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The Role of Mathematics Education in Achieving Sustainable Development Goals (SDGs)

[1]Omosowon Victoria Olasoji, [2]Ugwu Ukamaka Felicity & [3]David O. Onoh

[1,2&3]Department of Mathematics and Computer Education, Enugu State University of Science and Technology, Enugu.

Email: [1]olasoji@yahoo.com [2]felicityugwu@gmail.com & [3]onoh.david@esut.edu.ng

ABSTRACT

This study reviews the role of mathematics education in achieving quality Sustainable Development Goals (SDGs). Mathematics is the key to other fields of science education. Mathematics plays an important role in the achievement of the Sustainable Development Goals (SDG) and at the same time allow working with real situations in the subject of mathematics, providing the student with active learning. Sustainability is used to make the student see the usefulness of mathematics while instilling values and attitudes towards it. This paper examined the Mathematics Education for Sustainable Development and as well x-rays the constraints of mathematics education and the way forward in improving teaching and learning of mathematics education in order to support the realization of SDGs targets. Conclusion and a way forward were suggested based on the literature reviewed.

Keywords: Education, Mathemathics, mathematics Education Sustainable Development Goals (SDGs)

INTRODUCTION

One of the core subjects offered at all levels of education is mathematics. Mathematics is a compulsory subject from Pre-Primary level to Senior Secondary School level (Alio & Anibueze, 2015). Mathematics is one of the natural sciences which focuses on the living world. From all indications, mathematics is how the world is structured, how it functions and what these functions are, how it develops, how living things came into existence, and how they interact to one another and with their environment (Umar, 2011). Mathematics is one of the oldest school subjects that are indispensable for individual and societal development. It is widely used in everyday life such as politics, economics activities, science and technology. However, it is pitiable and a thing to be lamented about, that this very important Queen, king and servant is least desired by the learners. Aminu (2010). This includes medicines, pharmacy, nursing, agriculture, forestry, biotechnology, nanotechnology, and many other areas (Ahmed & Abimbola, 2011). Mathematics plays an important role in forming the basics of all other sciences. Ukeje (2010) described the importance and the attention given to Mathematics as stemming from the fact that without Mathematics, there is no science, without science, there is no modern technology and without modern technology, there is no modern society, therefore without mathematics there is no development and the sustainable development goals and its target will not be achieved.

Mathematics has helped to transform man's rural society to modern society. The need of mathematics can be said to be as old as mankind. This arose out of man's desire to

count and keep records of things around him. The fact that mathematics is the foundation of science which is the bed rock of modern development. It is well known that the level of social and economic development of any country is intimately connected with the level of development of that country in science and technology. Since mathematics is known to be at the foundation of science and technology, it means that the level of social and economic development is closely connected with the level of development in the mathematical sciences (Kuku, 2012). No society can develop without the effective teaching and learning of mathematics in schools (Azuka, 2015). Therefore, Mathematics education is vital to a nation development, particularly due to its contributions to the training of manpower in the fundamental basics of science and technology as vital tools useful in every sphere of life.

The fundamental reasons for teaching school mathematics include: contributing to the technological and socio-economic development of a society; contributing to its political, ideological and cultural maintenance and development; and providing individuals with prerequisites which may help them to cope with life in the various spheres of education or occupation, private life, social life, life as a citizen. Mathematical skills are relevant to a wide range of analytical, technological, scientific, security, political and economic applications and the solid foundation in mathematics prepares one for other educational and professional challenges (Ambali, 2014). Without mathematics there is no science, without science, there is no technology; without technology there is no modern development.. Hence, it has been asserted that the gap in the level of development between the advanced countries and the developing countries is as a result of the gap in the level of the teaching and learning of mathematics (Effiom 2015).

Out of all the problems affecting the teaching and learning of mathematics in schools, the teacher factor in terms of quantity and quality appear most prominent. Hence, no nation can achieve effective teaching and learning of mathematics in schools without adequate number of qualified teachers in the society. Therefore, it can be said that no nation can achieve meaningful development without adequate number of qualified mathematics teachers in the society. Generally, education is to make one fit to live with others in any society. It is to make one live a meaningful life and contribute meaningfully to the development of the society. An educated individual is expected to contribute to the development of the society better than he met it at birth. Education is the aggregate of all the processes which a child or a young adult develops the abilities, attitudes and other forms of behavior which are of positive value to the society in which he lives (Enaigbe, 2019)

Mathematics Education and Sustainable Development

Mathematics is the bedrock of the economic and technological development of any Nation. Researchers in mathematics are concerned with the tools, methods and approaches that facilitate practice. In the 18th and 19th centuries, the industrial revolution led to an enormous increase in urban populations. Basic numeric skills, such as the ability to tell the time, count money and simple arithmetic, which were essential in this new urban lifestyle. Within the education systems, mathematics becomes a central part of the curriculum for an early age. By the twentieth century, Mathematics education is the practice of teaching and learning mathematics with the associated scholarly research in contemporary education. Mathematics was part of the core curriculum in all the developed countries. In the 20th century, the cultural impact of the ‘electric age’ was also

taken up by educational theory and the teaching of mathematics, while previous approach focused on “working with specialized problem in arithmetic” (Marshall, cited in Ambali, 2014). The emergent structural approach to knowledge had small children meditating about number theory and sets.

