

The Case for Space Education in Nigerian Universities

Challenges, Models, and the Way Forward

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Executive Summary

This report presents a compelling case for the urgent and strategic integration of space education into Nigerian universities. Despite Nigeria's long-standing ambitions in space science and technology, a critical disconnect persists between these national goals and the educational pipeline required to support them. The global space economy is experiencing unprecedented growth, valued at over \$546 billion in 2023 and projected

to reach \$1 trillion by 2030, with the private sector driving a significant portion of this expansion.¹ Nigeria stands to gain substantially, with its space economy capable of contributing at least \$1 billion annually to its Gross Domestic Product (GDP) by the late 2020s.¹

This document highlights existing challenges such as curriculum rigidity, faculty shortages, and insufficient infrastructure, which are often exacerbated by broader systemic issues in science education. However, it also showcases promising models, including pioneering university-led satellite projects like the Federal University of Technology, Akure's (FUTA) NigeriaEduSat-1 and its globally recognized CanSat team, the specialized postgraduate programs at the Institute of Space Science and Engineering (ISSE), and vibrant grassroots initiatives like Space Clubs Lagos State University (LASU). Drawing lessons from successful international programs in India, the United States, South Africa, and Brazil, a phased roadmap of actionable solutions is proposed. These interventions, spanning short-, medium-, and long-term horizons, include introducing foundational space science courses, targeted faculty development, establishing innovation hubs, developing formal degree programs, and institutionalizing student-led satellite missions.

The objective is to spur collaboration among policymakers, university administrators, the National Space Research and Development Agency (NASRDA), and development partners to build an educational system that prepares Nigerian students for active participation in the global space industry. This transformation will foster innovation, strengthen Science, Technology, Engineering, and Mathematics (STEM) education, boost national development, and mitigate brain drain. Space education is not merely an academic pursuit; it is a strategic imperative for Nigeria's economic diversification, youth empowerment, and global relevance.

Chapter 1

Introduction: Charting Nigeria's Cosmic Ambition

Nigeria's aspirations in space science and technology are well-documented, yet the nation's higher education system has historically prioritized traditional disciplines, with limited integration of frontier technologies. This section sets the stage by examining the burgeoning global space economy and Nigeria's potential within it, highlighting the current educational gap, and outlining the purpose of this report.

1.1 The Expanding Global Space Economy and Nigeria's Strategic Position

The global space economy is undergoing a rapid transformation, evolving from a predominantly government-driven enterprise to a dynamic, commercially led sector. This expansion presents immense opportunities for nations capable of developing indigenous expertise and capabilities. The global space economy was valued at over \$546 billion in 2023 and is projected to hit \$1 trillion annually by 2030, making it one of the fastest-growing economic sectors worldwide.¹ A significant portion of this growth, approximately 77% in 2023, is driven by the private sector.¹

For Nigeria, this expansion offers substantial economic potential. The nation's space economy has the capacity to contribute at least \$1 billion annually to the national GDP by the late 2020s, with the private sector expected to account for \$700-800 million of this contribution.¹ Furthermore, by 2035, the broader business ecosystem in Nigeria could benefit from an annual value of up to \$15 to \$25 billion, impacting critical sectors such as agriculture, telecommunications, logistics, and oil and gas.¹

Emerging global trends underscore the dynamism of this sector. These include the development of next-generation launch vehicles, increased private sector involvement in human spaceflight, a renewed focus on lunar missions (though with mixed results), and a redefined space race between major powers like the United States and China. Key technological advancements driving this growth include Artificial Intelligence (AI)-enabled Earth imaging, asset tracking, and new satellite networks designed for direct-to-mobile communications.³

The rapid growth and significant economic potential of the global space economy, as evidenced by the projected \$1 trillion valuation and Nigeria's own \$1 billion GDP potential, highlight a critical opportunity for economic diversification. Nigeria's economy remains

heavily reliant on traditional sectors, particularly oil. If the nation fails to actively participate and build indigenous capabilities in the space sector, it risks perpetuating its role as a consumer of imported space technologies rather than a significant contributor.¹ This underscores that investing in space education is not just about scientific prestige but represents a strategic economic imperative for national resilience, job creation, and future prosperity, especially given the global demand for STEM skills in this burgeoning sector.

1.2 The Critical Disconnect: Bridging Ambition with Educational Reality

Despite Nigeria's visionary space ambitions, first declared in 1976 ⁶, and the approval of a National Space Policy in 2001 with a 25-year roadmap for implementation ⁵, a significant gap persists in the educational pipeline. The National Space Policy explicitly states that Nigeria shall "vigorously pursue the attainment of Space Capabilities as an essential tool for its socio-economic development... through research, rigorous education, engineering, development, design and manufacture".⁵ It further emphasizes developing a pool of Nigerian engineers, scientists, and technicians, providing attractive career opportunities, and training trainers.⁵ The policy even mandates making the study of space science "mandatory at all levels of education".⁵

However, despite these ambitious policy statements, Nigeria lags significantly in university-level participation in space science, satellite systems, and Earth observation, especially when compared to countries like India, South Africa, and Brazil. The absence of structured, widespread space education programs at the university level represents a critical gap for a nation with ambitious goals in satellite communication, remote sensing, and space exploration.

