



SCIENCE AND TECHNOLOGY EDUCATION IN PRIMARY AND SECONDARY SCHOOLS: PROBLEMS AND PROSPECTS

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Abstract

The significance of science and technology education to students in primary and secondary schools is examined in this paper. The growth of scientific and technology education, national policies on science and technology education, and the importance of science and technology to both learners and the country were all briefly highlighted. It lists the issues that make it difficult to accomplish the stated objectives. It also examined the nation's progress in terms of Information and Communication Technology (ICT), food production, health, employment, and other areas, as well as the prospects, expectations, and future of science and technology education. On how to further the growth of science and technology education in Nigeria, some suggestions were outlined.

Keywords: Science, Technology, Education, Learner, Remuneration

Introduction

The quality and competency of a nation's human resources, which were developed via a well-defined educational system, determine that nation's reputation (Bhoje, 2014). It has been said that education is a driving force behind societal progress (Federal Republic of Nigeria, 2013). Education is the process of acquiring knowledge and ideas that shape and condition man's attitude, actions, and accomplishments. It is also the art of utilizing knowledge for a complete living. It is a process of developing the child's moral, physical, emotional, and intellectual power for his or her contribution to societal change. It is a process of mastering the laws of nature and effectively using them for societal change. Education may be used as a powerful instrument to change the world (Duncan, 2013).

Internationally, this goal is represented by both the Universal Basic Education (UBE) Act of 2004 and the National Policy on Education (FRN, 2014). Every learner who has completed nine years of basic education "should have numeracy, manipulative skills, communication, and lifelong skills; as well as ethical, moral, and civic values needed for laying a solid foundation for lifelong learning as the basis for scientific, and reflective thinking," according to the UBE Act of 2004, on page 16. National Policy on Education provided for nine (9) years basic and compulsory education - six (6) years of elementary education and three (3) years of junior secondary education. One of the disciplines that assist pupils in achieving their academic objectives in the first nine (9) years of school is science and technology. The extraordinarily complex natural world that surrounds us provides us an example for a wide range of scientific ideas. Children must be scientifically educated in order to succeed as they grow up in the technologically and scientifically advanced environment. When the scientific method is taught to students, they should learn how to live, think, study, solve issues, and make objective judgments. These skills are necessary for all aspects of a student's education and life, including school and job. The quality and competency of a nation's human resources, which were developed via a well-defined educational system, determine that nation's reputation (Bhoje, 2014). It has been asserted that education is a driving force behind societal progress (FRN, 2014).

This is what science as a body of knowledge and process skills aims to achieve in a student and how it enables them to contribute to the advancement of the country. This is consistent with the claim made by Obianuju et al. (2013)

that science is concerned with a variety of investigative processes and activities that pertain to producing, acquiring, and regulating information, skills, abilities, and attitudes regarding the natural elements of the environment.

The Developmental Concept of Science and Technology Education in Nigeria.

Science Education is the field concerned with sharing science content and process with individuals not traditionally considered part of the scientific community. Science Education started in 1859, when the Christian Missionary Society (CMS) grammar school started in Lagos. It started as arithmetic, algebra, geometry, and physiology. Between 1859 and 1929 when teacher training schools were established, more science subjects were introduced into the curriculum, such as botany, geology, physiology, astronomy, etc. But due to a lack of resource personnel, science suffered a setback in Nigeria. Before independence, classic science was emphasized and science was taught in primary school as nature science, while general science was taught in junior secondary school. This continued till Phelps Stoke Foundation assisted in the training of science teachers. With the establishment of more institutes, teaching and learning of science became more recognized as more subjects were introduced which were geared toward meeting societal needs. After Nigeria's independence, a curriculum development movement was established to look into the science curriculum, frantic efforts and innovations were made yet science in secondary school lacked fruition because learners did not have a grip foundation from primary school. This necessitated a change in colonial curriculum content due to its inadequacies for the Nigerian child (Enwo-Irem, 2013; Nyamida, 2020).

Numerous organizations and conferences organized throughout Africa helped to address the issues with the scientific curriculum, ushering in a new age for primary and junior secondary science and technology education. Additionally, the Science Teachers Association of Nigeria (STAN) has made significant contributions to the advancement of science and is committed to the current state of science in Nigeria. According to policies, elementary science is meant to teach functional literacy that is focused on understanding fundamental scientific concepts and procedures, while in secondary school, understanding of fundamental concepts and acquisition of fundamental skills are stressed, as well as the development of desirable attitudes like honesty, patience, collaboration, accuracy, etc. Student preparation for future activities is a goal of senior secondary science. Students are given the information and abilities they need to excel in school and beyond by being taught technological literacy, critical thinking, and problem-solving via scientific education.

