

ISSUES AND TRENDS IN SCIENCE EDUCATION FOR SUSTAINABLE ECONOMIC DEVELOPMENT IN NIGERIA

BELLO, Moruff Ajadi

Department of Technical Education,
School of Vocational and Technical Education
Osun State College of Education, Ila-Orangun
E-mail: engrbellomoruff@gmail.com

Abstract

It is clearly noticeable that science education in the early 21st century is facing a myriad of issues in African countries particularly in Nigerian education system. Indeed, students in Nigeria still lag behind their counterpart in other nations in science achievement. Some of the complex issues in the field of science education include the availability of appropriate textbooks and classroom resources; the availability of financial support and curriculum resources; the preparation and training of science teachers (including both pre-service training and in-service professional development); political and religious opposition to cutting-edge science instruction; the need to meet standards and to prepare students for standardized examinations; and the dramatically increasing use of the internet as a source of information. Given these and other issues, it is extremely important to understand, acknowledge, and build upon the abilities of adolescent learners, while at the same time tailoring instruction to address the unique challenges faced by this age group. It is in the light of the above that this publication attempts to highlight the issues and trends in science education in Nigeria. The paper looks at the science education as a vehicle for sustainable economic development. The various challenges faced by science education were also discussed. Finally, the paper also provides way forward to the numerous challenges inhibiting the sustainable development of science education in Nigeria.

Keywords: Issues and Trends, Science Education, Challenges, Sustainable Economic Development.

Introduction

The satisfaction of human needs and aspirations has always been the major objective of development. For several decades, and particularly in the last century, economic growth and development had resulted in substantial improvements in health, education, and the quality of life for many people especially in the western countries. However, it has become very apparent that the global community, over these decades, has pursued a path of development which is clearly not sustainable. Thus, there are many reasons why education has to be regarded as the bedrock of sustainable development by all and sundry. According to the World Economic Forum Global Competitiveness Report (WEF 2016), education can be defined as the stock of skills, competencies, and other productivity, enhancing characteristics. The Forum further described education, as a

critical component of a country's human capital, increases the efficiency of each individual worker and helps economies to move up the value chain beyond manual tasks or simple production processes. The human capital which is a result of sound educational system has long been considered the most distinctive feature of the economic system and further studies have proven the impact of education on sustainable economic development in the society. Accordingly, educational system must be anchored on a sound philosophical foundation that encourages partnership for exchange of people, ideas and support facilities. This assertion indicates that education has a role to play in combating modern environmental and developmental challenges of the African continent and Nigeria in particular. The type of education that must be the priority of any nation must depend on the need of such nation. It is in line with this fact that Ogunmade (2006) added that for any nation including Nigeria to attain sustainable development; there is the need to recognize science education as a priority area of education for her citizens. This implies that no country can be globally recognized without talking about its scientific advancements. However, according to one of the key problems in evolving a development strategy for a developing country like Nigeria, is lack of the capacity for appreciation and application of science and technology through developmental efforts (Aina, 2012 as cited by Gabriel, 2019).

Science education is described by Pember & Humbe (2009) as a process of teaching or training especially, in school to improve one's knowledge about environment and to develop one's skill of systematic inquiry as well as natural attitudinal characteristics. Science education involves the study of science in depth and in addition, educational knowledge and concepts are learnt and verified. It has been recognized worldwide as a pre-requisite in technological development (Okoli et. al. 2013). This implies that no country can be globally recognized without talking about its scientific advancements. According to Lewis (2015) science education identifies natural phenomena appropriate to child interest and skills. Also, he went on to say that science education equips teachers, learners and the society with knowledge, skills, equipment and freedom to perform noble task useful for improving socioeconomic standard. In addition, he added that science education courses are designed to produce capable scientists who contribute meaningfully to academic excellence of the society to raise the economic level of nations.

Science is an area of learning that is absolutely necessary for development because of its linkage to technology and industry (Batomalague, 2015 as cited by Danjuma & Adakole 2019). Scientific development is essential for better quality of life, the sustainable development of the planet, and peaceful coexistence amongst peoples. From the immediate basic essentials of life such as access to water, food and shelter, to other issues such as management of agricultural production, water resources, health, energy resources, biodiversity, conservation, the environment, transport, communication, science provides the basis for action at local, regional, national and transnational levels (UNESCO, 2015). This is because Science and technology have been identified as the key drivers for growth and sustainable social development and transformation of nations, which could lead to industrialization (Uza, 2013 as cited by Danjuma & Adakole, 2019).

