For the Reform of Mathematics Education in Kenyan Secondary Schools

Charles KANJA

Training Award of JICA at Graduate School for International Development and Cooperation,
Hiroshima University between 20 Sep. '99 and 19 Nov. '99
SMASSE National Trainer, P.O. BOX 30596, Nairobi, Kenya

Hideki IWASAKI

Associate Professor, Graduate School for International Development and Cooperation,
Hiroshima University, 1-5-1 Kagamiyama, Higashi-hiroshima, 739-8529, Japan

Takuya BABA

Graduate Student, Graduate School for International Development and Cooperation,
Hiroshima University, 1-5-1 Kagamiyama, Higashi-hiroshima, 739-8529, Japan

Atsumi UEDA

Associate Professor, Faculty of Education,
Hiroshima University, 1-1-2 Kagamiyama, Higashi-hiroshima, 739-8523, Japan

Abstract

Strengthening mathematics and science education at secondary level was declared in the Seventh National Development Plan of Kenya to establish industrialization and its sustainability. On the other hand, Japan declared "the educational cooperation to African countries" at the general meeting of UNCTAD (United Nations Conference on Trade and Development) in April 1996. The declarations of both countries realized the fruition of SMASSE(1) project from July 1998 to June 2003.

In line with Kenyan government policy, the SMASSE project was launched to enhance mathematics and science education by in-servicing secondary school teachers in the country with assistance of Japan International Cooperation Agency (JICA). The project, therefore, conducted intensive baseline study in the very first year of operation in order to grasp the situation of mathematics and science education for its preparation.

Among this study , the views on educational objectives and on teaching approaches were asked both to students and to teachers by means of multiple-choice questionnaires. The students' data on mathematics was mainly presented in this paper, which was arranged per grade in terms of preference in choices, because it describes the characteristics of Kenyan mathematics classroom effectively. This can be a first step towards comprehensive understanding of mathematics education in Kenya.

Journal of International Development and Cooperation, Vol.7, No.1, 2001, pp. 67–75

1. Introduction

At the time of independence in Kenya (1963), the government adopted the existed western system of education, which was 8-4-2 system and changed to 7-4-2-3 system in 1966 (Eshiwani, pp. 36-38) culture, technology and social structures. Despite of richness in the country's tradition, many changes were required for modernization of the society. Due to inadequate natural resources in the country, there was especially need to develop human resource. Education therefore was seen as an essential resource and a passport to economic development in Kenya.

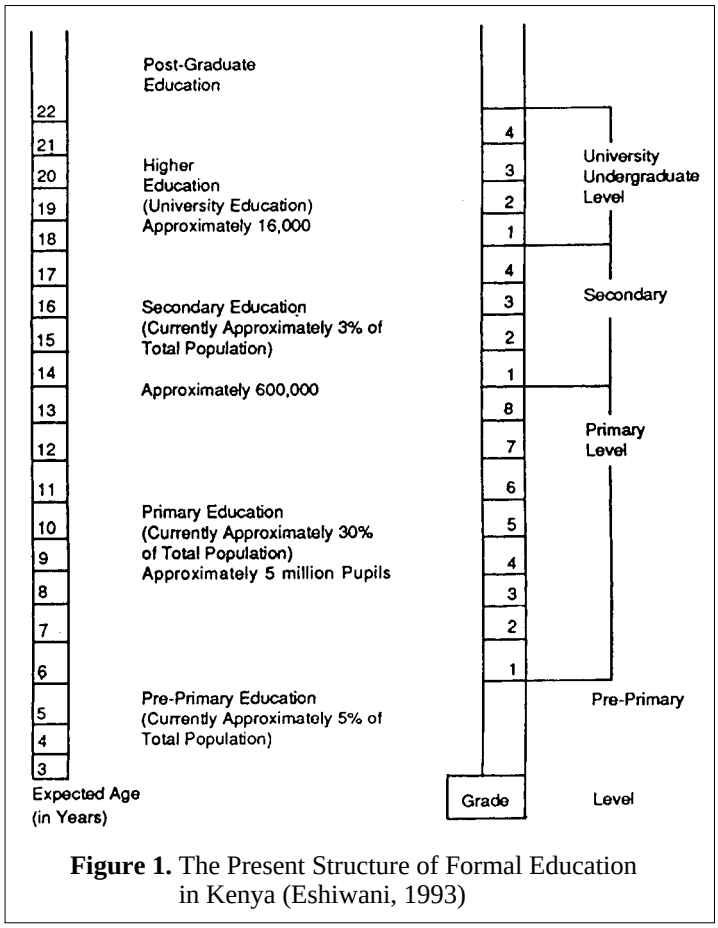

Figure 1. The Present Structure of Formal Education in Kenya (Eshiwani, 1993)

