

Assessment of the Challenges Facing Space Science Education in Nigeria

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ABSTRACT

Space science and technology has applications in various aspects, such as health, education, finance, oil and mineral exploration, the environment, etc. But despite these numerous applications, especially in the day-to-day life of the people, the study of space science education is at the lowest ebb. This work was aimed at discussing the challenges facing the study of space science education in Nigeria, especially at the primary and post-primary schools. From the results, it was observed that space science education has many benefits, such as inspiring students to explore the universe, enhancing national security, supporting economic growth and development, and inspiring students to pursue careers in emerging fields like planetary science, etc., but there are also impediments to this education, such as limited resources and funding, a lack of qualified educators, curriculum constraints, limited access to technology and equipment, etc. It was concluded that space science education has a lot of benefits that society can derive from, even as it is faced with numerous challenges.

KEYWORDS: Astronomy, Environment, Planet, Satellite, Space

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1. INTRODUCTION

Space science and technology has its applications in various aspects such as health, education, finance, oil and mineral exploration, environment, security, transportation, communication, education, etc. In a simple term, space science and technology “deals with the study of the upper atmosphere (space), the body in outer space or celestial body other than the earth, as well as how the engineering and scientific disciplines will be able to explore and use outer space to the benefit of humanity” (Mohammed and Ayegba, 2016). 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 (Njoku and Edori, 2022). Space science education

refers to the teaching and learning of the principles, concepts, and phenomena associated with space research, as well as outer space and what it contains. In spite of the numerous groundbreaking innovations and inventions that science education can achieve in Africa, its growth in the continent is stunted as a result of some challenges such as unavailability of laboratory equipment and instructional materials, inadequate funds, inadequate teacher quality, and teaching methods (Ayeni, 2022). Space education includes content, workshops, and activities that aim to promote, deepen, and reinforce STEM studies using content in the field of space. Thus, space education may encourage students to delve deeper into the basic fields of mathematics, physics, biology, and

chemistry, which provide a necessary foundation for advanced study in space engineering (Dovand Ciprian, 2022). In the US, for instance, space science education has its setbacks or challenges, especially in terms of the regular change in the curriculum. The study of space science education, which is called Earth and space science in the US, is guided by the trend or national standard. As reported by Cahyati and Liliawati (2019), according to the National Conference on Revolution on Earth and Space Science, all schools must review earth and space science curricula to ensure that the contents and pedagogy of earth and space science curricula are in accordance with national standards. According to Jiwaji (2016), with decreasing interest in pursuing pure science programmes, mostly due to many decades of teaching science to children without recourse to practical and hands-on activities leading to disillusionment among learners that science is difficult to comprehend, the onus is on primary and secondary schools to attract and maintain the interest of students to pursue science subjects. But aside from these problems, there are other problems facing science education in Africa or Nigeria. In addition, if general science is being faced by numerous challenges, then space science education, which is not even known to many people, especially at the primary and secondary school levels, will have more challenges than seen in science. This led to this research, which seeks to investigate the challenges facing the teaching and learning of space science education in Nigerian schools. The research made use of a mixed method of explanatory and review research methods.

1.1. DEFINITION OF SOME COMPONENTS OF SPACE SCIENCE EDUCATION

- 1.1.1. Astronomy: Astronomy is defined as the study of the universe, including stars, galaxies, planets, and other celestial objects. It is also defined as the scientific study of the stars, planets, and other natural objects in space.
- 1.1.2. Space Exploration: Space exploration is defined as the investigation and study of the objects and various activities in space, such as the solar system, space missions, the galaxy, spacecraft design, and propulsion systems, as well as their impacts on society and human culture.
- 1.1.3. Planetary Science: Planetary science is defined as the study of planets, moons, asteroids, comets, and other objects in our solar system and beyond.

- 1.1.4. Astrophysics: Astrophysics is defined as the study of the properties and interactions of space or celestial bodies such as stars, galaxies, and other space phenomena. It is the branch of space science that deals with the application of the laws of physics to explain the universe and its human interpretation.
- 1.1.5. Space Technology: Space technology is defined as the study of the design, development, and operation of spacecraft, satellites, rockets, drones, and other space-related technologies. It also deals with the understanding of the engineering and technological principles that guide space exploration.
- 1.1.6. Space Policy and Law: Space Policy and Law is defined as the study of the policies and laws that govern space exploration and the use of space.
- 1.1.7. Space science: Space science is defined as the field that covers space exploration or investigation of space and the phenomena and bodies in outer space. It is also defined as the study of all space exploration, whether performed at a distance or by humans.