However, despite the above motioned roles of science education to national development, Nigeria lacked sustainable science education since its independence and as a result; science education has not been able to move the country into industrialization and above poverty level. Similarly, Momeke (2007) supported this assertion when he said that science education has failed to produce skilled human resources needed for transformation into national prosperity. This implies that most of Nigeria's development in the direction of modernization has been haphazard leading to acquisition of obsolete technology. Sustainable science education development therefore represents a catalytic process for social educational, training and public awareness – the values, behaviour and lifestyles required for a sustainable future (Okoli et al. 2013).

Worthy of note is the fact that only quality science education can bring about effective learning among students which will eventually produce undoubted development for any country. Quality science education is effective science teaching which occurs when students learn and achieve many scientific goals and not just being able to repeat scientific knowledge (Omoifo, 2012). Recent studies have reported that quality of teaching and teachers were dominant factors for student poor performance in science subjects. for instance, in a research conducted by Ayodeji et.al., (2018) on "science education in south-west Nigeria" it was found that many factors such as inadequately equipped laboratories, inadequate access to ICT by the in-school youth, low ratio of teacher to students are challenges in majority of the schools. Others factors include lack of textbooks, science equipment and facilities and poorly equipped laboratory rooms (Batomalague, 2015). Large class sizes, inadequate funding, insufficient curriculum resources, poor teaching skills and lack of supports for teachers among other factors further limit the quality of science teaching and learning in Nigerian schools (Okebukola 1997). Thus, improving scientific education has become of paramount importance in determining a country's socio-economic development of the country. Nevertheless, this may be difficult to achieve without the adequate understanding of the current status of science education and the means to improve it.

The Concepts of Science and Science Education

Science is an organized body of knowledge in form of concepts, laws, theories and generalizations. Urevbu (2001) defined science as a study of nature and natural phenomena in order to discover their principles and laws. Similarly, Gottlieb (2004) as cited by Christiana (2012) viewed science as an intellectual activity carried out by human that are designed to discover information about the natural world in which humans live and to discover the ways in which this information can be organized into meaningful patterns. That is, science could be described as the structure and behaviour of the physical and natural world and society, especially through observation and experience (Omole & Ozoji, 2014 as cited by Danjuma & Adakole, 2019). The definitions above reveal that science is linked with observation of the environment, which proper understanding is plausible through experimental process. It further shows that science is the sensory process of epistemological comprehension of nature that aids man logically discovers and

interprets the principles through which man controls his environment naturally. According to Danjuma, & Adakole, (2019), it is the process of penetrating nature with the aim of discovering the laws that aid man to live sustainably.

Education is the total process of human learning by which knowledge is impacted, faculties trained and skills developed (Urevbu, 2001). Hence, science education according to Omorogbe & Ewansiha (2013) is a field of study concerned with producing a scientifically literate society. It acquaints students with certain basic knowledge, skills and attitudes needed for future work in science and science related field. Agbowuro et al. (2015) listed five aims and objectives of science education thus;

- To excite and enthuse children with a sense of awe and wonder at the natural world.
- To give pupils enough evidence-based knowledge to be able to make informed personal judgments in order to live healthy, safe, comfortable and environmentally sustainable lives.
- To develop pupils' understanding and experience of the scientific method, to understand its value and limits, and to enable them to apply the method.
- To be proficient at practical work and use of scientific equipment
- To know, understand at an abstract level, and be able to apply important scientific theories.

Educational systems all over the world place serious emphasis on science and technology because of their implications on technological advancement which is tied to national development. This desire is the case with all developing nations including Nigeria.

The Concept of Sustainable Development

The concept of sustainability is a complex one and has been at the forefront of the development movement since 1982, when the United Nations Conference on the Human Environment adopted a declaration for preservation and enhancement of the human environment.

Singh and Titi (1992) defined sustainable development as a process of change in which the utilization of resources, the direction of investments, the orientation of technological innovation and exchange and institutional change reflect both future and present needs. Accordingly, the Global Action Programme (GAP) on Education for Sustainable Development, ESD stated that any approaches to development that balance economic and social progress, address cultural differences, conform to global, national and local needs, and respect ecological values and limits is the key to sustainable development.