The current education system (8-4-4 system) was introduced in Kenya early 1985 with an important feature of curriculum as 'course of study' as opposed to the previous system where national textbook was interpreted to be the curriculum. However, the new system forced the increase of secondary school mathematics content that has been a heavy burden to both students and teachers. As a result, there has been public outcry about the poor performance of mathematics at secondary school level.

The chief defect of Kenya's educational system is that it is career-oriented. Its purpose is certification through the parameter of examinations. The teaching and learning of mathematics in the Kenyan classroom has taken a ritual platform on which the 'teacher' talks to the 'students' all the time. The 'students' are ready to repeat what they received from the teacher in examinations in order to merit certificate and a job. When they graduate from school, they usually feel a deep sigh of relief and never to return to mathematics again.

Instead, there is need to use the mathematics classroom to create a questioning mind throughout life. Mathematics students should grow up with curious and questioning minds. Students should not accept authority without thinking. There should be a constant dialogue between teacher and student. The system therefore should be the one in which the teacher is simultaneously a student and the student is simultaneously a teacher. In this direction, education will stand squarely in the way of all our economic, intellectual, cultural and political development.

This report presents initial findings about the present state of teaching and learning of mathematics in the nine selected pilot districts that are Kakamega, Butere-Mumias, Lugari, Central Kisii, Southern Kisii, Murang'a Maragua, Makueni, and Kajiado[2]. Their locations are shown in Figure 2. The study was done as a part of baseline study of SMASSE project after the government designated mathematics and science achievement in Kenya as an education priority.

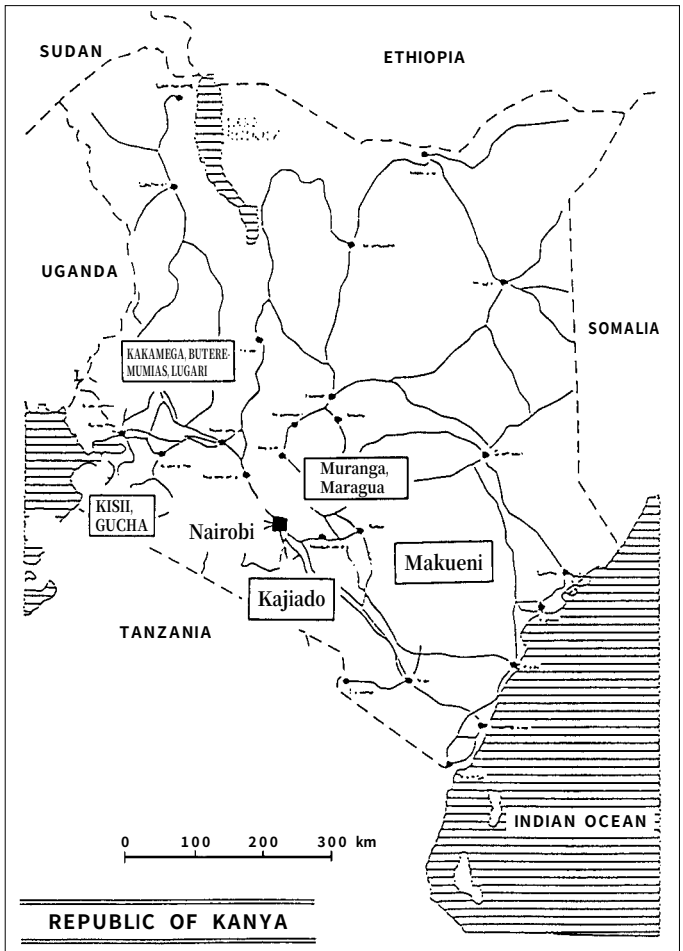

Figure 2. Pilot Districts in Kenya

Due to the new policy on industrialisation, Kenya has a choice to begin changing the mathematics classrooms with a real will to challenge the existing problems. Report by the Teachers Service Commission (*TSC*) said that there was shortage of mathematics and science teachers, and the attrition rate among teachers in these subjects was higher than in other subjects. Many teachers have left teaching for green pastures, which are the better paying private schools or the private sector. In 1997, the Government through *TSC* attempted to stem this problem by paying teachers, of 'special' subjects including mathematics and science, three increments higher than their colleagues.

