MATHEMATICS EDUCATION IN NIGERIA FOR SUSTAINABLE TECHNOLOGICAL DEVELOPMENT: CHALLENGES AND PROSPECTS.

BILKISU ABUBAKAR
DEPARTMENT OF MATHEMATICS
FEDERAL COLLEGE OF EDUCATION, KATSINA

Abstract

The need for science, technology and mathematics education in Nigeria cannot be over emphasized. This paper examined mathematics, science and technology and uses of technology in mathematics. Concept of sustainable technological development and challenges and Prospects were equally. Among the recommendations made wer; commercial mathematics should be taught up to the graduate level so as to enable them come up with sound economic policies needed by the country, and also mathematics students should be included in SIWES, since science technology cannot progress without mathematics. The paper concludes that, through mathematics education, we can produce sound mathematicians

Keywords: *Science, Technology, Mathematics education, sustainable development, Challenges, Prospect*

Introduction

Mathematics, as defined by Igbokwe (2003) is a postulation and logical thinking which uses symbols to establish relationship between qualities and ideas. Mathematics is the most important of all subjects. Similarly Eze (2008) defined mathematics as the study of size, numbers and patterns. Mathematical understanding influences decision making in all areas of private, social and civil life. It is the subject that enables scientists and technologists to develop relationship among biological, chemical, geophysical and physical qualities, understand and explain natural phenomena (Akase et al, 2015). This is a clear indication that, Mathematics is all around us since it is used in all aspects of life.

The importance of mathematics is not restricted to the development of the individual alone, mathematics has contributed to the development of society. It is the central intellectual discipline of any technological society. Adetula (2005) posited that, mathematics is man's most extensive and most profound effort to achieve precise and effective thinking and it accomplishes and measures the capacity of the human mind. He further mentioned that, mathematics represents the superb and sublime product of human reason. That, it is the upper limit of the reasony that is attained in all rational domains. The study of mathematics is a basic preparation for an informed citizenry and gateway into numerous career choices in life because of its scientific and technological investigation, as well as, all other activities of human development (Galadima, 2001). The importance of mathematics is obvious because candidate cannot get admission to higher institutions without a credit. Situations in life always call for the use of mathematics since every activity in life calls for use of numbers, quantities and measurement.

Aniodoh (2002) defined science as the systematic study of man and his environment based on the deductions and inferences which can be made, and the general laws which can be formulated from reproducible observations and measurements of events within the universe. Through scientific processes like

observation and experimentation, a body of knowledge is arrived at which leads to scientific product. The Nigerian government, having discovered the important role of mathematics and science in national development declared 2012 as "National Mathematical Year". The Ministry of Education was mandated by the Federal Government to demystify mathematics through innovative teaching since it is a key to national transformation (Nkechi as cited by Akase et al, 2015). It was, therefore, noted that, government commitment to mathematics and sciences will invariably enhance and build up the capacity of citizens to contribute to national development and increases productivity. Other traits associated with science include: curiosity, humanity, skepticism, objectivity, rationality, suspended judgment, open mindness and honesty, among others (Okafor, 2010). Science education is the instruction or training by which people learn to develop their critical thinking and develop their technological capacity.

Uza (2014) defined technology as a body of knowledge and devices by which man masters his environment. It is a systematic study of the methods and techniques employed in the industry, research, agriculture and commerce to improve the life of man in his environment. Also, Okeke (2007) defined technology as a disciplined process of devising and utilizing techniques to convert resources to material objects. He further stressed that, three major technologies; agriculture, medicine and engineering all made substantial progress before they were fully engaged to science.

Technology is the making usage and knowledge of tools, machines techniques crafts, system or methods of organization in order to solve a problem or perform a specific function. The impact of science, technology and mathematics education to national development is that, in several ways as it provides humanity with knowledge about environment, attitudes and values for social transformational resources, change in quality of life and improvement.