That is why, it is worth note that neither the needed innovations in technology, economics, participatory politics, crossover financial processes between the wealthy and developing nations, as well as the transformation of consumption and lifestyle patterns aren't going to develop on their own, nor are they going to be the result of a gradual cultural advancement. What is necessary is a systematically facilitated, large-scale mental/psychological transformation. This doesn't mean just raising awareness in

general. Rather, every person must use the opportunity to acquire the special values and knowledge, also the skills and abilities which everyone will need to shape a future worth living. Thus, we have to learn sustainability in formal educational institutions, out-of-school settings and informal daily situations. Education is a necessary and substantial contribution toward the preventive measure of setting sustainable development in motion. Therefore, sustainable development processes cannot be implemented without the appropriate education. Corroborating this view, Klaus (2013) stated that education for sustainable development falls short when it limits itself to instruction and teaching processes. More essential is the encouragement of deeper insights into how to safeguard the future through sustainability, into justice, ecological compatibility, economic achievement, potential and social responsibility. There is already conflict about what goals should be within these dimensions of sustainability. He further opined that apart from this, every person has her/his own concept of sustainability, justice, economic necessity and responsibility of individuals, businesses and society. Education processes should allow for expression of these convictions and for reflection through dialogue with fellow learners.

From the foregoing, it is very clear that sustainable development draws global attention to the urgent need to address issues that have the potential to endanger our individual and collective existence and threaten to rob future generations of their wellbeing, as captured by Sampson (2013 as cited by Ajibade, 2013).

Science Education as a Vehicle for Sustainable Economic Development in Nigeria

The practical use of science through technology created the climate for ever increasing emphasis on the pursuit of science and education in developed countries, where funding scientific enterprises is widely accepted as a vital and long-term investment. What is emerging from this priority is the close association of education and economic growth. Accelerating the rate of growth and rate of productivity can basically be accomplished by stimulating and supporting scientific education in universities by stimulating and nurturing scientific and technical talent, and to the concomitant training of students (Sinclair, 1988).

Education has been widely recognized not only as a fundamental human right but also as a catalyst for sustainable development and a vehicle for confronting the challenges facing societies in terms of socio-economic, environmental and ecological realities, considerable attention is shifting towards it (Hanachor & Wordu, 2021).

Also, at the Earth Summit in Rio de Janeiro, Brazil in 1992, 150 nations endorsed Agenda 21 document. Chapter 36 of Agenda 21 specifically focused on the role of education in promoting public awareness and training in achieving environmental decision-making. In it, (UNCED, 1992), world leaders asserted that: education is critical for promoting sustainable development and improving the capacity of people to address environmental and development, environmental mid ethical awareness, values and attitudes, skills and behaviour consistent with sustainable development and for effective public participation in decision-making.

The educational system is therefore expected to provide for the preparation and training of skilled human resources to manage the economy, to facilitate, by means of trained personnel, the generation and advancement of knowledge in pure and applied fields and to perform a consciousness - raising function with respect to the social, cultural, political, economic and physical environment.

In line with this, Gunmade (2006 as cited by Danjuma & Adakole, 2019) had reiterated that for Nigeria to attain sustainable development; there is need to recognize science education as a priority area of education for her citizens. This calls for the massive education of the citizens in science and science related courses. So also, there is the need to redesign the philosophy of science education in Nigeria. The 21st century requires citizens that are able to explore; understand and decide their own fate in the society on the basis of scientific and technological advancement. Hence, science education promotes and advocates scientific literacy and the practical application of scientific knowledge to bring about economic, environmental and societal development. Moreover, it must be emphasized that science courses create numerous opportunities for students to engage in doing activities that enable them translate the world around them, make new discoveries, solve social problems and develop skills that are sustainability driven. By and large, scientific knowledge is directed at addressing core objectives of sustainable development (economy, society and environment).

For Omoifo (2012), core science subjects expose students to natural phenomenal and help students understand the underlying principles of the world. Therefore, effective science education will help students understand their local, national and international milieu thereby preparing them for both man-made and natural environmental challenges; and measures to be taken while caring for environment(s). It is worthy to note that science educators have realized the necessity to become agents of change in order to achieve the goals of sustainable development and fulfill societal expectations about science education. That is, science education plays a crucial role in shaping the knowledge of students towards sustainable development (Danjuma & Adakole, 2019).

In recognition of science education as a vehicle for sustainable development in the country, Nigerian government like all other governments in the world realizes the role of science and its by product-technology in issues of national development. It is for this reason that their promotion is enshrined in section 18(2) of the 1999 Constitution of the Federal Republic of Nigeria. The goals of science education in Nigeria according to the National Policy on Education (FRN, 2004 as cited by Igbaji et al., 2017) are to:

- ✚ cultivate inquiring, knowing and rational mind for the conduct of a good life and democracy;
- ✚ produce scientists for national development,
- ✚ service studies in technology and the cause of technological development;
- ✚ provide knowledge and understanding of the complexity of the physical world, the forms and the conduct of life.

To this end, the government set up a National Policy Implementation Committee to translate the policy into workable blue prints that would guide the bodies whose duty

it would be to implement the policy. The committee was also to develop monitoring system for educational plan as it evolved (Christiana, 2012).

