ADDRESSING THE CHALLENGES OF SCIENCE EDUCATION IN AFRICA THROUGH A GLOBAL LENS

Oloyede Solomon Oyelekan
University of Ilorin

ABSTRACT

The African continent does not rank well in global development indices, and for many decades, African countries have relied significantly on more economically viable nations in the world. While development is known to be closely tied to scientific advancement, a major factor responsible for Africa's poor development rating is the comparatively low level of scientific and technological development; which has been adjudged to have significant influence on sustainable development and the quality of the human life. Many challenges have been identified as impediments to qualitative science education in Africa and evidences abound that the so called developed nations of the world today have in the past had, and still have similar challenges which they have addressed and which they are still addressing. This paper examines the position of science education in Africa within a global context, presents some of its challenges and suggests possible solutions through a global lens.

Introduction

Man has for long realized that a proper understanding of his environment is crucial to his survival. The earth is made up of various components; from the atmosphere to the land and down to the sea, all of which impact significantly on the human life. Attempts by man to satisfy his basic needs led into the quest to understand his environment and for a very long time, man has come to realize that he can manipulate his environment to suit his own purpose. Man has a persistent desire to use his mental prowess to manipulate the condition of his environment, improve the quality of his life and control events that occur in the environment. The field of knowledge that concerns itself with the understanding of the earth, nature and the universe as a whole is science. Hence, science is fundamentally a human activity and a dynamic enterprise geared towards a search for knowledge. Science is characterized by the systematic gathering of information through various forms of direct and indirect observations and the testing of this information by methods including, but not limited to experimentation (NSTA, 2000). Accordingly, the principal product of science is knowledge in the form of naturalistic concepts and the laws, principles and theories related to those concepts.

Scholars have given various definitions for the word 'science'. For example, Collette and Chiapeta (1984) defined science as a body of knowledge, a way of investigation, or method and a way of thinking in the pursuit of an understanding of nature. In another view, Conant (1951) defined science as an inter-conneced series of concepts and conceptual schemes that have developed as a result of experimentation and observation and are fruitful of further experimentation and observation. This definition emphasizes the dynamic nature of scientific knowledge. Scientific knowledge is subject to change. No scientific theory is foreclosed as further research could necessitate substantial modifications to existing theories.

Human needs have changed significantly and become more complex over the years and as this happen, scientific researches are directed towards science that could cater for our changing needs. Today, man seeks for better food, better housing and decent clothes, far from the simplicity that existed in the past; and why not? More often than not, scientific solutions are proffered to human problems, however, many problems have also emerged from scientific activities and this has called for some degree of caution in the way science is done. According to Olorundare (2014), science is a self-criticising, correcting and improving activity which deals with facts relating to natural phenomena of the universe and how these are interpreted. In the modern society, everyone requires some basic knowledge of science to function well in the society and this is where science education comes in.

Simply put, science education is the process of transferring scientific knowledge, skills and processes from one person to another. It can be viewed from two main perspectives, that is, education in science, and education about science. The former involves specific and sometimes rigorous
preparation and training in preparation for a lifelong career in science, while the latter engages an individual in the acquisition of requisite experience in understanding activities involved in and related to scientific knowledge and competencies (Olorundare, 2014). Education in science is confined strictly to the activities of scientists and has to do with core scientific knowledge and skills, and is restricted to a minority of people in the society (scientists). It produces professionals like medical doctors and engineers. On the other hand, education about science has to do with the general and basic scientific knowledge and skills required by all citizens to survive well in the society. It includes such basic information about HIV/AIDS and global warming, as well as basic ICT knowledge. It suffices that science can be viewed from the general and professional angles. Whichever way we look at it, the enormity of the importance of scientific knowledge to human survival will be revealed.

An important index of development is the level of scientific and technological advancement of a nation. Science and technology products have reduced human labour significantly and improve the quality of life. When we talk of developed nations, we talk of industrialized nations. Science and technology is the basis of industrialization. Industrialisation provides jobs, sustains families, engages people and hence engenders social order. By implication, science and technology has a network of effect on human survival. In spite of the inherent benefits of scientific knowledge, science education is still bedeviled by many challenges in Africa and this is the main thrust of this paper.

