

Policies and Strategies for the Improvement of Mathematics Teaching and Learning at the Senior Secondary School (SSS) Level

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Abstract

Mathematics is a subject meant to be enjoyed if properly handled by the teacher (teaching) and the students (learning). Nigerian schools have not been able to achieve hundred percent (100%) rate of success in mathematics in both external and internal examinations over the years due to some reasons (Jegade, 2003; Onabanjo, 2007). However, many researchers have proved some factors to be responsible for this among which are teaching and learning strategies, governmental factor, environmental factors and others. This paper therefore focuses on policies and strategies for the improvement of mathematics teaching and learning at the Senior Secondary School (SSS) level. Various policies and strategies were discussed which if put into practice continuously will improve the teaching learning situation of mathematics at the SSS level and will yield better results. Conclusion and recommendation were thereafter made.

Key words: *Policies, Strategies, Improvement, Mathematics, Teaching, Learning.*

Introduction

The importance of mathematics in one's education and in the socio-economic development of any nation has been emphasized in the series of literature. Mathematics is considered the foundation for success in many aspects of life because there will not be meaningful development without substantial knowledge of mathematics (Ugboaja, 2011). Charles-Organ (2014) opined that the knowledge of mathematics will play a vital role in the 21st century because it will serve as the path to political and cultural power. Educators, trainers and researchers are in constant search of policies, programmes, and strategies aimed at improving mathematics teaching and learning.

The study of mathematics has been and will continue to be of tremendous importance to humanity for its ability to explain natural phenomena and everyday occurrences as well as its central role in the world's current technological development drive (Ikwa, 2000; Ugbebor, 2009). The

importance attached to the learning of mathematics and sciences in schools tend to support the notion that the technological progress of any nation depends to a large extent on mathematics and science education in that country (Onabanjo, 2007). For any curriculum that places emphasis on genuine social and individual competence, mathematics will play an important part. The rise of modern science and desire for technological emancipation in the nations makes it mandatory for a nation or people to pay increasing attention to the content of mathematics in the curriculum, and also to the teaching and learning of mathematics in schools.

The subject, mathematics has many facets. One can look at it as a particular kind of logical structure, as a body of knowledge about number and space, as a series of method for deriving conclusions, as the essence of our knowledge of the physical world, or merely as an amusing intellectual activity (Fakuade, 1980 in Onabanjo, 2007). Mathematics as a discipline is a conglomerate of inter-related divisions of algebra, trigonometry, statistics, probability and geometry as they are being taught in our secondary schools. The teaching of mathematics has three major areas of emphasis namely: (1) facts and skills (2) understanding and (3) problem solving (Gadanidis, 1988 in Onabanjo, 2007). Individuals need fundamental skills that enable them to apply their knowledge to new situations and to take control of their own lifelong learning (National Council of Supervisors of Mathematics (NCSM), 1989 in Onabanjo, 2007).

In the study of Kulm and Bussman (1980), in Onabanjo (2007), it was shown that different topics in mathematics require different abilities, such as:

- ability to form mathematical gestalts,
- ability to perceive formalized mathematical materials,
- ability to relate general modes of descriptions to concrete situations,
- spatial ability,
- ability to comprehend and construct complex structures,
- ability to perceive details embedded in irrelevant material “perceptual speed”,
- ability to take in information and understand the properties of given objects, “cognition”,
- ability to arrange elements in a visual structure,
- ability to draw conclusions to reason logically,
- ability to perceive a problem as a generation of a problem already solved,
- ability to decode on how given information should be treated “evaluation”,
- ability to synthesize or separate data-globalization,
- ability to assess adequately varied information.

Thus for effective understanding of various topics in mathematics the above mentioned abilities are essential.

At senior secondary school level therefore, being a transition to tertiary institution is very crucial. At this stage, there is need for high quality instruction with which students will acquire skills in less time and make more adaptive generalization than they would with lower quality instruction.

Brief Review of the Senior Secondary School Mathematics Curriculum

The SSS mathematics topics include number and numeration, algebraic processes, geometry, mensuration, statistics, trigonometry and probability. Specifically, number and numeration include exponents, logarithms, set notation and progression. Topics as quadratic equations, simultaneous linear equations, inequalities are included in algebraic processes.

Geometry and mensuration deal with geometrical construction, basic euclidean theorems and harder mensuration in 2-Dimensional and 3-Dimensional shapes. Trigonometry essentially deals with further treatment of the angles. Probability treats theoretic and experimental probability. Statistics cover the graphical representations, preparations and interpretations of data, ungrouped and grouped, the central tendencies and use of standard deviation in practical problems.