The existence of a comprehensive National Space Policy since 2001, with clear mandates for "rigorous education" and human resource development ⁵, stands in stark contrast to the acknowledged "significant disconnect" and "lag in university-level participation". This indicates a profound gap between well-articulated policy objectives and their effective, widespread implementation within the higher education system. The challenge is not a lack of strategic vision, but rather difficulties in translating that vision into actionable, funded, and integrated educational programs across the nation's universities. This suggests that future efforts must focus not just on *what* to do, but *how* to overcome systemic barriers to implementation.

1.3 Purpose and Structure of this White Paper

This white paper aims to bridge the identified disconnect by presenting a comprehensive case for embedding space education in Nigerian universities. It will draw from national policies, analyze international examples, and highlight successful local initiatives to outline existing challenges, showcase promising models, and propose actionable solutions. The ultimate objective is to foster collaboration among all stakeholders—government agencies, universities, industry, and civil society—to build an educational ecosystem that empowers Nigerian students to drive national development and participate effectively in the global space industry.

Chapter 2

The Indispensable Role of Space Education in National Development

Space education is not a niche academic pursuit; it is a fundamental driver of national development, offering multifaceted benefits that extend far beyond the immediate space sector. Integrating it into university curricula is a strategic investment in Nigeria's future.

2.1 Fostering Innovation and Multidisciplinary Problem-Solving

Space science inherently demands a multidisciplinary approach, compelling students to integrate knowledge from diverse fields and apply it to complex, real-world challenges. Space science is intrinsically multidisciplinary, drawing upon physics, computer science, systems engineering, data analysis, and even policy. This integrated approach challenges students to think innovatively, collaborate across traditional academic silos, and devise novel solutions to intricate problems.

Engaging students in space-related challenges nurtures a culture of innovation and technological advancement. Astronomy education, for instance, is highlighted by NASRDA as a discipline that fosters curiosity, creativity, and critical thinking.¹⁰ This goes beyond rote learning, promoting deeper cognitive engagement. Furthermore, NASRDA actively advocates for the inclusion of students with disabilities in astronomy education, emphasizing that such inclusion is critical for promoting interest in STEM careers. Initiatives like the workshop held at the Special Education Centre in Oji River, Enugu State, which trained 170 visually and hearing-impaired students using tactile and audio-based methods, demonstrate that space science can be made accessible and inspiring for all.¹⁰

The emphasis on the multidisciplinary nature of space science, crucial for innovation, is further enriched by the focus on inclusive astronomy education. This reveals a deeper benefit: space education cultivates not just technical STEM skills, but also broader cognitive abilities like curiosity, creativity, and critical thinking. This implies that space education can serve as a powerful tool for holistic intellectual development across the student population, including those with special needs, making it a valuable asset for national human capital development beyond just producing space engineers.

2.2 Strengthening the STEM Pipeline for Future Workforce Needs

Introducing space-related topics significantly enhances student interest in Science, Technology, Engineering, and Mathematics (STEM), which is crucial for building a robust workforce for the 21st century. STEM occupations are projected to grow by 10.4% between 2023 and 2033, significantly outpacing the 4.0% growth rate for all occupations.¹¹ Specifically, employment in software development is projected for a 17% growth during the same period.¹¹ The space sector itself has seen remarkable employment growth, increasing by 27% in the last decade and 18% from 2019 to 2024.¹²

The economic incentives for pursuing STEM careers are substantial. The median annual wage for STEM workers in 2023 was \$101,650, more than double the median wage for all occupations, which stood at \$48,060.¹¹ This highlights the significant financial benefits of pursuing STEM careers. Studies show that students are more likely to pursue STEM careers when they can apply their knowledge in exciting fields like astronomy, satellite design, or robotics. NASA's STEM engagement strategy, for instance, explicitly aims to "build the next generation of explorers" and attract, engage, and prepare future STEM professionals, reaching over 970,000 students and 59,000 educators in Fiscal Year 2024.¹³

The global demand for STEM professionals is rapidly increasing, with millions of jobs projected to go unfilled.¹¹ Nigeria, with its large and youthful population, faces the dual challenge of high unemployment and a pressing need for economic diversification. By strategically investing in space education, Nigeria can directly address these issues. This investment not only prepares a skilled workforce for high-paying, future-proof jobs within the burgeoning global space economy¹¹ but also leverages Nigeria's demographic dividend, transforming a potential burden into a powerful engine for economic growth and stability.

2.3 Catalyzing Economic Diversification and Job Creation

Space technology is a powerful enabler for critical sectors, fostering economic diversification beyond traditional industries like oil. Satellite technology provides crucial support for precision agriculture, urban planning, telecommunications, and national security.⁸ It enables vital monitoring of environmental issues like floods, deforestation, and crop performance, and remote sensing is essential for early warning systems, environmental protection, and climate change monitoring.⁸ Access to geospatial data significantly improves governance, resource management, and public health.

The National Space Research and Development Agency (NASRDA) is mandated to develop Nigeria's indigenous expertise in designing and building hardware and software for space

science and technology, utilizing them as essential tools for socio-economic development.⁸ NASRDA's services include satellite building, launching, ground station communication, image generation for marketing and environmental analysis, and strategizing for national development.¹⁵ Developing a local space industry promotes job creation in advanced manufacturing, software engineering, data analytics, and aerospace systems integration.¹⁴ The Abuja Chamber of Commerce and Industry (ACCI) emphasizes that the space economy is a "vital engine of economic growth, job creation, innovation".¹

The various sectors benefiting from space technology are clearly outlined, and NASRDA's stated services, such as satellite building, image generation for agriculture and urban planning, and ground station communication¹⁵, further concretize these applications. This demonstrates that space education is not a standalone, isolated field but a foundational enabler whose benefits ripple across multiple critical national sectors. Investing in space education thus represents a strategic, high-leverage investment that yields returns across the entire economy, driving broad-based development and diversification, rather than just within a specialized space industry.

