

## Restructuring the Basic Science and Technology Curriculum through ICT for Sustainable National Development and Relevance

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### ABSTRACT

Science and technology are key indicators of a nation's standing in the global landscape, forming the foundation for development and progress. Countries that have prioritized investments in these fields have achieved significant advancements, while those that have not continue to struggle with economic challenges. Despite producing a substantial number of scientists, engineers, and technologists, Nigeria remains heavily dependent on foreign expertise for technological services and goods, contributing to its recessed economy. To address this dependence, Nigeria must develop a sustainable science and technology education curriculum that integrates Information and Communication Technology (ICT) and other modern approaches. This integration is essential for achieving the goals outlined in the national policy on education. The current Basic Science and Technology curriculum needs restructuring to better equip students with the knowledge, skills, and competencies required to succeed in the global economy. This paper examines the shortcomings of the existing curriculum and provides recommendations for enhancing it to create a more effective education system. By incorporating ICT and promoting creative and innovative thinking, the revised curriculum aims to prepare students not only for secondary and post-secondary education but also for the industrial workforce. Ultimately, this approach will foster a generation of students who are confident, skilled, and ready to pursue higher education in any field of science and technology, thus reducing Nigeria's reliance on foreign technological expertise.

### ARTICLE INFO

#### Article History

Received: May, 2024

Received in revised form: May, 2024

Accepted: June, 2024

Published online: September, 2024

### KEYWORDS

Basic Science and Technology, Curriculum,  
ICT, Re-structuring, Sustainable  
Development.

### INTRODUCTION

The roles of science and technology in national development cannot be overemphasized. Science and technological growth identify the status of any nation in the global village. Science and Technology has become the dominant world culture, rapid and sustainable development of a country can only be achieved through scientific research, rational application of science and technology knowledge and skills; it has also become the index of development among nations

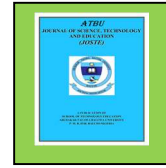
(Samuel, 2019). Countries that have invested heavily in science and technology have achieved greatness, while those that have not done so are lagging behind. Material well-being of the world is driven by science and technology, the rich countries of the world are the science and technology haves while the poor countries are the science and technology have not (Yan, 2019). The differences in the scientific and technological infrastructure and in the popularization of science and technology in the two groups of countries are

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the most important causes of differences in the social, economic, political and cultural developments. Also, the ability of the developed countries to convert scientific ideas to usable technology while the developing and underdeveloped countries are yet to do so effectively (Igwe, 2013). It is pertinent to note that in all aspects of human endeavour such as health, agriculture, food security, communication, economy, transportation, science and technology are applicable. Presently, countries in the world are categorized as: developed, developing, and less/under developed (Samuel, 2019).

Science and technology interplay with the society to bring about sustainable development. Nations that are considered to be developed and largely considered as civilized have achieved that status through purposeful scientific education of their citizens (Bolarin, 2011). Nations all over the world (including Nigeria), strive to have its citizens educated in Science, Technology, Engineering and Mathematics (STEM) disciplines (Ndirika, 2012; Umar & Salihu, 2015; Enemarie, 2016; Nwachukwu, 2017 & Ajayi, 2017). The reason is not far-fetched; there are numerous contributions of science and technology to human development. Nigeria as a developing nation has made quite commendable efforts to enhance scientific literacy of its citizens. Consequent upon these efforts, Nigerian policy-makers and educators recognize the role of science and technology in the achievement of education for all and national development in the present millennium (Ogundele, Okunlola, Damilola & Godfrey, 2020). It invites critical testing rather than acceptance (Stenhouse, 2013). This has informed an evaluation process that led to the development of the Nine-year Basic Science and Technology Curriculum of the Universal Basic Education (UBE) into the Nigeria educational school curriculum. Enemarie (2016) opined that, Nigeria is looking forward to be among the most scientific and technologically advanced nations of the world. The reason is not far-fetched from numerous contributions of science and technology to human development. For any nation, especially Nigeria, to achieve scientific and technologically

advancement, it becomes imperative to start planning for a firm basic scientific education foundation for her citizens from childhood. This is because children begin career exploration at a very young age.