The use of educational learning theories based on philosophical, sociological, and psychological views for information that will aid in the development of students' cognitive and psychomotor domains through scientific procedures is known as science education (Clement et al., 2017). It fosters and encourages the critical thinking ability that enables students to see issues and suggest solutions (Omole & Ozoji, 2014). It is designed to encourage the development of scientific attitudes and inquiry, which result in progressive growth. Additionally, it refers to the act of instructing or educating students, particularly in schools, to increase their environmental knowledge and foster natural attitudes as well as their capacity for systematic inquiry.

Technology can be defined as a systematic application of practical skills and theoretical knowledge to solve problems, particularly those problems that can hinder scientific development. A good technology must possess the qualities below:

- It must be relevant to the needs, desires and aspirations of the nations
- It must be relevant to the local content i.e. peculiar culture
- It must be practicable
- It must be scientific
- It must be efficient

Technology education is the systematic and scientific application of practical skills and theoretical knowledge of solving problems. It is the agent for sustainable national development. Science and technology education is regarded globally as the foundation of civilization and development. It is the application of scientific and technological knowledge in manufacturing and utilizing tools, techniques, resources and processes to shape the human and natural environment for individual well-being and social development.

National Policy on Science and Technology Education

Science and technology targets at achieving the following objectives:

- i. To inculcate positive attitude towards science and technology in Nigerian youths
- ii. To provide Nigerians who can man the nation's economy

- iii. To ensure sound foundation of the basic principles and facts of the society as scientists and technologists
- iv. To ensure that every person has such a grasp of science as to be ready to co-operate with understanding in the application of science to mans' needs.

Scientific literacy acquired through science learning enhances the production of citizens who can effectively participate in and contribute to the life of the society.

Relevance of Science and Technology Education

Higher education in science fields is typically acknowledged as crucial for addressing societal needs by producing scientists, engineers, and other professionals in the scientific fields and ensuring sustainable economic development. Science and technology education is regarded as a crucial component of education in Nigeria and other African nations (Taber, 2017). As a result, national goals and objectives for education in science and technology were formed.

The goal of science and technology education is to increase scientific and technological literacy, which helps people creatively apply scientific information to everyday life and familiarizes pupils/students with some scientific processes that help them make decisions and solve problems. It helps people make educated decisions about their health, food, environment, and way of life, among other things, as well as the scientific principles underpinning the technology equipment in their homes. Every nation must advance through science and technology education, especially if it wants to advance such fields (Danjuma & Ikpe, 2019). The importance of science and technology education affects every region of the world, including information and communication technology (ICT), agriculture, health, industry, etc. Man can better comprehend the physical world thanks to it.

Technology and Science Education Problems in Nigeria

Despite the innumerable advancements, innovations, and inventions that education in science and technology can lead to in Nigeria and throughout Africa. Fundamental issues are preventing it from growing as it should.

1. Unstable Staff

Due to teachers' low pay, there is a problem with their availability and instability. Many people utilize the teaching profession as a stepping stone to more alluring careers. For recent graduates of universities and schools of education, this has made teaching convenient employment; regrettably, though, they leave the profession as soon as they receive a better offer in another field. Due to the "peanut" pay that Nigerian teachers receive, the majority of them do have other professions (side businesses) that they attend to. They will undoubtedly be less effective teachers as a result of having to divide their time.

2. Poor Classroom Conditions

In most situations, classes are overcrowded with up to 90 to 100 students in a room intended for 35 pupils/students as 1:35 is the standard teacher-student ratio stipulated in the National Policy on Education (FRN, 2014). This is prominent in public primary and secondary schools, where there are not enough seats. A desk meant for one or two pupils/students is occupied by more than three pupils/students, and some even sit on the floor to learn. Students may struggle to focus because they will become readily sidetracked when studying science in such uncomfortable conditions. In some schools, the roofs are leaking, which makes the classrooms unfit for instruction during the rainy seasons.

3. Insufficient Learning Resources

The necessary educational tools, particularly for scientific practical lessons, are deficient in Nigerian schools at all levels. There is no doubt that this will impact the learning process. The majority of secondary schools are lacking in supplies, and those who do have them are using outdated ones. As a result, instead of doing the practical, pupils just cram theoretical processes. Additionally, many schools and universities have what they refer to as libraries, although the majority of these so-called libraries lack the necessary volumes, periodicals, and magazines.