2.4 Enhancing Global Competitiveness and Mitigating Brain Drain

Equipping Nigerian graduates with advanced space-related skills is crucial for enhancing their competitiveness on the international stage, attracting global investment, and reducing the pervasive issue of brain drain. The 21st-century workforce is increasingly global and digitally driven. Careers in aerospace engineering, Earth observation, satellite communications, AI for space systems, and planetary science are rapidly growing worldwide.¹⁴ For instance, aerospace engineers, information security analysts, and statisticians are projected to see significant growth and offer high median wages.¹⁴

Nigeria's National Space Policy aims to develop a "critical mass of Nigerians in the area of space science and technology to enable the country to realize its objectives for achieving technological, industrial and economic self-reliance".⁸ The ACCI emphasizes that Africa "must move beyond being a consumer of imported space technologies and begin to build its own capabilities in space research, development, and commercialisation".¹ The assertion that space education can reduce brain drain is supported by a deeper understanding of the issue. Brain drain is not solely about a lack of jobs, but a deficit of *high-tech, cutting-edge opportunities* and a challenging environment for advanced research within Nigeria. By creating a robust space education ecosystem and a thriving local space industry, Nigeria can offer compelling, globally competitive career pathways, thereby retaining its brightest minds and attracting back those in the diaspora, transforming brain drain into brain gain.

Chapter 3

Current Landscape: Space Education Initiatives in Nigeria

While Nigeria's space ambitions are clear, efforts to embed space education within the mainstream university system have been fragmented. This section details existing initiatives, highlighting both progress and persistent gaps.

3.1 NASRDA's Mandate and Evolving University Engagement

The National Space Research and Development Agency (NASRDA), established on May 5, 1999, with an initial budget of \$93 million ¹⁶, is the primary government agency responsible for Nigeria's space program. Its mandate explicitly includes education and human resource development. NASRDA's vision is "to develop Nigeria's indigenous expertise in designing and building hardware and software for space science and technology, utilizing them as essential tools for socio-economic development".¹⁵ Its mission includes "rigorous education" and "capacity building in the fields of science, engineering, space law, and administration".⁵

NASRDA has developed and launched six satellites, including NigeriaSat-1, NigeriaSat-2, NigComSat-1R, and NigeriaEduSat-1.¹⁷ Notably, NigeriaEduSat-1 was Nigeria's first university-based satellite, built in collaboration with the Federal University of Technology, Akure (FUTA) and Japan's Kyushu Institute of Technology (Kyutech).¹⁷ While most projects have been agency-led, this marked a significant step towards direct university involvement. NASRDA has also donated GIS laboratories to various Nigerian tertiary institutions and offers a one-month Geographic Information System (GIS) training program for final year students from geography-related courses in some universities.¹⁷ The agency actively urges the inclusion of students with disabilities in astronomy education to foster STEM interest.¹⁰

For postgraduate education, NASRDA established the Institute of Space Science and Engineering (ISSE) in 2018, in affiliation with the African University of Science and Technology (AUST). This institute awards NUC-approved MSc/PhD degrees in Advanced Space Sciences and Engineering.⁶

NASRDA's foundational mandate explicitly includes "rigorous education" and "capacity building" ⁵, positioning it not just as a space agency but as a key educational stakeholder. The donation of GIS labs and student training programs ¹⁷, alongside the establishment of ISSE for postgraduate studies ⁶, demonstrate a direct, albeit currently limited, engagement with the university system. This indicates that NASRDA is uniquely positioned to be a central catalyst for scaling space education, but its efforts need to be more systematically integrated and

expanded across a wider network of universities, moving beyond isolated initiatives.

3.2 Pioneering University-Led Satellite Projects (e.g., FUTA's NigeriaEduSat-1, CanSat Team)

The Federal University of Technology, Akure (FUTA) has emerged as a leader in university-led space projects, demonstrating the significant potential within Nigerian institutions. FUTA's role in NigeriaEduSat-1, a collaboration with NASRDA and Kyutech, was a landmark achievement. This project provided students with hands-on experience in satellite development, testing, and mission control.¹⁸ The primary objective was capacity building and domesticating satellite technology within a Nigerian university, with spillover effects on STEM education.¹⁸

Further underscoring its capabilities, a team of FUTA students emerged among the top five globally and was the first and only African university to participate in a prestigious international space competition organized by the American Astronautical Society in Virginia, USA, in October 2024.²³ Their CanSat project, simulating a space probe, achieved impressive scores of 98.96% in the Preliminary Design Review and 97.17% in the Critical Design Review.²³ The CanSat program provides invaluable hands-on experience, bridging the gap between theoretical knowledge and real-world application, and inspiring the next generation of engineers and scientists.²³

FUTA's pioneering work with NigeriaEduSat-1 and the subsequent global recognition of its CanSat team are strong indicators of existing, high-level student and faculty capability within Nigerian universities. The involvement of international partners like Kyutech and the American Astronautical Society demonstrates that when Nigerian institutions are provided with opportunities, mentorship, and collaborative frameworks, they can not only participate but also excel on the global stage. This highlights the critical role of strategic international partnerships in accelerating capacity building and providing real-world project experience that would otherwise be difficult to access.