However, Danjuma & Adakole (2019) affirmed that despite the laudable goals of science education to national development, Nigerians and indeed Nigeria have not harnessed the benefits of science since independence and as a result, science education has not been able to serve as a tool for sustainable development. This is because science education has failed to produce skilled human resources needed for sustainable development. The implication of this is that Nigeria does not have scientific and technological prowess to be among the leading scientific nations in the world- acquisition of obsolete technology (Momeke 2007).

Challenges Facing Science Education in Nigeria

According to Omorogbe & Ewansiha (2013), the 21st century is characterized by advancement in science and technology. Over the last two decades, there have been repeated calls for reforms and innovations aimed at improving science education in Nigeria. This suggests that there are issues in science education in Nigeria that require urgent attentions both collectively and individually. Hence, from the extensive review of researched literatures, and in a more comprehensive manner, the following have been identified as challenges facing sustainable science education in Nigeria.

❖ *Inadequate Funding*

There is gainsaying the fact that the success of any education programmes depends largely on financial support. This is because inadequate funding militates against the provision of quality education. Inadequate funding adversely affects the provision of infrastructure, facilities and sufficient number of workforce (teaching and non-teaching staff) needed to deliver quality science education for the recipients. Nwangwu (2004) reported that ill equipped workshops, libraries and laboratories exist because of serious shortfalls and inadequacies in education funding.

❖ *Lack of Instructional (Teaching and Learning) Materials*

Instructional materials are facilities, equipment or materials that the teacher uses to illustrate, emphasize and explain the lessons for better comprehension by the students. UNESCO (2000) equally confirmed that instructional materials are important in the actualization of the curriculum. Some aspects of science are full of abstract concepts which pose problems to the students in their understanding. Therefore, availability and use of instructional materials in teaching such difficult concepts will make for better understanding and thus enhance the objectives of science education. Experiments also allow students to observe non-intuitive phenomena they can then study in the course of resolving the gap between their intuition and the underlying physics or chemistry of an experiment. In this setting, a well-equipped laboratory can take advantage of versatile probe-ware and handheld devices to capture real data that can be transferred to a computer for further analysis and inclusion in a report. In other words, students benefit

when they do science, not just learn about science (David, 2009 as cited by Hamidu & Mohammed, 2015).

❖ *Shortage of Qualified Teachers*

Teacher–pupil ratio is a key challenge to teachers of science education. According to the objectives of science education, each student needs to have access to highly qualified teachers. And yet, in the areas of mathematics and science, such teachers seem to be in short supply. According to the Federal Republic of Nigeria (FRN, 2004), the teacher–pupil ratio should be 1:35. This is contrary to the 1:60 most schools have in most developing countries including Nigeria.

For science teachers to pass the message across effectively, they should be able to encourage the pupils positively, show love, recognize individual differences and plan cooperative teaching with the pupils. Conversely, the type and quality of interaction that exists in the classroom does not only determine the effectiveness of teaching and learning situation but also the attitudes, interest and even the personality of learners (Mbakwe, 2005 as cited by Ayodeji et al., 2018).

❖ *The difficult Nature of Science*

Scientific knowledge is by nature abstract and theoretical. It also often contradicts common sense, and is developed through controlled experiments in artificial and idealized laboratory settings. Learning science often requires hardwork and intellectual efforts, and concentration, which is not part of the present youth culture. In a world where so many channels compete for the attention of young people, such subjects become unpopular.

❖ *Inadequate Qualified Science Teachers*

Competent science teachers are not sufficient in public schools in Nigeria. Nada (2008) as cited by Christiana (2012) observed that the status of competency in secondary school appears to be very low. Stressing that majority of teachers who are already in the system seem to lack initiatives and skills that are imperative to move science education standards forward to meet the global requirements. However, some may have the knowledge of science but lack the expertise of effective method of teaching.

❖ *Poor Working Conditions, Remuneration and Teachers' Welfare*

It is a known fact that conducive working environment for teachers directly contributes to the good quality of science education (Okoli, et al., 2013). Again, there is need for the government to rehabilitate and restore the image of science teachers by enhancing teachers' packages, housing/accommodation and utility allowances so as to retain and attract qualified teachers to teaching profession. Those teachers posted to rural areas are supposed to be receiving additional allowances in order to find the profession attractive and interesting.

❖ ***Lack of Teachers' Training and Development***

Lack of teachers' training and development is a serious threat to the sustainability objectives of science education in Nigeria. Scientific knowledge, ideas and concepts are dynamic and witnessing changes constantly, as such it is imperative for teachers to be constantly trained and re-trained so as to keep abreast with the new and emerging facts and principles. It is assumed a teacher with adequate materials, enough time and sound content knowledge still requires further training on classroom and science experimental management skills in order to provide students with an excellent science education with remarkable achievements.

