

Investigative Study of the Roles of Nasrda's National Space Museum in the Growth and Development of Space Science Education in Nigeria

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Abstract: The aim of this research work was to investigate the roles of NASRDA's National Space Museum in the growth and development of space science education in Nigeria. The research method employed for the work was the interview research method. The interview was conducted by the researchers with the director of the museum, Dr. Adeleke, regarding the operation of the museum, their collections, and their contributions to the growth and development of space science education in Nigeria. The results show that the museum has been contributing, and is still contributing, to the growth and development of space science education in Nigeria in various ways, such as collaboration with researchers and research students, teaching health subjects through simulation, equipping the museum with state-of-the-art museum collections, laboratory experiments, STEM education and coding training, and real-time visualization of satellites, among others. From the results, it was concluded that the NASRDA Space Museum is contributing greatly to the growth and development of space science education at the primary, secondary, and tertiary education levels. It is recommended that future work should also be done regarding the challenges faced by the museum despite their outstanding facilities. It was advocated that adequate awareness be created by the museum or space science group(s) on the study benefits derived from the visit to the National Museum either for training, education, tourism, or research works.

Keywords: Astronomy, Museum, Satellite, Space Science, Virtual reality simulation

I. INTRODUCTION

A museum is defined as an institution responsible or dedicated to the collection, preservation, storage, and exhibition of artifacts or historical, cultural, artistic, and scientific objects. According to the International Council of Museums (ICOM), "A museum is a not-for-profit, permanent institution in the service of society that researches, collects, conserves, interprets, and exhibits tangible and intangible heritage. Open to the public, accessible, and inclusive, museums foster diversity and sustainability. They operate and communicate ethically, professionally and with the participation of communities, offering varied experiences for education, enjoyment, reflection, and knowledge sharing." There are various types of museums, and this classification is based on their collections or functions. Some types of museums are art museums, which keep and exhibit visual arts, including paintings and sculptures; history museums, which keep and exhibit historical or past artifacts or items that tell stories about the history, cultures, and traditions of a people; science museums, which store and exhibit scientific and technological

collections or items; specialty museums, which keep and exhibit specific area collections, such as medical museums and war museums; and natural museums, which keep and exhibit natural collections, like some plants and animals. In addition, a museum can be fixed, mobile, or virtual. A fixed museum is one in which the collection is in a building or fixed location. A mobile museum is the type of museum where the collection can be moved from one location to another for exhibition, teaching, etc. While a virtual museum is a museum that has its collection digitized and can be accessed online from any part of the world. Museums can also be national, state-owned, or private museums. The National Space Museum is a scientific museum. A space museum can be defined as the type of museum that deals with the collection, preservation, storage, and exhibition of collections relating to space science and technology, outer space, the universe, space exploration activities, and space-related applications.

According to Osama (2022), educational museums serve as research and innovation centers, adding that scholars, researchers, and students can have access to museum collections and other resources needed to conduct research and develop new ideas, including new theories in their fields of study. Maite and Jenaro (2014) stated that the visits and field trips of schools to museums and science centers are very powerful learning resources given their recreational and educational potential; however, such visits should be integrated into classroom programming to optimize learning. In the same way, Eni et al. (2020) have also opined that museum-based learning is oriented to facilitate ideas or inspiration generation for work. Museums, science centers, and other informal learning institutions are playing an important role in promoting science for all learners, as museums have the ability to reinforce scientific concepts and develop the practices employed by engineers and scientists (National Research Council, 2009 & 2011).

II. METHODOLOGY

A. Brief about the National Space Museum

The National Space Museum is located on the campus of NASRDA, Obasanjo Space Centre, Airport Road, Lugbe, Abuja, Nigeria. The museum was commissioned on April 25, 2019, by the then Minister of Science and Technology, Dr Ogbonnaya Onu. The museum is open between 9:00am – 4:00 pm on Monday – Friday, and 10:00 am – 3:00 pm on Saturday and Sunday. The museum charges 4000 per student/person for a tour, but is N1000 if it is for Virtual reality game alone. Python training is also done by the museum, and it is on Saturday only. The National Space Museum is open to students, children,

adults, researchers, tourists, scientists and space technology lovers.



Fig. 1: Some satellite models in the museum

B. Materials and method

The data used for this work was primary data. Primary data is the data collected by the researcher or researchers directly from the source. In this case, the data was collected directly by the researchers from the Director of the museum. The research adopted the interview research method. The reason was to obtain detailed and comprehensive information regarding the subject matter before documenting the summary. Another importance of the interview research method is that it allows the respondents to provide the needed information at his or her pace, which will enable the interviewer to ask some questions that arose in the course of the previous question. The interview or research questions were structured and unstructured, with the structured being “What are the roles of NASRDA’s National Museum in the growth and development of space science education in Nigeria?” while the unstructured ones came in the course of the interview. The interview was a one-on-one interview by the researchers’ representatives and the Director of the museum in his office. The interview was followed by a tour round the museum by the research group to observe and confirm some of the information gotten in the course of the interview, especially around the physical artifacts or collections on display. This is the first research work done on the museum, hence making this work very important.