3.3 Focused Research and Academic Contributions (e.g., Covenant University)

Covenant University, a private institution, has shown focused commitment to research in space-related fields, particularly satellite communications. Covenant University maintains active research in satellite communications and space systems, with faculty and students regularly publishing in international journals. Their research includes areas like the impact of

satellite communication on developing economies²⁴ and advanced wireless technologies such as millimetre wave (mmWave) massive multiple-input multiple-output (MIMO) for 5G networks.²⁵ The institution has engaged in design simulations and created platforms to encourage interdisciplinary research.

Covenant University also offers a pre-engineering dual degree program, allowing students to complete foundational studies before transferring to accredited engineering schools like Georgia Tech or the University of Tennessee - Chattanooga for specialized degrees, including Aerospace Engineering.²⁶

Covenant University's model, characterized by focused research and international academic partnerships, suggests a greater agility in curriculum development and collaboration, often associated with private institutions. This implies that private universities can serve as crucial catalysts for pioneering specialized space education programs, potentially offering effective blueprints or collaborative opportunities for public universities to emulate, bypassing some of the bureaucratic hurdles.

3.4 Awareness and Capacity Building Efforts (e.g., University of Lagos Hackathons)

The University of Lagos (UNILAG) has contributed to capacity building and awareness through innovation challenges, though not always exclusively focused on space. UNILAG has hosted innovation challenges that include space- and climate-themed hackathons. More recently, in June 2025, UNILAG's National Information Technology Hub (NITHUB) organized a "Hack for Health" hackathon focused on innovation in health technology, particularly Artificial Intelligence (AI).²⁸ This event saw 400 teams apply, with 200 selected and 10 making it to the grand finale, emphasizing multidisciplinary collaboration.²⁸

In March 2025, UNILAG and the United Nations Development Programme (UNDP) signed a Memorandum of Understanding (MoU) to create an AI-focused ecosystem within the university through the UNILAG UniPod project. This hub will feature an AI Lab, Design Lab, Maker Space, and collaboration areas, aiming to advance research, innovation, entrepreneurship, and leadership.³⁰ The Faculty of Science at UNILAG has been urged to deepen its commitment to research, industry collaboration, and academic innovation, acknowledging systemic barriers like lack of access to data.³¹

While UNILAG's hackathons and new UniPod project are not exclusively "space"-focused, their strong emphasis on technology, innovation, and Artificial Intelligence²⁸ is highly relevant to modern space applications. AI, data analytics, and problem-solving skills are

increasingly critical for space systems, Earth observation, and mission control.³ This suggests that existing strengths in general technology and STEM disciplines within Nigerian universities can be strategically leveraged and re-oriented towards space applications, rather than requiring an entirely new foundational build-out. The multidisciplinary nature of these initiatives also aligns with the inherent multidisciplinary nature of space science.

3.5 Grassroots Momentum: The Impact of Student Space Clubs (e.g., LASU)

Student initiatives, particularly Space Clubs LASU, demonstrate a strong bottom-up interest and capacity for space education despite significant infrastructural limitations. Space Clubs LASU is a highly active grassroots student initiative that organizes a wide range of activities, including webinars, technical workshops, and hands-on projects such as high-altitude balloon missions.³² Recent and upcoming events include "CosmoPi" (an immersive space workshop), "Under The Epe Sky" (night sky observation with telescopes), "The Yuri's Flight" (discussion on Yuri Gagarin), "InterPlanetary travel" discussions, and "Rocket Propulsion Systems" webinars.³² They also host webinars on topics like "Nigeria and Our Space Race" and "Monitoring the Planet: How Satellites are Combating Climate Change".³²

These clubs foster enthusiasm, provide students with leadership opportunities, technical experience, and exposure to international space developments, proving that student interest is strong despite systemic challenges.³³ Their vision is to "Inspire, Educate, and Engage students" and make space exploration accessible to everyone.³³

The vibrant activities and consistent engagement of Space Clubs LASU, despite operating with "infrastructural limitations", reveal a powerful, organic, and underutilized force: strong student interest and a willingness to self-organize and innovate. This "bottom-up" momentum demonstrates that the passion for space exists and can be channeled effectively. Their ability to organize practical projects and secure webinars with global experts showcases remarkable resourcefulness, providing a proof-of-concept for practical, hands-on learning even without formal university programs or significant institutional funding. This implies that supporting and scaling these grassroots initiatives can be a highly effective and cost-efficient strategy for fostering future space professionals.

3.6 Postgraduate Specialisation: The Institute of Space Science and Engineering (ISSE)

Nigeria has established a dedicated postgraduate institution for advanced space studies, indicating a commitment to higher-level capacity building. The Institute of Space Science and Engineering (ISSE) was fully established in 2018 by NASRDA and is affiliated with the African University of Science and Technology (AUST).⁶ ISSE, through AUST, offers NUC-approved MSc and PhD programs in Advanced Space Sciences and Engineering, including Space Physics, Geoinformatics and GIS Applications, Aerospace Engineering, and Systems Engineering.²⁰ The institute aims to address the growing needs for scientific and space knowledge and innovations in Nigeria and the African continent, providing advanced training, research, and innovation development in these specialized areas.²⁰

The existence of ISSE, offering NUC-approved MSc/PhD programs in core space disciplines²⁰, demonstrates that Nigeria *does* possess the capacity and framework for high-level academic training in space science. However, its focus on postgraduate studies and its affiliation with a private university (AUST) suggest a limited reach to the broader undergraduate population and the public university system. This implies a critical gap between this specialized, advanced capacity and the foundational undergraduate education needed to feed a robust pipeline of students into these postgraduate programs and ultimately into the space industry. The challenge lies in expanding this high-level expertise downwards and outwards.