❖ ***Curriculum Deficiencies***

Offorma (2005) described curriculum as a vehicle through which education takes place. Furthermore, she perceives it as involving the learner, the teacher; the content; the subject; the resources; the methods of teaching; the evaluation as well as the physical and psychological environment, which must be adequate and conducive for learning to take place. Science education curriculum is expected to equip learners with skills that will make them self-reliant, prepare them to enter into jobs and progress in them. That was why Adikwu (2008) as cited by (Christiana, 2012) stated that the problem with science education is a lack of good curriculum, that curriculum must be developed, and that there should be a readily-available inquiry-based curriculum. Furthermore, Hamidu & Mohammed (2015), reaffirmed that there are many factors that have a negative effect on curriculum implementation, it has been observed that, the nation's economy plays a vital role in as far as the implementations of the curriculum is concerned. The availability of all resources required in the education system to facilitate effective teaching and learning processes depend on the availability of funds too.

❖ ***Obsolete Teaching Methodology***

One of the qualities of a professional teacher is the use of appropriate and up to date teaching methods. It is of the common opinion that, methodology of teaching is what makes a teacher a professional. The old method only presents students as mere spectators listening to all that comes from the teachers. In order to achieve the objectives of science education, teachers should employ teaching strategies that will enable learners to develop adequate learning strategies which will eventually assist them to acquire basic knowledge, values and skills with some degree of freedom that allow learners to initiate and complete learning with minimal interference.

❖ ***Lack of Adequate Practical Exposure***

Science is an abstract course and will only be understood through the use of adequate and appropriate teaching methods. Practical work is an appropriate teaching method which can be defined as any teaching and learning activity which involves at some point the students in observing or manipulating real objects and materials. Practical work is widely and frequently used in the teaching of science in developed countries

(Bennett, 2003; Millar, 2004). A likely reason for this, as suggested, is that many science teachers see the frequent use of practical work as an essential part of what it means to be 'a science teacher'. Millar, (2004) emphasized that learning science should involve seeing, handling and manipulating real objects and materials, and that teaching science will involve acts of 'showing' as well as of 'telling'. He further added that practical work "seems the 'natural' and 'right' thing to do". Indeed, there is a common perception amongst teachers in England that the use of practical work can motivate students towards the study of science (Wellington, 2005). This means that many teachers see its use as the basic modus operandi for the teaching of science developed world.

However, the case is much different in Nigerian schools where almost every aspect of the subject is taught in theory. This presents a risk that for many teachers the use of practical work can become so routine that they cease to assess critically whether it is always the most effective way of achieving a specific learning outcome. In this regard, 'patronage' of sustainable development activities and programmes of the science education is likely to be low, except there is a sustained publicity stunt at all levels to create the level of awareness among the citizens about the importance of science education.

Improving Science Education in Nigeria for Sustainable Economic Development: The Way Forward

Larai et al. (2017) affirmed that knowledge of and about science are integral to preparing our population to be actively engaged and be responsible citizens, creative and innovative, able to work collaboratively and fully aware of and conversant with the complex challenges facing the society. They went further to say it helps us to explain and understand our world, to guide technological development and innovation and to forecast and plan for the future. This puts science education at the centre of a broader educational perspective for society as a whole. It is obvious that science educational attainment is linked to better health, personal empowerment and active engagement in public affairs and civil society being more trusting and supportive of other people, as well as feeding and housing our population, healthy living, protecting our environment, generating sufficient energy, supplying enough clean water, urbanization and global climate change. We have a much better chance of tackling these challenges if all societal actors understand the issues and their consequences and are actively involved in helping identify and monitor society's responses by working together in an inclusive participatory way, we can better align the goals and outcomes of science education and research with the values, needs and expectations.

✓ *Integrating innovation into Teaching methodology*

Methods are means that teachers use to drive home their lesson presentation thereby making learning experiences concrete to learners. Accordingly, Mbakwe (2005) as cited by Ayodeji et al., (2018), affirmed that methodology of teaching is what makes a teacher a professional. The old method only presents learners as mere spectators listening

and swallowing all that comes from the teachers. For proper achievement of the objectives of science by the learners the teachers should provide learners with basic knowledge, values and skills and with some degree of freedom allow learners to initiate and complete learning with some degree of freedom to allow learners to initiate and complete learning with minimal interference.

