STEM EDUCATION AND SUSTAINABLE DEVELOPMENT IN AFRICA-PROBLEMS AND PROSPECTS

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Abstract
Science, Technology, Engineering and Mathematics (STEM) education is the foundation for sustainable development the world over. It constitutes the primary driver of progress of nations and a veritable pivot on which human advancement revolves. STEM education delivery in Africa is however bedeviled with enormous problems. These problems are not insurmountable as there exists laudable springboard for improvement. This paper discusses the relevance of STEM education to sustainable development, the problems of STEM education delivery as well as its prospect. Some recommendations have also been made for effective STEM education programme for sustainable development in Africa.

Sustainable development is that development which is self-regenerating, self-sustaining and dependent mainly on internal inputs and initiatives (Ogban-Iyam, 1983). This type of development is needed to maximize the output of consumer and capital goods, reduce the problem arising from foreign trade and promote social and economic development. Badejo (2005) noted that sustainable development can only be meaningful when most of the inhabitants of a country have rudimentary knowledge of Science, Technology, Engineering and Mathematics (STEM).

Science as a body of knowledge comprises ideas, skills and information about the world, nature and man (Ango, 1990). Science is a two-way activity that involves product (knowledge and other outcomes of science) and process (skills and scientific procedures of investigation). It involves an attitude of inquiry, observation and reasoning with respect to the natural world. It can be developed through practice, observation and reasoning.

STEM educations assist the learner in developing certain attitudes, knowledge and skills regarding the order in nature. It aims at producing scientifically literate citizens as well as producing a potential of scientific and technological manpower. Awareness has been created about an ever-increasing gap between the scientific elite and scientific illiterate. Scientific literacy is an aspect of cultural literacy which centres on a functional understanding of the nature of science. (Mbah, Leghara, 2008).

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A scientifically and technologically illiterate person is considerably circumscribed in playing his full potential role in the socio-economic development of his community.

STEM education has introduced a lot of changes in the world today and it will continue to do so in the future (Orukota, 2007). Achievement of STEM education will go a long way in reducing illiteracy and poverty, which are impediments to sustainable development. There is need to produce scientifically and technologically literate citizens that can sustain the natural environment and sustainable development.

**Relevance of STEM Education to Sustainable Development in Africa**

The significance of Science, Technology, Engineering and Mathematics (STEM) education for the attainment of sustainable development in Africa cannot be over emphasized. STEM education is fundamental to the strengthening of higher levels of education, capacity building and self-reliant development. The strategic and inimitable role of STEM education towards the development of the world is beyond doubt (Okoro, 2013).

Meanwhile, the symbiotic nature of science, technology, engineering, and mathematics is such that as a seamless robe it is integrated into one entity science education whose principles and structure are anchored in Mathematics. Significantly, STEM education contributes to general educational development and practice. It has become a stimulating elixir, the necessary catalyst, which has engendered the spirit of sustainable development world wide.

Indeed, the role of STEM education for achieving sustainable development for Africa is so self-evident that any country that fails to pay due credence to the development of a veritable STEM-based education at the grassroot can only do so to her peril. Fafunwa (1972) observed that, “we are living in a world where science and technology have become an integral part of the world’s culture and any country that over looks this significant truism does so at its own peril”. Hence, science education is a worthy platform to prepare African youths for the challenges ahead, in a highly technological world. To Akpan (2008), “the international competitiveness today is increasingly being defined in terms of ability to access, learn, adapt, utilize and innovate from available technology”. That is to say, nations that fail to innovate lose their competitive position. Explicitly, a sound and veritable STEM based oriented education at the grass root holds the key to the answer.

Ordinarily, since science education is considered the key to effective development strategies, science, technology, engineering and mathematics (STEM) education must be the master key that can alleviate poverty, promote peace, conserve the environment, improve the quality of life for all and help achieve sustainable development. (Okoro, 2013).
STEM education expose students to development in science and technology along-side skills that will enable them face challenges, make informed decisions, develop survival strategies and learn to live effectively within the global community (F.M.E., 2007).

Challenges of STEM Education Delivery in Africa

1. **Poor Teacher Supply**
   Most African states are facing the challenge of shortage of STEM education teachers. This shortage is even worst in the rural schools. Akinsola, Lawal & Oyedokun (2007), reported that very low percentage of teachers are found in the rural areas. The dearth of teachers makes a single teacher handle virtually all the students for that particular subject in the school. This situation makes the teacher worked up each day and so cannot be effective. Most teachers therefore, avoid the student-centred approaches to teaching e.g project, field trip, excursions, demonstrations etc. They rather resort to the teacher-centred methods which are not effective for science teaching.

2. **Poor Teacher Quality**
   Some teachers in schools today are highly incompetent. They lack content knowledge as well as pedagogical skills as a result of laxity during their undergraduate days. Today, they find themselves in schools and are not able to deliver. According to Amuzie (2008) this category of teachers showed high level of compromise in their college days. When they scored 39% or 40% in an examination that was rated to be 100%, they celebrated with great excitement and enthusiasm. Such teachers do not teach but cheat and bring poor image to the profession.

3. **Unavailability of Teaching Facilities**
   Most schools across the continent lack teaching equipments and facilities necessary for effective teaching and learning (Mgbomo, 2013). Some Schools, especially in the rural areas lack laboratory spaces and necessary equipments. There is a limit to what teachers can improvise. The extensive sourcing for and preparation of teaching materials at every stage coupled with problems of overcrowded classrooms, and sometimes administrative work, etc becomes very cumbersome.