2. BENEFITS OF SPACE SCIENCE EDUCATION

Some of studying of Space science education are as follows:

2.1. The study of space science education can contribute to enhancing national security:

Space science education helps develop a skilled workforce with areas of specialisation like space-based surveillance, satellite operations, and missile defense. This workforce can support national security efforts through the development of advanced space-based surveillance and reconnaissance systems, which are critical for national security, using space science education.

Space science education contributes to the development of advanced military communications and data transmission systems, which rely on space-based assets. These systems enable secure and reliable communication between military units and command centers. Space science education enables the development of advanced navigation and timing systems, such as GPS, which are critical for national security, as they enable precise navigation and timing for military operations. Space science education helps develop expertise in space situational awareness, which enables the tracking and monitoring of space objects, helping to prevent collisions and ensure the safe operation of space-based systems.

2.2. The study of space science education can help students to explore the universe.

Universe is defined as the things in space. Through space science education, students can learn about the planets, asteroids, comets, and other objects in space, as well as their characteristics and orbits. Students can learn about the different types of astronomy, including optical, radio, infrared, ultraviolet, X-ray, and gamma-ray astronomy; the life cycle of stars; and how they help us understand the universe. Students can learn about the formation and evolution of galaxies, including our own Milky Way, and study the mysteries of black holes and dark matter, including their properties, behaviors, and roles in the universe. Through space science education, students can take part in simulated space missions and explorations, using software and hardware tools to design, launch, and navigate virtual spacecraft. Also, students can engage in hands-on activities and experiments, such as building model rockets and creating asteroid impact craters in the space laboratory.

2.3. The study of space science education can help students in developing data analysis and interpretation skills.

Space science education helps students develop data analysis and interpretation skills in several ways. This can be in the form of the students working with real-world data from space agencies, such as the National Space Research and Development Agency (NASRDA), and other organisations, like NIMET to study, analyze and interpret data related to space weather, planetary science, and astronomy. It will also help students to learn how to use data visualization tools, such as graphs, charts, and maps, to represent and interpret data. In addition, students can also develop the knowledge of data processing using statistical method like regression analysis to draw conclusions based on the analysis of the data.

2.4. The study of space science education can help in supporting economic growth and development.

Economic growth and development is the change in income, investment, and savings along with the change in economic structure of a country in a progressive form. The support of economic growth and development through space science education could be in the form of inspiring the students to involve themselves in innovation and entrepreneurship, which can lead to the development of new technologies and industries in the space area. It can also help in developing a skilled workforce with expertise in space science and technology areas like satellite communications, geoinformatics, and

aerospace engineering, which are the backbone of communication (like broadcasting and telecommunication); health (like telemedicine, disease mapping and prediction); online trading; digital marketing; tele-governance; precision agriculture; etc. The study of space science education allows international collaboration between nations or people in different countries, thus leading to global partnerships and economic opportunities.

2.5. Fostering Environmental Awareness

Space science education enables environmental awareness in several ways, such as students studying Earth's systems, including the atmosphere, oceans, and land surfaces, to understand the interconnectedness of our planet and the change in weather conditions or atmospheric parameters like temperature, pressure, and relative humidity, in addition to their changes and the factors responsible for their changes. Also, students analyse climate change data and research to understand the impact of it on the environment as well as humans or other living things in the environment. Furthermore, students can make use of sustainable practices, such as renewable energy like solar energy, wind power, and resource management, to understand the importance of it in environmental sustainability.

2.6. Providing Opportunities for Hands-on Training

Hands-on training simply means practical training or work done involving general participation outside theoretical work. Space science education can provide the students as well as teachers the opportunities to engage in hands-on training in the form of building model rockets to learn about propulsion systems. This will not only teach them how to build rockets but also how rockets operate, their functions, and various mechanisms and laws guiding their operations. It will also help the students to learn the way to design and build satellites, thus getting acquainted with spacecraft design, electronics, and other various subsystems of the satellite, including the power subsystem, thermal control subsystem, communication subsystem, altitude subsystem, telemetry, tracking and command subsystem, onboard data handling subsystem, etc. With the study of space science education, students can conduct experiments, such as growing plants in space or testing materials in microgravity, to learn about the scientific effect of “no-gravity or microgravity on plants’ growth.