4. Research Centers and Tests

This frequently necessitates science instructors devoting a significant amount of time to planning and putting up experiments. However, because there are fewer laboratory experiments, science teachers must put in extra time or arrive early to complete their assignments. Additionally, many lab experiments cannot be finished in less than fifty minutes due to the limited equipment available for use in instructing the students. It can be difficult for science instructors to spread out labs over a few days (Ngozi & Halima, 2015).

5. Information and comprehension

Since there are so many topics covered in science classes, it can be difficult to decide how in-depth or broad to go with the curriculum. Due to time restrictions, most lecturers will cover a wide range of subjects without going in-depth on each one.

6. Insufficient Funding

Funding is necessary for quality science education; as a result, workshops, laboratories, and libraries are ill-equipped (Nwangwu, 2014). Lack of financing makes it difficult to provide the necessary facilities, infrastructure, and science teachers (Danjuma & Ikpe, 2019). Lack of funding for science education results in teaching and learning environments that are unfriendly to both teachers and students, which directly affects Nigeria's low standard of science and technology output (Obianuju et al., 2013).

7. Teaching strategies

One may anticipate that as interest in science subjects and basic scientific concepts and ways of thinking develop, so too should the growing importance of science and technology. This is not the case, however, as there are significant concerns about the lack of ideal resources for scientific teaching and learning in Nigerian schools. The majority of schools lack the necessary tools for teaching scientific principles. The majority of pupils understand little science, and their rote memorization makes science boring to many of them (Ogunmade, 2015). Since the use of appropriate teaching methods is what makes successful teaching and learning of school subjects, it has been determined that inadequate teaching is one of the major issues in science and technology education (Njoku & Mgbomo, 2021). According to Omorogbe and Ewansiha (2013), a significant barrier to students' understanding and achievement in science is the employment of improper, ineffective teaching methods. According to other studies, a lot of teachers abstract their courses, which causes pupils to have trouble understanding scientific concepts, techniques, and principles. According to Abdulalu (2016), the majority of teachers place more emphasis on theory than on the practical side of science, and many of them lack sufficient subject knowledge and teaching skills. He also emphasized how the lecture technique has turned science instruction into a descriptive exercise.

8. Complicated Scientific Concepts

The scientific curriculum has been criticized for some of its more challenging subjects. Examples from Biology include genetics, evolution, and sweating; from Physics, electromagnetic field, quantum reality, and thermodynamics; from Chemistry, electrochemistry and hydrocarbons, which some students frequently find difficult to understand due to a lack of learning resources (Babajide, & Smith, 2022). The growth of science and technology education in Nigeria has been severely hampered by the lack of resources necessary to excite these concepts for better assimilation. Because of this, students are less interested in studying science and instead favour art or social science (Ekanem & Obodom, 2014).

9. Large Class Size

The teacher-to-student ratio is a significant obstacle to Nigerian science and technology education. According to FRN (2014), the teacher-to-student ratio should be 1:35, but this is not the case in Nigerian classrooms today. The number of students being taught by a teacher in a classroom at any particular time is known as the class size. The overwhelming size of the classes in Nigerian public institutions makes learning challenging.

10. Low Compensation

Teachers of science and technology are paid little for the contribution they provide to education. Obilor (2018) discovered that irregular salary payments, a poor work environment, low compensation, a negative social image, a heavy workload due to a high student-teacher ratio, and a lack of incentives were significant factors in science instructors' turnover. Obilor (2018) suggested that to reduce the turnover of science teachers, teachers' salaries should be higher than those of all other professions (since teachers created them), salaries should be paid promptly and on time, the work environment of teachers should be comparable to that of employees of multinational corporations, and teachers should be given access to car and housing loans.

11. Education Politics

The majority of Nigerian politicians mock education. They merely give lip service to education, particularly in the fields of science and technology (Babajide, & Smith, 2022). It becomes challenging for the Nigerian school system to advance in line with the objectives of science and technology education due to frequent changes in government and a lack of continuity in projects and policies (Lenshie, 2013).

