

## UPDATING AND SUSTAINING TECHNOLOGICAL DEVELOPMENT: THE SCIENCE EDUCATION INCLUSION

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**Abstract:** *This paper presents the significance of science education inclusion to sustaining technological development in the society. Science is the basis of Technology and Technology can be identified as an applied science. A society devoid of qualitative science education cannot develop technologically. Science and Technology is involved in every day to day activity of the modern individual, to add value and make life meaningful. This puts science education at the center of broader educational goals for society as a whole. In our contemporary society, the relationship between the domains of science and technology has never been stronger, they serve to inform and extend each other in both intended and unexpected ways. The paper recognised and explained the need for Educators to develop science interests in children at early stages to remove any barrier to, and encourage their learning of science. The researcher recommends that proactive measures should be put in by the Government and stakeholders to ensure acquisition of qualitative science education which will allow for informed citizenship and have notable impact on updating and sustaining the development of technology in the society.*

**Keywords:** Updating, Sustaining, Technology, Developing, Science Education

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### INTRODUCTION

Science is the study of the natural World by scientific methods where data are collected through a systematic process. Science knowledge is integral to preparing a population of active engagement and responsible citizenry, creative and innovative, able to work collaboratively and fully aware of and conversant with the complex challenges facing society. Science aims at expounding the natural World. This it does through interaction, investigation and intellectual practices that enable observations and controlled manipulations of the natural World for improved socio-economic development. Furthermore, Lopez & Potter (2001) comfortably argued Science in terms of its 'critical realist' stance which support the view that there is natural existence of 'things' in the world. Thus, it is expectant of scientists to interrogate the natural things of the world to be able to construct explanations for them. Validation of knowledge in the domain of Science, require adherence to logical reasoning and reasonable coherence with the paradigm. In an alternatively way, it should provide a substantial challenge to the paradigm, while still operating within the tolerance levels of the wider domain (Compton, 2004). Science is the study of the natural World by scientific method

where data are collected through a systematic process. Science knowledge is integral to preparing a population of active engagement and responsible citizenry, creative and innovative, able to work collaboratively; fully aware and conversant with the complex challenges facing the society. Science is different and separate from all other subjects that are disconnected from people's lives beyond school. Science influences all parts of our lives and our decision-making processes. The knowledge of science is the basis for personal accomplishment and responsible citizenship, social and economic development, and a benchmark of innovation, entrepreneurship and competitiveness in our global world.

Despite the emphasis on the importance of Science and Technology, noticeable deficits exist;

- Declining interest in science studies and related careers
- The quality and quantity of teachers (Osborne & Dillon, 2008).
- 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).

- Wide disparities in science education participation in formal, non-formal and informal settings, across regions, cultures and gender (Ballas, Lupton, Kavrouidakis, Hennig, Yiagopoulou, Dale & Dorling, 2012).
- Inadequate teaching and insufficient family involvement needed to inspire children's curiosity (Hayden, Ouyang, Scinski, Olszewski & Bielefeldt, 2011)
- Short-fall in skills and competences required to early- identify stage global trends necessary to reach targets for smart and sustainable growth (Jackson, Brooks, Greaves & Alexander (2013).
- Insufficient investments in strategic co-operation and development of ecosystems that would foster adoption of latest research findings and emerging technologies in industry and enterprise, particularly SMEs (European Commission, 2013).

Nations in the World now make efforts to develop their human and natural resources to the fullest (Olu- Ajayi, 2013). This is required, to enable them acquire recognition among countries and move with the trend of development, for the contemporary World can rightly be expressed as that of science and technology.

## CONCEPT OF SCIENCE EDUCATION

Science learning may be defined as an embodiment of what Science is and what learning is all combined together. Science can be viewed as a body of knowledge, a process, products, motives and explanation of the world around us. It is a systematic enterprise that builds and organizes knowledge in the form of explanations and predictions about nature. Learning has also been viewed as the acquisition of knowledge, skills and competencies. Science education can be explained as the process of studying Science which is usually carried out in schools. It is all about pedagogy and learning. It was described by Pember & Humbe (2009) as a process of teaching or training which is especially carried out in school to improve

