Uganda. Some textbooks in use in public schools were published more than 20 years ago. For O-level a majority of the textbooks are published in the UK, although some were specifically published for Ugandan schools. School Mathematics for East Africa, and Entebbe Math textbooks were written to adopt British and American modern mathematics approaches to East African and African curriculum, respectively. At A-level none of the text-books are published for or in Uganda. As well, as a result of policy and global migrations international schools and private schooling is on the rise. Many of the international schools use textbooks published for Western countries. Table 1 shows books available at a major book store in the capital city, Kampala and those that are referred to in the teaching curriculum. What follows is an analysis of a sample of commonly used textbooks at primary and lower secondary level.

Table 1. Textbooks commonly Used in Ugandan Schools

Primary-level Textbooks	**O- Level Textbooks**	**Additional Math/Subsidiary Mathematics Content**	**A-Level Text books**
PSM[a] by Okello, Uganda	SMEA[b] Books 1, 2, 3 & 4 by Cambridge, UK	Additional Mathematics Book, UK 1 & 2	Backhouse & Houldsworth [c], UK, Book 1 & 2
UPM [d] by Okello and Suffolk, Uganda	SSM [e] by Macmillan, UK under NCDC, Uganda Books 1, 2 & 3		
PM [f] by MK Publishers, Uganda	SMU [g] Books 1, 2, 3 & 4 by Evans, UK		
	SM[i] by Par &Durrell book, UK1, 2, & 3		
	Math [j] by Macmillan, UK		
	MRC[k] by Fountain, Uganda		
	UCE[l] by Oxford University Press, UK		
	MFSS[m], by MK, Uganda		

Note: **A**-*Primary School Mathematics, PSM;* **B**- School Mathematics of East Africa, SMEA (1977/2000); **C** - PURE MATHEMATICS by Backhouse & Houldsworth; D- *The Uganda Primary Mathematics, UPM (New Edition 2000);* **E**- Secondary School Mathematics, SSM ; **F**- Primary Mathematics 1998/2006; **G**-

Secondary Mathematics for Uganda, SMU; **I**–School Mathematics (1949/1955); **J** -Mathematics (An integrated Approach), Math; MRC; **K** - Mathematics revision Course for UCE, MRC; **L** -Uganda Certificate Examinations Essential Mathematics, UK, UCE; **M-** Mathematics For Secondary Schools (2000).

Because the main intent of analyzing Ugandan mathematics textbooks is to examine the character of mathematics education we focus on the common features among the Ugandan mathematics textbook. We draw from textual analyses of books from other countries to highlight these commonalities. The comparative aspect of the analysis strengthens the relevance of the analysis to school mathematics education systems in other countries

Results: Common Features among the Ugandan Mathematics Textbooks

We identified some peculiarities about the physical appearance, nature of content, ancillary materials and contexts used in a. These peculiarities include: Ugandan textbooks are thinner at about 250 pages and light weight; The high frequency of definitions, summary and remember notes, and revision exercises is notably high; Examinations and texts in the form of test and past national examination papers are included in the textbooks; Both secondary and primary books have plenty of units ranging from 13-20 units; Textbooks for some consecutive grades repeat content at the two levels; There is evidence in the elementary level textbooks, in a manner aligned to the curriculum, that more units (5 of 10) are concerned with numeration-number and algebra strands than say geometry and measurement strands; Students' textbooks appear to be written in a teacher-proof style. They contain extensive explanations, rules, generalizations, comments and the like. They are definitely not work or practice books; There are shifts in pedagogy as shown in textbooks between early grades and latter grades of primary and lower secondary levels. Teaching through investigations and projects appears at early grades. Fewer real life examples appear in secondary mathematics texts. Project work is unique to SMEA 1 and SMEA 2 and Puzzle corners to SMEA 2. The MK7 book for the last year of

primary school is devoid of stories and contexts, yet MK 1-5 have some contexts and stories. Also these shifts in pedagogy at times exist between units—for instance statistics uses more word problems and real life stories; Textbooks have fewer ancillary materials such as work books, material and software kits than many developed countries' textbooks. Only a few of the Ugandan textbooks are accompanied by a teacher's manual. Mathematical logarithm tables and formulae pages are the only student ancillary resources; many units such as graphing and integer units are presented in ways devoid of any real life contexts. Contexts used in the textbooks are predominantly commercial: banking and trade, telegram postage and factory production. Most drawings in the textbooks are pictures of settings from these business contexts; many of the contexts in textbooks are set in foreign, esoteric to Ugandan students. For instance, train journey contexts, a remnant of contexts pervasively used in the past British-type curriculum (Mmari, 1980), are used, yet Uganda has not had a functional passenger train system for close to 2 decades. International contexts such as temperate sports, foreign names (see artists, William Hogarth or cartoonists, Noman's Isle in SMEA, page 138) are more commonly cited than local contexts. Many of the local contexts appear through the eye of tourist (see many pictures from game parks); Pockets of African mathematics examples, say brick-laying, fruit stalling, African game park activities, and Egyptian pyramids, should be heralded. Due to space limitations we only discuss the physical appearance of Ugandan textbooks and what this reveals about the character of mathematics education in Uganda.