III. RESULTS AND DISCUSSION

The following are some the contributions by the NASRDA National Space Museum towards the growth and development of space science education in Nigeria.

A. Real-time Visualization of Satellites

According to the Director of the museum, the Nigeria National Space Museum offers a unique learning experience for students by providing real-time visualization of satellites in space or orbits, including the ones owned by Nigeria, such as NigSat-2 and NigSat-X. This interactive exhibit allows students to understand the different types of satellites, their orbits, and their functions. The visualization will also allow the students to understand why the satellites are moving at different speeds and positioned at various heights or altitudes, as well as why satellites have shapes, and even know more about some of the parts of the satellite in space, like the antenna and the solar panels, and why they are positioned or facing the direction they are facing in their orbits. The real-time visualization feature of

the NASRDA Space Museum also enables students to understand the forces acting on the satellites that did not obey the “law” of gravity, that whatever goes up will come down. In addition, the Director also stated, in this section, students or those on excursion to the museum will learn about satellite launch, the processes passed through by the satellites or spacecrafts to travel from the earth’s surface to the outer space or its orbit during launch which is at the secondary school level can be explained in a simple term as a project, but with a greater force such that the force of gravity does not have much impact on it, hence will be able to take the advantage of escape velocity and then gets into the space where it will employ the centrifugal and centripetal forces, in which one will be dragging it towards the centre of the earth while the other will be dragging away from the earth, thus balancing themselves, and keeping the satellite in its orbit.

The students, the director said, would also learn how to prevent a satellite from colliding with another satellite or space object or from falling below its intended altitude or shifting upward above its intended altitude, adding that all these can be controlled from the satellite ground station, where a command will be sent to the satellite like a signal, and the devices on it will readjust and bring the satellite to the desired position or shift it from the way should there be a possibility of it colliding with another satellite or space object like asteroids, which are like stones in space.

B. Astronomy Corner

The national museum, though being the first in Nigeria, has many interesting sections or corners, and one of them is the astronomy corner. The astronomy corner at the museum provides an engaging and interactive space for students to learn about astronomy, which is the study of celestial objects, space, and the universe as a whole. The section is where the students will learn about stars, especially our own galaxy called the Milky Way Galaxy, the planets, and some of their properties or characteristics. The director added that Astronomy Corner is the location where the moon of the earth, why part of it is seen at some point and not even seen on the earth at some other point while it can fully be seen in the whole size at some points, etc. The other things studied in this place are asteroids, comets, meteoroids, and the nature of the space environment, which is mostly extremely hot with various gases and radiations, thus making it unsafe for humans except in special wear called spacesuits or in the International Space Station. The students also would learn what the International Space Station is, its location, its function, and how people are living there for some months for study or experiment before coming back to the earth.

C. STEM Education and Coding Training

The museum Director stated that one of the ways the museum is contributing to the growth and development of space science and technology education in Nigeria is through the STEM programme. He stated that the NASRDA’s National Museum offers STEM (Science, Technology, Engineering and Mathematics) education and coding training to students, with a focus on designing space-related projects. Speaking further, he added that some of the activities in this section include coding and Python programming, which students can learn Python programming and coding skills from, which can be used to design space-related projects. Students or trainees learn hands-on some aspects of space science, and at the end, they can carry out various designs and simulations themselves. Recently, he said, some students were able to design a planet orbiting or moving around a planet and could be seen clearly

on the screen after the students were trained on the design projects. This result got many of them very excited, with some promising to become a space scientist or space engineer in the future. The training also made them understand that most of the complex things we are seeing today can be achieved through coding or programming, as the result can, first of all, be seen through simulation before the project can be carried out, thus, being impacted with the idea of problem-solving at the early stage.

D. Laboratory Experiments

The national space museum offers laboratory experiments, the director said. The director, Dr.Adeleke explained that major experiments in biology, physics, and chemistry at both secondary and tertiary education levels can be done in the virtual laboratories of the museum. The museum's laboratory can be used to perform an experiment, for instance, Snell's law in physics, and after teaching or practical demonstration by the museum curator or teacher, the students can be asked to perform the experiment on their own, fixing the optical pins in the appropriate location, getting the line of refraction, getting down various values at various stages, plotting the graph virtually by entering the correct values for the horizontal and vertical axes, and then performing further evaluation such as the slope and values of one quantity at the given value or values of the other quantity if needed. For the purpose of awareness and to take advantage of the technology, many schools have been invited for this section, and after that first visit, some of the schools started bringing their students and/or teachers by themselves for the practical training, as they have seen the improvement in the performances of their students who earlier visited the museum. And one beautiful thing about this is that the people visiting this laboratory or attending this practical at the museum range from primary to tertiary institutions, as there are classes for each stage or category of students.

