

# Constraints to Performance of Mathematics, Strategies and Interventions to Improve Performance of Mathematics in Uganda

Kenji HIRAOKA\* Busobozi NICHOLAS\*\*

(Received October 31 , 2012)

## 1 . Introduction

The Education and Sports Sector in Uganda is comprised of government and private as well as non-formal educational institutions spanning all educational levels namely: Pre-primary, Primary, Secondary, Business, Technical and Vocational Education and Training (BTVET) , and Higher Educational levels. It also includes public, private and community physical education and sports institutions. It has multiple objectives including the transmission of general and applied knowledge as well as skills development. Primary education caters for 6-12 years olds. It is provided through a network of 16,600 public and private schools scattered across the county. Of these , 73.8% were public primary schools in 2008 . Secondary Education is provided through a network of schools totaling to 3020 , of which 31% are government , 57% are private , 12% are community schools. There are also a very small number of international schools that deliver foreign curricula. Rural based schools account for 37.8% of the total number of schools; most of the private schools are in urban areas. The introduction of Universal Secondary Education (USE) in 2007 increased secondary school enrolment (S1 - S6) by 25% from 814,087 in 2006 to 1,165,355 students in 2009 , with girls constituting 45.6% of total enrolment.

In order to bring about a transformation to move into a knowledge based society and globalization, with improved levels of technological advancement and more scientists, the government made the study of the science subjects Physics, Chemistry, Biology and Mathematics compulsory to all students at the lower secondary level of education. But the performance in Science and Mathematics at lower level of secondary schools has been poor for a long time and students who proceed on with science based courses and careers are very few compared to those who take up humanities after the lower secondary level of education. The government has made interventions to improve the situation through; building and renovating laboratories, supplying equipment, chemicals, and text books; recruiting more science teachers; establishment of Teacher Resource Centers (TRC) , introducing computer science and ICT skills to both teachers and students.

---

\*Nagasaki University

\*\*Trinity College Nabbingo

## 2 . Constraints to performance of education

The education of Uganda is facing a lot of problems that are hindering it to bring about an appreciable and balance development of the country .

Some of the problems facing the education of Uganda include the following

### 2.1 Lack of enough trained teachers

There is a general lack of trained teachers especially the science and mathematics teachers in secondary schools as a result you find a situation where one science teacher has to teach in two or more schools (part-time teaching) and basically this leads to poor performance since the teacher is exhausted and has no time to interact and discuss with students .

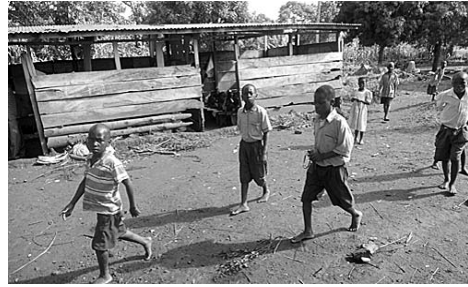
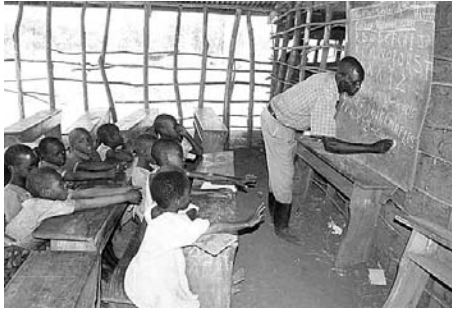
The quality of teachers also affects the education system in that in most Private schools both primary and secondary schools, some of the teachers are not trained at all. For instance it is very common to find students who have just finished advance education (A-level) teaching at lower secondary schools .

### 2.2 Lack of infrastructures

The infrastructure of some of the schools is so appalling for good education delivery in Uganda. Some of the school structures are half built and in others there is no single permanent structure. Also looking at the type of chalkboards used in almost all schools it becomes difficult for a teacher to give clear illustration to students like using charts since the chalkboards are not magnetic and thus displaying charts is very difficult .

In Uganda all the science subjects are compulsory that is students are supposed to study Physics, Chemistry, Biology and Mathematics but most of the private schools lack labora-





tories and even those that have them they don't have enough equipment to use for all students even the very good schools there is the problem of lack of enough science apparatus.

Most schools lack or have inadequate textbooks and for those schools that have the textbooks, the teachers and students don't use those textbooks. In most cases teachers and students have resorted to using pamphlets and thus a lot of knowledge about a given subject is left out. Also you find that there is no standard textbooks used where by each school has its own set of textbooks and also it depends on the teachers' choice of textbook.