Chapter 4

Key Challenges to Integrating Space Education

Despite existing initiatives and clear national ambitions, several significant challenges impede the widespread integration and effective delivery of space education in Nigerian universities. These challenges are often interconnected and reflective of broader issues within the nation's education system.

4.1 Curriculum Rigidity and Bureaucratic Approval Processes

The existing academic frameworks and regulatory mechanisms within Nigerian universities often present significant barriers to introducing new, rapidly evolving fields like space science. Most Nigerian universities operate within outdated curricular frameworks that do not readily accommodate emerging fields. Introducing new programs requires lengthy bureaucratic processes and approvals from the National Universities Commission (NUC). The NUC is empowered by law to set Minimum Academic Standards (MAS) and accredit degree programs, with accreditation valid for five years.³⁴ While essential for quality assurance, this process can be slow to adapt to new disciplines.

The NUC's role in setting academic standards and accrediting programs ³⁴ is crucial for maintaining educational quality. However, the "lengthy bureaucratic processes" for new program approval effectively create a significant bottleneck, hindering the agility required to integrate rapidly evolving fields like space science. This implies that the regulatory framework, while necessary, may inadvertently stifle innovation and responsiveness to global technological shifts. A streamlined or fast-track mechanism for strategic national priority areas like space education could be critical for overcoming this hurdle.

4.2 Limited Awareness and Perceived Career Pathways

A fundamental lack of awareness among key stakeholders, including students and faculty, about the relevance and career opportunities in space science limits interest and engagement. Many students and even faculty members are unaware of the diverse space-related careers available or the strategic importance of space to national development. Without visible role models or adequate exposure, interest in space education remains low, perpetuating a cycle of disengagement. While NASRDA advocates for inclusive astronomy education for students with disabilities ¹⁰, the general lack of awareness extends to how space science can be made

accessible and appealing to a broader demographic.

The "limited awareness" of space careers and the strategic importance of space extends beyond students to faculty and potentially even some policymakers. This suggests a systemic failure in communicating the value proposition of space science. Without a clear understanding of "why" space education matters for national development and individual career prospects, sustained interest, student enrollment, and political will for funding and policy support will remain low. This highlights the critical need for targeted, pervasive advocacy and outreach campaigns to shift perceptions and build a national consensus around the importance of space education.

4.3 Critical Shortage of Qualified Faculty and Trainers

A severe deficit of trained professionals capable of teaching and supervising space-related research is a major impediment. There is a critical shortage of trained professionals in specialized fields such as space science, aerospace engineering, and satellite systems. Most universities lack academic staff with the technical expertise required to teach or supervise advanced space-related research. This shortage is exacerbated by broader issues within Nigeria's science education landscape, including the poor remuneration of teachers, which leads to low morale, lack of motivation, and an inability to invest in professional development.³⁷ The "attrition of qualified teachers" and the broader "brain drain" phenomenon, where many qualified scientists and educators migrate abroad for better opportunities, further deplete the pool of available talent, adversely affecting the quality and continuity of education.³⁷

The critical shortage of qualified faculty is not an isolated problem but a symptom of deeper, interconnected systemic issues within Nigeria's education sector. The poor remuneration of teachers, leading to low morale and attrition, and the broader "brain drain" phenomenon³⁷, directly undermine efforts to build a robust space education workforce. This implies that simply creating new space programs will be insufficient; a holistic approach that addresses teacher welfare, professional development, and retention strategies is crucial to attract and keep the necessary talent. The existing "train the trainers" mandate of ISSE⁷ is a positive step but requires significant scaling and integration into broader faculty development initiatives.

4.4 Insufficient Infrastructure and Access to Specialized Equipment

The lack of modern, well-equipped laboratories and specialized tools severely limits practical learning and research in space science. Laboratories equipped for electronics, rocketry, remote sensing, and satellite simulation are rare across Nigerian universities. Even basic tools like telemetry kits or weather balloons are difficult to access. Corruption significantly contributes to poor infrastructure, as resources intended for educational development are often misallocated or embezzled, resulting in substandard facilities and a lack of essential equipment for practical science learning.³⁷

The explicit link between "insufficient infrastructure" and the underlying issue of "corruption" leading to "poor infrastructure" and "misallocation of funds" ³⁷ reveals a critical causal relationship. This means that simply injecting more funds into infrastructure development will not guarantee success if governance and accountability mechanisms are not simultaneously strengthened. Practical, hands-on learning is indispensable for STEM fields, especially space science; therefore, addressing corruption is as vital as securing funding to ensure that resources translate into tangible, functional facilities that enable effective space education.

4.5 Persistent Funding Gaps and Resource Constraints

Nigerian public universities frequently operate under severe budget constraints, making it challenging to initiate and sustain capital-intensive space education initiatives. Public universities in Nigeria often face severe budget constraints, making it difficult to fund new, specialized programs that require significant investment in infrastructure, equipment, and faculty.