Mathematics could be taken to be a difficult subject if the teaching and learning of each topic is not strategically handled (Onabanjo & Famuyiwa, 2005). Therefore, to make the teaching and learning improved and because of its abstract nature, the following policies and strategies are considered:

*** Adoption of a Teaching Plan**

The brief review of the SSS 3 mathematics curriculum reveals that there are variations in the weightings of the topics/contents. These variations call for the adoption of a teaching plan which ensures that the contact hours are appropriately distributed to match the varying concentrations of the contents throughout a suggested Teaching Plan.

TOPICS	SSS 1		SSS 2		SSS 3		SSS 4	
	Weight	Hour	Weight	Hour	Weight	Hour	Weight	Hour
Number & Numeration	7	37	5	40	2	23	14	100
Algebraic	2	14	5	46	2	23	9	83
Measurement	3	25	-	-	3	24	6	49
Plane Geometry	5	38	2	23	-	-	7	68
Trigonometry	2	14	1	10	1	10	4	34
Statistics	3	19	-	-	4	4-	7	59
Probability	-	-	3	27	-	-	3	27
Total	22	150	16	150	12	120	50	420

From the above analysis, it could be observed that the contents lean heavily towards SSS 1 and SSS 2. This is so, in order to give room for a lot of revision activities in SSS 3, thus allowing consolidation of what is learnt in the earlier years to take place. It should be noted that lesser workload is expected at this level of the SSS 3.

The illustration above shows a 10 week teaching period for SSS 1 and SSS 2, and an average of 4 week teaching period for SSS 3 due to allowance for the SSS examination (WASCE). Further, if a contact of 40 minutes per lesson is assumed, and five lessons per week, we would get 150 contact hours for each of SSS 1 and SSS 2, and 120 hours for SSS 3. Based on these criteria, the contact hours allowed for each are shown in the above illustration and could easily be interpreted. In this way, we can ensure an equitable distribution of contact hours according to the weights the topics carried in the curriculum.

Planning properly will also ensure wide coverage of the contents and this will also help the teaching and learning of the subject directly or indirectly.

*** Giving room for flexibility**

In the senior secondary school, students aspirations and interests are becoming stable unlike it was in the junior secondary school. Students aspirations and interests vary. While some are inclined towards the mathematics and natural sciences, some have aptitudes for the social sciences while others demonstrate inclinations toward the language and liberal arts. The flexibility has been accomplished in Nigeria by running separate mathematics classes for potential mathematics, engineers and scientists using the Further Mathematics Curriculum. For effective teaching and learning the SSS mathematics should be adopted to suit the separate group of language/liberal arts and social sciences respectively FRN (2014). The contents will remain the same but the instruments of instructions will vary, and at the end the required knowledge will be imparted as appropriate thus benefiting both groups.

* **Remedial Classes for Slow Learners and Underachievers**

It should be a policy to identify using appropriate diagnostic instruments such as developed by Obioma (1986) for slow learners and underachievers in mathematics prior to their entry into the senior secondary school. A different teaching plan which allow for more contact hours would then be devised to cater for the needs of those special groups. France has adopted this strategy successfully for children with serious difficulties in mathematics. A survey in Nigeria (Onabanjo, 2009) and more show that these types of learners abound in mathematics classrooms and teachers can be fully prepared to cope with them. Experimental results in Nigeria show that this strategy can be gainfully employed (Obioma & Adibe, 1987, 1988, 1990), (Onabanjo, 2005), (Onabanjo & Iyawe, 2014).

* **Establishment of Mathematics Laboratory**

Mathematics laboratory is very essential and it should be a matter of policy concerning its establishment as is the case for the sciences. As a matter of fact, due to its importance in improving the mathematics achievement especially for the less gifted, mathematics laboratory should be mandatory as a qualifying criterion for entry into the SSS examinations in mathematics.

Mathematical work will be done in many other rooms, but the mathematics laboratory should be available at same time to all students. It should serve as the focal point for all the mathematical works in the school.

Work in the mathematics laboratory will afford exploration of various mathematics ideas. Abstract generalisations can be concretised especially to slow learners and underachievers. A number of concrete materials that can fit into a mathematics laboratory are available elsewhere but the essential practice is to ensure functionality, appropriateness and currency of these materials. The said difficult topics like 2 and 3-Dimensional shapes, circle theorems, Mensuration, Longitude and Latitude, etc. are being made easy when the students can see, touch and feel, especially when they are dismantled and analysed (Onabanjo & Odunuga, 2005).