The role of education in the developmental effort of any nation cannot be overemphasized. The development of the educational sector facilities can stimulate the development in all other sectors. According to Sule (2004), education is a pure pathway to liberation of the mind and improvement of socio economic status of people Development may be defined as the collective activities by any human society directed at reducing the totality of perceived obstacles to a higher standard of living, thus maximizing the quality of life of citizens. Development is widely conceived as a " participatory process of social change in the society, intended to bring both social and material advancement (including greater equality, freedom and other valued qualities) for the majority of people through their gaining control over the environment"(Ambali, 2012).

Some of the elements of development include high standard of living, high agricultural productivity, high technological productivity, adequate exploration and exploitation of the natural and mineral resources of the society, less dependence on imported materials, presence of heavy industries, high literacy and numeracy rate of the citizens, appropriate health care delivery and low unemployment. Every society aspires to develop and achieve a better standard of living for her citizens and this is only possible with the presence of well trained technologists who can help to transform the society. Therefore, the under development of Nigeria could be readily traced to her lack of economic independence which in turn arise from her backwardness in science and technology. Development is expected to be purposeful and sustainable in order to be beneficial to the society for a long time. In the words of Ambali (2012) "without sustainability, development itself is ultimately counterfeit and counterproductive".

Sustainable development is development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs. It is a process of change in which exploitation of resources, the direction of investments, the orientation of technological development, and institutional change are all in harmony and enhance both current and future potential to meet human needs and aspirations (Umar, 2011). Sustainable development process must reflect and be dictated by the resource base available to that society and should strive towards optimal utilization of natural and human resources in its environment. The Brundtland report defines sustainability as “the ability to meet the needs of the present without compromising the ability of the future generations to meet their own needs” (Kuku, 2012). Sustainability has three dimensions: economic, environmental and social. Development is only sustainable if concepts related to economic viability, social justice and environmental impacts are addressed.

The importance of education to achieve sustainable development is increasing. In 2005, the Decade of Education for Sustainable Development 2005–2014 was signed, and in 2015, the United Nations approved Agenda 2030 which set out 17 Goals for Sustainable Development (SDGs), with the aims of ending poverty, promoting quality education, achieving gender equality and sustainable cities and communities, among other goals. it will first be explained about 17 Sustainable Development Goals

(SDGs), namely: (1) no poverty; (2) zero hunger; (3) good health and well being; (4) quality education; (5) gender equality; (6) clear water and sanitation; (7) affordable and clean energy; (8) decent work and economic growth; (9) industry, innovation and infrastructure; (10) reduced inequalities; (11) sustainable cities and communities; (12) responsible consumption and production; (13) climate action; (14) life below water; (15) life on land (16) peace, justice and strong institution and (17) partnerships for the goals. According to Sachs (2015), adopting global goals is important for the following reasons:

- eencourage social mobilization
- create peer pressure among political leaders
- spur networks of expertise, knowledge and practice into action
- mobilize stakeholder networks across countries, sectors and regions, coming together for a common purpose.

The 17 Sustainable Development Goals (SDGs) associated with the Agenda help the region's countries to gauge the starting point from which they set out towards this new, collective vision of sustainable development set forth in the 2030 Agenda and to analyze and craft the means of its implementation. The SDGs also represent a planning and follow-up tool for the countries at the national and local levels. With their long-term approach, they offer support for each country on its path towards sustained, inclusive and environmentally friendly development, through the formulation of public policies and budget, monitoring and evaluation instruments. The 2030 Agenda is a civilizing agenda that places dignity and equality at the center. At once far-sighted and ambitious, its implementation will require the engagement of all sectors of society and of the State. Providing equitable access to quality education for all children is an urgent goal for global sustainable development (Azuka, 2015).

Obtaining a quality education is the foundation to improving people's lives and sustainable development. Major progress has been made towards increasing access to education at all levels and increasing enrolment rates in schools particularly for women and girls. Basic literacy skills have improved tremendously, yet bolder efforts are needed to make even greater strides for achieving universal education goals. By 2030, ensure that all youth and a substantial proportion of adults, both men and women, achieve literacy and numeracy skills. Mathematics matters because it permeates all aspects of daily life, and learning mathematics develops 21st century skills related to critical thinking and problem solving. While it can be difficult to disentangle the myriad social, economic, and institutional factors that influence outcomes for learners, there is clear evidence that teachers are the key influence on student learning at the classroom and school level. The quality of mathematics teachers is especially significant, since mathematics achievement has a profound impact on young people's life chances after leaving school.