4. **Overloaded Syllabus**
   There is need to reduce pressure on science teachers. To be good scientist and innovators the process skills are needed. However, this ingredient is lost because in an attempt to cover grounds for the purpose of examinations, effective science teaching is not carried out. Lawal (2011) found out in a survey
that the SSCE biology curriculum was overloaded. This, he pointed out, makes teachers skip or haphazardly treat some topics.

5. **Inadequate Incentives**
   STEM education has mostly to do with practical work in and out of the laboratories. It sometimes involve hazardous exercise and the use of poisonous chemicals. In the oil companies and firms, workers who do hazardous jobs are covered by insurance policy either in cases of injuries or death and are paid some special allowances. In the case of science teachers no recognition is given. In some states in Nigeria, STEM teachers are paid peanuts e.g. ₦1000.00 as science allowance. This uncompensated working condition does not motivate teachers and so, they can choose to do their work haphazardly.

6. **Poor Environment**
   Teachers need to be accorded respect and honour for the work they do. It is observed that teachers work in harsh conditions. Some lack tables to work on and even manage half broken chairs in over-congested staff rooms. In many cases, they manage with dirty non functioning toilets.

7. **Capacity Building**
   Science is dynamic in nature. New methods and strategies are continually being evolved to facilitate teaching. Teachers need to update and upgrade themselves by attending training programmes. These enable them live up to expectation by exhibiting mastery of subject matter as well as distinguish themselves pedagogically.
   However, due to personal financial constrains and lack of sponsorship teachers hardly attend workshops and conferences. Awosika (2006) in a survey found out that only 25% of his subject had attended workshops, seminars, conferences and symposia for the past 10 years.

8. **Large Class Size**
   In Nigeria, explosive enrolment due to the UBE programme has resulted in overcrowded classes. STEM demands that students be involved in practical work. Okeke & Chinwe (2006), emphasized that all learning in science must begin and end in the laboratory. The laboratory, according to them is a place where students explore problems, generate and test the related hypotheses and ultimately discover newly invented concepts. Due to the over-crowded condition of the classes coupled with the absence of laboratory support staff, teachers in majority of cases carry out practicals only two or three weeks to external examinations such as SSCE because they are overburdened with the
task in the face of the large classes. This state of affairs will have a negative effect on overall productivity.

9. **Deficient Curriculum**
Teacher education programmes in Africa are long overdue for review. There seems to be a mismatch between the teacher education programmes and the secondary school curriculum requirements which has led to the inadequacies found in some graduate teachers. Ovute in Ovute & Ugwanyi (2011) reported that the current minimum standard at the college of education level seems not adequate for the 9 years basic education curriculum. According to Ovute, most N.C.E graduates cannot adequately fit into the new basic education classroom for effective delivery of the U.B.E programme. Similarly Lesi, Awobodu & Adegbamigbe (2009) stated that there is a large mismatch between the skills required for the modern economy and the education imparted to most of the students in higher learning. Teachers, teach according to the way they were trained (Mgbono, 2013).

**Prospect of Stem Education Delivery in Africa**
Although the problems enumerated seem enormous, there is still hope for the future as regards adequate STEM education delivery in Africa. The curriculum guidelines are adequate and the policy on education is clear on what is expected for development through STEM education (Chinwe, 2008). The efforts on ground for improvement are encouraging. There is potential for a better tomorrow as:

1. The establishment of more universities and colleges of education with specifications for minimum academic standards would solve the problem of both professional teacher supply and quality of instruction. With enough teachers, large class size would be effectively handled.
2. The science equipment centres already established in various African countries would provide enough standardized equipment for effective delivery of instruction and for the laboratories.
3. Research results on the effects of innovative teaching styles and better ways of improving curricula delivery would equip teachers to better fulfill their roles.
4. More research findings are becoming available for improving teacher education at various levels of teacher training institutions.
5. There is movement towards a unified syllabus in each STEM subject at the secondary school level and a national guideline at the primary level in various African countries.
6. There is local production of standardized STEM equipment by governments and some private firms across the continent.
Conclusion

STEM Education is a meta-disciplinary learning approach where students are equipped with the ability to compete in the new economy. It is undoubtedly, a vital tool for sustainable development in Africa. To make it meaningful, stakeholders in the system, particularly; the teachers must rise up to the challenge of translating theories into practice as well as making STEM relevant and interesting to learners. There is need to shift from the traditional practice of rote learning and memorization of facts to the new approach which focuses on helping students to think scientifically and creatively.

Recommendations

In order to make further progress in STEM education in Africa, the following recommendations are proffered:

1. Professional STEM education teachers alone should be allowed to teach STEM subjects in secondary schools, while the non-professionals should be encouraged to understand professional teacher training programme.

2. Following the encouraging efforts made so far by curriculum development experts, governments are called upon to increase the present level of funding of these agents so that more innovations in STEM education may be enhanced.

3. African governments should encourage individuals and organizations to embark on the manufacturing of STEM equipment through the granting of incentives such as tax-relief and import liberalization.

4. Various African governments should seriously consider the issue of employing laboratory assistants to support STEM teachers to cope with the enormous demands for effective laboratory activities involving large classes.

5. STEM education teachers should be encouraged to enroll as active members of Science Teachers Association in their various countries and other professional bodies by assisting them pay membership subscriptions and purchase relevant Journals and materials. STEM teachers should also be sponsored to workshop in their subject areas to update knowledge.

6. There should be greater and enhanced incentive by way of science and hazard allowances for all STEM teachers.

7. Model STEM laboratories and workshops should be provided in schools for appropriate use by STEM teachers and students.

References