**The African Continent and Development Indices**

The economy of any nation is driven by her natural and human resources both of which complement each other. Natural resources are to be tapped by humans; and doing this successfully requires a deep knowledge of science and extensive deployment of technology. For instance, one could just imagine the level of technological sophistication required to drill crude oil from beneath the ocean.

The quality of science education directly impacts on the extent of growth and development of science and technology (Arinaitwe, 2007), hence, science education has a great impact on a nation’s ability to harness her natural resources. African countries are blessed with rich natural resources that could transform the economy but many of these countries lack the scientific prowess to tap these resources due to the unsatisfactory state of science education in such countries. This is one of the reasons why the African continent is rated low in development indices.

Since early 2014, many Central Banks in Asia, Latin America, Europe and Africa have raised interest rates and in developing African countries like Angola, Ghana, Malawi, Nigeria, and Zambia, the Central banks have continued to increase interest rates (The World Bank, 2015). In the World Development Indicators database, published by The World Bank on the 18th of September 2015, the ranking order of nations according to the Gross Domestic Product in US Dollars was presented. In this ranking, the United States ranked 1st out of 194 countries, followed by China. The first African nation in the rank was Nigeria which ranked 22nd. South Africa ranked 33rd while Angola, Kenya and Ghana ranked 60th, 74th and 92nd respectively. So also, South Sudan, Malawi and Liberia rank 128th, 158th and 168th respectively. It was also reported by UNESCO (2015) that ‘while in East Asia and the Pacific, the share of those living in extreme poverty decreased from 45% in 1990 to 14% in 2010, the decline in sub-Saharan Africa was far more modest, from 56% to 48%’ (p.23). The same report presented a graph that indicates that Sub-Saharan Africa faced greater demographic challenges than other regions (p.22).

Economic growth in the developing countries of the Middle East and North Africa had been retarded by domestic and regional conflicts. However, these countries were reported to have recovered to 1.2% in 2014 (GEP15a p.5). This recovery is very fragile as the region is still largely in conflict. The Syrian political problem remains unresolved. Saudi Arabia is at loggerheads with Iran and the story from Yemen is worrisome. The situation in the region is worsened by the global fall in crude oil price.

According to The World Bank Global Economic Prospect Report (2015), the economic situation in Sub-Saharan Africa is summarized as follows:

*Sub-Saharan Africa’s growth improved, for the second consecutive year to 4.5 percent in 2014. Despite headwinds, growth is projected to pick up to 5.1 percent by 2017, lifted by infrastructure investment, increased agriculture production, and buoyant services. The outlook is subject to downside risks arising from a renewed spread of the Ebola epidemic, violent insurrections, lower commodity prices, and volatile global financial conditions. Policy priorities include a need for budget restraint for some countries in the region and a shift of*
spending to increasingly productive ends, as infrastructure constraints are acute. Project selection and management could be improved with greater transparency and accountability in the use of public resources (p.101).

The fiscal positions of many Sub-Saharan countries continue to deteriorate due to increased wage bill, higher spending, the collapse of global crude oil price and internal political and religious conflicts among others. In Nigeria for instance, the economy has been slowed down significantly by the high rate of corruption and looting of public fund by public officials, the fall in global oil price and the Boko haram insurgency. Rao (2002) reported that:

According to RAND’s classification, there are 22 scientifically advanced countries, 24 scientifically proficient countries, 24 scientifically developing countries, and 80 scientifically lagging countries. The developing countries belong to the last three categories. The least developed countries (LDCs) are in the last category, mainly in Africa (p.36). The situation in Africa is considerably more serious and offers many challenges (p.37).

From every indication, the gloomy picture painted here about Africa since 2002 has not changed.

It has been reiterated earlier in this paper that science and technology education is the basis of economic development. So what relationship exists between the economy and science education? Apart from industrialization that emanates from advanced science and technology, only a scientifically developed nation would be able to deploy science and technology in tackling the challenges facing economic development. For instance, the current administration in Nigeria has been able to recover billions of dollars of looted funds through the deployment of science and technology. The Treasury Single Account (TSA) system has blocked many avenues through which politicians, civil servants and their cohorts divert public money into personal use. Similarly, many ghost workers have been identified through the introduction of the Bank Verification Number (BVN) which reveals all bank accounts to which an individual is a signatory. The Federal Government has been able to identify and delete about twenty four thousand ghost workers from its pay roll and saved 2.2 billion naira (about $11,111,111) monthly from payment of salaries.

