SCIENCE EDUCATION: PANACEA FOR SUSTAINABLE QUALITY TECHNOLOGY EDUCATION

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Abstract
Science education has the potential for scientific and technological development of a nation through sustainable scientific activities and ideas. This paper focuses on the need to reposition and restructure the teaching and learning of science with the view of learning quality technology education. It therefore demands looking at what science is, its relationship with technology education, and its impact on society. Hence, the historical development of teaching science in Nigeria was discussed with the trends. Also, the relevance and teaching methods in science education were discussed, together with the relationship and relevance of science teaching to technology education. The teaching of Science and Technology at Junior Secondary School was encouraged here. The contributions of science teachers in the teaching of science were also highlighted in this work in terms of the practical application of scientific knowledge and skills in learning technology at secondary schools. It was suggested that science needs to be taught as both content and process to students with the utilization of various methods and materials that will facilitate students' learning and applications of the acquired scientific knowledge and skills in learning different aspects of technology education for quality and sustainability.

Keywords: learning, science education, technology education, quality

Introduction

Science is the body of knowledge organized from investigations and experiments about natural events and phenomena. Many scholars have defined and described science from different perspectives. Alozie (1996) described science as a systematic process by which knowledge is obtained through explanation and empirical teachings of speculations, Eshiet, (2004) defined science, as a body of knowledge that is organized from human quests to understand natural phenomena and responds to challenges through processes of knowledge testing. In Staver's (2007) definition, science was described as a way of knowing and learning about nature; while Agogo (2017) described science as a process of finding out about the environment and how the various components of the environment relate to one another. Whatever the definition is given, it would be observed that science is a systematic study of the structure and behaviour of the natural world through human observations and experimentations. Science helps to observe and understand our environment, therefore it is important to learn science to appropriately live and interact successively and survive in the environment.

On the other hand, technology is defined by Victor, Kpam & Nevkar, (2021), as the process of using scientific materials and human resources to meet human needs or purposes. In general, technology is the conversion of scientific ideals into practical solutions to satisfy human wants. Victor, Kpam & Nevkar, (2021), claim that technology education is designed to teach students to

be prepared for several technologies within a specific field of study. Quality technology education, therefore, will involve appropriate utilization or conversion of scientific facilities (knowledge, skills, ideas, etc.) into practical solutions to meet human purposes. This implies that to successfully apply scientific knowledge and skills in technology education, science contents, activities, materials must be adequately taught and learnt (for proper acquisition by students) in science education. This is a sinequanon to the making of technology education.

Nature of Science Education

Science deals with investigations about nature or natural events. Therefore, science education is concerned with the changes in learner's behaviour as a result of exposure to knowledge and principles of nature and natural events. The teaching and learning of science in schools is described as science education. Science education is described as the study of the inter-relationship between science concepts and the application of education principles in teaching and learning. Igbaji, Miswaru & Sadiyya (2017) referred to science education as the process whereby teachers who are equipped with skills help to ensure the effective dissemination and inculcation of scientific concepts, culture and thinking processes and activities through generally accepted pedagogical strategies based on the applications of teaching, learning and educational theories to students. Science education involves the exposition of learners to science knowledge, skills, and processes by a knowledgeable teacher or facilitator.

According to FGN (2013), the objectives of teaching science include

- to observe and explore the environment,
- develop science process skills,
- develop functional knowledge of science concepts and principles,
- explain natural phenomena,
- apply scientific knowledge and skills to solving everyday problems in the environment,
- develop problem-solving abilities from scientific activities and develop scientific attitudes such as curiosity and critical thinking,

It could be deduced from the foregoing, that teaching and learning science is very important in our schools. Science knowledge, skills and attitudes provided in science education offer students an opportunity to improve their overall understanding of the world around them. It allows students to gain better knowledge of how and why things function in the world. Science education can develop students' potential scientific ideas, ability to ask questions about nature, collect information, organize and test such information, etc. With this, science education boosts critical thinking in students. The logical approach of connecting theory and practical activities helps in the development of critical thinking which leads to problem-solving abilities in students. Therefore, teaching science knowledge and skills to students means teaching them how to think, learn, solve problems and make informed decisions. Science education is also important for the development of a nation because according to Kola (2013), many of the developed countries can achieve so much in development. After all, such countries have put science education in proper

perspective at all levels. Applications of scientific knowledge in a country improve the country's economy and consequently the nation's development.