Mathematics has confined to play a significant role in the national development of any country. Development here is conceived as the capacity of a nation to apply technology for the exploitation of the resources of nature. Such exploitation will rely very heavily on mathematics for laying the foundation for political, government, military, scientific, technological advancement, economic development, socio-cultural environmental peace. For the general development of any nation, mathematics has central roles to play. The effective teaching and learning of Mathematics cannot be achieved without adequate number of qualified and motivated teachers in the school system. Irrespective of the provision of classrooms, instructional materials, facilities and general

administration in any school, the effective teaching of Mathematics cannot be achieved without sufficient number of qualified and motivated mathematics teachers. Therefore, one sure strategies for ensuring a sustainable development in any nation is to sincerely address to problems of the production and retention of qualified mathematics teachers in any society.

The teaching and learning of mathematics in Nigeria can be said to unsatisfactory and disturbing. This is evidenced by the declining trend in the performance of students in school and public examinations. According to Gomoha (2015), results from Junior secondary III (JS3), Senior secondary certificate Examinations (SSCE), Mathematics both WAEC and NECO sre instances of poor mathematics achievement in the country.the annual releases of certificate examination by National Examination Council (NECO). For instance, NECO reported that only 36.57% and 31.28% of Nigerian students got five credits or more including mathematics and English in NECO in 2015 and 2016 respectively. This does not spell well for a nation like ours that is striving to grow economically and technologically therefore this situation has to be addressed if the Nation is to achieve a sustainable development. This poor state of the study of mathematics can only be improved upon when adequate number of qualified Mathematics teachers are employed by the Nation.

Constraints of Mathematics Education in Nigeria

According to Oviawe (2010), the following factors hinder mathematics education in Nigeria, they include:

1. Poor knowledge based economy and low spirit of competition
2. Poor enterprising culture
3. Lack of entrepreneurship teachers, materials and equipment.
4. Unavailability of funds
5. Non-inclusion of entrepreneurship in the school curricular
6. Poor societal attitude to technical and vocational education development
7. Inadequate facilities and equipment for teaching and learning
8. Problem of shortage of mathematics teachers in Nigeria.
9. Insensitivity of government to enterprise creation and expansion strategy.
10. Poor plan and execution of processes of action.
11. Isolated packet of ineffective programs and management incompetencies.

In Nigeria today, there are not enough number of qualified teachers in schools especially in mathematics. In fact in some schools there are no single qualified mathematics teachers to teach the students. Sometimes, they resort to using graduates in other subject areas to teach mathematics. Of course, this would not result to effective teaching. The shortage of Mathematics teachers is due to the poor condition of service of the teaching profession as many students go for other professional courses that are considered more lucrative and avoid studying mathematics and mathematics education. The problems of the shortage of teachers and the consequences can be be improved with the help of following:

Improving the Teaching Service Conditions of Mathematics Teachers: Condition of Service of any profession determines how likeable the profession would be. The more likeable the profession is, the more attractive it would be to skilled and qualified personnel. Decent and lucrative employment will always attract best hands. If the Mathematics Teaching Profession will attract best hands, then its service condition must be seriously improved upon and its remunerations made very attractive. When this is done, the profession would definitely become competitive and adequately staffed with

competent hands which will in turn culminate in the desired outcome from the students. In Nigeria and indeed in most African Countries, many teachers leave the profession to other more lucrative professions few years from the date of employment. Teaching is regarded as a "stepping stone" or a "half-way house" to other more lucrative professions. Teaching of Mathematics is worst hit by the problem of mass exodus to other professions. Due to the poor condition of teachers, many students do not apply to study mathematics or mathematics education in our Tertiary Institutions. Rather they prefer to apply to study Medicine, Engineering, Pharmacy, Accounting and other Professional courses that are seen as being more lucrative in the society. Then those students who could not get admission to study those choice courses take up the study of mathematics and mathematics education as last resort. Thus, in our society we have our best brains treat the sick; build our roads and bridges, manage our finances, but we have our worse brains to bring up our children who hold the future of the Nigerian economy. So where lies the hope of our technological development?

Improving the Competencies and Proficiencies of Mathematics Teachers: There must be a total divorce and disconnect from the old methods of teaching Mathematics. Mathematics must be presented in such a way that it becomes real, concrete, attractive, interesting, captivating, motivating and directly related and relevant to life. This can only be achieved by employing a new method of teaching which is termed 'Activity Based Learning'. This method involves students actively in the teaching and learning process. This is a globally acceptable method which has proved to be very potent, efficient and productive. Therefore, a programme should be put in place to train and retrain teachers on how to improve their competencies and proficiencies in the area of actively involving students in the teaching and learning process. Therefore, there should be regular workshops and seminars for mathematics teachers to improve their competencies. This would improve the productivity of the teachers and the quality of our school graduates in the mathematical sciences. In the long run more qualified teachers of mathematics would be available in the educational system.