* **Periodic Evaluation of Curriculum and Textual Materials**

It should be a matter of policy for the institutionalisation of periodic evaluation of curriculum and textual materials. Curriculum and textual materials evaluation can afford school supervisors opportunities to make more informed decisions about the system's goal for mathematics education. One of such curriculum/textual materials models is the Second International Mathematics Study (SIMS) of the IEA. It considered the intended curriculum by identifying aspects of a system's curriculum that are aligned with desired framework as well as those aspects still needing refinement. Also, SIMS focuses on the implemented curriculum through analysing data on teacher coverage (opportunity to learn) and their topics and strategies that need further attention (say through in-service programmes). The last component, that is the attained curriculum is accomplished by measures on test and questionnaire on what students have learned.

It is possible for a country to devise its own evaluation model to achieve its local need as in the case of China, evaluation of the mathematics curriculum is geared to probing more deeply into its adequacy to meet national needs and their appropriateness in relation to the rapidly evolving nature of science and technology (GER, 1986). So also we have similar

evaluation studies in German Democratic Republic (Janke, 1988) and USSR (Razumorshi (ed), 1987) and Adegoke, 2004). Such exploratory evaluation studies should be encouraged and extended to senior secondary mathematics in the Nigerian context besides large scale national studies on curriculum evaluation.

* **Relating Mathematics to Societal Needs**

Nowadays, mathematics is no longer separated from the realities of the society. The utility of senior secondary mathematics lies in its functionality, especially for those who may not pursue the study of the subject further. The relationship between mathematics and society and its implementation in school instruction have aptly been demonstrated in the United Kingdom, Japan and Italy (Ojo, 2003; Adegoke, 2003), (Hudson, Kawaguchi and Sanchez, 1989). The British experience includes presenting mathematics from a global perspective including such issues as world development, sports, military technology and arms race. In Japan, mathematical thoughts have been shown to be latent in various artistic activities like library and painting work, theatre plays/movies. In Italy, such vehicles as radio programmes have been used as a medium for popularising mathematics. Mathematics can be related to the society through such issues as agriculture, large scale merchandise, industrial development, sports, music and dance, health talk and a host of other local activities.

* **Establishment of Mathematics Society/Club in School**

Every school should endeavour to create and sustain mathematics society/club. Here the students will be free to discuss all issues pertaining to mathematics and the way forward. Problems and solutions can also be discussed. This, directly or indirectly will help the slow learners and underachievers to learn from the genius. It will also make all the students to be more aware of the importance of mathematics in day-to-day interactions (Onabanjo, 2007).