Relevance of Science Education to Technology Education

Science is a systematic search for knowledge about nature through observations and experiments from natural phenomena. Agogo (2017) claims science is concerned with finding out about our environment and how various components relate to one another. Therefore, science education could be described as learning about the environment through observations and experimentation. Science education involves the teaching and learning of scientific knowledge, skills, ideas, and attitudes by an experienced or specialized scientist. Technology education is an integrated, experience-based instructional program designed to prepare students about technology – its evolution, systems, utilization and cultural significance. According to Victor, Kpam & Nevkar, (2021), technology education is the study of purposeful application of scientific knowledge, skills and experience in using resources to create and add value to the system to meet human needs.

Science and technology have been together, and central to the development and economic growth of a country. Most developed countries (such as China, Japan, and South Korea) were able to succeed technologically because of the emphasis on science. The two play a vital role in our daily lives and make life simpler, faster, easier, comfortable and safer. Science suggests ideas while technology operationalized them. According to Anaeto, et al, (2016), technology is the complete application of scientific knowledge and skills to develop and produce goods and services useful for man. Science systematically searches, clarifies, and justifies truth to provide the basis for technology. Oduor, (2013) stated that without science, technology cannot exist. Technology is a practical solving enterprise which is propelled by scientific discoveries and societal needs. This may be one of the reasons why science and technology subjects are organized together in a curriculum at primary and junior secondary schools. To enable students to learn science and its applications in technology education.

Science arranges the discoveries together in an organized way in the form of knowledge, skills, and attitudes, while technology translates the ideas and discoveries into technology and enterprise for the use of society. Therefore, the teaching and learning of science forms the basis for technology education. The implication is that the knowledge, skills acquired in science knowledge, and concepts are being used in technology. Technology education is the study of how to utilize science concepts to discover, create and solve problems and construct solutions to human problems in the environment. Hence, for adequate acquisition of quality technology education, scientific knowledge is very important and required.

Quality education according to UNICEF (2000) involves the provision of adequate resources, content that is reflected in relevant curricula and materials for the acquisition of basic skills, processes involving child-centred teaching approaches and outcomes that encompass that knowledge, skills and attitudes that are linked with the society. This implies that quality of education lies in the availability of adequate learning resources for learners, relevant content for

the appropriate acquisition of necessary skills in a child-centred approach classroom, for outcomes that show relevance of acquired skills to the society. These are to be ensured for a sustainable quality education. Given this, UNESCO (2017) stated that sustainable quality education ensures effective learning and the acquisition of relevant skills and competencies.

Therefore, it could be deduced that adequate scientific resources, contents, knowledge, skills, and attitude acquisition and application are germane for quality technology education. These can be acquired through teaching and learning of science. Science should be taught (and learnt) with approaches that will enable students to apply the scientific knowledge, skill, attitude, and process learnt in science for technology purposes. A good science education lays a good foundation for quality technology education.

Approaches to Science Education that Can Enhance Students' Applications of Science Concepts in Technology Education

Science education involves the study of how scientific concepts are learnt and verified, how scientific concepts are programmed for understanding and how science curriculum is meaningfully evaluated. Hence, it could be said that science is fundamental to human survival. Technology operationalizes the scientific concepts for human use and enterprise. Technology education involves learning about technological understanding and the ability to transform scientific knowledge and skills into reality. Science is the basis of technology; therefore, science education is the basis of technology education. For adequate acquisition of technological knowledge in our institutions, students need to be taught scientific knowledge, skills, ideas, and attitudes appropriately in a way to recognize the need for acquired scientific knowledge in technological development and how to integrate the knowledge appropriately and adequately in technology education.

