MATHEMATICS EDUCATION AS A STRATEGY FOR NATIONAL SURVIVAL AND DEVELOPMENT IN NIGERIA: AN OVERVIEW

Daniel Adikpe Ekirigwe

Abstract

Science and technology serve as vehicles for sustainable development of all nations of the world. Science and technology have components or associated processes which lend themselves to quantitative description or representation of which deepening understanding Is often associated with mathematical analysis to enhance progress. Mathematics serves as handle with which scientific and technological developments are realized or executed. Thus, this paper intends to discuss the place of mathematics education as a strategy for national survival and development. The paper examines the relationship between science, technology and Mathematics. The paper' also examines the essence of mathematics in the school curriculum. The paper concludes that (he training received in the principles and activities of mathematics are essential ingredients for the survival and development in Nigeria. That adequate human and material resources should be provided to enhance acquisition of adequate knowledge in this discipline for sustainable development in Nigeria.

Introduction

Nnoli (1981), observed that National Development constitutes the development of a country. in terms of seeking to achieve many of the conditions of good life in the Western Europe, America and Japan. These checklists of artifacts include industrialization, economic affluence, military hegemony, advance technology, urbanization and parliamentary process. Artifacts represent development when they are end-products of the efforts of the population to apply their creative energy to the transformation of local, physical, biological and socio-cultural environment.

The interest and concerns of Nations in the world, is the ascendancy of the nationals over others, through national development. Nationals struggle among themselves to excel and surprise one another in all fields of human endeavour. It is a competitive struggle. They struggle to take the lead in all aspects of development. Some or all the nations do this through development of education in science, technology and Mathematics, which serve as a catalyst and a panacea for national survival and development (Mgberkem, 2004). Thus, Russia and United States of America, having excelled in science, technology and mathematics were able to launch space expedition and exploration.

Maduabum (2000), opined that science, technology and mathematics education constitute both the foundation of wealth and development as well as the basis for classifying nations as developing. Little wonder the nations the world over accord priority to science, technology and mathematics in their scheme of things.

Nnoli (1981), observed that for Nigeria, a developing nation, the existing scientific capacity was quite marginal to her needs, including that of exploiting effectively the accumulated store of knowledge in science and technology, of selecting from the elements appropriate for her development, of modifying it for adaptation to the use of local raw materials and man power possibilities as well as the specific requirements. Margoram (1974), opined that as far as the developing countries are concerned, the need for mathematical and scientific education was a far more fundamental kind, that it was simply a need for scientists and mathematicians of any kind to harness their resources.

The New Encyclopedia Britannica (1988), quoted Carl Friedrich Gauss, German born mathematician, as staling that "mathematics is the queen of sciences..." In today's terminology, it means the mother of all sciences (Odili, 1990). Thus, mathematics must not be taken for granted at secondary school level where foundation is laid for scientific and technological advancement.

However, the students' achievement in mathematics has not been encouraging over the years in the Senior School Certificate Examinations (SSCE). West African Examination Council (1996:148), remarked that the performance of candidates in mathematics continued to "slide on downward trend". This examination body explained further that it appeared that many candidates did not have clear understanding of the subject matter. Onah (2006) and Yusuf (2002), re-echoed these remarks of West African Examination Council and attributed (he poor achievement in mathematics to "how the subject is taught". With these scenarios, the questions are: (1) how can national survival and development be achieved? (2) How can Nigerians participate in their development processes? When the foundations are-weak, -

Thus, the purpose of this paper is to highlight the relationship between science, technology, and mathematics that stimulate development; the essence of mathematics in the school curriculum prospects, problems and recommendations to facilitate high achievement in mathematics at secondary school level; and conclusion which integrated the issues highlighted.

Relationship Between Science, Technology and Mathematics

According to Nickaf (1999), science began thousands of years before man learned to read and write. It is difficult to say who first discovered fire, invented (he wheel, developed the bow and arrow, or tried to explain the rising and setting of sun. But all these rank as advances in science and their application and exploitation (technology) has affected and contributed to the comfort of every man., In general, mathematics was the first of the sciences to develop followed by physical science, the biological science and the social sciences noted Nickaf (1999).