### 2.3 The teacher-student ratio

The teacher-student ratio is very big especially in primary schools where there is Universal Primary Education (UPE) and secondary schools where there is Universal Secondary Education (USE) programs. This is due to the fact that there are a big number of students in the school compared to the facilities available and the number of teachers. Thus it becomes difficult for the teacher to look at the individual students' problem and also it becomes difficult for the teacher to monitor a child - centered teaching system. Therefore this hinders the students from active participation in class .

### 2.4 Time wastage

In Uganda a school term is 12weeks which is around 60days (Monday-Friday) , but in most schools the 1<sup>st</sup> week of the term is spent doing Beginning of term examinations, then in the middle of the term another week is spent doing mid-term examinations and at the end of the term two-three weeks are spent on doing and marking end of term examinations thus the actual number of days put to good use is between 35 - 40 days in a school term.

Also there is a problem of poor time management on both the teachers and students. In most cases teachers enter class after 10minutes and also leave 10minutes earlier, this means that more than 20minutes is lost almost per lesson due to poor time management.

In some schools there is a lot of teacher and student absenteeism. Students normally don't want to go to school especially on market days if the market day is a week day, during the time of harvesting certain crops talking care of young ones at home and sometimes teachers make it a habit of being absent with very lame excuses if any. This brings about inadequate syllabus coverage on the side of the teachers and students.

## 2.5 Poor/ Low remuneration and motivation of teachers

The remuneration of teachers is very low that most teachers in Uganda are unable to meet the rising cost of living. In fact last year (2011) teachers under there umbrella engaged in an industrial action (strike) demanding 100% increase in their salary thou the government forced them back to class threatening to expel them. Because of poor remuneration teachers are forced to look for employment elsewhere like in farming, part-timing to other private schools thus this lead to loss of physical contact between students and teachers as teachers are never in school to attend to students.

## 2.6 Poor teaching methods, planning and supervision

In Uganda most teachers teach using the talk and chalk teaching method. This means that it's only the teacher who does the talking and writing on the chalk board. Students are expected to listen, observe, and write what the teacher has written on the chalk board or what the teacher has said. Thus students do not participate in the lesson, there less practical activities done to help students understand what is being taught and also it is difficult for the teacher to gauge whether the students have understood what has been taught .

In most cases there is lack of proper lesson planning by teachers, a teacher just enters the classroom asks students where they stopped last time and he will teach until the time of end the lesson. So in this case the teacher doesn't know where to start from and where to end. Also it is seen that most teachers don't update their notes they use the same notes (yellow notes) for as long as they have been teaching. Sometimes these are the same notes that they wrote when they were students themselves and there is less supervision on the side of administrators to see what and how the teachers are teaching. All this leads to poor performance.

## 2.7 Dropping out of school

Social and cultural practices, attitudes, and perceptions; Although the cost factor appears to be the most important for boys, girls drop out of school due to teenage pregnancy, sexual harassment and early marriages. In addition a significant number of girls help with household chores. There is limited access to education for marginalized groups including children with disabilities and those in post conflict areas. There is an increased gender disparity in completion rates with girls dropping out more than the boys; in 2006 , 53% of the boys and 42% of the girls completed primary school, only  $\frac{1}{3}$  of the girls who enrolled in primary are still in school at the age of 18 compared to  $\frac{1}{2}$  of the boys.

## 2.8 Gaps in efficiency and quality

There is a big gap in efficiency and quality in both primary and secondary educations.

This is due to inequitable recruitment and deployment of teachers and also due to the quality of students admitted in schools for example very good secondary schools will only admit the very bright students whose parents can afford to pay very high school fees, then

the poor schools will admit students with poor grades and from poor families.

### 3 . Strategies and Interventions

The above factors affect students' performance especially in Sciences and Mathematics in Particular and this brings about poor performance in Mathematics and Science in general. Thus this leads about the low levels of technological advancement, scientists, doctors, engineers and the entire workforce where Mathematics is a prerequisite. Thus if we are to bring about a transformation to move into a knowledge based society and globalization, with improved levels of technological advancement and more scientists, we need to solve some of the above problems and encourage students to put in emphasis and also teachers to change their attitudes and methods of teaching Mathematics.