The developed world has overcome some of these challenges to a very large extent because some of these technologies that are just being deployed in developing nations have for long been in place. From the preceding discussion, it becomes imperative that underdeveloped and developing nations should prioritise science education while developed nations should consolidate on their successes to make life worthwhile for the populace.

The Challenges of Science Education from the Global Perspective

Development is a never ending process, this is why in spite of the status of ‘developed country’ ascribed to some nations, they still do not rest on their oars, if for nothing at all, at least to sustain the status and avoid a slip-back. In fact, developed nations seem to be more aggressive in developing science and technology than developing and underdeveloped nations, perhaps because of the realization of the role played by science and technology in attaining their status. Hence, while developed nations continue to improve on their level of scientific and technological development, developing and underdeveloped nations are also struggling to beef of their development through science and technology. In both cases, challenges cannot but suffice.

In Europe, a report of the expert group on science education indicates that there exist wide differences in educational outcomes and public understanding of science education across the continent (European Union, 2015). The challenges facing science education in the region as listed by the European Union are as follows:

1. Unevenness in basic science literacy across Europe which is necessary to ensure a rigorous understanding and use of scientific knowledge in decision-making, particularly in domains such as health, the environment, food, energy and consumption (Ballas, Lupton,Kavroudakis, Hennig, Yiagopoulou Dale & Dorling, 2012).
2. Wide disparities in participation in science education, in formal, non-formal and informal settings, across regions, cultures and gender which are blocking full involvement in society of all citizens and talents (Ballas, Lupton,Kavroudakis, Hennig, Yiagopoulou Dale & Dorling, 2012).
3. Declining interest in science studies and related careers that are essential to meet the demand for well-prepared graduates (at all levels) and researchers, especially amongst women, necessary for our knowledge and innovation-intensive societies and economies (Olsen & Lie (2011).
4. Concerns about quality arising from a mismatch between demand and supply of qualified teachers and about the gap between science education research findings and what happens in the classroom (Osborne & Dillon, 2008).
5. Insufficient understanding of the breadth of competences required of teachers and teacher educators for enhancing personal and collaborative achievement, innovation and cultural and economic sustainability (Blatchford & Kutnick, 2014).
6. Inadequate teaching and insufficient family involvement needed to inspire children’s curiosity and the need to shift the emphasis from knowing facts to doing innovative and enjoyable things with knowledge, including being creative with the application of ideas (Hayden, Ouyang Scinski, Olszewski, & Bielefeldt, 2011).
7. Shortfall in skills and competences required to identify early-stage global trends necessary to reach EU targets for smart and sustainable growth and high value-added jobs responding to the need to design science-based solutions to the global challenges (Jackson, Brooks, Greaves & Alexander, 2013).
8. Insufficient investments in strategic co-operation and development of ecosystems that would foster effective adoption of latest research findings and emerging technologies in industry and enterprise, particularly SMEs (European Commission, 2013).
9. Inadequate public knowledge about and understanding of the complexities of the scientific and social challenges facing humanity, across Europe and globally (Sinatra, Kienhues & Hofer, 2014).
10. Little involvement of stakeholders in science education policy, research, development and innovation, particularly between students, families, teachers, employers and civil society in the formal education system (Jenkins & Insenga, 2013). (European Union, 2015).

On the basis of these challenges, the experts recommend the following objectives as the way forward:

1. Science education should be an essential component of a learning continuum for all, from pre-school to active engaged citizenship.
2. Science education should focus on competences with an emphasis on learning through science and shifting from STEM to STEAM by linking science with other subjects and disciplines.
3. The quality of teaching, teacher induction, pre-service preparation and in-service professional development should be enhanced to improve the depth and quality of learning outcomes.
4. Collaboration between formal, non-formal and informal educational providers, enterprise, industry and civil society, should be enhanced to ensure relevant and meaningful engagement of all societal actors with science and increase uptake of science studies and science-based careers to improve employability and competitiveness.
5. Greater attention should be given to promoting responsible research and innovation and enhancing public understanding of scientific findings and the capabilities to discuss their benefits and consequences.
6. Emphasis should be placed on connecting innovation and science education strategies, at local, regional, national, European and international levels, taking into account societal needs and global developments (European Union, 2015, pp.8-11).