SMASSE national team embarked on a baseline study in all pilot districts where video recording, interviews and questionnaires were administered to all stakeholders in education. Students completed questionnaires about their experiences in mathematics class and were interviewed about their experiences in school. Head-teachers were interviewed about school policies and practices. Teachers' questionnaires and interviews about experiences in their mathematics class and school practices were administered as well.

2. Existing Conditions

In Kenya, mathematics is a compulsory subject up to the secondary school level. During the last couple of years, mathematics performance in national examinations has dropped significantly, and this has been a major concern for the society. The Kenya National Examinations Council (*KNEC*) has continued

Table 1. Districts , Schools and Number of Students

DISTRICT	SCHOOL	DATE	FORM	MALES	FEMALES	TOTAL
Kajiado	Olooseos	30/10/98	3	06	08	14
	Oloitokitok	29/10/98	2	22	00	22
			3	22	18	40
	Kimana	29/10/98	1	15	23	38
			2	24	15	39
			3	19	21	40
Murang'a	Kiangunyi	05/11/98	1	00	24	24
			2	00	29	29
			3	00	24	24
	Mukangu	06/11/98	1	22	18	40
			2	20	37	57
			3	12	11	23
Maragua	Ngàraria	09/11/98	1	00	46	46
			2	00	51	51
			3	00	32	32

to raise concern over the poor performance in KCSE[3] mathematics examinations. KNEC (1996) identified as reasons for poor performance inadequate coverage and practice and inability to master simple and basic concepts.

There have also been serious implications, which may lead to lack of admissions to careers and institutions of higher learning in future. Employers have taken particular interests in this problem and criticized the schools' inability to teach mathematics well. For this reason parents have began to send students for hired tuition in mathematics and students' interests in classroom teaching have deteriorated.

According to the study carried out on general issues, a characteristic of teaching method was observed as students worked less by themselves and the teacher served as the sole source of information.

There is need to focus upon life and work in mathematics classrooms and require the development of very different methods of teaching. The primary target is the teacher because "The teacher is the primary source of instruction in most societies and has been recognised as such by most curricula and forms of classroom organization." (UNESCO, 1992, p.17) Teachers need to be involved in the actual implementation in order to cause some change in mathematics classroom. And this is why the in-service course for secondary school teachers has started with initiative of SMASSE project.

3. Method of Data Collection and Analysis

The aim of baseline study was to collect wide range of opinions on what is mathematics curriculum in Kenya and analyse it. In this study, mathematics problems, teaching approaches and opinions on mathematics were asked mainly by selecting an alternative. By doing this, we want to seek the present situation and future direction of Kenya's mathematics education.

Table 2. Response Rate of Students Questionnaire (Total and Individual Forms' Data)

*Total Data				
1. LIKES MATHS	81			
Choices	1st	2nd	3rd	4th
2. Important factor in mathematics class:	31 ⑥ formula	19 ① explanation	13 ⑨ calculation	12 ② exercise
3. Why study mathematics in school:	21 ④ for job	18 ③ understand other subject	17 ⑥ enlightens	15 ⑧ nation building
**Form 1				
1. LIKES MATHS	81			
Choices	1st	2nd	3rd	4th
2. Important factor in mathematics class:	34 ⑥ formula	18 ① explanation	15 ⑨ calculation	10 ② exercise
3. Why study mathematics in school:	20 ④ for job	18 ③ understand other subject	15 ⑥ enlightens	14 ⑧ nation building
***Form 2				
1. LIKES MATHS	79			
Choices	1st	2nd	3rd	4th
2. Important factor in mathematics class:	32 ⑥ formula	20 ① explanation	13 ⑨ calculation	11 ② exercise
3. Why study mathematics in school:	21 ④ for job	20 ③ understand other subject	18 ⑥ enlightens	15 ⑧ nation building
****Form 3				
1. LIKES MATHS	82			
Choices	1st	2nd	3rd	4th
2. Important factor in mathematics class:	26 ⑥ formula	19 ① explanation	15 ② exercise	11 ⑨ calculation/ ⑦ application
3. Why study mathematics in school:	21 ④ for job	17 ⑥ enlightens	16 ③ understand other subject	15 ⑧ nation building

(The figures given in this table are in percentages (%) and rounded to 2-significant figures.)