Science is an intellectual nursery for generation of scientists and technologists (Alamina, 1987). Doing science involves physical and cognitive manipulation of objects and science substructures respectively. Science on its own is a process of acquiring and modifying acquired knowledge in the light of more emerging facts. Scientific knowledge is based on the following substructures: *Facts, concepts, theories* and *models.* Scientific facts are discrete information that are in most cases directly observable. Concepts are correlations of facts that show meaningful pattern of integration involving a broad frame of reference. Theories and models are respectively induced or deduced from concepts. These science substructures are the working ideas in science and technology.

Denga (1999), asserted that technology connotes systematic application of theoretical and practical knowledge and skills to create things, handle problems and resolves practical tasks in industrial and non-industrial settings. That technology also implies mechanization and automation. Thus, technology is applied science or the application of the knowledge of science and the manipulation of the physical world for the benefits and amusement of man. In making new discoveries, existing science substructures are cognitivcly.manipulated and here lies the common base of science and technology.

Science has been of tremendous importance to humanity for its ability to explain everyday occurrences as well as its role in the world's technology advancement. Jegede (1989), noted that in performing this role, science depends on mathematics as a means of communicating its quantitative aspects. Also Kline (1979), asserted that mathematics has been a beacon light to the sciences and had continually helped them in reaching the position they occupy in our present civilization. Fremont (1967), noted that mathematics being a vital living, growing and contributing force in the society is seen as the finest construction of the mind of man, that this construction only takes significance when it becomes involved in the life of man in interaction with his environment. According to Marut (1999), mathematics, the mother and language of all sciences has been defined by many as the science of number and space. Mathematics arose from the need for a system for counting and calculating areas of surfaces and volume of objects, but it has over the centuries become less concerned with practical matters and has turned to logic and intellectual speculation. Mitchell (1977), noted that mathematics is a continuously expanding system of organized thought. Also that throughout history, mathematics has not only reflected development in civilization but also a major contributor to those developments. And further that everything natural or man-made has a structure comprising elements that are related in some special ways, be it a crystal, a plant, a spaceship or a political system each has a structure, the study is mathematical. Mathematics is the result of the thought process known as abstraction, in which activities related to the physical structure can be organized in such a way that the physical structure can be replaced by a mental one, an abstract mathematical model. Mathematical model, here, is not just a visual aid or a piece of teaching apparatus but a piece of mathematics which behaves in the way that does the real situation it models and from which some hitherto untested reaction of the concrete (real) situation can be predicted theoretically from the abstract model (Marjoram, 1974). Also when a well-developed theory can be represented as a set of equations which in turn represented a real-world system of interest, this is known as a mathematical model (Wilson and Kirkby, 1980). A simple example of such a model is $V=880-9.8t$ which could be used either for predicting the velocity and position of an orange fruit t seconds after projection or for predicting the state of a bank account after t weeks. According to Evans (1977), mathematics has the advantage of being simultaneously organic and dynamic. On one hand, the history of mathematics only reveals the way in which man has investigated what already existed and has devised means of his discoveries adapting them for his purpose and using them to probe further. On the other hand, it can be seen as a process which is continually revealing new fact, new demands and new possibilities and carving new path ways.

Hence Davies (2001), noted that no subject better illustrates the divide between the two cultures-arts and

sciences-than mathematics. That, to the outsider, mathematics is a strange, abstract world of horrendous technicality, full of complex symbols and complicated procedures, and impenetrable language of black art. But that, to the scientist, mathematics is the guarantor of precision and objectivity. It is also, astonishingly, the language of nature itself. That no one who is closed off from mathematics can ever grasp the full significance of natural order that is woven so deeply into the rubric of physical reality. He further noted that, because of its role in science, many scientists especially physicists invest the ultimate reality of the physical world in mathematics. Modern science and technology derives their inspiration and initiation from the philosophy that affirmed the mathematical design of nature. Science was born of a faith in the mathematical interpretation of nature before it was empirically verified (Randall, 1948). The mathematization of natural science in the modern era is part of the revolution which brought technological development in its train.