For each of the above listed objectives, the experts provide a comprehensive roadmap towards achieving the objectives in terms of recommendations, indicative actions at EU level and at the National level of each member country.

According to UNESCO (2010), the main challenge of basic science education globally is finding and educating sufficient teachers in the process. Other challenges identified have to do with the content of science, its curricular approach and appropriate didactics and teaching approaches. There is also the challenge of educating stakeholders, beyond members of scientific communities and researchers in science education, to include representatives of business and commercial groups, politicians and parents with a view to reforming science education.

UNESCO (2010) recommends that:

1. The science curriculum should be based on science as process rather than a product.
2. There should be adequate and appropriate teacher education since basic education crucially depends on the person who brings about the curriculum.
3. There is need to adopt strategies that support Inquiry Based Learning
4. There is need to add complementary strategies and actions that improve equality of access for groups such as girls, the poor and minority ethnic groups.
5. There is need to be aware of the factors that help increase the numbers of students who wish to follow careers in science.
6. There is the need to involve actors from outside the school system (pp.57-58).

The United States is regarded as the most powerful nation in the world and one major factor responsible for her to be so referred is her level of scientific and technological development. One may be surprised that in spite of the feats the United States has achieved in science and technology, her science education is still being plagued by some challenges. In fact, Paulson (2007) describing a report of the Organization for Economic Cooperation and Development (OECD) which measured student literacy in science, math, and reading among 15 years olds in the United States stated that the US ranked 29th in science among 57 countries in 2007. Glod (2007) further stated that the United States ranked 29th behind countries like Croatia, the Czech Republic, and Liechtenstein, and ahead of just nine other OECD countries while the country at the very top in science education was Finland. According to OECD (2014), the United States performed below the OECD average in the 2012 Programme for International Student Assessment (PISA) science performance falling below countries like Estonia, Korea, Canada, Ireland, Slovenia etc.

Thornburg (2009) identified some challenges facing science education in the United States to include:

1. The shortage of qualified teachers
2. The idea of science not being reflected as a vibrant field with participants of all genders and heritage
3. Inadequate hands-on science
4. The process of having students explore new questions on their own falling outside most State standards
5. Deficiency in connecting science to other subjects (Thornburg, 2009).

Mcfarlane (2013) while commenting about science education in the United States remarked that science has for too long been taught and learned as a mono-methodological branch of knowledge that deemphasized participatory pedagogy. Bartholomew, Osborne and Ratcliffe (2004) emphasized the need for pupils to appreciate that science is an activity that involves creativity and imagination as much as many other human activities. Science has for too long been taught as a form of dead poetry (McFarlane, 2013).

Mcfarlane (2013) suggested that:

1. curricular and instructional methodologies and structures that are designed, implemented and effectuated at the classroom and school levels should be appropriate
2. science teachers should ensure that students understand and appreciate the nature of science (NOS).
3. Philosophy of science (POS) should include a new understanding of science in the context of human affairs as they impact survival in a decisively global economy of contracting resources.
4. mono-methodological approach to science education should be discarded.

The United States is not alone amongst developed nations in terms of the challenges facing science education. Studies have indicated a downward trend in the interest shown by the younger generation towards science in the United Kingdom as well as in Australia (Jenkins & Nelson, 2005; Tytler, 2007). Masters (2006) presented series of data that showed a downward trend in the number of students enrolling for science at various levels of the Australian education system.

Some gloomy pictures have been painted about the state of science education in Australia. According to Tytler (2007), there are four main elements to the ‘crisis’ in science education in Australia:

1. evidence of students developing increasingly negative attitudes to science over the secondary school years
2. decreasing participation in post-compulsory science subjects, especially the ‘enabling’ sciences of physics and chemistry, and higher mathematics
3. a shortage of science-qualified people in the skilled workforce
4. a shortage of qualified science teachers. (p.7).

This made him to conclude that science education in Australia was in a state of crisis. Australia is regarded as a developed country by any standard, and an important index in classifying a nation on the basis of development is the nation’s level of scientific and technological development. Australia is by far more scientifically and technologically developed than many other nations of the world, hence, to have this discontent remarks about Australia cannot but be shocking to people in the developing and underdeveloped world.