Nigerian Science and Technology Education Prospects

There are high hopes for the progress of science and technology education in the countries, despite the multiple difficulties that science and technology face in Nigeria. Below are some of these prospects that are discussed:

Technology for Information and Communication (ICT)

Africa is far behind in terms of its information and communication technology (ICT) sector when compared to developed countries, in terms of invention and innovation in the form of products and techniques in the information sciences, communications, space and aeronautics, biotechnology, medicine, etc. It is crucial that educational institutions and research facilities take on the problem. According to Monks (2019), China, South Korea, and the USA have all produced cell phones for more than ten years, while Africa only recently launched its first wholly homegrown smartphone in Rwanda. Science and technology should be more responsive, and schools should be restocked with efficient and pertinent resources, given that technology has been incorporated into many sectors, including agriculture, education, industry, transportation, health, etc. to boost development. Additionally, because it has so many uses in the modern world, it can have a significant impact on a variety of fields and innovations now in use.

Medical Care

According to the World Health Organization (WHO, 2019), there are a number of health issues that are having an impact on the global health sector. For example, more than 90% of the estimated annual cases of malaria, which primarily affect children under five years old, are estimated to occur in Africa. Additionally, the Human Immunodeficiency Virus/Acquired Immune Deficiency Syndrome (HIV/AIDS) still plagues the World Africa Region. The proper presentation or teaching of science and technology education would not only be important for producing competent scientists who will be in charge of creating vaccines and medications, but it would also educate the general public, who are illiterate, on how to prevent or treat diseases when they are contracted.

Food Production

Approximately 820 million people worldwide are malnourished. Sadly, the continent with the most undernourished population is Africa (FAO, 2019). The production of food in Nigeria is being constrained by a number of tragic incidents. Food prices are rising sharply as a result of the poor harvest caused by flooding and other factors. Through the study of agricultural science, people can learn how to use mechanical equipment for the cultivation, planting, and harvesting of crops as well as how to prepare for adverse meteorological events. The rate of food production will increase as a result. There is always potential for improvement despite the notable advancements in crop management technology that have contributed to higher agricultural productivity.

Employment

Employers in Africa view a shortage of trained personnel as a significant hurdle to their enterprises (Leopold et al., 2017). Nigerians would be better prepared for available positions in the many businesses where they will be directly involved in the research and development of biotechnology, food-related goods, and medications as a result of the improvement of science and technology education in that country. The fundamental reason for this skills instability is that more and more occupations throughout the world are becoming dependent on the use of (ICT)/digital technologies. Nearly all occupations in the country have embraced digital technology, including those in the creative sectors like designers, culinary technologists, data analysts, educators, and healthcare professionals. This indicates that the only education that would provide students with the knowledge they need to be employed now and in the near future in Nigeria and abroad is scientific and technological education.

Conclusion

Nigeria's growth in science and technology education is very valuable to the country since it is essential to teaching and preparing young people to be technologically and scientifically literate. Implementing science and education programs will hasten the rapid social, economic, political, and cultural growth that a country has to experience to rank among the developed nations of the world. Nigeria needs sustainable national development, and science and technology education is seen as the cornerstone of that development. It is hoped that Nigeria can attain sustainable national growth if the concerns with science and technology education are addressed.

Suggestions

Following the discussion of issues and future directions for science and technology education in Nigeria, the following suggestions are offered to address the issues:

1. Government spending on science and technology education should be increased, and non-governmental organizations like the Parents Teachers Association (PTA) should give lab supplies to both elementary and secondary schools.

2. To keep them abreast of the most recent advancements in scientific education, science and technology education teachers and lecturers should be given allowances, cash raises, and sponsorship for seminars, conferences, and training sessions.
3. Teachers should adapt their science lessons to their students' modern preferences. By doing pertinent local research and using the results, as is done in industrialized nations, there is a need to assess the teaching techniques utilized in science education.
4. To enhance the growth of science and technology education, students should be made aware of the difficulties they may encounter and inspired to improve.
5. In order to develop a creative and inventive atmosphere, science students should work in teams. The curriculum and teaching strategies should be evaluated in light of current job needs and entrepreneurship.

