

Mathematics Education for Sustainable Development: Implications for Scientific and Technological Literacy

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Abstract

This paper seeks to investigate and thoroughly examine mathematics education for sustainable development using the ambit of scientific and technological literacy. The obvious importance of mathematics in facilitating scientific and technological development in the 'developed', 'developing' and 'under-developed' nations of the world are quite glaring. This paper therefore considered mathematics education in relation to the sustenance of scientific and technological development in Nigeria. Issues such as the political implications of mathematics education and the social implications of mathematics education were delved into. This paper also discussed the principles behind the actualization of scientific and technological literacy using mathematics education as a focal point. Hence, suggestions on how mathematics education could be improved by both the Federal government and other agencies were given. Recommendations on how attendant problems in mathematics education could be solved were proffered.

Keywords: Mathematics Education, Sustainable Development, Scientific, Technological Literacy.

Introduction

Jayeola-Omoyemi (1995) posited that scientific and technological breakthrough have a tremendous impact in revolutionizing many industrial and social activities of mankind. If this assertion is correct, one would equivocally admit that there will be no scientific and technological development without proper mathematics education. Moreso, development has more often than not been associated with scientific and technological breakthrough of various nations in question. Development may be attained by the so called 'developing' nations of Africa, but the main issue is the sustenance of that development.

Furthermore, the encouragement given to students to love mathematics; teachers to diversify their methods of teaching; as well as incentives by government to teachers are noteworthy in most African nations and Nigeria in particular. The question now comes – are these incentives sufficient to sustain the so far scientific and technological development attained especially in Nigeria? Since mathematics is the bedrock of science and technology, its level of understanding among the Nigerian population becomes a serious concern for scientific and technological literacy. This concern stems from the fact that if the level of mathematics among the Nigerian population remains so low, the sustenance of the scientific and technological development so far attained becomes a mirage. Harping from the views of Ogunniyi, Eniayeju and Emereole (1992), a scientifically and technologically illiterate person is considerably circumscribed in playing his/her full potential role in the socio-economic development of his/her community. This means that there is need for massive mathematics education among the Nigerian population. Corroborating their views, The Federal Ministry of Education, FME (1998) stated that the objectives of primary education

include among others – the inculcation of permanent literacy and numeracy, and the laying of sound basis for scientific and reflective thinking. The implication here is that much more attention must be paid to mathematics education in the nation's school system. The role played by mathematics in the scientific and technological development of America and the NATO nations cannot be overemphasized. For instance, the news of the launching of the first artificial satellite, the Sputnik by the USSR in 1957 shook America. This spurred America to make major revisions of science, technology and mathematics curriculum. Also, teacher preparation and welfare were greatly improved. More funds were equally made available at all levels of the educational system. These efforts yielded dividends in 1969 when two Americans successfully landed on the moon (Iji, 1999). This connotes that massive scientific and technological literacy would depend on massive mathematics education with respect to issues of curriculum, strategy and teacher education. In an attempt to discuss this issue, this paper seeks to take a parasonic view of the political and social implications for science and technology via effective and efficient mathematics education.

Political Implication of Mathematics Education for Scientific and Technological Development

Aghaduno (1999) observed that mathematics has been exceedingly successful, especially when applied to science. Invariably, mathematics has some unique characteristics which science share to some degree. This is why Bishop, Hart, Lerman and Nane (1993) said that "schools and individual learners exist within societies and in the concern to ensure the maximal effectiveness of school mathematics teaching, we often ignore the educational influence of other aspects of living within a particular society". This therefore, creates more responsibility to mathematics educators ensuring that their mathematics teaching is relevant to the particular society in which they found themselves. This responsibility of mathematics teaching must not separate itself from the economic, cultural and political context of the society. The obvious implication here is that society influences mathematics teaching and learning through the formal and instructional structure, which it intentionally establishes for this purpose.

Societies therefore influence the intended mathematics curriculum in most countries through nationally or regionally structured organizations. Buttressing this point, Bishop et al (1993) posited that;

For example in the United Kingdom, the present government has recently instituted a national curriculum, a development in which the highly political nature of national curricular decision-making has been rather obviously demonstrated. We have therefore seen the typical political pressure groups being very active – the back to basis groups led by traditionalists among the employers and government, the teachers and educators concerned about the erosion of their influence of the central government's interference, the more progressive industrialists who want to ensure that school leavers compete with the best of the rest Europe.

The above suggests that the scientific and technological attainment of the developed and industrialized nations was due to the political will of the government and other organizations. This resulted to massive mathematics curriculum reform and appropriate mathematics – the case of back to basis. This has far-reaching implication for all stakeholders in Nigeria's scientific and technological development. The political groups, parents, civil servants and others with educational power should not claim ignorance of the need for massive scientific and technological literacy for

Nigeria, which its achievement could only be facilitated by an effective and efficient mathematics education.