Engaging Adequate Qualified Hands to Teach Mathematics: There is gross inadequacy of competent hands to teach mathematics in our schools. Therefore, there is an urgent need to recruit enough qualified personnel in the teaching of the subject. This can be achieved by the recruitment of Mathematics Education Graduates. The recruitment exercise should be such that Mathematics Education Graduates are subjected to Aptitude Tests and successful ones are subsequently made to undergo interviews so that best candidates can eventually be recruited for the job. Another dimension of the problems of shortage of mathematics teachers is that while there surplus and unemployed mathematics and mathematics education graduates in some states , they are grossly lacking in some other states of the federation. This is due to the problem of ethnicity as non state indigenes if at all recruited in other states are appointed as contract staff and usually have their appointments terminated after few years. This is happening among states in the same Federal Republic. A policy should be put in place to have mathematics teachers given permanent and pensionable appointment in any part of the country. This would definitely improve the supply of mathematics teachers in Nigeria.

Conversion of Non Mathematics Graduates to Mathematics Teachers: One of the ways to increase the number of Mathematics teachers in Nigeria is the

introduction of Post-Graduate Mathematics Education Conversion Programme for Graduates of Mathematics Related Disciplines. The programme should involve Graduates of other Sciences and Social Science disciplines who are willing to be converted to Mathematics Teachers. The course should be for about a twelve months intensive course after which the Graduates would be certificated and employed as Mathematics Teachers. The programme for the education of good mathematical sciences teacher at all levels should consist of three basic components: General Education; Specialized Education and Professional Education. The general education should include English Language and Sociology of Education. The specialized education component consists of the main topics in Mathematics. The Professional component include child growth and development, Theories and principles of learning, curriculum theories and practice, teaching strategies and methodologies, Assessment and Evaluation, and principles and Theories of school management and supervision(Ukeje, 2002). The course should cover basic education courses and mathematics courses emphasizing mastery of the subject matter from primary to senior secondary school level and elements of post secondary mathematics topics. Such converted teachers should be given appointment with good conditions of service. This will ensure uninterrupted supply of mathematics teachers to schools.

Attraction of Good Students and Personnel for Careers in Mathematics and Mathematics Education: Most Tertiary Institutions in Nigeria record very low enrolment of students into Mathematics and Mathematics Education annually. In fact, many of the Universities in Nigeria do not graduate up to five students in Mathematics and Mathematics education annually at the Master and doctorate degree levels annually. The number of specialists in Mathematics and Mathematics Education is dwindling and on the decline. Hence, specialists in these areas are gradually becoming endangered species because those on ground cannot be adequately replaced their retirement (Kuku, 2012). Now, good students in mathematics at the secondary school are attracted to more lucrative careers in Engineering, Medicine and Banking and Finance. There is urgent need for a special incentive package inform of generous scholarships to attract talented students to study mathematics and Mathematics education. When scholarships are provided, students are attracted to apply for such courses in Tertiary institutions. Besides, qualified Mathematics and Mathematics education graduates should be offered special remunerations on employment. When many prospective students are attracted into the study of mathematics and mathematics education, in the long run the nation shall have enough personnel as teachers at all levels and a good number of them in Science and technology for the development of the Country.

Recruitment of the best Brains into the teaching of Mathematics: Generally, the best graduates in all the subject areas should be identified and recruited in the teaching profession as practiced in some other African and advanced countries such as Finland. The best brains in any subject discipline should be the teachers of such a discipline at all levels. This is the only way of ensuring quality control and development in that subject area. Best brains in a subject would be enthusiastic about the teaching, research and development in the area of study.

Conclusion

The study of mathematics at all levels of our educational system is faced with so many problems. Among all the problems, the most important one is the problem of the quantity

and quality of mathematics teachers in our school system. The best way to address the problems of the teaching and learning of the mathematical sciences is to address the problems of teachers especially their condition of service. With attractive condition of service, many students would opt to study the subject, more qualified teachers would be available in the school system, and then the performance of students would improve.

The researchers therefore, suggested a way forward as follows:

1. Action should be put in place to deliberately improve the salaries and conditions of service of teachers as done in some advanced countries.
2. Arrangements should be made to retrain our unemployed graduates especially those in social sciences to convert them to mathematics teachers.
3. Students wishing to study the mathematics education should be awarded bursary to attract them to the courses.
4. Specialist teachers should be employed to teach mathematics at the different school level especially in primary school to lay basic foundation to the learners.

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