Perhaps the most worrisome of the challenges facing science education in Australia is the shortage of qualified science teachers. Many research reports from Australia have pointed in this direction. For instance DEST (2003) reported that the number of students in secondary teacher education courses specializing in chemistry and physics subjects declined by 62% and 37% respectively between 1992 and 2000. Harris (2006) also reported that percentage of schools that reported experiencing difficulty in adequately staffing physics and chemistry classes was 40% and 33% respectively. Lyons, Cooksey, Panizzon, Parnell, & Pegg (2006) also reported that rural schools were more likely to have difficulty in filling vacant teaching positions in Science, ICT and Mathematics.

As a measure towards addressing some of the challenges facing science education in Australia, the Australian Council for Educational Research (ACER) 2006 conference plenary session came up with the following propositions:

1. The need to re-imagine science education, accepting a shift that is occurring and must occur in the way we think of its nature and purposes. The implication of this is that any move towards a national agenda for science education needs to be premised on this re-imagining rather than refinement of the existing curriculum and assessment.
2. The is need to develop a new metaphor for science education that will capture its nature as well as developing rigorous assessment processes appropriate to this re-imagined science education.
3. The need for a national teacher education agenda focusing on re-imagining the role of the science teacher and developing teachers’ capabilities especially in the area of knowledge, pedagogy and disposition which enables the support of the new directions (Tytler, 2007).

The report of the primary school teaching survey conducted among primary and secondary school teaching professionals by the Australian Science Teachers association (ASTA, 2014) came up with the following findings among others:

1. In terms of teaching priority, science achieves the third highest rating among the respondents, but falls significantly below literacy and numeracy.
2. Most of the survey respondents (70%) did not have access to a science laboratory and taught science in the classroom.
3. Interest in additional science professional development was high but it can be expensive and time consuming not only for organisers, but also for teaching staff attending, particularly if they are in regional or rural/remote locations.
4. Respondents with more than 20 years teaching experience rated science as a higher priority on average than those with less than 20 years tenure.
5. Despite most survey respondents being reasonably confident in their science teaching ability, they typically feel relatively poorly supported in terms of pre-service training, on-going Professional Development and resource availability, particularly compared to numeracy (and literacy) (pp. 4-7).

So also, Crook and Wilson (2015) listed five challenges for science in Australian primary schools:

1. The Australian curriculum not being national. Every state and territory implements the curriculum in its own way.
2. Blind implementation of an Australian science curriculum called ‘Primary Connections’ by schools which irrespective of whether it is consistent with their state or territory requirements.
3. Out of field teaching. One in five teachers in science classes teaches out of their area of specialisation. Only around 50% of teachers teaching science in 2013 had received training in teaching methods for science.

4. While 1.5 to 2.5 hours is recommended for science teaching in a week, there is substantial variation in the time devoted to science across states and schools. Many schools are operating on only one hour a week.

5. Problems with recruitment of specialist science teachers into secondary and primary schools.

ASTA (2015) suggests as follows:

1. Developing prescriptive resources may be useful for primary teachers lacking confidence due to not really understanding content and strategies for teaching science concepts.

2. ASTA should make effort at providing additional content and teaching strategy advice and support to science teachers.

3. When developing resources for primary teachers, ASTA needs to consider the time available each week for teaching science lessons.

4. ASTA needs to develop a strategy to increase awareness about instructional resources developed by ASTA such as Science Web.

5. Additional professional development (PD) in using inquiry based teaching and learning methods is clearly required. ASTA needs to assist in this area to including providing videos on Science Web that demonstrate how to implement inquiry based methods.

6. There is need to revise some units in the ‘primary connections’.

7. It is however important to also ensure primary teachers have access to suitable resources as well as a mentor.

8. There may be an opportunity for ASTA to provide teachers with a framework for conducting their own internal competitions or science nights which can clearly be successful and a means of engaging students who otherwise may not be exposed to these types of activities.

9. Most respondents conduct science in the classroom and possibly without even a wet area available. This is something ASTA needs to consider when developing resources specifically aimed at primary school level.

There is a high level of interest in additional science PD among survey respondents, particularly if it has a focus on specific year levels. To make PD opportunities easier to access, webinars could be considered (ASTA Primary School Science Teaching Survey Report June 2014).