While limitations exist, various funding mechanisms offer potential avenues:

- **TETFund:** The Tertiary Education Trust Fund (TETFund) is mandated to provide funding for public tertiary institutions, focusing on educational facilities, infrastructure development, and research. Its National Research Fund (NRF) supports applied research addressing national concerns, including technology processes.³⁸ For instance, the Federal University of Technology Akure (FUTA) secured 17 grants from TETFund's 2023 NRF cycle, totaling over N426 million.³⁹
- **World Bank:** The World Bank offers grants for projects aligning with its mission, focusing on education, health, infrastructure, and environmental sustainability.⁴⁰ While recent approvals for Nigeria (totaling \$1.08 billion in 2025) focus on basic education, nutrition, and economic resilience ⁴¹, there are Knowledge, Learning, and Innovation (KLI) Grants that support results-based financing in education systems in low- and

middle-income countries.⁴²

- **Private Sector Potential:** An expanded corporate social responsibility (ECSR) framework can significantly improve public higher education infrastructure in Nigeria, helping to achieve Sustainable Development Goal 4 (quality education). This involves encouraging private investment through measures like tax incentives.⁴³ The SG Holdings Foundation serves as a model for impactful CSR in Nigeria, demonstrating private sector willingness to address critical societal gaps.⁴⁴ Global impact investment surpassed \$1.5 trillion in 2024, with over 50% of investors planning to expand their African portfolios. Blended finance and social bonds are also on the rise, using public or philanthropic capital to de-risk and attract private investment.⁴⁵ The President of the Abuja Chamber of Commerce and Industry (ACCI) notes that Nigeria's space economy has the potential to contribute \$1 billion annually to the GDP, with the private sector accounting for \$700-800 million of that. He emphasizes mobilizing strategic public-private partnerships and attracting domestic and foreign direct investment.¹

The inherent "funding gaps" in Nigerian public universities make reliance solely on federal budgets unsustainable for capital-intensive space education. However, the available information reveals multiple, underutilized funding avenues: existing TETFund grants (which FUTA has successfully leveraged ³⁸), potential World Bank education grants (by aligning with broader development goals ⁴⁰), and, most significantly, the vast potential of private sector Corporate Social Responsibility (CSR) and global impact investment.¹ This implies that a sustainable funding model for space education must be diversified, actively pursuing and structuring partnerships with private entities and international development funds by clearly articulating space education's alignment with national development goals and economic growth.

4.6 Broader Systemic Issues Affecting Science and Technology Education

The challenges to space education are often symptoms of deeper, systemic issues within Nigeria's overall science and technology education framework. A comprehensive analysis of science education in Nigeria highlights a range of multifaceted problems, including:

- **Politics of Education:** Political interference and unfulfilled promises.³⁷
- **Insecurity:** Frequent school closures due to terrorism, banditry, and communal conflicts.³⁷
- **Corruption:** Misallocation of funds, poor infrastructure, compromised quality of instruction, examination malpractices, and limited research opportunities.³⁷
- **Language of Instruction:** Barriers in comprehending complex scientific concepts due to English not being the first language for many students.³⁷

- **Home Factor:** Lack of parental understanding, insufficient guidance, cultural factors (e.g., gender stereotypes), and lack of time.³⁷
- **Inappropriate Instructional Strategies:** Over-reliance on lectures, insufficient practical experience, and failure to address diverse learning needs.³⁷
- **Outdated Curriculum:** Curricula that do not reflect modern scientific discoveries and advancements.³⁷
- **Lack of Technology-Based Teaching:** Limited access to modern technology and digital resources, hindering up-to-date learning.³⁷

The extensive list of systemic challenges affecting science education in Nigeria ³⁷ demonstrates that space education cannot be developed in isolation; it is deeply intertwined with these broader issues. However, the unique, inspiring, and inherently multidisciplinary nature of space science presents a powerful opportunity to

catalyze broader systemic reforms. By making science exciting and directly relevant to national development, space education can attract talent, justify increased investment, and create a compelling narrative that encourages improvements in curriculum, infrastructure, teacher quality, and public engagement across the entire STEM landscape, thereby addressing some of these deeper issues indirectly.

Chapter 5

Lessons from Successful Models and International Best Practices

Examining successful space education models, both local and international, provides valuable insights and actionable blueprints for Nigeria.

5.1 Local Innovation: The Success of Space Clubs LASU

Grassroots student initiatives like Space Clubs LASU demonstrate the immense potential of student-led innovation and resourcefulness. Space Clubs LASU has shown what is possible with passion and resourcefulness, organizing projects, webinars with global aerospace experts, and advocacy events to promote space education.³² Their activities, such as the "CosmoPi" workshop and "Under The Epe Sky" observation sessions, provide students with practical experience, leadership opportunities, and exposure to international space developments.³² The club's vision is to "Inspire, Educate, and Engage students" and make space exploration accessible.³³

The remarkable success and sustained activity of Space Clubs LASU, despite operating within "infrastructural limitations", highlight that student enthusiasm and initiative are powerful, yet often under-leveraged, assets. This model demonstrates that practical, hands-on learning and community building can thrive even with limited formal support. Supporting and scaling these grassroots efforts with microgrants and mentorship can be a highly cost-effective way to foster future space professionals and build a vibrant space culture from the bottom up.