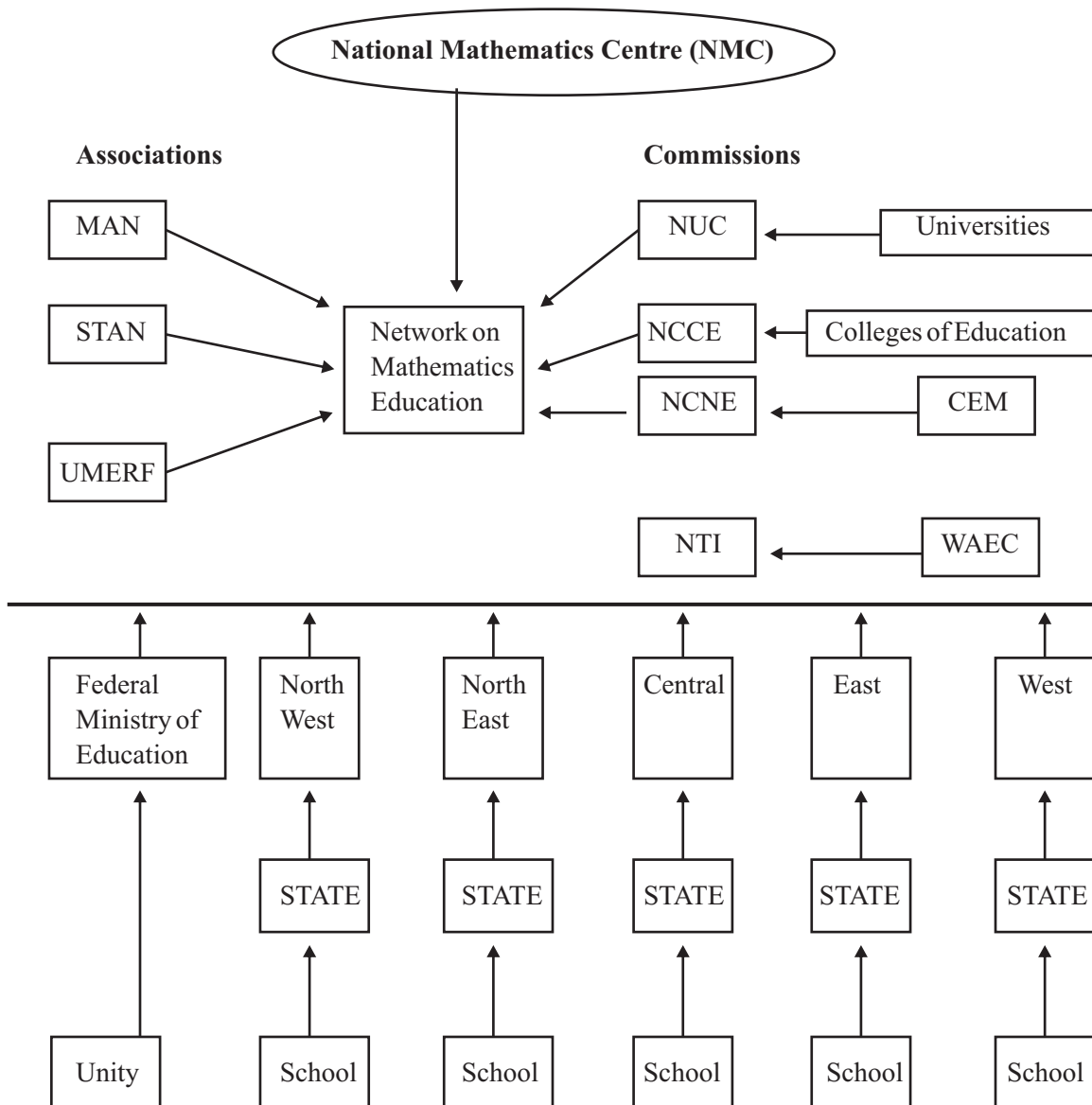
* **Establishment of Mathematics Network**

There should be establishment of active and functional network on mathematics education at national, zonal and state levels. This will profit the effective teaching and learning of secondary school mathematics. Beside this, it will serve as a platform for cross fertilization and promotion of mathematics education at the school levels.

* **Membership**

The members of mathematics education network should include National Mathematical Centre (as Convener), various commissions, examination bodies, professional associations, universities (offering maths/maths education programmes), the Federal Ministry of Education, each of the five geographical zones, and State schools.

* **Organisational Structure of Network on Mathematics Education**



The Federal Ministry of Education will co-ordinate information from Unity Schools and report to NEME. The zones will coordinate information from the State Schools through the States within the zone, meaning that there should be a mini network at the zonal level.

* **Functioning**

Network on Mathematics Education (NEME) should meet twice or thrice in a year to formulate, review, modify policies in their different avenues as would be decided. NEME should also deliberate on strategies for implementing these policies such as:

- * Monitoring innovation programmes.
- * Curriculum evaluation, adaptation, review and innovation/re-planning.
- * Periodic monitoring of learners progress/attainments.
- * Periodic monitoring of teachers attainments.
- * Periodic monitoring of programmes for special learners.

- * Encouraging, reinforcing and supervising the activities of associations in the mathematics profession.
- * Arranging field trips on mathematics for the students zone by zone.
- * Arranging scholarship for the winning students in all the zones.
- * Establishment of counselling unit in each school.

NEME should also deliberate and discuss the financial implications of these and recommend same to National Mathematical Centre for possible implementations.

Conclusion

Since mathematics is a compulsory subject at SSS level and one of the requirements for tertiary institution, efforts should be made to carry out all the possible things that will improve the teaching and learning of the subjects at SSS level, which will devoid it of its dry and fearful outlook at least, to the slow learners. Carrying out meaningful policies and strategies will also boost the interest of the students and will make them learn fast, also, will ease the tension of teaching the subject.

Recommendation

The teachers of mathematics need to be refreshed from time to time for effective teaching situation. This calls for training, workshops and seminars on part of the teachers. It is therefore recommended that both the NEME, Zones, States, Federal Ministry of Education and Schools work with professional organisation like Universal Multidisciplinary Educational Research Foundation (UMERF) which specialises in training and re-training of teachers in various fields (www.umerfacad.org).

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