Discussion on Physical appearance of Ugandan Mathematics Textbooks

Overall the Ugandan textbooks are thinner at about 250 pages and light weight when compared, to say Canadian and American textbooks. They are not anywhere close to Canadian textbooks that Foxmann (1999) identified as the largest, strongest in bind and heaviest. Ugandan

books akin to Japanese texts especially MK have very minimal white, blank spaces. Further, there are almost no photographs—only a couple of black and white photographs in a few of the textbooks—much fewer than those found in a Canadian 1961 mathematic textbook, Everyday Mathematics by Wiggan, Musson, Hartwig and Barry. There are no pictures of students or of teaching materials, which is in sharp contrast with most current Canadian mathematics textbooks. Charts, illustrations, and artful depictions of mathematical procedures—some hand drawn and less attractive—are common. As well, the books are printed in four or less colors. Again, this is a remarkable contrast with many current Canadian and American books (Foxmann, 1999).

Comparing a Ugandan textbook MK 7 with a Canadian textbook for an equivalent grade, Mathbase 1 by Pitman (1989), both printed in 3 colors, shows differences and similarities: More photos—over 50 more photos, pages in the Canadian textbook; few stories, minimal connections to other subjects and minimal general informational contexts in the Ugandan textbooks. Similarities among the two textbooks—current Ugandan textbook and twenty year old Canadian textbook—included no pictures of mathematics concrete materials other than the traditional geometrical tools, dice and geometrical shapes.

Where is the mathematics, narrowly defined as formulae, rules and iconic diagrams? is a common question raised by critiques of non-traditional, newer American textbooks (Doerr & Chandler-Olcott, 2005). Every page of Ugandan textbooks is covered with numbers, signs, notations, geometrical drawings, arrows and graphs. MK primary 7 ranks first among the most dominated by mathematics symbolism even when compared to secondary school texts such as SMEA 3.

The feature of thinness and light weight is likely not related to the level of economic and technological development. Wu, M., Park, K., & Leung, K. S. F (2006) observe the same about Korean textbooks, and Reys, B., Reys, R. &, Koyama (1996) the same about Japanese textbooks.

Wu et al. explained that American and English textbooks were larger than Korean textbooks because of the presence of remediation, exploratory and enrichment activities in American and English textbooks. The thin appearance of Uganda text-books might also be due to the low use of non-symbolic forms of presentations. Reys et al. (1996) thought about the blank spaces common in American textbooks as space in which students are expected to take notes. Ugandan students are very keen at taking notes (Namukasa & Kaahwa, 2007) but they mainly write their work and notes in personal exercise books. Usually a textbook is shared, received second hand or owned by the school. Drawings are also more common in Japanese textbooks than USA textbooks that instead have more photographs (Reys et al., 1996). Mauch and Mc Dermot (2007), and Reys et al. (1996) maintain that when considering illustrations and color, a delicate balance and organization is beneficial.

Dowling's (1996) sociological analysis of two UK textbooks by the same publisher but for different courses, the Y (upper achievement) and G (lower achievement) series revealed that G1 involved more mathematical symbolism and fewer pictures as opposed to Y1. He concluded that G1 mathematics was intellectually oriented, specialized and esoteric whereas Y1 mathematics was more manually oriented and a mundane human activity. Based on Dowling's analysis Ugandan mathematics textbooks evidence *intellectually oriented, specialized and esoteric mathematics*.

Perhaps, more symbolism makes sense for lower grades that are still learning the language of mathematics instruction, English. Quinn (1983) noticed that exceptional textbook chapters such as linear programming and statistics in SMEA that were more text-based were less popular among Ugandan students, a majority of whom were English learners.

The most common genre in Ugandan textbook is: background/content explanation with a few example followed by practice exercises, and then lengthy and difficult practice exercises.

Only a few detailed explorations, informational and investigation contexts are found in the textbook. Foxmann's (1999) analysis revealed the same about Hong Kong textbooks. Mauch and Mc Dermot (2007) identified an American textbook, Math by Scott Foreman-Addison Wesley to have this explanation-example-practice genre and labeled it a *Traditional mathematics textbook.* Most Uganda textbooks are not *reform based textbook,* in the sense of most current international reforms that outline concept building activities (ibid.).