The following are suggested approaches for teaching science for appropriate application in technology education:

1. Relate the teaching of science with real-life experience or environment: when science is taught by relating the concepts with the environment, it assists in building the gap between or disconnections between science and students' environment (home, marketplace, farm, community). Science should be presented in a way to show its relevance to daily activities in our environment. There are several phenomena in the environment which can be used to teach science. Examples include:
    i. using, boiling of foods to teach (or water) to teach state of matter, vapourization, condensation;
    ii. bush burning by individuals (e.g., farmers, hunters) can be used to teach climate change, pollution, desertification, and waste management (incubation, recycling);
    iii. electricity in the house can be used to teach circuits, conductors and insulations;
    iv. slaughter slap in an environment where animals are slaughtered for community consumption can be used to teach the internal organs of animals by observation;
    v. bicycles can be used to teach levers, centripetal force

2. Hands-on activities: this is teaching science beyond the lecture method. It's an approach where students are guided to gain scientific knowledge, skills, and attitudes through experience. It involves teaching scientific concepts with relevant activities and involving students in the process of the activities. The approach is a means to increase learners' understanding of scientific concepts through manipulating objects, thereby making abstract knowledge more concrete. The use and involvement of students in hands-on activities will expose more facts and understanding about the supposed abstract concepts to students, improve their learning, and enable acquisition of certain skills which makes students develop critical thinking and problem-solving skills necessary for their existence and that of their community. When principles of learning science by doing hands-on-activities are applied concerning spontaneous activities of learners' experience, meaningful learning in science can be guaranteed for technology application.
3. Science Project: this approach to the teaching of science is teaching science concepts with enquiry and experiment. It involves teaching science concepts through experiments. Students discover learning in the process of the experiment. This approach encourages investigative learning and solutions to practical problems. The learners are independent and encouraged to actively learn through thinking, how to reach conclusions, problem-solving, describe or express information through writing, oral, graphical representation, etc. Students are required to present in concrete, the results of information gathered about a concept, idea or principle. The approach emphasizes students' ability to learn by doing and not to impose a learning style on them. The teacher facilitates a collaborative approach in which students acquire and apply knowledge and skills to define and solve realistic problems using a process of extended inquiry. Therefore, if students are taught science through this approach, learning many concepts may be more convenient and the application of such scientific knowledge, skills, and attitudes in technology education would be more encouraged.
4. Phenomena–based learning: in this case, the teaching will specify the objectives for the science concept to be learnt during a lesson, and students will be allowed to observe the phenomena, ask questions, organize their findings and make decisions on their own or with the guidance of the teacher. This approach is student-centred and based on inquiry and problem-solving skills. Students investigate and solve their questions by applying what topics are relevant to the problem. The students will observe the real phenomena in the environment. The goal of phenomenon-based learning is to prepare learners to solve problems in real life. Therefore, since this approach is inquiry in nature, teaching students using this approach, would teach students both the science content as well as investigative skills which could be utilized while applying scientific knowledge, concepts, skills, and attitudes in technology education.

Conclusion

Science gives rise to technology and technology forms the basis for development. Without proper science education, technology cannot advance. There is a need for science properly taught in schools with appropriate approaches. This will enable students to acquire the necessary scientific knowledge, concepts, skills, and attitudes for personal and societal development. Scientific knowledge is important in technological development. Therefore, the teaching of science is important for a solid foundation of the science and technology capacity of a nation. There are tremendous contents to study in science and applied in technology to solve problems and make life easier for everyone. Therefore, when the above-suggested approaches are employed in science education, students will learn better, be more equipped and able to apply the acquired scientific knowledge to solve practical problems and develop new technologies. Students must be taught science education in a way that they with learn, the connection of science to technology and master the scientific principles for possible applications in the development of science and technology education.

Recommendations

Considering the importance of science education in science and technology education, it is therefore recommended that:

1. science should be taught and learnt about our environment
2. the teaching and learning of science should be activity-based and problem-solving
3. students should be made to learn and understand that scientific knowledge and skills are being applied in technology education, hence they need a good understanding of scientific concepts for learning in technology education.

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