The below table shows districts, schools and number of students which questionnaires (see the appendix) and interviews were administered for.

4. Result of Analysis

The results of questionnaires are summarized in Table 2. A few points are noted for these tables.

◇ Students were to express their views on the learning of mathematics.
◇ Several choices were given and students were asked to select any *three* in order of priority.
◇ Their first choice was weighted 3-points, second choice 2-points and third choice 1-point.
◇ The percentage choice for each item was calculated as follows: X % =
sum of scores/(number of students $\times 6$) $\times 100$ %.

4-1. Main Findings from Questionnaires (Table 2)

When students were asked

*** Total data**

1. Whether or not they *like* mathematics; 81% responded yes.
2. What they consider as most important factor in a mathematics class; *formula* was considered by 31%, *explanation* by 19%, *calculation* by 13% and *exercise* by 12%.
3. Why they study mathematics in school; 21% think that mathematics is necessary for *job*, 18% think that mathematics is necessary for *understanding other subjects*, 17% think that mathematics is important because it *enlightens* them and 15% think that they study mathematics so as to *contribute to the nation building*.

**** Form 1**

1. Whether or not they *like* mathematics; 81% responded yes.
2. What they consider as most important factor in a mathematics class; *formula* was considered by 34%, *explanation* by 18%, *calculation* by 15% and *exercise* by 10%.
3. Why they study mathematics in school; 20% think that mathematics is necessary for *job*, 18% think that mathematics is necessary for *understanding other subjects*, 15% think that mathematics is important because it *enlightens* them and 14% think that they study mathematics so as to *contribute to the nation building*.

***** Form 2**

1. Whether or not they *like* mathematics; 79% responded yes.
2. What they consider as most important factor in a mathematics class; *formula* was considered by 32%, *explanation* by 20%, *calculation* by 13% and *exercise* by 11%.
3. Why they study mathematics in school; 21% think that mathematics is necessary for *job*, 20% think that mathematics is necessary for *understanding other subjects*, 18% think that mathematics is important because it *enlightens* them and 15% think that they study mathematics so as to *contribute to the nation building*.

****** Form 3**

1. Whether or not they *like* mathematics; 82% responded yes.
2. What they consider as most important factor in a mathematics class; *formula* was considered by 26%, *explanation* by19%, *exercise* by 15% and *application* by 11%.

3. Why they study mathematics in school; 21% think that mathematics is necessary for *job*, 17% think that mathematics *enlightens* them, 16% think that mathematics is important for *understanding other subjects*, and 15% think that they study mathematics so as to *contribute to the nation building*.

Besides these findings, we also conducted a statistical t-test against total data. The followings are results of the test.

◇ In item 2, the differences between the 1st choice ⑥ and the 2nd choice ①, and between the 2nd ① and the 3rd ⑨ are statistically significant using 0.05 as the confidence level in two tailed t-test of significance.

◇ In item 3, only the only difference between the 1st choice ④ and the 2nd choice ③ is statistically significant using 0.05 as the confidence level in two tailed t-test of significance.

4-2. Other Findings from Baseline Study

Analysis of the other data besides questionnaires revealed some unexpected weakness:

(a) Students perform poorly in the basic concepts of mathematics.
(b) The quality of teaching is poor.
(c) Most students said that classroom environment is harsh and unfriendly.
(d) Students do not understand the basic mathematics needed to function effectively in the society.
(e) Students appear to lose interest in the learning of mathematics as they progress through the school system.
(f) The performance of students in mathematics at the end of secondary school education is the lowest compared with other subjects in the curriculum.
(g) Parents and community do not interact with the school.

(NB: *Most Kenyan teachers are trained and have clear goals to guide their teaching, but good teaching and good learning materials seem not to be seen in most mathematics lessons*.)