In order to improve the teaching of mathematics in Uganda, the following has been done or should be done

#### 3.1 In service training

The current government policy to improve science and technology for economic development, called for improvement practices in the teaching and learning of Science and Mathematics. In 2005 the Government of Uganda through Ministry of Education and Sports (MoES) , with technical assistance from the Government of Japan through JICA, established SESEMAT program to enhance the quality of teaching and learning of Science and Mathematics through In-service Education Training (INSET) for secondary Science and Mathematics teachers.

The purpose of the Program is to improve the teaching ability of Science and Mathematics teachers at secondary level and the overall goal is to improve performance in those subjects. Secondary Science and Mathematics Teachers Program (SESEMAT) was designed to re-tool science teachers so that there is: a change of attitude among students towards the learning of science and mathematics; a change of perception among teachers in the teaching of science and mathematics, using the available instructional materials. The Ministry of Education and Sports has designed hands-on and minds-on activities to enhance the teaching and learning of science and mathematics in secondary schools.

The first cycle of the SESEMAT program training was implemented in August 2007. The 2nd cycle training for the expansion program took place at the National INSET Centre at Kololo from 28th April to 7th May 2008 and at the Districts from 14th to 23rd May. The training was based on the theme " Hands-on and minds-on activities to enhance the teaching and learning of Science and Mathematics ". The training followed a designed program of both general and subject sessions. The general sessions include presentations on:

- Learners' participation in the teaching and learning of Science and Mathematics
- Resources Mobilization and Utilization in the teaching and learning of Science and Mathematics
- Practical approach in the teaching and learning of Science and Mathematics

- Appropriate Methods and Approaches in the teaching and learning of Science and Mathematics
- Team Building in the teaching and learning of Science and Mathematics
- Instructional Design and Programming.
- ALEI/PIEI pedagogical paradigm shift.

The subject sessions were focused on those subjects identified as difficult for both teachers and students.

Active participation and involvement of all the stakeholders in the SESEMAT program has helped the project to steadily propel forward. Yearning for SESEMAT intervention in non-pilot districts is a clear indication of the successes of the program activities. The positive attitude and teaching abilities of the Science and Mathematics teachers will enhance performance of students in the subjects

### 3.2 Teach Using Mathematical Activities.

Teachers are always interested in looking for ways to improve their teaching and to help students understand mathematics. Research in England, Japan, China, and the United States supports the idea that mathematics instruction and student mathematics understanding will be more effective if manipulative materials are used (Canny , 1984; Clements & Battista , 1990; Dienes , 1960; Driscoll , 1981; Fennema , 1972, 1973; Skemp , 1987; Sugiyama , 1987; Suydam , 1984).

Mathematical activities play an important role in helping students acquire fundamental and basic knowledge and skills, in increasing students' ability to think and express mathematically, and in enabling students to feel the joy and purpose in learning mathematics.

All mathematics comes from the real world. Then the real situation must be translated into the symbolism of mathematics for calculating. For example, putting three goats with five goats to get eight goats is the real world situation but on the mathematics level we say  $3 + 5 = 8$  (Read three add five equals eight) . These are not two different worlds but they are in the same world expressing the concepts in different ways .

What are Mathematical activities? Mathematical activities are concrete models that involve mathematics concepts, appealing to several senses that can be touched and moved around by the students (not demonstrations of materials by the teacher) .

Each student needs material to manipulate independently. Demonstrations by the teacher or by one student are not sufficient. With students actively involved in manipulating materials, interest in mathematics will be aroused. Mathematical activities must be selected that are appropriate for the concept being developed and appropriate for the developmental level of the students. Good Mathematical activities are durable, simplistic (easily manipulated) , attractive (to create interest) , and manageable. Using Mathematical activities in teaching mathematics will help students learn:

- To relate real world situations to mathematics symbolism .
- To work together cooperatively in solving problems .

- To discuss mathematical ideas and concepts .
- To verbalize their mathematics thinking .
- To make presentations in front of a large group .
- That there are many different ways to solve problems .
- That mathematics problem can be symbolized in many different ways .
- That they can solve mathematics problems without just following teachers' directions .

### 3.3 Helping the student

The most important task of the teacher is to help his students. This task is not easy; it demands time, practice, devotion and sound principle .

The student should be allowed to work independently as much as possible. But if left alone with the problem without insufficient help, the student may not progress at all. If the teacher helps too much, nothing is left for the student. The teacher should help not too much, but not too little, so that the student should have a reasonable share of the work. Thus teachers in Uganda should change from the chalk and talk teaching method where it is only the teacher who does everything in the class to the child-centered method where the teacher guides students to solve problems on their own. Teachers will receive more insight into students' mathematics understanding by:

- Listening to students' talk about their mathematics thinking .
- Observing students working individually and in cooperative groups .