Sustainable development implies the development that can be sustained over a period of time. Since science and technology are part of the national strategy for development, its literacy is elemental in Nigerian economic sector. Part of what is needed to enhance that process is public pressure to encourage more Nigerians to study science and technology. Hence, there is no doubt that these are vital tools for national development of any country including Nigeria (Emaviwe, 2016). Due to its utilitarian value to national development, every effort should, therefore, be made to promote its development by any state that wants development. Nigeria as a state yearning for development can, therefore, not shy away from it in its developmental agenda (Igbaji, 2017). The relationship between science and technology and industrialization is such that the dividing line between them is very thin. While industrial development of any nation depends very highly on the level of advanced science and technology that the nation had achieved, it is worthwhile to note that science and technology are prime instruments in the exploitation of resources for human use.

Many natural resources that have been exploited and developed for technological progress and economic development such as petroleum, forest (for fuel, pulp and paper, timber and ply-wood at Sapele), iron ore (for production of steel at Aladja and Ajaokuta) and limestone (for production of cement at Sokoto, Abeokuta and Nkalagu) are attained through advances in science and technology. These are modern industries employing higher level of science and technology than traditional industries yet using mainly local agricultural raw materials for processing activities. However, more is needed for an improved developing economy like Nigeria. Therefore, there is a need to educate citizens who are aware of the problems in the world and could make critical decisions for the environment and society (Güliz & Gaye, 2016). Whereas technological development propels

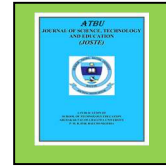
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industrialization and promotes the development of the capacity to manufacture goods, particularly capital goods, industrial development in turn provides the impetus for technological development and innovation (Beisheim, 2015). A major prerequisite for this transformation is the acquisition of technological capacity – that is, the ability to select, diffuse, develop or adapt technology and build on imported technology. The point here is that technological progress is a vital requirement for industrialization and sustainable development. The purpose of science and technology in the 21st century has been set as to help students make critical judgments about science and increase their engagement to work for a more socially just, equitable and sustainable world (Akinjide & Olusegun, 2018). As a part of educational curriculum, Science and technology is an all-embracing concept that is applied to boost sustainable development and create wealth through industrialization for everyone especially as globalization has brought about a more competitive environment (Bello, 2019).

### **The Basic Science & Technology Curriculum**

Curriculum is a particular form of specification about the practice of teaching. It is not a package of materials or syllabus on ground to be covered rather it is a way of translating educational idea into a hypothetical statement. Curriculum is an organized plan of course outlined with the objectives and learning experience to be used for achievement of these objectives (Ogundele, Okunlola, Damilola & Godfrey, 2020). According to Bello (2015), “curriculum is all the learning which is planned and guided by the school, whether it is carried out in groups or individually, inside or outside the school”. Thus, curriculum is a tool of education where teachers educate and humanize the whole man.

The Basic Science & Technology Curriculum that was revised in 2012 is the result of the restructuring and integration of four Primary and Junior Secondary science curricula. The following science subjects were integrated into one: Basic science; Basic technology; Physical education and health; Information technology. This became necessary in order to reduce the

number of subjects offered in Primary and Junior Secondary schools, to prevent repetition and duplication of concepts that resulted in curriculum overload, to encourage innovative teaching and learning approaches and techniques that promote creativity and critical thinking in students, to promote the holistic view of science at this level for better understanding of a contemporary and changing world, and to infuse emergent issues that are of national and global concern, such as gender sensitivity, globalisation and entrepreneurship, into the curricula (NERDC, 2012).