✓ ***Creating Awareness on Sustainable Development Issues***

Improving awareness of sustainability includes such issues as control of greenhouse gases, land and energy use, consumption patterns, pollution and transport, all of which have direct connections to education for sustainable development (Ajibade, 2013). There is a high degree of interdependence between all these factors. An understanding of these matters through education contributes to building the skills and attitudes needed to question the way we think, the values we hold and the decisions we make in the context of sustainable development. This in turn would seek to enable individuals to take informed and responsible decisions and actions on the need to take science education as the most appropriate means to achieve the sustainable development goals.

✓ ***Improving Practical Exposure to students***

As stated earlier, scientific knowledge is by nature abstract and theoretical. For students to acquire basic knowledge, values and skills for the required technological advancement, they must undergo series of practical experiences with modern and functional practical equipment that meet the global standards. Hinged on these practical experiences, students are expected to use a foundational knowledge of a scientific field as a springboard to asking and answering their own questions and proffering solutions to societal problems accordingly. This move to a more student directed approach which in turn promotes acquisition of scientific skills (David, 2009 as cited by Hamidu & Mohammed, 2015).

Practical work provides 'hands-on' experiences that promote the learning and practice of manipulative laboratory skills. Science educators and science students agree that practical work is an essential part of scientific research as well as science education.

✓ ***Engagement with Industry, Commerce and the Community***

Achieving economic sustainability in science education requires social change, which is predicated on changing public awareness. Both educators and students of science have a responsibility to articulate and disseminate new sustainability related scientific knowledge and information, including its attendant uncertainty, to society at large through various fora. For example, through roundtable discussions, conferences, seminars and dialogue between scientists and other stakeholders, including citizens and policy makers, new knowledge can be a catalyst for social innovation and effective policymaking. Conversely, this dialogue can spur further innovations in knowledge that help society progress along the path of sustainability (Ajibade, 2013).

✓ ***Remuneration and Improved Work Conditions of Science Teachers***

It is a known fact that optimal working condition for teachers directly contribute to the good quality of public education (Igbuzor, 2006). It is therefore necessary for the government to rehabilitate and restore the image of science teachers. This could be done by enhancing teachers' packages. Science teachers' housing, accommodation and utility allowances should be improved. Transfer allowances should be paid to teachers who go on transfer, and those who dwell in rural areas to perform their duties should be given special allowances to motivate them. This will give them job satisfaction and enhance their productivity.

✓ ***Conducting Research on Sustainable Development***

Institutions of science and technology can initiate different types of research (pure or action research) in specific areas that are germane to issues addressing science education for sustainable development. Such research plays an indispensable role in development, albeit a very complex and perhaps an indirect one as stated by Vessuri (2008) as cited by Ajibade, (2013). Research, apart from creating and increasing knowledge, also enhances understanding of sustainability issues and informs policy decisions.

To make its research outcomes useful and beneficial for the purpose of promoting sustainability practices, every stakeholder is expected to ensure the dissemination, transfer or sharing of its research ideas and knowledge to those who require the input of such research findings to enhance good sustainability practices especially at local or community levels.

✓ ***Inclusion of Entrepreneurship in science Education***

Again, inclusion of entrepreneurship in science education in the Nigerian Universities, Polytechnics, Colleges of Educations and Secondary Schools will enhance the output in science education. This will in turn aid economic sustainability of the nation.

✓ ***Development of Self-regulation***

Self-regulation is also referred to as self-management/self-development. Self-regulation refers to the ability of students to control, regulate, and monitor their use of various learning strategies (Zimmerman, 2000). It is the term used to describe students' abilities to manage and regulate their behaviors. Self-regulated learners set goals for their learning, and then monitor their progress and adjust their strategies toward reaching those goals. Research indicates that self-regulatory skills are extremely important in the domain of science. Science educators can support the development of self-regulation in their students in several ways. First, students must be allowed to have some control over how they learn or process science material. Self-regulation is by definition a "self" controlled process; when science curricula are tightly regulated and prescribed by the teacher (offering students little flexibility) students are unlikely to engage in self-regulatory behaviors. Second, educators must encourage students to evaluate their work

as they progress (Pintrich & Schunk, 2002). If students do not stop and reflect on whether they are reaching their goals, then they often will not attain their goals, particularly if they do not adjust their strategies when necessary.

✓ *Creating Adaptive Motivational Contexts in Science Classrooms*

There has been much research in recent years examining the role of motivational constructs in science education. In particular, research clearly indicates that the types of motivational goals, beliefs, and attitudes that students have are directly related to the ways in which students cognitively process information. Research from a goal orientation theory perspective explains the complex relations between the motivational climates created by teachers in classrooms, and students' cognitive functioning (Ames, 1992; Dweck & Leggett, 1988).