It is necessary that the lower secondary school mathematics emphasize the mastery of the fundamental and basic content while depending students' understanding of the underlying principles and rules and developing the knowledge and skills that are based on such understanding.

For example, while learning algebraic expressions with letters and solving equations, it is important that students understand not only that the procedures are based on principles and rules, but also that by using principles and rules, mathematical procedures may be developed. Furthermore students should be able to utilize the knowledge and skills built on principles and rules in solving problems in their everyday life and in the society by representing and then processing phenomena mathematically.

Moreover, it is important to help students become able to use mathematical concepts, principles and rules as well as mathematical representations and procedures while solving problems. Considerations must be given to teach through mathematical activities so that students can, through experiences, deepen their understanding and master procedures.

### 3.4 Questions and Answering techniques

Having students write a solution to a problem rather than by only responding with correct or incorrect values .

Paper-and-pencil method of assessment limits the scope of student evaluation. Requiring

students to defend their mathematical reasoning provides insight into the development of the students' thinking skills. Observation of students' functioning within a group will provide data for assessment. The teacher will move around the classroom observing how students are working and interacting .

To facilitate collecting assessment data, different types of questions will need to be asked by the teacher. The traditional questions which focus on calculating and correct answers will change to:

- How and why questions .
- Probing questions to stimulate the thinking process of the students .
- Having students write responses to mathematics problems .

This helps the students to know that numerical values are not sufficient for answers to mathematics problems and presents an opportunity for reflection, which is conducive to students' cognitive development. It also helps identify students having mathematical difficulties, and helps identify the conceptual level of development of the students .

Some examples of appropriate questions and responses for students might be:

- How do you know that?
- What would happen if . . . ?
- Why do you suppose . . . ?
- What makes you think your answer is correct?
- How could you prove your answer is correct?
- Could you express your answer in a different way?
- What is another way to solve the problem?
- How many different ways can you find to solve problems?
- How can you convince the other members of your group that your way is the best method to solve the problem?

### 3.5 Using Standard Textbooks

The Ministry of Education and Sports of Uganda and the National Curriculum Development Center (NCDC) should take up the responsibility of scrutinizing all the textbooks used in the teaching of mathematics. At the moment, there are no standard set of textbooks used to teach mathematics and it's upon the teacher to decide which textbook to use and in the end there is no uniformity of what is being taught to students.

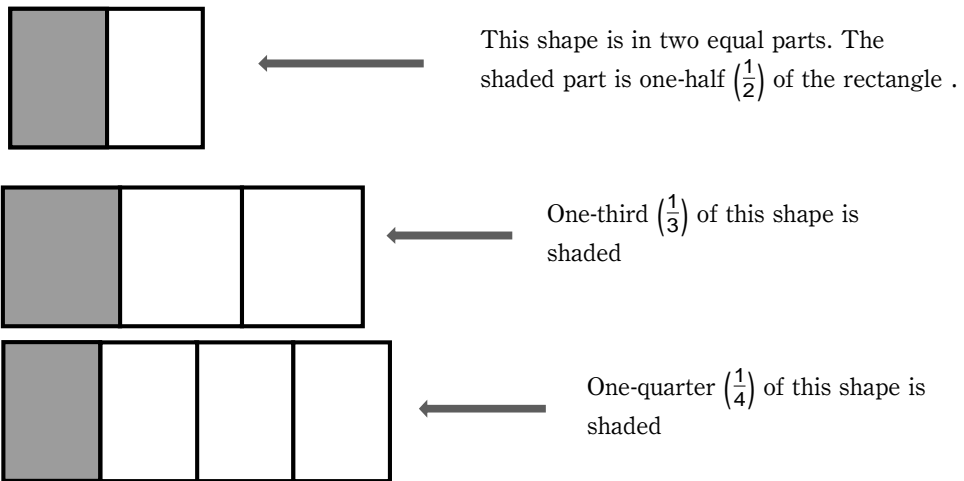
Also textbooks should be written with relevant diagrams or pictures that depict the student's environment so that they can easily relate mathematics to their daily life. Comparing Japanese and Ugandan mathematics textbooks, it can be seen that whereas the Japanese textbooks have got very many different diagrams which relate to the environment, the Ugandan text books have got very many calculations and word problems. Also most of the Japanese mathematics textbooks are blue in color and students relate mathematics to blue color. In Uganda the textbooks are extremely many and in any color thus students cannot relate mathematics to the color of the textbooks. From the research I



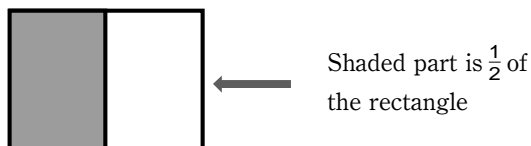
carried out, I found that students in Japan like mathematics because the color of the note and textbooks is blue and they also like blue color.