Essence of Mathematics in the School Curriculum

According to National Policy on Education (1981), the following were outlined as the national educational aims and objectives: (1) the inculcation of national consciousness and unity, (2) the inculcation of the right types of values and attitudes for the survival of the individual and Nigeria society, (3) the training of the mind in the understanding of the world around, and (4) the acquisition of appropriate skills, abilities and competences both mental and physical as equipment for the individual to live in and contribute to the development of his society. The National policy on Education noted that the desire that Nigeria should be a free, just and democratic society, a land full of opportunities for all its citizen, also to generate a great and dynamic economy, and growing into a united, strong and self-reliant nation cannot be over-emphasized. It further noted that education is the greatest investment that the nation can make for quick development of its economic, political, and sociological and human resources.

Among the school subjects included in the curriculum of educational institutions in Nigeria for the realization of these national educational aims and objectives is mathematics. The school mathematics resulted from the confluence of two traditions. The first is rooted in Babylonia astronomy, Egyptian earth measurement and ancient commerce, is mathematics as reckoning, as a tool required for everyday life. The second tradition is rooted in Greek geometry and medieval algebra is mathematics as reasoning, as one of liberal art whose -mastery marks on educated person. In this tradition, mathematics offers aesthetic satisfaction as well as a means of developing the mind capacity for abstract thought. Every society attempts to pass to its children the language and skills it has acquired or developed for dealing with numerical and spatial problems. When schools are organized to give children grounding in their culture or to achieve their desires, this practical sort of mathematics is what appears in the curriculum.

The Federal Government of Nigeria being aware of the role of mathematics in achieving the national educational aims and objective made mathematics, a school subject, a compulsory subject for all learners in primary and post primary institutions in Nigeria, and has put in much resources for the acquisition of mathematical knowledge. Tertiary institutions, in Nigeria, in the same vein made a proven success in mathematics as a basic entry requirement for some courses. According to Odili (1990), mathematics is a systematized, organized and exact branch of science, and that it is a creation of human mind, concerned primarily with ideas, processes and reasoning which could foster the achievement of the national educational aims and objectives. That training in mathematics exposes individuals to the development of intellectual efforts, positive attitudes towards life, technological forces and individual capabilities that can foster national survival and development. Thus, mathematics is much more than arithmetic-the science of numbers and computation; it is not enough with algebra-the language of symbols and relations, far more than geometry-the study of shapes, sizes and space. It is more than numerical trigonometry-which measures distance to stars and analyses oscillation. It involves more than statistics-the science of interpreting data and graphs, more than calculus the study of changes, infinity and limits. Hence Watch Tower Bible and Tract society (2003, May) noted that:

Math is not just for scientists. It is for all of us.

When you shop, decorate your home or listen to the daily weather report, you are using or benefiting from mathematical principles...Over the centuries Math has become a truly universal language shared by everyone regardless of culture, religion or gender. In science, industry, business and everyday fife math has the power to solve some of the toughest riddles we face. Whether you are trying to unravel the mysteries of the universe or balance the family budget, being able to use the language of number is a key to success, (p.23).

Thus, in spite of the fact that the school mathematics has been fragmented into many special branches,

its principles and activities find form in all human activities in striving to attain national survival and development.

A highlight of some outcomes and results of the training received in the principles and activities of mathematics as a strategy for national survival and development include:

1. A good knowledge of integral transform and algebra among other things are necessary for the design and fabrication of machines, bridges and building by engineers. Modern algebra has given rise to many applications, one of which involves the use of Boolean Algebra to study the design of computers and switching circuits as well as algebra coding. Topology has produced models in integrated circuit design.
2. A good knowledge of set and logic is important in terms of their applications in information and linguistic technology.
3. A good knowledge of group's theory can be applied in crystallography and quantum mechanics.
4. Today children learn Pythagoras theorem and other elements of Euclidean geometry as training for mathematical and logical thought.
5. The chemist or pharmacist needs the knowledge of mathematics to determine the rate of reaction of different chemicals and drugs in different circumstances.
6. The medical scientist needs the knowledge of mathematics to determine appropriately the quantity of drugs needed to cure a disease condition. Statistical data are essential to the medical doctor to determine the prevalent rate of any disease for appropriate action and the potency of any drug. Also the medical doctors need the knowledge of geometrical transformation to enhance effective surgical ability.
7. The astronomer needs the knowledge of mathematics to study the orbital motion of the heavenly (Planetary) bodies to make interpretation and good prediction of atmospheric phenomena.
8. The knowledge of mathematics is required to solve problems of investment and growth,: supply and demand. Improvement made possible to many industrial situation are purely the application of mathematics such as linear programming, critical path analysis, queuing; theory, sampling techniques, quality control and one sees the applied mathematician entrenched indispensably at the hub of industry and commerce.
9. Musicians need mathematics to know that the lengths of strings that produced harmonically related tones bore simple numerical relationship to each other.
10. The Banker needs the knowledge of mathematics to work on different number bases to calculated interest, annuities, etc. Also management staff of business organization must have the good background of mathematics in order to minimize waste and maximize profit.
11. The lawyer needs the knowledge of mathematics to be able to work on the antecedents of his clients in order to get valid consequence before his arguments are upheld in the court.
12. Government agencies and parastatal need mathematical evidence to plan the programmes of activities so as to match with the available scarce resources for optimum out-put and utility.
13. A home keeper needs the knowledge of mathematics to be able to use correct quantity of resources for the family size and resources available in order to avoid surplus, wastage or deficiency
34. The teacher needs the knowledge of mathematics to be able to rate and make appropriate placements of the learner to enhance the learner realize his aptitude.
15. A farmer needs the knowledge to be equipped with the knowledge of appropriate spacing in planting crops; and to determine appropriate quantity of agro-chemical to be used, the land size available for use and the right time to cultivate any crops and to apply any agro-chemical to enhance optimum yield.

    A necessary condition for a happy and prosperous life is the art of economical living. Economy in the matter of money is not enough; a person has be economical in every single act of his life. Mathematics education is a very suitable subject for inculcating the spirit of economy. It deals with economy of time, money, space, speech and thought and is bound to develop the corresponding attitudes in the individual.
17. Any significant sample of the newspapers and the television presentation reveals a greatly increased reliance on conic forms of Symbolism, pictogram, bar charts, pie charts, graphs, maps and plans - also formulae and equations. The mathematics class exposes learners to the

experience of representing information in iconic form for variety of techniques. Beneficiaries of the exposure can read and interpret iconic forms of representations particularly relating to statistical evidence and should know devices whereby statistics can be used to mislead rather than to enlighten.

18. In preparing individuals in life, consideration can be given to the power of mathematics in character building through active involvement, personal success, work with others and opportunities for stimulating curiosity, self-expression and self-criticism. The study of mathematics develops the habit of self-education and hard work. By solving a problem correctly, the student develops the habit of self-confidence,

19. The methods of mathematics: Scientific, activities, deductive and inductive are used to investigate, interpret and to make decisions. These will help to raise a generation of people who are rational, who can think for themselves, respect the views and feeling of others and this will go a long way in giving the much needed peace and unity in the contemporary society.

Thus Dareng and Altah (2000), noted that mathematics education is the backbone knowledge through which the average Nigerian is helped to cope adequately with the problems of meeting his basic needs and to manage with ease his economic affairs. Also Davies (2001), noted that a colleagues of his once had an opinion that the world is nothing but bits and pieces of mathematics, that the contentions that mathematics is a key that enabled the initiate to unlock cosmic secrets, is as old as the subject itself. Furthermore, Westfall (1994), noted that nature is written in code and the key to the code is mathematics.