The Challenges of Science Education in Africa

The African continent is relatively backward in terms of scientific and technological development. This explains in part, the economic woes bedeviling the continent. Some parts of Africa still experience extreme poverty and hunger. The continent still relies heavily on imported goods from Asia, America and Europe. To change this current status, many challenges facing science education in Africa have to be confronted. Africa has produced great scientists trained both locally and abroad. Unfortunately, many of these have sought for greener pastures out of their home countries.

Reporting on the state of science education in developing countries, Rao (2002) reported that:

"Scientists who work in laboratories or teach in educational institutions in most of the developing countries face immense problems. Even in the best of the developing countries, libraries are in a pathetic shape. Information technology has not made much headway. There is little computer capability in many of the institutions and people are not connected to the new information highway. The laboratories have poor infrastructure and outdated equipment. A recent international survey shows that 83% of the schools in the developing world do not have laboratories, 73% do not have proper buildings and 58% do not have science teachers. A large proportion of the schools (20-40%) have no facilities or teachers. Many are single-teacher schools and most teachers are not equipped adequately to teach science. The gap between the laboratories in the developing world and in the advanced world is increasing day by day (p.36)."

Existing literature reveals a high level of commonality in the challenges facing science education in African nations. Some of these challenges are highlighted as follows:
1. Irregularities in curriculum contents
2. Low teacher-pupil ratio
3. The teaching of science not being practical oriented.
4. Inadequate infrastructural facilities conducive for science learning
5. Inadequate provision of laboratory and laboratory materials
6. Poor working conditions for teachers
7. Low investment in science education
8. Gender imbalances in science education
9. The perception of science as a difficult subject by some students

It has been observed that the school science curricula of many African nations are ‘westocentric’ delving extensively on western concepts to the detriment of local contents (Jegede, 1989, 1994, Jegede & Fraser, 1990, Omosewo, 2012). This is especially typical of nations that had been earlier on colonized by western nations like Britain and France. Part of the problems that confronted science education at the advent of western education was the lack of indigenous examination bodies, hence, many Africans wrote the Cambridge or London GCE, the curricular of which took no cognizance of Africa’s local contents. There has been a tremendous improvement in this area but the traces of western science are still very conspicuous. Another major problem is curriculum overload. Teachers hardly cover the syllabus for the various science subjects before students are enrolled for school certificate examinations. This is made worse by the recurrent industrial action that characterizes the African education system.

Many African nations face acute shortage of qualified science teachers. There are cases of many out of field teaching of science subjects. In many cases when qualified teachers are even available, government is not financially buoyant enough to get them employed into the school system. Science classrooms are overcrowded, especially in public schools. This makes it difficult for science teachers to give adequate attention to individual student.

Science is a practical oriented field. The acquisition of scientific knowledge and skills cannot be feasible without students trying their own hands on scientific experiments. The teaching of practical science is expensive and it is even more expensive to conduct scientific research. There are few laboratories in schools and many of these laboratories are ill-equipped (Arinaitwe, 2007, Omosewo, 2012). The inability of government to provide schools with science practical equipment and reagents has left teachers with no alternative than to teach some science concepts as merely theoretically.

The working condition of teachers in many African countries is not encouraging. For instance, in Nigeria, teachers’ salaries are not enough for decent living. Hence, they have to resort to other means to make ends meet. This causes a lot of distraction from their official duties and reduces their productivity. Teachers are owed salaries for months, they are not promoted as at when due and they are often piled up in overcrowded offices. There is particularly low morale for science teachers as they are often confronted with a dearth of laboratory materials for science practical (Omosoewo, 2012).

In spite of the remarkable feats of the female gender in science and technology, science is still largely perceived as a discipline for the men. For so many years, significant gender difference in favour of boys were reported by researchers like Raimi and Akinremi (1997) who observed poor performance in science among females and stated that this has often led to low enrolment of females for science-based courses in higher institutions of learning. Asimeng-Boahene (2006) also reported that disparity in the quality of education received by boys and girls in favour of the boys.

It is apparent from the preceding discussion that many challenges facing science education in Africa have been experienced in the developed world in the past and in fact some of these challenges are still subsisting. In spite of all these challenges, the developed nations have somehow managed to retain their status as developed on the premise of advanced science and technology that has impacted tremendously on their economy. The question is what can African nations learn from the experiences of these developed nations to improve on the continent’s science and technology status as a means of improving the standard of living of the people?