E. Virtual Reality (VR) System

A virtual reality system is defined as a combination of hardware and software that allows users to interact with a computer-generated, three-dimensional environment, creating an immersive experience. A virtual reality (VR) system performs a simulation of real-world sensations, including sight, sound, and potentially touch, which will make the users feel like they are actually present in the virtual world. The NASRDA national museum has a virtual reality (VR) system with about 40 different experiences. According to the director, some of the experiences that can be provided in the museum are virtual travel, in which the students can use the VR system to take virtual trips, such as flying from Nigeria to New York, and see every step of the journey; immersive learning, in which the VR system provides an immersive learning experience, allowing students to engage with complex concepts in a more interactive and engaging way; and enhanced understanding, in which the VR system can help students develop a deeper understanding of complex concepts, like in science.

F. Teaching Health Subjects through Simulation

The museum can use simulation technology to teach health subjects to health students and health personnel such as doctors, pharmacists, and other healthcare professionals. According to the Director, it is always very important to be competent in health practices before one begins to treat humans or perform important health activities like surgery on humans. In other words, it is not very good to carry out some experiments, like surgery, on real humans; hence, the need for

the inanimate objects that are available in some areas for such important and critical training. In the space museum here, he said, the simulation system allows realistic training in which healthcare professionals, like students or training doctors, can practice surgeries and other medical procedures on simulated patients, which helps them develop their skills in a realistic and safe environment. In order for the students or health officer to access his or her performances or test his or her degree of competence, there is assessment and feedback as part of the simulation. With the assessment and feedback, the simulation system provides immediate feedback and assessment, allowing healthcare professionals to identify areas for improvement. It will report to the students if the treatment or operation was well done or if there were mistakes at some stages and the effects of those mistakes, including if the health officer or student has killed the patient in the course of the surgery. In simple terms, the simulation system helps healthcare professionals or students in particular to develop their competence and confidence before working with real patients.

G. Telemedicine

The museum offers telemedicine services, which allow patients to connect with doctors remotely. Telemedicine is defined as the diagnosis and treatment of patients by doctor or health personnel in another geographical location through the use of electronic or telecommunication technologies.

When the patient makes a request regarding the particular country that he or she wants a doctor from, the connection will be made immediately, and the direct interaction or discussion can be initiated. The museum, as stated by the director, has some of the features of the telemedicine service as follows:

Remote consultations in which the patients can connect with doctors in other locations, such as the USA or UK, for remote consultations; real-time communication in which the telemedicine system allows for real-time communication between patients and doctors, enabling timely diagnosis and treatment; Ultrasound technology, which allows doctors to remotely monitor patients, such as pregnant women, and provide accurate diagnoses, etc.

H. Equipping of the museum with state-of-the-art museum collections

The Nigeria National Space Museum, being a special kind of museum, is equipped with cutting-edge, advanced, and contemporary collections. The Director, Dr.Adeleke, explained that the museum, apart from the virtual collections or simulation sections, has numerous physical collections or artifacts on display and in their archives for the visitors. Artifacts are objects used or made by humans, often for cultural, historical, or scientific purposes. He stated that the museum has some important space-related collections, such as satellite models, space mission control, spacesuits, atmospheric layer models, astronaut models, space debris, rocket models, space orbit models, meteors, comets, asteroids, space exploration instruments, spacecraft components, unmanned aerial vehicles or drones, space shuttle models, spacewalk materials, satellite electrical power subsystems, etc. All these are to enable the students or the people on the excursion to familiarize themselves with the necessary terms and objects being measured in the course of the studies. It also gives the students a clear understanding of what space science and technology are all about, as well as expanding the horizon of their knowledge regarding what is in space and other things that have to do with outer space.

I. Collaboration with researchers and research students

In order to support or contribute to the growth of research in space science and technology areas, the museum acts as a research ground for researchers, including lecturers as well as students. They make use of the museum collection for their research and, in some cases, ask questions regarding their research or thesis topics according to their objectives or research questions. This makes it easy for students to choose the topic related to space science and technology, as they know that they have the location or place to get the research materials or data that will make their research work easy and robust. In addition, researchers also make use of some of the experiment section or simulation devices for their research works or school projects. This will help in a great way, as it will provide the researchers access to tools and resources as well as create an avenue for collaboration with other experts and researchers in the same field, thus sharing knowledge and ideas.

CONCLUSION

The investigative study of the roles of NASRDA's National Space Museum in the growth and development of space science education in Nigeria has been conducted using the interview research method. The research, which involved the interview of the director of the museum, Dr. Adeleke, revealed that the museum, which is the first and only space museum in Nigeria, has been contributing, and is still contributing, to the growth and development of space science education in Nigeria through various ways, such as collaboration with researchers and research students, teaching health subjects through simulation, equipping the museum with state-of-the-art museum collections, laboratory experiments, STEM education and coding training, and real-time visualization of satellites, among others. From the results, it can be concluded that the NASRDA Space Museum, known as the National Space Museum, is contributing greatly to the growth and development of space science education at the primary, secondary, and tertiary education levels.

Recommendation

Based on these results or findings, especially with respect to how equipped the museum is with both physical and virtual collections, it is recommended that adequate awareness be created by the museum or space science group(s) on the study benefits derived from the visit to the National Museum, either for training, education, tourism, or research works. Future work should also be done regarding the challenges faced by the museum despite their outstanding facilities.

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