Uses of Technology in Mathematics Teaching

In the principles and standards of school mathematics, the National Councils of Teachers of Mathematics (NCTM) mentioned that, "Technology principle" is one of the principles of high quality mathematics (NCTM, 2000). This principle, states that, "technology is essential in teaching and learning mathematics, it influences the mathematics that is taught and enhances student learning". There is widespread agreement that, mathematics teachers, not technological tools, are the key change agents to bringing about reforms in mathematics teaching with technology (NCTM, 1991, 2000). Garofalo et al (2016) mentioned five guidelines which reflect to be appropriate use of technology in mathematics teaching as follows:

1. Introduce technology context: - Features of technology, whether mathematics specific or more generic, should be introduced and illustrated in the context of meaningful context based activities. Teaching a set of technology of software based skills and then trying to find mathematical topics for which they might be useful is comparable to teaching a set of procedural mathematical skills and then giving a collection of "Word Problems" to solve using the procedures. The use of technology in mathematics teaching is not for the purpose of teaching about technology but for the purpose of enhancing mathematics teaching and learning with technology. Furthermore, the Presidents Committee of Advisors on Science and Technology Panel on Educational Technology (1997)

observed that, focus on learning with technology not about technology. Example is of activity connecting quadratic equations and projectile motion, the parametric graphing features of graphing calculators. Derive an expression for the height of an object dropped from 400m above the surface of the earth, as a function of time students can be asked to construct a graph of this relationship first with paper and pencil and then with graphing calculators

2. Address worthwhile mathematics with appropriate pedagogy: - Content based activities using technology should address worthwhile mathematics concept procedures, strategies and should reflect the nature and spirit of mathematics. The use of technology in mathematics should support and facilitate conceptual development, exploration, reasoning and problem-solving as described by the NCTM (1991, 2000).
3. Take advantage of technology: - Activities should take advantage of the capabilities of technology and hence, should extend beyond or significantly enhance what could be done without technology. Technology enables users to explore topic in more depth e.g inter connect mathematics topics, write programs device multiple proofs and solution sand in more interactive ways (e.g simulations, data collection with probes). Technology also makes accessible the study of mathematics topics that were previously impractical such as recursion and regression by removing computational constraints. Teachers should use technology to enhance their students learning opportunities by selecting or creating mathematical tasks that, take advantage of what technology can do efficiently and well graphing, visualizing and computing (NCTM, 2000).
4. Connection mathematics topics: - Technology augmented activities should facilitate mathematical connections in two ways as stated by National Council of Teachers of Mathematics (NCTM, 2000), which are:
   a. Interconnect mathematics topics and,
   b. Connect mathematics to real world phenomena. Technology blurs some of artificial separations among some topics in algebra, geometry and data analysis by allowing students to use ideas from one area of mathematics to better understand another area of mathematics. School mathematics can be used to model and resolve situations arising in the physical, biological, environmental, social and managerial sciences. Many topics can be connected to the arts and humanities as well. Appropriate use of technology can facilitate such applications by providing ready access for application more practical (e.g regression and recursion).
5. Activities should incorporate multiple representations of mathematical topics. Research shows that, many students have difficulty connecting the verbal graphical, numerical and algebraic representations of mathematical functions (Goldenberg, 1988, Leinhardt et al, 1990 as cited by Garofalo et al, 2016). Appropriate use of technology can be effective in helping students make some

connections (e.g connecting tabulated data of graphic and curve of best fit, generating sequences and series numerically, algebraically and geometrically). Mathematics educators should make the best use of multiple representations, especially those enhanced by the use of technology, encourage multiple approaches to mathematical problem solving and engaging students in creative thinking right from their childhood, primary and secondary schools to tertiary institutions.

There is a report that qualified the ways which Mathematical Science Research (MSR) in 2010 influenced economic performance in the UK and its economic value in terms of direct employment and Gross Value Added (GVA) generated. The introduction of the report set the scene with a brief survey of some areas in which MSR effect everyday's daily lives in the world Nigeria inclusive. MSR (2010) further explained some specific areas like: -

- Smart phones which use mathematical techniques such as linear algebra to maximize the amount of information that can be transmitted across a limited spectrum.
- Mathematical models predicting the movement of weather system to allow air planes to quickly and safely return to the skies after major metrological events such as the 2010 ice landic volcanic ash cloud.
- Health care that applies the insights from fluid mechanic to better understand blood related diseases in order to save lives.
- The latest hollywood block busters that take advantage of the mathematics behind software of 3D modeling to show case cutting edge special effects, and
- The performance of elite athletes at the 2012 Olympic games who have maximized their performance using tools that harness mathematical tools and techniques such as inverse dynamic.

The Concept of Sustainable Technological Development

Definitions of development have been proposed by various authors. According to Encarta (2009), development is the process of changing and becoming larger, stronger or more impressive, successful or advanced or of causing someone or something to change in this way. This is a view of development as a process. Mohammad (2008) mentioned that, development can be conceived as an improvement on the material welfare of a people. Development, as viewed by the authors, is all round progress in humanity to live comfortably.