The main objectives of the curriculum set to prepare the students to: develop interest in science and technology; acquire basic knowledge and skills in science and technology; apply scientific and technological knowledge and skills to meet contemporary societal needs; take advantage of the avoid drug abuse and related vices; be safety and security conscious. Major issues shaping contemporary growth and development of nations and influencing knowledge-driven societies, such as those listed below, were identified and infused into the curriculum content at every level: environmental education; climate change; drug abuse education; foods and drugs safety education; disaster risk reduction education; consumer education; safety and security; entrepreneurship; numerous career opportunities provided by science and technology; become prepared for further studies in science and technology (NERDC, 2012).

Basic Science and Technology prepares students at the basic level for the study of core science subjects (biology, chemistry and physics) at the senior secondary school level (Chukwunke & Chikwenze, 2012). By implication, this will be of great importance to man by getting swindled into obscurity and extinction while he still lives on earth. It serves as the bedrock which provides the required training in scientific skills to meet the growing needs of the society. It is the fundamental knowledge acquired through basic science at the upper basic level that leads to the transformation of the world through dramatic advances in almost all fields including medicine, engineering, electronics and

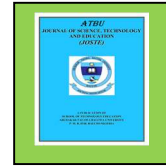
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aeronautics among others (Garuba, Agweda & Abumere, 2012). The importance of basic science and technology curriculum is enormous. It inculcates the right values and norms of the society to foster development. Basic Science and technology equally help to bring information; action and international education. But the teachers of Basic science and technology do not seem to adequately possess the required skills thereby creating competency gaps during instructional delivery. Ukor and Agbidye (2015) concludes that basic science and technology curriculum infrastructure raises more concerns than hopes and calls for a more proactive reform in the curriculum of science and technology at the basic school level. It serves as the bedrock which provides the required training in scientific and technological skills to meet the growing needs of the society. It is the fundamental knowledge acquired through basic science at the upper basic level that leads to the transformation of the world through dramatic advances in almost all fields including medicine, engineering, electronics and aeronautics among others (Chima, 2021).

As a part of educational curriculum, Basic Science and technology is an all-embracing concept that is applied to boost sustainable development and create wealth through industrialization for everyone especially as globalization has brought about a more competitive environment (Innocent, 2016). Since basic science and technology are part of the national strategy for development, its literacy is elemental in Nigerian economic sector. Part of what is needed to enhance that process is public pressure to encourage more Nigerians to study science and technology. Hence, there is no doubt that these are vital tools for national development of any country including Nigeria. Due to its utilitarian value to national development, every effort should, therefore, be made to promote its development by any state that wants development. Nigeria as a state yearning for development can, therefore, not shy away from it in its developmental agenda (Igbaji, 2017).

For Nigeria to become a great economy, science and technology will have to be taken very seriously. In health care delivery, there are only 2

physicians per 10,000 people and Nigeria suffers capital flight in millions of dollars annually, through foreign medical trips (World Health organization, WHO, 2013). This could be halted if science and technology should be employed in the manufacture of new drugs and vaccines to help to increase the life span. Also, a lot of diagnostic tools if produced, will facilitate treatment of various diseases. In electricity, communication, agriculture, transport and other areas of national life, science and technology must be employed to achieve the development agenda. Scientists will be needed in quantity and quality for this to be possible. This explains why the nation's education curriculum must have to be overhauled (Garuba, Agweda & Abumere, 2012).

The trend in curriculum development in Nigeria over the past years, shows, however, that a lot of efforts are being put in place to improve the school curricula in relation to the happenings in the society. Such efforts saw significant improvements in the curricula of basic science and technology with a view to providing learners with life-coping skills. The laying of emphasis on science and technology is understandable because of its capacity to raise the country's rank in global competitiveness (Damian, 2016). A society provides and operates schools not only to preserve and maintain continuity, but also to bring about progressive changes. In planning educational programmes for any society, therefore, the needs, goals and values, expectations of the society must be considered. Without doubt, this provision has curricular implications in view of the enormous changes that occur every day (Yusuf & Alabi, 2015).