Problems

Onah (2006), noted that the mathematics syllabus as contained in the West African Examination Council (WAEC) "Regulation and Syllabus" is quite adequate and appropriate to lay solid foundation in the learners for scientific and technological advancement in Nigeria. That the pertinent issue is how mathematics should be taught in Secondary schools as to yield the desired results of sustaining or at least laying sound foundation for national development in the long run. This is the crux of the matter as it is the major aspect at that could either mar or make students at that level of education. Also Yusuf (2002), attributed the poor achievement of students in mathematics examinations to how the subject is taught. The issues of shortage of teachers, unenthusiastic and low morale of teachers as result of poor incentives should, however, not be overlooked. These certainly contribute immensely to the poor performance of students due to frustration of teachers as teachers may be reluctant in to teach or sometimes refuse to put in their best. The fulcrum, however, is the 'how' the subject is taught.

The poor performance of students in mathematics examination due to the reasons identified above casts a gloomy future for scientific and technological development in Nigeria.

Recommendations

The most crucial problem that has been identified to have led to the poor performance of students in mathematics examination and consequently may impede national survival and development in Nigeria is how the subject is taught to achieve the desired results. Thus, the following recommendations are made to improve teaching and learning processes in our school system:

a. Mathematics teachers must demand of themselves and their colleagues a high level of professionalism. This must be done to provide the nation, its young people and its future with the mathematical programme-; worthy of them and of that future.

b. Stringent standard of both effectiveness and efficiency must be applied to the leaching of mathematics. What is termed relative to a topic, and how long it is retained, how readily it is applied, all these depend on the learning process that students pass through and how effectively they are engaged in that process. It is fruitless to consider topics taught apart from the way learners meet these topics.

c. Competent and qualified teachers should be employed to teach mathematics. The situation where teachers in other subject areas are asked to teach mathematics should be discouraged. These teachers may not be competent enough to impart the knowledge required by the students.

d. Mathematics teachers should be exposed to seminars and workshops to keep them abreast with innovations in the teaching and learning processes in mathematics.

e. Mathematics teachers should be encouraged and also be given the opportunity to go for re training to enhance their efficiency and effectiveness in the teaching of the subject.

f. Mathematics teachers should be provided with adequate incentives to enable them put in their best. Teaching of mathematics requires a great deal of efforts and concentration; adequate incentives given can sustain the efforts and concentration to achieve positive results.

g. The authorities of academic institutions should provide adequate material resources for effective teaching and learning to take place. A situation where in some secondary schools such materials as chalkboard, graph, rulers, protractors, pairs of dividers and compasses are not available for use in teaching is not encouraging.

h. Parents and Guardians should provide their children and wards with adequate learning materials such as textbooks, workbooks and a mathematical set to enhance students' participation in the learning process.

i. Learners should be made to be aware that apart from teaching, there are other opportunities opened in other fields of human endeavours for those who performed well in mathematics.

j. Public support for mathematics instruction must be raised to a level commensurate with the importance of mathematical understanding to individual and society. Solutions to the problems identified above cannot be achieved solely within the educational community but require active participation *and* support by parental and societal groups.

Conclusion

This paper identified that science, technology and mathematics education are required in Nigeria to facilitate resources exploitation and utilization. This is expected to yield revenue for national survival and development. Also through science, technology and mathematics education, Nigeria will produce scientists and technologists (engineers) to handle construction projects, oil processing engineering, production of agricultural equipment and in other specialized scientific fields 10 enhance self-reliance. Also furthermore, through mathematics education Nigerians can develop positive and worthwhile attitudes towards attributes required for national survival and development.

This paper further identified that mathematics education is the fulcrum of science and technology education that enhances the. development of any nation. It is human efforts that create development machines do not. National survival and development will be elusive and practically impossible without existence of adequate supply of competent and qualified engineers, technicians who reside in the school system. A strategy for science and technological advancement of any nation must give top priority to the provision of higher staff and high quality equipment to institutions responsible for training and research in science and technology. The central role of teachers in the entire process of education cannot be overemphasized. It is necessary to stress that no system of education can rise above the quality of its teachers. Thus, competent and dedicated, well motivated teachers are needed at all levels of our education to raise a generation of scientists and technologists for sustainable development in Nigeria.

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