knowledge about the environment in learners, and develop their skill of systematic inquiry as well as natural attitudinal characteristics. Science learning, according to Olu-Ajayi (2017) could be viewed as the mode of acquiring the scientific skills, knowledge and procedures through individual's interaction with materials. Despite the importance of Science Education (SE) to national development, in Nigeria, since independence, SE has not been able to raise the country above poverty level to industrialization. Momeke (2007) opined that SE has failed to produce skilled human resources required for transformation into national development. Nada (2008) submitted that the status of competency in secondary school Science education in Nigeria appears to be low, supporting this assertion with a report indicating that majority of teacher, teaching science subjects, seem to lack initiatives and skills that are imperative to move science education standard forward to meet the global education challenges. Other researchers Garner (2005): and Modebelu (2007) noted that many of the teachers lacked substantial professional development and the desired competency for imparting science education. The target of SE was to integrate scientific knowledge to real life activities. It was suggested that science educators should grow citizens who understand science and have positive attitudes toward scientists. Deboer (2000) reported the change in the focus of SE to Science and Technology education to be; meeting the needs of daily life, contributing to the development in science and technology and sustaining the society. Thus, encouraging science learning from childhood, the primary SE should enable a Nigerian child to:

- i. observe and explore the environment
- ii. develop basic scientific process skill including observing, manipulating, classifying, communicating, inferring, hypothesizing, interpreting data and formulating models
- iii. develop functional knowledge of science concepts and principles
- iv. explain simple natural phenomena
- v. develop scientific attitude including curiosity, critical reflection and objectivity
- vi. apply the skills and knowledge gained through science to solve

- everyday problems in his environment
- vii. develop self-confidence and self-reliance through problem solving activities in science
  - viii. develop a functional awareness of and sensitivity to the orderliness and beauty of nature

Science Education helps to understand our world, to guide technological innovation and development and to forecast and plan for the future. Researches clearly identifies educational attainment with better health, personal empowerment and active engagement in public affairs and civil society, being more trusting and supportive of other people, as well as enhanced employability (European Commission, 2010 and OECD, 2013). Considering how Science knowledge and practice are essentially related to building a sustainable relationship between nature and human society, the roles of Science Education needs to be routed to issues and challenges to life in recent century. It is hence imperative, that for any nation, to attain sustainable development, there is need to recognize Science Education as a priority area of education for her citizens (Ogunmade, 2006).

The knowledge of, and about Science are integral to preparing the population to be actively engaged and responsible citizens, creative and innovative, able to work collaboratively and fully aware of, and conversant with the complex challenges facing the society. 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 center of broader educational goals for society as a whole. Researches clearly shows that educational attainment is linked to better health, personal empowerment and active engagement in public and civil society, being more trusting and supportive of other people, as well as enhanced employability (OECD 2012, European Union 2013). The Society faces a range of challenges, such as feeding and housing the population, healthy living, protecting the environment, generating sufficient energy, supplying enough clean water, urbanization and global climate change. Thus, Science education is vital to promote a culture of scientific thinking and inspire citizens to use evidence-based reasoning for decision making; ensuring that citizens have the confidence, knowledge and

skills to participate actively in an increasingly complex scientific and technological world; to develop the competencies for problem-solving and innovation, as well as analytical and critical thinking that are necessary to empower citizens to lead personally fulfilling, socially responsible and professionally -engaged lives; and to inspire children and students of all ages and talents to aspire for careers in Science and in other occupations and professions that underpin knowledge and innovation-intensive societies and economies, in which they can be creative and accomplished. Science learning as rightly put by European Commission (2013) helps us to interpret and understand our world, to manage risk and put uncertainty into perspective, to guide technological development and innovation and to forecast and plan for the future. It improves job prospects, cultural awareness and our ability to act as well-informed citizens in solidarity with citizens around the world.

*Qualitative Science Education* could be explained as the level of science education one acquires that enables him/her become a good contributor to the society. It is a process of imparting the learners with total Science pedagogy. The teaching of Science involves the use of various Science teaching methods which are required for teaching the various topics in the school Science curriculum; these can only be utilized by Science teaching professionals, that is, trained/skilled teachers. Also the teaching and learning of Science ought to be made interesting to learners through a participatory class. These contribute to why teacher's qualification is essential in Science education. Furthermore, the teaching and learning of Science are usually complimented with experiments for practical application of the theory and proper understanding of the topics taught by teachers to the learners, only skilled teachers can handle practical lessons. Qualitative Science education involves the use of books, learning resources, laboratory tools and equipment, natural environment, instructional materials and other materials in carrying out instructions of Science to learners. Conducive learning environment is also required for pedagogy and active participation of learners. Thus qualitative Science Education may be cost implicative to stake holders, but vital to the society The 21st century SE is aimed at helping students make critical judgments about science and to increase their participation in working for an equitable and sustainable world.