The national policy on education (FGN, 2014) stipulates that the country's educational goals should be relevant to the needs of individual citizens in relation to the realities of the modern world and rapid social changes. These changes call for integration of the emerging issues into the curriculum with a view to meeting the changing needs of the learners occasioned by the changes. The relevance of contemporary issues in the curriculum is re-echoed by National Educational and Research Development Council (NERDC, 2012) in its review of the 9- year Basic education

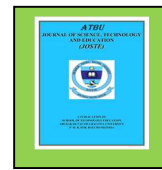
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curriculum. NERDC clearly states that “in selecting the contents of the curriculum, those major issues shaping the development of nations worldwide, and influencing the world of knowledge today were identified and integrated. These are globalization, ICT, environmental education, drug abuse education, and entrepreneurship. The desire of Nigeria to be identified with contemporary development worldwide, called for the infusion of relevant contents of approved innovations in school curriculum.

In 2011, the National Council on Education (NCE) directed the Nigerian Educational Research and Development Council (NERDC) to carry out a review of the nine - year Universal Basic Education (UBE) Curricula. One of the outcomes of that review is the change in nomenclature and content of junior secondary school science. The subject hitherto known as basic science is now to be known as basic science and technology and is to be implemented starting from September, 2014. The reviewed curriculum, according to the Nigerian Educational Research and Development Council, which is the government agency in charge of curriculum development, incorporated all observations, suggestions and new ideas noted in the implementation of the phased-out curriculum. However, instead of proffering solutions, the review created new problems than intended to solve.

### General Revision of Basic Education Curriculum

According to NERDC (2012), the curriculum review process involved consultations with stakeholders (curriculum experts, subject matter specialists, teachers, policy makers, employers of labour, parents, etc) in education at various levels of concept formation and High-Level Policy Committee, to prepare a conceptual framework for the review of the 9-year BEC. NERDC (2012) further explained that the feedback received from the implementation of the BEC called for an urgent need for the review of the 9-year BEC to achieve a reduction in the subject overload in the context of the number of subjects offered at the primary and junior secondary schools. This, they added, is in line with global best practices and for elimination of repetitions within and across subjects. The Conceptual framework identified and grouped related disciplines, thereby, achieving (so to say) a reduction in subject listings. For example, basic science, basic technology, physical and health education (PHE), and Information Technology now combine to form a new UBE subject to be known as basic science and technology.

### The New Basic Science and Technology Curriculum

The new Basic Science and Technology Curriculum, like the preceding one, is organized around themes as the integrating threads. The structure is as presented in Table 1:

**Table 1:** Structure of the Revised Basic Science and Technology Curriculum

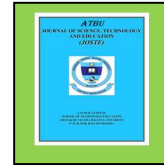
BASIC SCIENCE AND TECHNOLOGY CURRICULUM	
THEME	Sub-Theme
Basic Science	Learning about our environment
	You and energy
Basic Technology	Science and development
	Understanding basic technology
	Materials and processing
	Drawing practice
	Tools, machines and processes
Physical and Health Education (PHE)	Safety
	Basic human movement
	Sports and games

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	Health education
	Moving our body parts
	Athletics
	Contact and non-contact games
Information Technology (IT)	Basic computer operations and concepts
	Computer ethics
	Computer application packages
	Basic knowledge of information technology

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Source: Basic Science and Technology Curriculum (NERDC, 2012)

The revised Basic Science and Technology Curriculum (NERDC, 2012) is a product of the restructuring and integration of four subject curricula previously taught at primary and junior secondary schools (JSS) namely Basic Science, Basic Technology, Physical and Health Education, and Computer Studies/Information Communication Technology (ICT). According to NERDC (2012) the integration of these science curricula became necessary for the following reasons:

1. Recommendations of the Presidential Summit on Education to reduce the number of subjects offered in primary and junior secondary schools.
2. Feedback from the implementation of the curricula in schools that identified repetition and duplication of concepts as the major cause of curriculum being loaded
3. Need to encourage innovative teaching and learning approaches and techniques that promoted creativity and critical thinking in learners.
4. Need to promote the holistic view of science at the basic education level for better understanding of contemporary and changing world.
5. Need to infuse emergent issues that are of national and global concern such as gender sensitivity, globalization and entrepreneurship.