Again, Nigeria and Nigerians should realize that the impetus to become ever more, industrialized and technologically developed as the so-called developed or developing nations has been underpinned by the belief in the importance of adopting the mathematics and science curricula of the more industrialized societies. Should mathematics then become more of a critical and politically informed subject serving the needs of a concerned society or should it become more of a vehicle for developing democratic values? It connotes that the mathematics curriculum is clearly too important an instrument to be determined by mathematicians alone. Politicians, economists and other stakeholders are equally needed.

Social Implication of Mathematics Education for Scientific and Technological Development

Keitel (1986) arguing for social needs for mathematics states that;

By social needs demand I understand here the pressures urging school mathematics to comply with the needs for certain skills and abilities required in social practice. Mathematics education should qualify the students in mathematical skills and abilities so that they can apply mathematics appropriately and correctly in the concrete problem situations they may encounter in their lives and works. Conversely, social usefulness has been the strongest argument in favour of mathematics as a school discipline and the prerequisite to assigning mathematics a highly selective function in the school system.

This is a major challenge of scientific and technological literacy in Nigeria today – how to link scientific and technological knowledge of the citizenry to their everyday life. More important is to what extent their mathematics knowledge so far helped to sustain the scientific and technological knowledge acquired. The position taken by Keitel as indicated above showed that the social interaction between science and technological functions in the society is inseparable from mathematics education.

Furthermore, Ohuche (1995) said;

The purpose of scientific activity is to build up knowledge, to give an explanation for something; to provide a time description of some event; to diagnose the nature of some condition. While the purpose behind technological activity is to facilitate human aspiration to solve some practical problems; to put knowledge to good use; to extend the boundaries of existing possibilities. Thus it is the purpose of science to explain why air that moves rapidly over a surface exerts least pressure upon the surface than does slowly moving air. But to demonstrate how this fact might be used to build a machine that will fly is a technological achievement.

This implied that if the activities of science and technology are to be promoted and sustained by Nigeria, her citizenry must need to be properly tutored in their social implications. This means that mathematics education must be made relevant in the Nigerian school systems i.e. primary, secondary and tertiary levels of education. The issue now is how do we actualize the scientific and technological literacy so advocated?

Actualizing Scientific and Technological Literacy via Mathematics education

According to Baptiste (2000) more than 90% of the scientists said that the general public's current level of understanding of science, its methods and impacts is adequate. He further stated that only 32% of American parents surveyed felt they were science literate. The frightening situation is that only 36% of all teachers surveyed believed they were science literate. The Nigerian case is far much frightening than what we are seeing, he averred.

On this ground, it was observed that workers of this 21st century require not just a larger set of facts or a larger repertoire of specific skills, but the capacity to readily acquire new knowledge, to solve new problems and to employ creativity and critical thinking in the design of new approach to existing problems. Trotter in Bantiste (2000) stated that the evaluation of our goals for the enhancement of scientific literacy, technological effectiveness and mathematical skills in our educational system is not only unclear but until very recently lacked any public or political support. Okoro (2000) therefore felt that the training of skilled manpower in science and technology for the different aspects of national development should be considered a national priority area. This is because science and technology education provides a means whereby the individual can organize human concepts and attitudes, classify experience as well as communicate with others.

Since mathematics teachers are primarily the source of science, technology literacy (STL), their inadequacy both in qualitative and quantitative form becomes a concern (Hogan, 2000). Furthermore, Iji (2001) noted that for science and technology to be sustained, there is the need for mass production of mathematics teachers both quantitatively and qualitatively. This may be so because mathematics teachers stress scientific and technological literacy by demanding a rational and independent approach to science and technology and its impact on society. Functional, relevant and related mathematics, which enhances the scientific and technological literacy of the society can only be realized through the use of qualified mathematics educators.

Recommendations

The obvious nature of intimacy of science, technology and mathematics is seen in this paper. The fact that sustaining what one has already is better than going for a fresh new one which might be more expensive and possibly time consuming, recommends the following:

- The school systems should be enriched with qualitative mathematics educators by giving them specific training relevant to science and technology
- Political groups, parents, civil servants and other stakeholders in science and technology should be co-opted in the planning of mathematics curriculum and not leaving it out totally to mathematicians.
- Since scientific and technological development and its sustenance is to some extent hinged on the competency of the mathematics teacher, he/she should give his/her teaching a human face.

Conclusion

This paper critically examined the position of mathematics education on the development of science and technology. It pointed out the political will of the developed nations that had to go back to basis which saw them to their present technological position. Political and social implications of science and technology to the Nigerian society were discussed. It is expedient to

know that to disseminate the science and technology literacy among Nigerians, the teacher of mathematics in Nigeria educational system is considered indispensable.

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