Tackling the Challenges of Science Education in Africa through a Global Lens
It has been revealed in this paper that the African continent shares some challenges with the developed nations in the area of science education. In tackling these challenges, the African continent needs a global lens to visualize how the previous challenges were addressed by the developed world and how the current ones are being addressed. This will accelerate the rate at which the challenges would be addressed. The way and manner such challenges are being handled in the developed world could serve as a template for African countries in proffering solutions to the existing challenges. For Africa to develop economically, science and technology education has to be prioritized. Hence, African countries could borrow from the Australian purposes of science in the compulsory years as proposed by Symington & Tytler (2004).

1. Cultural purpose: to ensure that all members of society develop an understanding of the scope of science and its application in contemporary culture.
2. Democratic purpose: to ensure that the students develop a confidence about science which would enable them to be involved in scientific and technological issues as they impact on society.
3. Economic purpose: to ensure that Australia has the number and quality of people with strong backgrounds in science and technology in business and public life, as well as in science and technology, that are needed to secure the country’s future prosperity.
4. Personal development purpose: to ensure that all members of society benefit from the contribution that the values and skills of science can make to their ability to learn and operate successfully throughout life.
5. Utilitarian purpose: to ensure that all members of society have sufficient knowledge of science to enable them to operate effectively and critically in activities where science can make a contribution to their personal wellbeing (p.1411).

Conclusion

This paper has explored and situated the challenges confronting science education in Africa within the global arena. The challenges confronting science education in Europe, United States of America, Australia and some other parts of the world are highlighted on the basis of existing literature. The conclusion from the literature is that the challenges facing science education in Africa is not exclusive to the continent as it has been revealed that most of these challenges are still existing in the developed world. The approaches being adopted in tackling the challenges existing in the developed nations are suggested for African nations but bearing in mind the peculiarities of each nation.

Tackling the Challenges of Science Education in Africa through a Global Lens: The recommendations.

On the basis of the extensive literature, the following lists of recommendations suffice on how to confront the challenges facing science education in Africa, on the basis of the experience of nations across the globe:

1. To tackle pedagogical challenges, teachers need to receive further training on modern pedagogical styles that are more supportive of students. In this era of ICT, adequate training should be provided for teachers on appropriate use of ICT for classroom instruction. The content of the teacher training programs should be revised to take care of this area.
2. The science curriculum should be more focused on engendering scientific literacy.
3. There is need for massive recruitment of science teachers and programs should be instituted to recognize and reward good and dedicated teachers.
4. The idea of automatic promotion for teachers on the basis of mere number of years of service should be jettisoned. There is need for a definite teacher professional development program that will form the basis of promotion across the service cadre. This will drive teachers to develop themselves professionally.
5. There is need to promote co-operative activities by regional associations of teachers and scientists in the same field through science teachers’ professional associations. At a regional level, centres for science teacher development such as the Centre for Mathematics, Science and Technology Education in Africa, Nairobi, Kenya should be established to organize in-service training for African teachers. African scientist-teachers should to form an online network to
promote science education and make available to one another, sources of the latest materials and research in cognitive sciences.

6. African science teachers should design activities that would encourage the participation of school girls and women in science education. The teachers should also form partnerships with Non-governmental organisations involved in this type of activity.

7. There is need for a regional forum for addressing the challenges of science education in Africa through collaboration by the Ministries of Education. Governments in developing countries should invest significantly on Science and Technology education.

8. National and regional meetings are to be organized by science teachers to make case for science education. Science teachers associations should employ the media and the Internet to build a case for science education.

9. Laboratories and laboratory facilities are crucial for science education. One of the major reasons why African school laboratories are ill-equipped is the fact that most laboratory materials have to be imported from overseas at very high cost. Indigenous production of laboratory materials should be promoted. This will reduce cost and improve their availability in schools.

10. African nations could seek mentorship from nations well acclaimed to have better science education programs to fast-track local advancement in science and technology.

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Oloyede Solomon Oyelekan
Department of Science Education
Faculty of Education
University of Ilorin, Ilorin, Nigeria
solomonoyelekan@hotmail.com