#### **Contentious Issues in the Revised Curriculum**

The revised basic education curriculum generally which streamlined the number of junior school subjects to ten is a bundle of confusion, as one science teacher puts it. But this argument

shall be restricted to the basic science and technology curriculum only. Some of the worrisome and contending issues in the newly introduced curriculum are discussed here.

1. Issues of entrepreneurship and self-reliance often cited as reasons for the review finds more expressions in technology, computer and basic science than six other subjects put together. For the benefit of our children, for legacy and posterity, these subjects (introductory technology, computer science and basic science) should not have been merged into a single subject. To do so negates John Dewey's concept of progressive education and amounts to a disservice to the Nigerian child.
2. Another contentious issue that the Basic Science and Technology Curriculum (revised, 2012) has raised is the fact that the former basic science curriculum is being phased out too soon. It is to be noted that the curriculum being phased was implemented in 2008 (first in JSS1) and the first batch of learners who used the curriculum graduated in June 2010 after sitting for the Basic Education Certificate Examination (BECE). Regrettably and surprisingly, some teachers were still writing the nomenclature of the subject for their students as integrated science, not knowing that it had been changed to basic science. As teachers were trying to cope with the initial change, the curriculum was again changed.

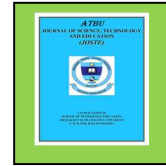
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3. Another issue is that the teachers who are expected to implement the new curriculum were not and are not adequately trained and sensitized on how to implement the new curriculum. Even the NERDC who developed the curriculum recognizes that for effective implementation of the revised curriculum, teachers must be trained and retrained. As Gbamanja (1998) observed, many educational programmes have failed because teachers lack knowledge of the philosophy, objectives, and methodologies of the new system. Such pedagogical issues are to be taught at teacher training and retraining programmes.
4. Other questions that stakeholders are asking are: is it one teacher that will teach the science, technology, computer and the PHE component? Do teachers have such capacity? Have the teachers been retrained prior to the take-off of the curriculum? Won't such curriculum undermine Nigeria's desire to catch children young for science and technology?
5. A compromise of the learning experiences is inevitable by watering down the content of the many emerging sub-themes.
6. Teacher training institutions are not adequately sensitized so that they could redesign their teacher education curricula.

### **Integrating ICT into Basic Science and Technology Curriculum**

Information and communication technology (ICT) is a catalyst for future innovation in teaching and learning practices. ICT transforms the method of delivering the content between the teacher and the learner and also creates an easy access to information. During the 19th century the use of ICT in both public and private sectors was minimal. The production chain relied mostly on the use of human labour. However, in the 20th century

it became obvious that more developments emerged in ICT. There were a number of people interacting with the rest of the global community through modern technology systems. Most of the students at academic institutions (i.e. primary schools, high schools, further education and training colleges, and universities) performed multitasks, and others worked from home by accessing material through web-based tools such as Blackboard. These tools and new gadgets enabled the students to create, communicate and access information and solve problems (Maribe & Twum-Darko, 2015).

More innovations on technology are introduced at a fast pace and allow people to share information and communicate instantly. The social media such as Twitter, Facebook and Instagram have an increased interaction and information sharing. Alhawiti (2013), opined that the integration of technology in the classroom is a necessary measure to improve the teaching-learning process. A modern way of delivering knowledge is important and necessary, especially at the basic school level. The expectation is that ICT integration in the classroom should bring about the solution to skills shortage, especially in the areas of technology, education, engineering and medicine. It is also necessary for bridging the gap between the disadvantaged and advantaged groups in a multiracial classroom environment. The primary objective of this paper is to discuss the significant role of the ICT curriculum in modern-day classroom at the basic school level and how it should be integrated into daily learning modes to allow and encourage active learning. The paper also highlights the significance of the rationale behind the strategies for incorporating technology in the classroom.