Science learning helps us to interpret and understand the world, manage risk and put uncertainty into perspective. It guides technological development and help plan for the future. It improves job prospects, cultural awareness and keep one well-informed compared with others around the world. Science education reform has to be part of systemic efforts at different levels. It should be aligned with and contribute to strategies developed by decision-makers or governments at all levels of society. All stakeholders across the learning continuum, including schools, universities, enterprises and civil society organizations should develop strategies for sustaining the society technologically and structures should be established to provide crucial support to develop and implement science education for responsible citizenship and technology development.

### CONCEPT OF TECHNOLOGY

Technology can be most broadly defined as the entities, both material and immaterial, created by the application of mental and physical effort in order to achieve some value. Technology is defined as consisting of both hardware and software (the knowledge required to produce and use technological hardware) Technology is dynamic in nature as the older ones require replacement by the new technologies. Technology refer to tools and machines that may be used to solve real-world problems in various sectors; Education, health, economic, agriculture, engineering among others. Technology is where we apply science to create devices that can solve problem and perform various tasks. Literarily, Technology is the application of Science. Science and Technology knowledge are important in modern contemporary society as it provide students with insights into how different processes of knowledge are initiated and progressed, and how innovative technological processes are developed and employed. Technology is the use of scientific knowledge for practical purposes or applications., whether in industry or in our everyday lives. It includes everything from the wheel to computers to medicines to zippers and buttons on clothes.

The aim of science learning is to maximize benefits derivable from science to improve technology. Qualitative science education with focus on the development of scientists, who are capable of inventive science,

has been seen as a pedestal for the achievement of technological feats in the contemporary society.

### *Relationship between Science and Technology*

Science and Technology are related to each other in terms of new inventions. We can say technology leads to science or vice versa. Technology is application of Science and both are dependent on each other for their growth (Daniel, 2009). Technology uses Science to solve problems, and Science uses Technology to make new discoveries. Scientific knowledge is used to create new Technologies such as the space telescope while new Technologies often allow scientists to explore nature in new and better ways. The purposes of science and technology, as argued by Wolpert (1992), are also distinctly different. The purpose of science is to produce 'tested knowledge', whereas technology results in the production of usable objects, valued for their human and economic value rather than their contribution to knowledge. It can be argued that such a view is assuming a certain value position with regard to the status given to different forms of knowledge. Implicit within Wolpert's argument is a picture of science as independent and objective, describing external reality in nature independent of human culture, contrasting with technological knowledge which is accorded the low status of 'common sense'. Scientists are highly dependent on the products of technology - computers, scanners, particle accelerators etc. - for their work. They do, of course, make some contribution back to the development of new technology, but this is very much in a background or peripheral role according to proponents of this view:

"...science is far from irrelevant, although its role is often a supporting rather than an initiating one. For example, it offers techniques and advice which can be critically important in the successful development of a technological innovation." (Layton, 1993)

In Education, scientific knowledge and methodologies are useful, and in many cases critical, to students successful undertaking of technological practice and in the development of technological knowledge. Technological knowledge, practices and outcomes in turn can provide useful, and again in many cases critical, tools (both conceptual and material) for scientific practice, Daniel (2009) and the development of

scientific knowledge. Technological practices and outcomes can also provide authentic contexts which enable students to develop deeper more meaningful understandings of scientific knowledge and methodologies. This in turn allows for the development of a critical frame essential to the development of scientific and technological literacy that supports students towards informed citizenship and sustainable development of the society.

### ***Impacts of Science and Technology to the Society***

Impacts of Science and Technology to the Society cannot be over-emphasized; these include; making information more accessible, improve communication, changing transportation and improve medical facility. Science and Technology have formed the foundations for progress in society, and have helped to make people's lives more materially prosperous, inventions in machine tools have been linked to advances in energy Technology to achieve automation and acceleration of manufacturing processes.

The advent of Technology to the world is to make impart on the original state of its existence. It achieves this through interactive, intellectual and design-based practices that involve multiple sources of input, which could be defined as natural, material, simulated, conceptual, emotional, and imagined. Technologists also deduce from the past, current and a range of possible and probable futures.