Technological development, as described, is better felt in a country like Nigeria when it is sustained. Sustainable technological development, according to Muhammad (2008), can be conceived within the content of growth, advancement in the utilization of energy and to manipulate scientific knowledge to satisfy needs. Conceiving technology as applied science, we can say that, science is concerned with know-how. Science produces the knowledge, and technology uses that knowledge to produce tools, machines, structures e.t.c. So, technology depends on mathematics. Therefore, logically, there would be no science and technology without mathematics. In view of this, therefore, sustainable technology development is said to be attained when a country manages its advances in all spheres of life and wisely maintains that, without any prejudice to the needs of the future generations. For Nigeria to develop and sustain such development it should aim at rapid promotion of science and technology in all facets of life.

Challenges and Prospects of science Technology and Mathematics

Science, technology and mathematics education in Nigeria is grossly characterized by the following challenges:

Poor teacher/student quality: Some teachers are highly incompetent. They cannot deliver as expected of them because they lack content knowledge as well as pedagogical skills. Amazie in Umoh (2016) clearly described this category of teachers as those who showed high level of compromise in their college days. Such teachers merely find their ways to teaching profession, they do not teach but cheat and bring poor image to the profession. In a similar situation, poor student quality is due to lack of proper foundation right from their primary schools.

Poor teacher supply: Shortage of teachers is a serious challenge to the development of science, technology and mathematics. This shortage is worst in both urban and rural schools. Akinsola; Lawal, and Oyedokun in Umoh (2016) reported that, very low percentage of teachers are found in STM class compared with the population of students. This is the reason why most teachers avoid student centre approaches to teaching.

Inadequate content: Oriafo (2002) mentioned that, inadequate mathematics content contributes to the unrapid improvement of technology in Nigeria. Invisibility of the subject, most people just do not understand what the subject is all about and why they are studying it for so many hours over so many years.

Ineffective methodology by teachers: It's important to provide the students with effective instruction throughout their time in schools. Surprisingly, some teachers appear to be mismatching their instruction. The types of instruction some teachers use can have a noticeable effect on students' achievement. Teachers should engage students to have meaningful mathematical and scientific thinking through the use of appropriate methodology.

Unavailability of teaching facilities: Nigeria schools lack equipment and facilities necessary for effective teaching and learning (Mgbono in Umoh,2016). Most schools lack laboratory spaces and the necessary equipments. Most science subjects need various equipment and materials to practicalize the theory part of the subject concerned for proper understanding and total assimilation.

Socio-cultural lapses: Cultural heritage and social backgrounds are related to advantages in schooling, hence educational success. We need to look at primary effect of this relationship between social and cultural learning. Thus, social-economic status, language and ethno-mathematcs have very important relation to learning. For instance, social-economic measures an individual's position relative to others around him/her, understanding concepts of what's being taught using language. Then, the ethno-mathematics which is the study of relationship between one's culture and mathematics (Davis; Kenney; King & Rumbolt,2005). Often the connection between the two is the key to overcoming some problems in mathematics.

Prospects of STM Education

Science equipment centres: Already established in some parts of the country would provide enough standardized equipment for effective teaching and learning processes through laboratory instruction.

The establishment of more universities and colleges of education: With specification for minimum academic standards, the upgrading of some colleges of education to run degree programmes, this would eventually solve the problem of professional teacher supply and quality of instruction with enough teachers.

More research findings: These are becoming available for improving teacher education at various levels of training institutions. Tetfund intervention programmes are really making impact on the research sector and sponsorship of teachers at various level.

Local production: Standardize STM equipment by both government and some private firms. The production of crafts, soap, detergent, shoes making, shampoos, are positive impact of STM education.

Traditional beliefs: These were reinforced through various activities, such as the importance of maintaining balance to achieve harmony, connect the material to be learned to other relevant social, cultural, and political things so that it empowers the students to want to learn.

Having reviewed some of the common challenges and prospects of STM, it becomes necessary for stakeholders to rise up to the challenges, provide situation where students can learn effectively to justify their thinking and making real world contexts. Employers and public officials should have some degree of scientific and technological literacy in order to lead productive live as citizens.