5.2 University-Agency Collaboration: FUTA and NigeriaEduSat-1

FUTA's involvement in NigeriaEduSat-1 showcases the transformative potential of strong partnerships between universities and national space agencies, bolstered by international collaboration. FUTA's role in NigeriaEduSat-1, a collaboration with NASRDA and Japan's Kyushu Institute of Technology, was a landmark achievement, providing students with hands-on experience in satellite development, testing, and mission control.¹⁸ The recent success of FUTA's CanSat team, emerging among the top five globally in an American Astronautical Society competition in October 2024, further underscores the university's capability and the value of such projects in preparing future space engineers.²³

FUTA's pioneering work with NigeriaEduSat-1 and the subsequent global recognition of its CanSat team clearly demonstrate that university-agency-international collaborations are vital for advancing space education. These partnerships provide crucial access to expertise, specialized infrastructure, and invaluable launch opportunities that individual universities or even NASRDA alone might lack. This model accelerates capacity building, offers students real-world project experience, and validates Nigeria's potential on the global stage.

5.3 Institutional Commitment: Covenant University's Research Focus

Covenant University's approach highlights how focused institutional commitment, particularly within the private sector, can yield high-impact outcomes in specialized space-related fields. Covenant University has successfully integrated satellite communication research into its electrical and information engineering programs, with faculty and students actively publishing in international journals.²⁴ This model demonstrates how focused institutional commitment, often characterized by private sector efficiency and investment in research, can drive significant advancements. Their established dual-degree programs with international institutions like Georgia Tech, which include pathways for Aerospace Engineering, further enhance their capacity and student opportunities.²⁶

Covenant University's model, characterized by focused research and international academic partnerships, suggests a greater agility in curriculum development and collaboration, often associated with private institutions. This implies that private universities can serve as crucial catalysts for pioneering specialized space education programs, potentially offering effective blueprints or collaborative opportunities for public universities to emulate, bypassing some of the bureaucratic hurdles.

5.4 India's Student Satellite Program: A Model for National Engagement

India's approach, spearheaded by the Indian Space Research Organisation (ISRO), provides a robust model for integrating student-led satellite projects into a national space program. ISRO actively supports numerous student satellite missions across Indian universities, many of which have been successfully launched.⁴⁶ This has become a national phenomenon, engaging thousands of students in hands-on, orbital missions. This program has created a robust pipeline of skilled graduates and significantly boosted national pride in space achievements. India's first astronaut on the International Space Station (ISS) recently spearheaded seven ISRO-backed microgravity experiments, showcasing a powerful public-private partnership in space research.⁴⁷

India's student satellite program demonstrates how a national space agency (ISRO) can systematically and widely integrate universities into its core mission. This model is crucial for *scaling* student involvement beyond isolated projects to a national level, fostering a widespread space culture, and building a robust talent pipeline. It highlights the power of a coordinated national strategy to leverage academic capabilities and public-private partnerships for large-scale impact.

5.5 NASA's CubeSat Launch Initiative: Hands-on Learning and Innovation

The U.S. model, exemplified by NASA's CubeSat Launch Initiative, focuses on providing practical, low-cost opportunities for university students to engage in real space missions. U.S. universities benefit from CubeSat launch programs where student-built satellites are sent into orbit aboard commercial or government rockets.⁴⁸ This initiative provides a low-cost pathway for educational institutions and non-profits to conduct scientific investigations and technology demonstrations in space.⁴⁹ These programs combine academia, government, and private sector collaboration, enabling students and faculty to gain invaluable hands-on experience in flight hardware design, development, and building.⁴⁹

NASA's CubeSat Launch Initiative is a prime example of how a national space agency can actively "democratize" access to space for academic institutions. The emphasis on a "low-cost pathway" ⁴⁹ is particularly relevant for countries with limited resources. This model directly addresses the infrastructure challenge by providing launch opportunities and fosters critical hands-on experience, which is paramount for developing practical engineering and scientific skills essential for the space industry.

5.6 South Africa and Brazil: Integrated National Space Science Programmes

Both South Africa and Brazil offer comprehensive national frameworks that integrate space education across various levels, linking universities with national space agencies and research facilities. South Africa has developed a comprehensive framework that links universities with its space agency and research facilities. This includes scholarships, internships, and project-based learning, significantly boosting its space ecosystem.⁵⁰ The Intelsat Africa Space STEM Program, active in Nigeria, Kenya, Senegal, and South Africa, provides schools with cutting-edge STEM kits, teacher training, and resources to integrate space science, sustainability, and IoT education.⁵¹ It aims to build a future-ready workforce and advance national development goals.⁵¹

Brazil's space agency (AEB) has programs like the "AEB School" (for elementary and high

schools, focusing on themes like satellites, astronomy, remote sensing) and the "Uniespaço Program" (integrating universities with the National Programme of Space Activities). The AEB also provides materials, finances projects, and trains teachers.⁵² These comprehensive, multi-level integration strategies offer a robust blueprint for Nigeria to develop a fully interconnected space education ecosystem, fostering talent from foundational learning through advanced research.

Chapter 6

Proposed Interventions and Solutions

To effectively integrate space education into Nigerian universities and address the identified challenges, a phased approach is essential.

Short-Term (1–2 years)

Immediate interventions can lay the groundwork for a more robust space education ecosystem.