2.7. Inspiring Students to Pursue Careers in Emerging Technology and Space-Related Fields

Even at the primary school level, some pupils chose their future field. This could be as a result of the love

for the topic or subject. In the same way, learning about space science education by pupils of primary schools or students of secondary schools could develop their interest in the space-related fields like space science, astronomy, aerospace engineering, space navigation, remote sensing, and Geographical Information System (GIS). The study of space science education will also expose the students to new or emerging technologies such as cyber security, artificial intelligence, machine learning, data science, and nanotechnology.

3. CHALLENGES FACING THE STUDY OF SPACE SCIENCE EDUCATION IN NIGERIA

Some of the challenges facing the teaching and learning of Space science education in Nigeria are as follows:

3.1. Insufficient funding and limited resources:

Today, some educational institutions face budget constraints, making it challenging to allocate sufficient funds for science education or space science education programmes. According to Premium Times Online News on December 23, 2023, with a caption, “2024 Budget: Tinubu’s Improved Funding for Education Still Below UNESCO Recommendation,” it was reported that the president’s 2024 budget increased the allocations for education when compared to the previous years. It went further to state that the education sector got N1.54 trillion, which represents 6.39 percent of the total budget. But, despite the increase, the funding is below the UNESCO recommendation level. This is not limited to Nigeria, as various parts of the world are having different challenges that are affecting their science educational sector negatively. In addition, space science education often requires specialized laboratories, like gravity demonstration laboratories, as well as some equipment, such as telescopes, planetarium software, or spacecraft simulators, which can be expensive and difficult to access. There is no way the effective teaching or learning of space science education can be done without adequate textbooks or study materials. From our investigation, there is limited availability of space and educational resources such as textbooks that cater to the specific needs of space science education, especially at the elementary school levels. As confirmed by Nwangwu (2014), poorly equipped workshops, laboratories, and libraries exist in some African countries’ schools due to shortfalls and inadequacies in education funding, which will affect science education as quality science education demands funding. 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; Njoku and Edori, 2022).

3.2. Inadequate Qualified Educators

The field of space science and technology is not very common, as the greater majority of the people in the society may not even know how to explain what a low earth orbit satellite, medium earth orbit satellite, or geostationary orbit satellite is, even as a science-inclined person. This is because space science and technology, or space science education, is not taught in most schools in Nigeria like other courses. As of today, the only higher institutions offering satellite communications or space science and technology in Nigeria are probably ARCTEE Ile Ife, Osun State, which offers satellite communications and Remote Sensing/GIS programmes at the PGD and Master’s degree level; the Institute of Space Science Engineering, NASDRA, Abuja, which offers Aerospace Engineering, Space Physics and Geoinformatics /GIS programmes at the masters and PhD levels; and some other few universities that offer related courses. From investigation, there is perhaps no university in Nigeria that offers space science and technology with a satellite communication option at the PhD level. Satellite communications deals with the study of the operations of various satellites, the design, the applications, and many other aspects, including its applications as well as the study of the ground station and its subsystem. This makes the qualified space science educators or experts limited or inadequate, and this will affect the teaching of it in schools.

Also, space science educators may require professional development opportunities to enhance their knowledge and skills in space science education, and this can be challenging sometimes, especially if such trainings are not easily accessible to them. Furthermore, the rapid evolution of space science and technology can make it challenging for educators to stay current with the latest developments and discoveries. That is why there is always a need for training and retraining of staff to remain current and updated with the present development in space science and technology.

3.3. Curriculum Constraints

There may be some schools that may be interested in teaching space science to their pupils, especially at the primary level or secondary school level, but there is no curriculum for space science study. It becomes worse when there are no textbooks for these classes or groups of students, which may help the teachers to perform their functions effectively. In some cases, the curriculum may be crowded with other subjects,

making it challenging to allocate sufficient time and resources for space science education. Also, other subjects, such as mathematics, science, or language arts, may be prioritised over space science education, making it challenging to secure a place in the curriculum. Another challenging part is the difficulty in integrating space science into existing subjects. In other words, space science education may not be easily integrated into existing subjects because it requires educators to develop new and innovative approaches and also the government to make a policy that will allow schools to include it in their subjects to be offered just like other subjects if they so will.