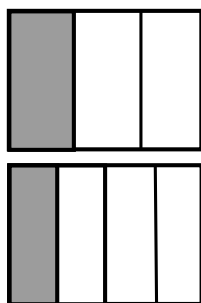
Also the examples and Exercises given in textbooks should be related to the environment so that students can see the usefulness of mathematics to their everyday life. For example instead of asking students work out;  $(+ 9) + (- 5)$ , students can be asked a question like; Aaron is 9 km East of his home. He then moves 5 km towards his home. How far East of his home is he? Another example can be; the temperature is 26 during the day and then drops by 7 at night. What is the temperature at night?

Also the diagrams used in the textbooks should not be ambiguous for the students to understand them well for example consider these diagrams representing fractions.



When students look at the above diagrams, they will interpret them differently. Some will say/think that  $\frac{1}{3} > \frac{1}{2}$  because from the diagram, it can clearly be seen that the area of  $\frac{1}{3}$  is greater than the area of  $\frac{1}{2}$ . Thus when diagrams are drawn in textbooks they should be in such a way that they are not misinterpreted by students. In this case, the three whole rectangles should be of the same area so that students are able to interpret them correctly. Thus the diagrams above should appear like this





From the diagrams on the left, a student can clearly see that

$$\frac{1}{2} > \frac{1}{3} > \frac{1}{4}$$

And can therefore be able to interpret what is meant by fractions by a mere look at the diagram.

#### 4 . Conclusion

Mathematics in Uganda is one of the worst performed subjects at the compulsory level. This is due to the fact that there is poor school management, monitoring and feedback, over-loaded curriculum, teachers' attitudes and student motivation. These bring about students' loss of interest and poor performance in schools.

Teachers may have to own the responsibility of helping their students understand the reason of learning mathematics and ensure that they learn effectively in a classroom situation. This can be effectively done through mathematical activities; teachers should maximize resources and as much as possible use materials around and relate the lessons to the reality of life .

Teachers should give students enough time in class to actively participate in the lesson, encourage them to give their opinions and different ways that they think they could use to solve a certain mathematical problem and also a teacher must try to understand his/her students very well, their attitudes towards mathematics, in order to help students to experience the success of solving mathematical problems and see the importance of learning mathematics .

The mathematics content should be stratified into different domains so that there is always continuity and cyclic teaching relating the different domains .

The main aim of mathematics is not just enabling students to solve given problems, but to enable students master fundamental and basic knowledge and skills, nurturing the abilities necessary for problem solving such as the ability to think, to make decisions and to express and developing the attitude to actively engage in the study of mathematics.

On the contrary, the present education system has caused very high competition in education, hence it has resulted in most students' becoming stressful due to aspiration to get high academic qualifications and there has been a weakening of desire to learn. There is need to spell out clearly the goals of the mathematics curriculum at all levels and particularly at the compulsory level.

The Ministry of Education in Uganda should put up a mechanism of cross-checking the text books used in the teaching of mathematics to be in line with teaching syllabus and efforts be made to make sure that the same content is taught at a particular time in all schools

in Uganda .

#### References

The Uganda National Development Plan (2010/11 - 2014/15)

SESEMAT update as per 30th May 2008

G. Polya (2<sup>nd</sup> edition) , 1978 , *How to solve it, A new aspect of mathematical method*, Princeton University Press.

Canny, M.E . (1984) . *The relationship of manipulative materials to achievement in three areas of Fourth-Grade mathematics: computation , concept development, and problem solving*. *Dissertation Abstracts International 45A* (775-76) .

Secondary School Mathematics 1 (New Edition)

Junior High School Teaching guide for the Japanese course of study: Mathematics (Grade 7-9)

Graduate School of Education, Nagasaki University 2012; *Report on the In-Service Training Program for Foreign Teachers April , 2011 - March , 2012 No . 26*