- **Introduce Space Science into General Studies (GNS):** A foundational GNS course titled "Introduction to Space Science and National Development" should be developed and mandated. This course would cover the basics of space technology, Nigeria's space policy, and global trends, raising general awareness among all university students.
- **Faculty Development Programs:** Capacity-building workshops and exchange programs should be initiated. These programs, in collaboration with NASRDA, Kyutech, or African regional centers, would train lecturers and postgraduate students in specialized space disciplines, addressing the critical shortage of qualified faculty.
- **Student Competitions and Hackathons:** Launching national CanSat competitions, balloon payload design challenges, and software-focused space hackathons will foster innovation and cross-disciplinary teamwork. The success of FUTA's CanSat team ²³ and UNILAG's hackathons ²⁸ demonstrates the viability and engagement potential of such initiatives.
- **Innovation Grants:** Provide competitive microgrants through existing channels like TETFund, World Bank initiatives, or private Corporate Social Responsibility (CSR) programs. These grants would support student-led space projects, clubs, or undergraduate theses, leveraging existing funding mechanisms such as TETFund's National Research Fund ³⁸, World Bank Knowledge, Learning, and Innovation (KLI) grants ⁴², and the growing interest from private sector CSR. ⁴³

Medium-Term (3–5 years)

These interventions focus on establishing dedicated infrastructure and formal academic pathways.

- **Create Space Innovation Hubs:** Establish small, well-equipped laboratories in key universities. These hubs would provide tools for satellite prototyping, telemetry tracking, Arduino-based systems, and Earth observation analysis, addressing the current lack of specialized infrastructure.
- **Develop Formal Degree Programs:** Work closely with the National Universities Commission (NUC) and NASRDA to accredit Bachelor of Science (B.Sc.) and Master of Science (M.Sc.) programs in Space Science, Remote Sensing, and Aerospace Systems Engineering. The existence of NUC-approved postgraduate degrees at ISSE ²⁰ demonstrates that such accreditation is feasible.
- **Forge Institutional Partnerships:** Facilitate Memoranda of Understanding (MoUs) between universities and NASRDA, leveraging shared facilities and promoting joint research. Encourage exchange programs with universities in India, South Africa, Japan, and Europe that are actively involved in student satellite missions, building on NASRDA's mandate for collaboration.⁶

Long-Term (5+ years)

Long-term strategies aim for systemic integration and sustained leadership.

- **National Space Education Policy:** Draft and adopt a comprehensive national policy that formally integrates space education into Nigeria's science and technology education roadmap. This policy should align with national development blueprints such as Vision 2050 and the African Union's Agenda 2063. Nigeria already possesses a National Space Policy ⁵ and a National Science, Technology and Innovation Policy ⁵⁴, providing a strong foundation for this integration.
- **Satellite Missions by Nigerian Students:** Institutionalize pathways for student-led CubeSat missions in collaboration with international launch providers, making Nigeria a regular participant in space payload programs. FUTA's NigeriaEduSat-1 ¹⁸ and the successful models from India and NASA ⁴⁶ provide clear precedents and demonstrate the feasibility of such ambitious projects.

Chapter 7

The Way Forward: A Phased Rollout for Sustainable Impact

To implement these changes effectively, a phased rollout is essential, allowing for learning, adaptation, and scaling.

Pilot Phase (Initial Implementation): Begin by piloting the proposed interventions at a select number of institutions, for example, LASU and two other universities. This would involve integrating a GNS course on space education into their academic calendars and establishing Space Innovation Hubs equipped with essential tools for basic space experiments. Additionally, organizing a national-level CanSat or balloon launch competition would generate momentum and public interest.

Evaluation Phase: Following the pilot, a thorough evaluation phase is crucial. This involves measuring outcomes based on student participation, faculty engagement, and project results. Gathering both qualitative and quantitative data will be vital to assess curriculum relevance and overall impact, allowing for necessary adjustments and refinements before broader expansion.

Scaling Phase: Once successful models are identified and refined, expand the programs to 5–10 additional universities, particularly those with existing strong engineering, environmental science, or computer science departments. This strategic expansion leverages existing institutional strengths. Concurrently, launch an annual national faculty training summit focused on space education, in collaboration with NASRDA and international partners, to continuously build and update the expertise of academic staff across the country.

Sustainability Plan: Design funding models that combine federal support, international development aid, and private investment. Align space education projects with broader national goals such as climate action, smart agriculture, and digital transformation to secure long-term relevance and support. This diversified funding approach is critical given the persistent funding gaps in public universities, as discussed in Section 4.5. By demonstrating clear alignment with national priorities, space education can attract sustained investment from various stakeholders.

Chapter 8

Conclusion

The future of Nigeria's participation in the global space economy depends significantly on the education provided to its students today. By embedding space education within the university system, Nigeria can prepare a generation equipped to build satellites, solve real-world problems, and position the nation as a technological leader in Africa. The examples of FUTA, Covenant University, and Space Clubs LASU unequivocally demonstrate that Nigeria already possesses the raw talent and passion for space exploration and technology; what remains is the provision of structured support and a conducive ecosystem.

Space education is not a luxury; it is a strategic imperative for national development, youth empowerment, and global relevance. Policymakers, university administrators, and development partners must act decisively to support this transformation. This involves streamlining bureaucratic processes, increasing awareness, investing in faculty development and modern infrastructure, and diversifying funding sources through robust public-private partnerships. By fostering an environment where space science is accessible, engaging, and directly linked to national aspirations, Nigeria can truly build its future, from the classroom to the cosmos.

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