It is not a matter of mere exposition of procedures that, mathematics was vitally important for everyone in this technological age. Government faces a range of distinct but interrelated policy challenges, which include providing universal mathematical foundation to support the study of other subjects that are increasingly demanding higher levels of mathematics, and stimulating the most able to continue with mathematics study (Institute of Mathematics and its Application (IMA) (2015). It is, thus, almost universally accepted that we live in a world that is increasingly shaped by mathematics with mathematical models underpining so much of the persuasive and ubiquitous technological infrastructure for our society. Hoyles and Lagrange (2010) mentioned that, for many teachers, educators and researchers, new advances in technology and increased access to technology in mathematics education provided opportunities for new perspectives on the development of students' understanding. Many claims have been made concerning the potential for change in mathematics education as a result of availability of technology and the subsequent benefits for student learning outcomes.

Recommendations

Following the discussion made so far, the following recommendations were made:

- Commercial mathematics should be taught to the country's citizenry to graduate level so as to enable them to come up with sound economic policies desired by the country.
- The experienced and trained mathematics specialists teachers be allowed to teach mathematics courses right from primary school level with minimum class size population.
- Establishment of mathematical centres at each local government level.
- Mathematics students should be involved in student industrial work experience scheme SIWES, since scientific and technological progress cannot be possible without mathematics. Mathematicians can give their direct contributions to scientific and technological breakthrough.

Conclusion

Science and technology for sustainable development in Nigeria depend to a large extent, on mathematics education. It is a known fact that, through mathematics education, we can produce sound mathematicians who can face the challenges of the modern era of science and technology. Quality mathematics education is required for any nation to advance scientifically and technologically.

References

Adetula, L.O. (2005). Mathematics: A cognitive tools for nation building. Published by National Mathematics Centre (NMC) Abuja.

Akase J. Mwekaven, S.S., Awuhe, R.T. & Tombuwua, P.T. (2015). Mathematics Science and Technology Education their place in the Nigeria National Transformation Agenda. *International Journal of Science and Technology* 4, (5).61-70.

Aniodoh H. S. (2012). *History and Philosophy of Science: A comprehensive text on general studies for tertiary institution*. Enugu, Nigeria: Hacorfarm Educational Books.

Davis, D., Kenney, M.B., King, B. and Rumbolt, D. (2005). Social and Cultural Issues in Mathematics Learning.https://www.math,mun.<a> retrieved 29/9/19

Encarta (2009). "Development". Microsoft Corporation.

Eze, A.E. (2008). Science Technology and Mathematics Education: the gateway to Nigeria's economy empowerment development. *Journal of science education* 9(1) 1 – 9.

Galadima, I. (2001). The effects of heuristic problem solving strategies on SSS students achievement in algebra. Unpublished PhD dissertation, A.B.U Zaria.

Garofalo J., Stouldrier, H., Herper S., Timmerman M. A., and Schockey, T. (2016). Promoting Appropriate uses of Technology in Mathematics Teacher Preparation https://www.citejournal retrieved 22/4/19

Hoyles, C. and Largrenge, J.B. (Eds) (2010). Mathematics Education and Technology Rethinking the terrain. New York/Berlin: Springehttps://epsrc.ukri.orgretrived 20/4/19

Igbokwe, O. (2003). An assessment of the Foundation of a Sustainable Scientific and Technological Development in Nigeria Statul *Journal of issues of mathematics* 6 (1) 1 – 16.

IMA Presidential Address (2015). The Potential Challenges for Mathematics Teaching and Learning in the Digital Age. https://imaan.org.uk retrived 22/4/19

Mathematical Science Research (MSR) (2010). Economic Performance.https://epsrc.ukri.org retrieved 20/4/19.

Muhammad, Z. (2008). Education and Sustainable National Development *Journal of Management in Nigeria*. 44 (2), 6 – 12.

National Council of Teachers of Mathematics NCTM (2000). Principles and Standards for School Mathematics, Reston, V A: Author.

Okafor, J.O. (2010). Transforming the Nigeria Nation through Science Technology and Mathematics Education. Lead paper presented at the 2nd annual conference of school of sciences Federal College of Education Obudu, Cross River state 26th – 29th March.

Oriafo, S.O. (2002). *Refocusing Science Technology and Mathematics (STME) Education in Nigeria: A book of Reading*. Agbor: Kmenswo Educational Publishers.

Presidents Committee of Advisors on Science and Technology, Panel on Educational Technology (1997). Report to the Presidents on the use of technology to strenglhen K – 12 educations in the united state.

Umoh, S.W. (2016) Problems and Prospects of effective *STEM Education Delivery in Nigeria*.Vol 35 No1 ISSN 1595-2126. www.globalacademicgroup.com retrieved 29/9/19

Uza, D. V. (2014) Science and Technology: key to our national development. http://www.com Retrieved 21/4/19.