3.4. Accessibility challenge

Space science education is not to be limited to a particular geographical location or a group of people in the country. But because of the peculiar nature of space education, especially due to the limited number of space science educators, not every school or schoolchild can access space science education. Space science education may not be accessible to all students, particularly those from underrepresented groups or with limited resources. It may not be accessible to children in schools in rural areas, some of which do not have access to the internet. In simple terms, there may be disparities in access to technology, such as computers or internet connectivity, which can limit students' ability to participate in space science education programmes. Even if space science education is provided in the rural areas, accessibility to practical areas like space institutions, microgravity laboratories, or space museums such as one in Abuja will be difficult due to some factors, especially economic challenges.



Plate 1: National Space Museum, Abuja, Nigeria



Plate 2: Institute of Space Science and Engineering (ISSE), Abuja, Nigeria

3.5. Limited Access to Technology and Equipment

Effective and efficient space science education requires specialised equipment, such as GPS receivers, telescopes, spectrometers, or spacecraft simulators; AI and robotics laboratories; etc. Apart from the expensive nature of these equipment, most of them need electricity to function, but electric power is not in some schools in the rural area, thereby making the put into use of the equipment very difficult. There is no doubt that the students who are privileged to use these equipment in their schools will perform better in practical or hands-on areas than the students from other schools that do not have access to any of these equipment. This is a very big challenge because even after acquiring the space science education theoretically, there is still a challenge when such a person comes across any of the space equipment, especially how to use them. More so, there may be limited availability of technology, such as computers or software, that can support space science education or even the competent person that can make use of the software or computer to provide the students with the needed training. In some schools today, there are a few computers in the computer laboratory, and some of them are not even working perfectly again. In some cases, the power supply to the school, for those connected to the power supply, is not even steady, especially if the school depends majorly on public power supply. There is no way this will not affect the students negatively, especially in areas of simulations or modellings, to provide students with hands-on learning experiences. In all, one can also not afford to underscore the need for good infrastructure stocked with quality teaching and learning materials for use by both teachers and learners (Ellis and Goodyear, 2016).

3.6. Lack of Motivation

As a result of the inadequate knowledge of space science education or space science and technology by some Nigerians, the study of it is seen by some people as not important or relevant. It is easy to understand when someone says he or she is studying medicine, law, accounting, engineering, or agriculture in the university or in any higher institution than when told by someone that he or she is studying satellite communication or remote sensing and GIS. This is because, according to some, space science may seem abstract or disconnected from students' everyday lives, making it challenging to motivate and engage them. In addition, students may have limited exposure to space science or an imaginary view regarding space science and technology, which can make it difficult to develop interest in the study of space-related courses at the higher levels. There is a need for public awareness, orientation, television, and radio jingles on space science and technology applications for the students as well as parents to see the need for the study of space science education in school.

3.7. Policy and administrative challenges

In some countries, the study of space science education is at every part or level of their education. In Nigeria, it is not so. To the best of our knowledge, there is no policy or law that space science education must be offered in either primary schools or secondary schools, which are the foundation levels. As a result of this, school teachers or school owners do not even take it seriously. And since schools do not even prioritise it, pupils or students don't even see any importance in studying it. But even in some schools that may want their pupils or students to offer it at the primary or secondary school level, the implementation and sustainability of the teaching and learning of space science education will be difficult since there is probably no policy in Nigeria for now mandating schools to include it in the programmes. And the absence or yet-to-be-available law on the study of space science education in primary and post-primary schools by the government could be as a result of some of the challenges earlier mentioned, such as inadequate qualified space science educators and space science education materials.

4. Conclusion

The work on the challenges facing the study of space science education in Nigeria has been carried out in addition to the benefits derived from its studies. The study made use of the explanatory and review research methods in order to provide a detailed insight into the various points for a deeper understanding of the topic under study. From the

results, it was observed that space science education has many benefits, such as inspiring students to explore the universe, enhancing national security, supporting economic growth and development, and inspiring students to pursue careers in emerging fields like planetary science, etc., but there are also impediments to this education, such as limited resources and funding, a lack of qualified educators, curriculum constraints, limited access to technology and equipment, etc. It can be concluded that space science education has a lot of benefits that society can derive from even as it is faced with numerous challenges.

5. Recommendation

It is recommended that the research on the possible solutions to the challenges facing the space science education in Nigeria be carried out in future work.

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