In a related study, Anderman and Young (1994) used multilevel modeling (HLM) to examine the relations between teachers' instructional practices in adolescent science classrooms and student outcomes. Results indicated that teachers' use of ability-focused instructional practices (e.g. displaying the work of the highest achieving students as examples, pointing out students who do exceptionally well in science, and giving them special privileges) was related to motivational goals and orientation.

Conclusion

The development of any nation depends directly on its level of scientific literacy. Efforts by scholars, researchers and educationists have shown the nexus between science education and sustainable development. This paper posits that Nigerians and indeed Nigeria require an effective science education in order to achieve the goals of sustainable development. This is based on the fact that development in the 21st century should be anchored on the scientific knowledge and skills in which science education plays a pivotal role.

Thus, science education if fully implemented will accelerate the sustainable development of Nigeria by providing the bedrock upon which technological advancement of the nation is built. Finally, the philosophy of science education has to be reviewed to promote modern scientific discoveries on local, national and international scale.

References

- Agbowuro, C., Oriade, L. T. & Shuaibu, S. (2015). The Nigerian Child, Science And Technology Education, Current Challenges And Possible Solutions. *International Journal of Education, Learning and Development*. 4 (1), 60-69. Published by European Centre for Research Training and Development UK (www.eajournals.org)
- Ajibade A. P. (2013). Building Human Capital for Sustainable Development: Role of the University. A paper delivered on the occasion of the 2013 University of Ibadan Registry Discourse On Thursday, 26th September.

- Ames, C. (1992). Classrooms: Goals, structures, and student motivation. *Journal of Educational Psychology*, 84(3), 261-271.
- Anderman, E. M., & Young, A. J. (1994). Motivation and strategy use in science: Individual differences and classroom effects. *Journal of Research in Science Teaching*, 31(8), 811-831.
- Ayodeji M. A. et al. (2018). Science Education in South-West Nigeria: Implication for Educational Policy. Proceedings of the Nigerian Academy of Science Volume 11.
- Batomalague, A. E. (2015). Basic Science Development Program of the Philippines for International Cooperation. University of San Carlos, Cebu City, Philippines. Retrieved from www.criced.tsukuba.ac.jp/pdf/09_Philippines_Antonio.pdf (Last accessed on 16th September, 2015).
- Bennett, J. (2003). Teaching and learning science: A guide to recent research and its applications. London: Continuum.
- Christiana, O. N. (2012). Revisiting Science Education and National Development: Nigerian Situation and the Way Forward. *Kuwait Chapter of Arabian Journal of Business and Management Review*, 1(10), 1-13.
- Danjuma, D. & Adakole, I. (2019). Science Education and Sustainable Development in Nigeria: An Analytic Approach. *IOSR Journal of Humanities and Social Science (IOSR-JHSS)* 24(6), 0837-0845. www.iosrjournals.org.
- Dweck, C. S., & Leggett, E. L. (1988). A social-cognitive approach to motivation and personality. *Psychological Review*, 95(2), 256-273.
- Federal Republic of Nigeria (2004): "National Policy on Education". Lagos, Nigeria.
- Gabriel, O. A. (2019). Science and Technology Education Development and the Nigerian Child: Challenges and Prospects (*BSUJEM*). 1(2), 57- 66.
- Garner, N., Hayes, S. M., and Eilks, I. (2014). Linking Formal and Non-Formal Learning in Science Education – A Reflection from Two Cases in Ireland and Germany. *Sisyphus Journal of Education*, 2(2), 10-31.
- Hamidu, M. Y. & Mohammed, A. (2015). The Challenges Facing Science Education in Developing Countries and the Way Forward. *International Journal of Scientific Engineering and Research (IJSER)* www.ijser.in 3(11), 181-188.
- Hanachor, M. E. & Wordu, E. N. (2021). Achieving Sustainable Development Goal 4 in Nigeria: Problems and Prospects. *International Journal of Education, Learning and Development*. 9(2), 10-25.
- Igbaji, C., Miswaru, B. and Sadiyya, A. S. (2017). Science Education and Nigeria National Development Effort: The Missing Link *International Journal of Education and Evaluation*. 3(5). www.iiardpub.org.
- Igbuzor, O. (2009). Challenges of development in Nigeria. Lagos: Robitos Alliance Publishers.
- Ingo, E. (2014). Science Education and Education for Sustainable Development – Justifications, Models, Practices and Perspectives. *Eurasia Journal of Mathematics, Science & Technology Education*, 11(1), 149-158.