### **THE CONCEPT OF SUSTAINABLE DEVELOPMENT**

The concept of sustainable development is based on three factors; economic development, environmental conservation and social justice. Sustainability science can be explained as an emerging field of research dealing with the interactions between natural and social systems, and with how those interactions affect the challenges of sustainability that is, meeting the need of present and future generations while substantially reducing poverty.

The goals of sustainable development are the blueprints to achieve a better and more sustainable future for all. To balance economic, environmental and social needs of the society thus, allowing prosperity for now and future

generations. They address the global challenges like; poverty, inequality, climate change, environmental degradation, peace and justice. The main types of sustainable developments are; human, social, economic and environment sustainable development.

Achieving sustainable development involves, eradicating poverty and hunger as rightly put by UNESCO (2014) guaranteeing a healthy life, universal access to basic services like water, sanitation, and sustainable energy. Sustainability is the ability to support the generation with development opportunities through inclusive education and decent work. Poverty reduction, improving socio-economic status, widening participation and gender equality are pertinent of personal and societal goals and are essential to ensuring sustainable development. The 21st century science education is aimed at helping students make critical judgments about science and to increase their participation in working for an equitable and sustainable world.

Feldman & Nation (2015) considered the three aspects of sustainability; social, environmental and economics and discussed the need to integrate sustainability to science teacher education to meet with the goals of economy sustainable development. Science educators, at all levels, have an obligation to encapsulate economic, social and ethical principles into their teaching and learning in order to prepare students for active citizenship and employability (Ellen, 2015).

Science education is vital for the following reasons

- To develop innovative and problem-solving competencies that are needed to ensure personally fulfilling, socially responsible and professionally-engaged lives
- To encourage a culture of scientific thinking and inspire citizens to use evidence-based reasoning for decision making
- To inspire children and students of all ages towards careers in science of which they can be creative and accomplished.
- To assure confidence, knowledge and skills in to enable active participation of individuals in an increasingly technological world.

Today, digital technologies are widely and intensively used in every sector of contemporary life hence developments in industrial and economic technologies have been influencing SE. Science has changed in recent decades with economic and technological developments and the effects of globalization. These rapid changes in science and technology brought changes in human life as well (Choi, Shin, Kim & Krajcik, 2011). Therefore, the need arise to educate citizens who could make critical decisions for the environment and society (Choi et al., 2011). Furthermore, students of recent times compared to olden days have broader worldviews and have more interest in global issues (Tytler, 2007). Hence, science could be set as a bridge to understand these issues and take necessary action (Tytler, 2007).

Developing a sustainable Science education is the ability to educate smart, creative and entrepreneurial individuals with the confidence and capability to think autonomously and critically, engage in lifelong learning (LLL), as well as the ability to generate new knowledge, social and technological innovation and utilize and adapt to technological change. This requires input from all citizens with the competences and confidence in future possibilities as well as the desire, engagement and capabilities for active citizenship, from an early age National Research Council (2012). Poverty reduction, improving socio-economic status, widening participation and gender equality are pertinent of personal and societal goals and are essential to ensuring sustainable development

As engines of modern societies, science and Technology are fundamental to the intelligent management and use of natural resources, they are essential to sustainability. Science and Technology can provide the information needed to develop a sound environment by understanding and monitoring the natural processes that affect the carrying capacity of the environment. Science and Technology capabilities are fundamental for social and economic progress in developing countries. Innovations and researches in Science and Technology is critical to saving the environment, thus reducing the impact of global warming, helping in adapting to climate change, health care and cleaning up polluted areas,

## CONCLUSION

The relevance of science education for sustainable technological development cannot be over-emphasized. Technology is dynamic. New innovations emerge daily with development in the society and these places high demands on science education, which is laden with the responsibility of meeting the societal expectations from science classrooms. Since education is a continuous process, sustainable technological development in the society become easier when students are made to pass through sound science education. Technology can be referred to as 'applied science' that is, the science knowledge through education. A society devoid of scientists cannot develop technologically. Thus for a sustainable technological development of a society, Science Education is prerequisite and basic.

## Recommendations

Science education is vital to the sustainable development of technology in the society. It also provides the necessary knowledge for sustainability attainment within the environment. The paper encourages improved interest in science learning among the youths and students. Also active participation in science based programs (seminars and workshops) among the teachers and students. 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 sustain technology and improve employability and competitiveness. This paper encourages proactive measures of the Government and stakeholders in ensuring adequate science Education in schools.

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