References

- Abdulalu, A. (2016). Functional science, technology and mathematics education for national economic empowerment and development. *A Paper presented at Federal College of Education conference, Zaria Nigeria. International journal of Education, learning and development*, 4(1), 60-69.
- Babajide, O. P. & Smith, C. (2022). Teachers' challenges in the introduction and implementation of systemic change in the Nigerian primary school system. *Sage open* 12(2), 1-11. <https://doi.org/10.1177/21582440221093033>
- Bhoje, G. (2014). *Application of Motivational Theory in Classroom Situation* (2nd ed.). Laxmi Book Publication, Solapur, India.
- Clement, I., Bello, M., & Sunusi, S. A. (2017). Science education and Nigeria national development effort: The missing link. *International Journal of Education and Evaluation*, 3(5), 46-56.
- Danjuma, S. G., & Ikpe, A. (2019). Science education and sustainable development in Nigeria: An analytic approach. *IOSR Journal of Humanities and Social Science*, 24(6), 29-34.
- Duncan, A. (2013). Education: The most powerful weapon for changing the world. *United States Agency International Development (USAID)*. <https://blog.usaid.gov/2013/04/education-the-most-powerful-weapon/>
- Ekanem, N. U., & Obodom, M. I. (2014). Education for all: problems and prospects of science education in Nigerian School. *Journal of Resourcefulness and Distinction*, 8(1), 1-4.
- Enwo-Irem, I. N. (2013). Colonialism and education: The challenges for sustainable development in Nigeria. *Mediterranean Journal of Social Sciences*, 4(5), 163-168. Doi:10.59017mjss.2013.v4n5p163
- FAO, IFAD, UNICEF, WFP & WHO (2019). *The State of Food Security and Nutrition in the World 2019. Safeguarding against economic slowdowns and downturns*. Rome, FAO. <http://www.fao.org/3/ca5162en/ca5162en.pdf>
- Federal Republic of Nigeria, FRN. (2013). *National Policy on Education*, 6th edition: Lagos: NERDC Press. <https://infoguidenigeria.com/science-education-nigeria/>
- Lenshie, N. E. (2013). Politicisation of Education in Nigeria: Implications for national transformation. *Global Journal of Human Social Science Political Science*, 13(5), 23-33.
- Leopold, T. A., Ratcheva, V., Zahidi, S., & Samans, R. (2017). The future of jobs and skills in Africa: preparing the region for the Fourth Industrial Revolution. In *World Economic Forum*, 1-19.
- Monks, K. (2019). Rwanda opens 'first entirely homemade' Smartphone factory in Africa. CNN. <https://edition.cnn.com/2019/10/08/africa/rwanda-smartphonefactory/index.html>
- Ngozi, D. I., & Halima, S. (2015). Inadequate Laboratory Facilities and Utilization: Pedagogical Hindrance to Students' Academic Performance in Biology in Senior Secondary Certificate Examination in Zaria Metropolis, Kaduna State, Nigeria. *International Business Research*, 8(9), 124.
- Njoku, M. I. A. & Mgbomo, T. (2021). Effect of Field Trip and Demonstration Methods on the Achievement of Secondary School Students in Biology. *Rivers State University Journal of Education (RSUJOE)*, 24(2), 55-64.
- Nwangwu, R. (2014). Teachers for Technology: Basic Principles of School Technology Report. *PATT 3 Conference*, 2, 487 – 493.
- Nyamida, A. (2020). Curriculum change and its impact on the teaching and learning process of history on secondary school students. Munich, GRIN Verlag <https://www.grin.com/document/889321>
- Obianuju, O. S., Obiajulu, A. N., & Ella, F. A. (2013). Science education for sustainable development in Nigeria: challenges and prospects. *Academic Journal of interdisciplinary studies*, 2(6), 159-159.

- Obilor, E. I. (2018). Causes and Remedies of Mathematics and Science Teachers Turnover in Nigeria. *International Journal of Innovative Social & Science Education Research*, 6(3), 103-117.
- Ogunmade, T. O. (2015). The status and quality of secondary school teachers and learning in Lagos State, Nigeria. Doctoral dissertation, Edith Cowan University, Joondalup, Western Australia. <http://www.researchgate.net/publication/49282187>
- Omole, C.O. & Ozoji, B. E. (2014). Science Education and Sustainable Development in Nigeria. *American Journal of Educational Research*, 2(8), 595-599.
- Omorogbe, E., & Ewansiha, J. C. (2013). The challenge of effective science teaching in Nigerian secondary schools. *Academic Journal of Interdisciplinary Studies*, 2(7), 181.
- Taber, K. S. (2017). Science education as a field of scholarship. In *Science Education* (pp. 1-19). Brill Sense.
- World Health Organization, the African Regional Health Report: *The Health of the People*. WHO Bulletin Volume 97. November 2019. <https://www.who.int/bulletin/africanhealth/en/>