### **The significance of ICT curriculum integration**

The integrated ICT curriculum pedagogy allows students to use computers to access information and form collaborative groups to solve complex tasks in various learning areas. Alhawiti (2013) believed that the success of ICT integration is based on evidence-based policy formulation. This policy formulation should guide the strategic implementation of such a technology

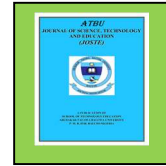
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within the universities. Chima (2021) argued that the central role of educational technology is to provide additional strategies that can be used to address the seriousness of environmental and educational challenges in Nigerian basic schools. Therefore, the formulation of evidence-based policy should speak directly to these challenges and proposes the solutions needed. This will enable students to acquire more knowledge and to adapt to evolving technology innovations by doing things differently. The role of technology in education is vital in globalising challenges faced at the basic school level. It has the ability to change and shape the educational system to conform to current practices. However, ICT integration is significant because of its prevalence in the 'modern era' and its potential to change education environment, and it is also an effective tool for classroom management for teachers (Aldossari, 2013). It should be employed as a tool for the development of relevant and locally produced content (Unwin, 2014).

#### Teaching and Learning Models

The ICT teaching and learning models (TLMs) should assist students to be able to draw a comparison from more than one variable. These learning resources are very crucial for developing innovation and creativity. Ogbonnaya (2015) believed that the TLMs motivate students and could instill the learning curiosity if employed correctly, enabling students to want to learn further. Furthermore, Ogbonnaya (2015) stated that these models enable students to be creative in examining changing relationships, which in return are able to answer 'what if' questions. In the context of adopting change on educational landscape, it is pertinent that teachers become aware of the latest technology to improve their skills (Hramiak & Boulton, 2013). Teachers need to be familiar with the latest technology. This familiarity will help them to enhance their teaching and learning as well as innovation skills. There is a need to align the successful integration of technology in the classroom with a teacher's performance, this is possible with appropriate pedagogy to improve their critical skills necessary

for the adoption of modern technology in classrooms (Hramiak & Boulton, 2013).

#### CONCLUSION

Basic science and technology are a major pillar needed to sustain the nation's growth in science and technology. The curriculum therefore needs to be re-structured and integrating it with ICT for a functional science and technology education that could transform and sustain development in science and technology. The global communities are advancing towards technology-centred education, therefore, the integration of ICT in modern-day classroom is possible if the strategy for implementing educational technologies is in place and supported by all stakeholders. Hence, re-structuring the basic science and technology curriculum would re-awaken the interest of students and reposition their attitude towards the learning and practice of scientific and technological concepts. This would definitely improve the standard of science and technology education in Nigeria and prepare the platform for economic growth and sustainable development.

#### RECOMMENDATIONS

The integration of ICT into the basic science and technology curriculum is very significant for the transformation of science and technology education for relevance and sustainable development, therefore, the following were recommended;

1. A long-term and sustainable basic science and technology education curriculum integrated with ICT should be developed. This would build a solid foundation that would usher in a new era of creative and innovative students who are prepared for secondary, post-secondary industrial work and at the same time could proceed with higher confidence and adequate creative potential and practical skills to higher education in any science and technological field.

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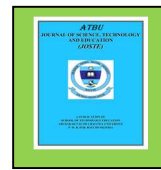
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2. Classroom instructions and learning packages should be driven by the fast-moving communication technologies.
3. Teacher education should focus on training teachers to be reflective in practice, be active in learning and be innovative, creative and partnership building.
4. A programme for training and retraining of basic science and technology teachers should be put in place, the teachers must be well informed about the new change that is going to take place and should receive proper training on how to use the new technologies.

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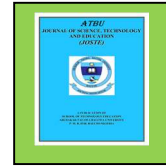
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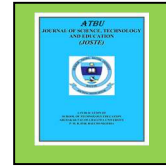
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