- Klaus, D. M. (2013). TVET for a Green Economy. Institute for Sustainable TVET & Management Services. BMZ Berlin Dahlmannstrasse 4 Stresemannstrasse 94 53113, Bonn 10963 Berlin Germany Germanypoststelle@bmz.bund.de www.bmz.de
- Larai, A. K, Christine, A., Christiana, S. J. & Naomi, A. G. (2017). Development of Science Education in a Globally Depressed Economy. *International Journal of Innovation and Research in Educational Sciences*. 4 (1), 35-39.
- Leicht, A., Heiss, J. and Byun, W. J. (2018). Issues and trends in Education for Sustainable Development. The United Nations Educational, Scientific and Cultural Organization, 7, place de Fontenoy, 75352 Paris 07 SP, France.
- Lewis, A. (2015). Science Teaching in Africa. London: Heineman Educational Book Ltd.
- Millar, R. (2004). The role of practical work in the teaching and learning of science. Paper prepared for the meeting: High school science laboratories: Role and vision.
- Momeke, C. O. (2007). 'Effects of the Learning Cycle and Expository Instructional Approaches on Students' Learning Outcome in Secondary Biology' An unpublished PhD thesis submitted to the school of postgraduate studies, University of Benin, Benin City.
- Nwangwu, R. (2014). Teachers for Technology: Basic Principles of School Technology Report. PATT 3 Conference, 2, 487 - 493.
- Offorma, G.C. (2005): "Curriculum for Wealth Creation". A Paper presented at the Seminar of the World Council for Curriculum and Instruction Held at the Federal College of Education, Kano.
- Ogunmade, T.O (2006). And Quality of Secondary Science Teaching and Learning of Secondary Science Teaching and Learning of Secondary in Lagos State, Nigeria. An Unpublished Doctoral Thesis, Edith Cowan University, Perth, Western Australia.
- Okebukola, P.A.O. (1997). The state of science education in Nigeria. Paper presented at the ELLSA- British Council Primary Science Forum, Kaduna, Nigeria.
- Okoli, S. O., Obiajulu, A. N. and Ella, F. A. (2013). Science Education for Sustainable Development in Nigeria: Challenges and Prospects. *Academic Journal of Interdisciplinary Studies Published by MCSER-CEMAS-Sapienza University of Rome*. (2)6.
- Omoifo, C. N. (2012). Dance of the limits - reversing the trends in science education in Nigeria. Inaugural Lecture Series 124, Benin City: University of Benin Press.
- Omorogbe, E. & Ewansiha, J. C. (2013). The Challenge of Effective Science Teaching in Nigerian Secondary Schools *Academic Journal of Interdisciplinary Studies MCSER Publishing, Rome-Italy*. 2 (7).
- Pember, S. T. & Humbe, T. T. (2009). Science Education and National Development. Being a paper presented at the ASSUTIBS Maiden National Conference at CEO Katsina-Ala 6th -9th October.
- Pintrich, P.R., & Schunk, D.H. (2002). Motivation in education: Theory, research, and applications (2nd ed.). Upper Saddle River: Merrill/Prentice Hall.

- Sinclair C. (1988). Science and Technology in Greece, Portugal and Turkey. *Science and Public Policy*, 15, 354.
- Singh, M. C. and Titi, V. (1992). Empowerment for Sustainable Development: Towards Operational Strategies. Canada. A Publication of International Institute of Sustainable Development (USD).
- UNCED (1992). United Nations Conference on Environment and Development Agenda 21: Action Plan for the Next Century United Nations. Rio de Janeiro.
- UNESCO (2000). Current challenges in basic science education. Retrieved from [www.http://portal.unesdoc.unesco.org/images/0019/001914/191425e.pdf](http://portal.unesdoc.unesco.org/images/0019/001914/191425e.pdf).
- UNESCO (2015). Current challenges in basic science education. Retrieved from [www.http://portal.unesdoc.unesco.org/images/0019/001914/191425e.pdf](http://portal.unesdoc.unesco.org/images/0019/001914/191425e.pdf) (Last accessed on 16th September, 2015).
- Urevbu, A. O. (2001). *Methodology of Science Teaching*, Jutland Education Publishers. Lagos.
- W. E. F. (2016). World Economic Forum Global Competitiveness Report 2015-2016 <http://reports.weforum.org/global-competitiveness-report-2015-2016/education/#view/fn-53>
- Wellington (2005). *Practical work in school science: Which way now?* (pp. 3-15). London: Routledge.
- Zimmerman, B. J. (2000). Attaining self-regulation: A social cognitive perspective. *Handbook of self-regulation* (pp. 451-502). San Diego, CA: Academic.