5. Conclusion

Towards solution of complexity of problems, teachers and all other concerned bodies should orchestrate their efforts in order to reverse this negative trend. Especially the KNEC may need to do curriculum analysis so that their examination questions may truly reflect acquisition of knowledge, which is important for students. Among all these problems that Kenyan secondary schools are in, this paper focused on the analysis of mathematics classroom situations. It is because this forms a core of educational endeavor by the schools and at large by the society.

Since baseline study showed that poor school management, monitoring and feedback, over-loaded curriculum, teachers attitudes and student motivation affect students' loss of interests and poor performance in school, 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.

The main aim of mathematics education is to help young people understand mathematics needed to function effectively in society by the end of secondary education. Although the current secondary school mathematics curriculum emphasizes on the development of good attitudes and thinking, most teachers

feel that it is not realistic. 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. Families and society have also experienced this kind of change. And there has been a weakening of desire to learn. There are definitely some weak points in the Kenyan mathematics education system and these weak points should be changed.

The most important issue in any education system is the emphasis on the major objective in mathematics curriculum. There is need to spell out clearly the goals of the mathematics curriculum at all levels and particularly at the compulsory level. The essential factor is the need for high standards of the national courses of studies. The curriculum to be followed should raise students who will be capable of creative thought and action. It is therefore imperative that Kenyan educators think of **what is important in the future mathematics education**.

Mathematics teacher therefore has to understand and implement good teaching skills to alleviate this situation. This involves getting everything work well and in balance. It can only be done out of professional commitment if the teacher would find it rewarding in terms of students' response. As Kenyan teachers rediscover mathematics classroom, they will need to fight against 'complacency' and do a little bit better in a little different way. Towards its realization, SMASSE project should utilize the baseline study effectively.

Notes

(1) SMASSE stands for Strengthening of Mathematics and Science at Secondary Education. It is a project co-funded by Kenyan and Japanese governments. Its aim is to strengthen mathematics and science at secondary education through systematic in-servicing of teachers. Main office is located within Kenya Science Teachers College.

(2) Formerly the pilots districts were five, Kakamega, Kisii, Murang'a, Makueni and Kajiado. After some administrative change, Kakamega district was divided into three districts, Kakamega, Butere-Mumias and Lugari. Kisii was into two, Kisii and Gucha, and Murang'a was into two, Murang'a and Maragua.

(3) KCSE stands for Kenya Certificate of Secondary Education. Students should take this national examination after completion of secondary education if they wish to proceed for further study.

References:

1. Eshiwani, G.S. (1993), *Education in Kenya, Since Independence*, East African Educational Publishers Ltd., Nairobi, Kenya.
2. Kenya National Examinations Council (1996), *KCSE mathematics reports in Kenya*, Government Printers, Nairobi, Kenya.
3. The Central Council for Education (1997) *The Model for Japanese education in the perspective of the* 21st *Century (The* 2nd *Report by the Central Council for Education)*, 1997June, Monbushou, Japan.
   http://www.monbu.go.jp/news-en/00000072/
4. UNESCO (1992), *Reports on Education*, Paris, UNESCO.

Appendix

The sample questionnaire is as follows:

MATHEMATICS−Student

District: Makueni

School:
Form:
Sex: M / F
Date:

Please kindly answer the following questions.

1. Do you like mathematics? (Tick one.)
   yes no
   i) If yes, please state the reason.
   ii) If no, please state the reason.
2. Which of the following choices do you think are most important in mathematics class?
   ①explanation ②exercise ③drawing sketches ④solution ⑤way of thinking ⑥formula
   ⑦application ⑧examination ⑨Hcalculation ⑩final answer

   Select THREE in order of priority.

   1st 2nd 3rd

3. Why do you think you study mathematics in school?
   ①to understand society ②for examination ③to understand other subjects ④for job
   ⑤because it is a compulsory subject ⑥because it enlightens me ⑦because it is interesting
   ⑧to contribute to nation building

   Select THREE in order of priority.

   1st 2nd 3rd

4. Do you feel free to discuss with your deskmate during mathematics class? (Tick one.)
   yes no
   i) If yes, when do you do so? (Circle one below.)
   a) when teacher permits b) when I couldn't understand c)other[ ]
   (Please specify.)
   ii) If no, please state the reason.

Thank you very much for your cooperation.