Reys et al., (1996) observe that Japanese texts had fewer practice exercises than USA textbooks. Japanese as is the case with Singaporean lesson are planned around fewer key problems rather than lists of short problems (Foxmann, 1999; Yeap, Ferrucci & Carter, 2006). In Japan, practice activities, and hence *drill* and *practice* books, is an after school activity that parents and *after school* institutions are responsible for (Reys, et al., 1996). In Uganda separate practice books exist, these are mainly written by teachers, are usually modeled after national examinations, and are mainly meant, for classes such grade 7 and grade 11 at which national examinations are administered.

Another reason why Ugandan textbooks are thinner might be because they are dominated by symbol exercises instead of fewer word and context-based problems. Few word problems are assigned at the end of a unit for students to apply mathematical procedures learned in a preceding lesson (Chapman, 2006). In the respect of limited context- based problem solving, Ugandan textbooks are more like Scotland's books than Singaporean books (Foxmann, 1999). Broadly speaking, even when mention of doing mathematics is made in the curriculum, there is not much coherent emphasis on mathematics activities beyond learning new procedures and practicing them. Reasoning and mathematical thinking, in a manner common with formal mathematics of New Math reform, are limited to thinking logically, and communication is limited to written representations (Walmsley, 2003).

Conclusions: Implications for curriculum reform

Our analysis was delimited to textbooks. A study of the examination system, teacher education and other mathematics teaching and learning artifacts as well as field work in school and education office would be more insightful. Elsewhere we carried out a historical analysis of the mathematics education system of Uganda (Namukasa, Quinn & Kaahwa, in Press) and we analyzed curriculum documents. An overarching view about mathematics is stated in the National lower secondary syllabus: "Mathematics should be visualized as the vehicle for aiding a student to think, reason, analyze and articulate logically" (NCDC, 1991, p. 5). This statement reflects a more formal view of mathematics (Davis & Hersh, 1981), perhaps one promoted by the British and American modern mathematics reforms of the 1960 and 1970s (Namukasa, Quinn & Kaahwa, in Press). The outgoing text book analysis illustrates two broad characteristics about Ugandan school mathematics:

1. It is mainly traditional, formal and academic.
2. It is intellectually oriented, specialized and esoteric mathematics.

The broader study of which the outgoing analysis is part revealed more characteristics about Ugandan School mathematics education: it is generalized and decontextualized school mathematics content, with a commercial, arithmetized and algebrized focus, and is dominated by a landscape of practicing as, testing and examining compared to a landscape of investigation (Skovsmose, 2007). The academic, generalized and abstract nature of mathematics is likely a strength of the system for gifted students in well established urban schools, which students we speculate might perform comparably well on international examinations such as TIMMS[2].

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[2] Uganda has never participated in TIMMS. It at times participated in the African Mathematics Olympiad.

But for the benefit of all students including the average and slow learners and students from local, rural schools, there is need to balance this logical, formal and academic view of mathematics with a less formal, non elitist view. Internationally speaking, the face of mathematics education is changing rapidly in favor of making mathematics more accessible and meaningful to more students. A review of recent reforms in developed countries that are addressing related issues, such as New Zealand with indigenous mathematics, and Canada on mathematics for English learners might be another great place for the National Curriculum Development Center begins when considering reforming the Ugandan mathematics education curriculum. On the other hand the preference for symbolic representations by most Uganda students who are English learners in a mathematics education system that uses English as the language of instructions has implications for the use of reform based books that are more textual with English Learners and indigenous populations in countries such as Canada and USA.

Countries with equally constrained financial resources such as those in the Caribbean appear to have substantially developed their mathematics curriculum: quality and relevance of curriculum, teacher engagement, response to globalization, and language issues (Berry, J., Poonwassie, & Berry D. B, 1999). In addition, Ugandan mathematics curriculum needs to be reformed along the lines of equity, indigenous mathematics, active and social learning, and numeracy development. As well, aids epidemic, political instabilities and civil wars, and not to mention corruption statistics create new issues to be addressed by the mathematics curriculum. For instance teaching could use contexts that integrate health, social justice, and ethics issues.

Also pressing is the need for policy makers to put in place basic structures such as teacher organizations, subject specialist panels at the national level and at the districts level that will facilitate curriculum and professional development activities for all subjects. Limiting educational effort in developing countries to improving access and quantity of education

provision and management has resulted in retarded curricula. Developing countries should seek to balance development projects with educational and research projects, and access and management of education projects with curriculum and education resource improvement projects. As well, isolated reforms by examination body, curriculum developers, by teachers, by short term bilateral and multilateral funded projects such as those involved in five year teacher training projects funded by Britain, United States of America and recently Japan and by commercial textbook publishers have not gone far enough for the Ugandan case.

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