# STEM Education in Tertiary Education in Nigeria

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## Abstract

This paper examines the concept of tertiary education, with a specific focus on STEM education, and identifies the challenges hindering its development in Nigerian tertiary institutions. It is a review paper that relies on secondary data sourced from both print and online publications. Content analysis was utilized to analyze the literature reviewed in this paper. Several challenges were identified as obstacles to the advancement of STEM education in Nigeria's tertiary institutions. These include poor funding, a shortage of academic staff specializing in science, inadequate infrastructure, the necessity of teaching large classes, brain drain, insecurity, corruption, and frequent strike actions. To address these issues, the paper suggests several measures. Adequate funding of STEM education is crucial to support necessary resources and initiatives. Improving infrastructure within tertiary institutions will create a conducive environment for STEM learning and research. Enhancing security within these institutions will ensure a safe and stable learning environment. Increasing the salaries of lecturers is recommended to attract and retain qualified science academics. Furthermore, the deployment of advanced technologies in the management of tertiary institutions can help curb corruption and improve overall efficiency. The development of STEM education in Nigerian tertiary institutions requires a multifaceted approach that addresses both financial and structural challenges. By implementing these recommendations, Nigeria can foster a more robust and effective STEM education system, contributing to the nation's overall educational and technological advancement.

**Keywords:** STEM education, tertiary education, Nigerian tertiary institutions, academic staff shortage, institutional security.

## Introduction:

Tertiary education is an educational system designed to solve local, national, and international pressing problems (Ogunode & Musa, 2024). It fosters individual development and growth as well as positively impacts society at large (Schrader-King, 2024). Tertiary education can be defined as the planned and organized system of learning designed for the total development of individuals and the total transformation of society through the utilization of teaching, research, and the provision of community service (Ogunode et al., 2023a).

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Community service is a vital component of tertiary education, playing a significant role in connecting academic institutions with their surrounding communities. According to Ogunode et al. (2022a), community service programs in Nigerian public tertiary institutions are designed to leverage academic expertise and resources to address community needs. These programs encompass various activities, such as health outreach, educational support, environmental conservation, and socio-economic development projects. By engaging in community service, tertiary institutions not only contribute to societal welfare but also provide students with practical experiences that enhance their learning and foster a sense of civic responsibility. This dual benefit underscores the importance of integrating community service into the core mission of tertiary education, ensuring that institutions act as catalysts for positive social change and development.

In the context of Nigeria, where numerous socio-economic challenges persist, the role of tertiary institutions in community service becomes even more critical. These institutions are uniquely positioned to mobilize knowledge, skills, and innovation to address local issues effectively. According to Álvarez & Olatunde-Aiyedun (2024), the integration of STEAM (Science, Technology, Engineering, Arts, and Mathematics) education into teacher training programs for sustainability highlights how tertiary education can prepare educators to tackle complex societal challenges. This preparation extends beyond the classroom, where educators equipped with STEAM knowledge can actively engage in community initiatives aimed at enhancing environmental sustainability and promoting technological literacy.

Moreover, as emphasized by Ogunode et al. (2022a), community service programs in Nigerian public tertiary institutions are instrumental in addressing community needs while providing students with practical learning experiences. These programs encompass diverse activities such as health outreach, educational support, and socio-economic development projects. Through such initiatives, tertiary institutions not only contribute to improving public health and literacy rates but also play a pivotal role in environmental conservation efforts. This holistic approach to community engagement underscores the broader impact of tertiary education on societal development in Nigeria.

Furthermore, Olatunde-Aiyedun (2024) discusses the integration of artificial intelligence (AI) into science education curricula in Nigerian universities, highlighting how technological advancements can enhance teaching methodologies and research capabilities. By leveraging AI, tertiary institutions can foster innovation in addressing local challenges, thereby promoting sustainable development and economic growth. Through community service, tertiary education in Nigeria can significantly impact areas such as public health, literacy rates, and environmental sustainability. These efforts not only address immediate societal needs but also contribute to the long-term development and progress of the nation, reflecting the transformative potential of tertiary institutions in driving positive change across communities (Ogunode et al., 2022c).

Tertiary education is a subset of the general society comprising the collection of different people with different cultural and ethnic backgrounds, lifestyles, living standards and moral values (Ogunode et al., 2023b; Ogunode, Godwin et al., 2021c; Ogunode et al., 2022b) solving communities problems and participating in educational activities. The diversities of formal and informal educational activities carried out in tertiary institutions (Singh, 2015) usually put into consideration the value system obtainable within a particular country. Thus, according to Ogunode & Mcbrown (2022), tertiary education is an educational system that advances the implementation of the teaching programme, research programme and community service programme for the socio-economic, socio-cultural and technological development of a particular country.

Ibrahim (2017) stated that higher institutions are very important tools in meeting the socio-cultural and developmental needs of a country. Education at the tertiary level is founded on the quest for discovery and scholarly excellence arising from the Greco-Roman vision that all citizens could engage in the investigation of higher-level thinking as well as more remote ideals that were not obtainable in ordinary utilitarian lives. These are reflected in the actions of ancient Greek philosophers who removed the 'groves of academe' in the foundation of their higher institution of learning from mainstream education and, consequently, from such mundane realities as accountability (Clinchy, 1994).

Vital areas of the tertiary education system are teaching, research and community service. The most damaging incongruence of function in the tertiary education system is the conflict between two components of a lecturer's job: teaching and researching. This distinction gives rise to particular practices, reward systems, and clichéd arguments of the value/importance of one, the other, or teaching aspect of lectureship that is currently experiencing an insurgence of attention and innovation (Svinicki, 1990). Tertiary education programmes include STEM education. STEM education at the tertiary education is geared towards solving humanities problems.

**STEM Education:**

STEM is an acronym for Science, Technology, Engineering and Mathematics. STEM education is a science-oriented programme. David et al. (2018) pointed out that education is in this regard that in the framework of the New Partnership for Africa's Development (NEPAD), African leaders recognized that Science and Technology will play a major role in the economic transformation and sustainable development of any nation. STEM education is used in research, policy issues, teaching for innovation, problem-solving and prospects. STEM is needed towards globalization demands. The complexity of today's world requires all people to be engaged with a new set of core knowledge and skills, to solve difficult problems like the novel coronavirus pandemic, gather and evaluate evidence and make sense of the information they receive from varied print and increasingly digital media. It is therefore clear that the learning and doing of STEM helps develop skills and prepare students for a workforce where success results not just from what one knows but from what one can do with the knowledge. STEM education is important in meeting societal needs like food, shelter, shelter, clothing, water, energy, employment, basic education, healthcare, defence and security, governance, etc.

STEM has been the critical instrument used to uplift not only the standard of living but also the economy of any nation. Developed nations such as the USA, China, Japan and the UK are not unconnected to the type of science and technology available to them (Wasagu, 2019). Olorundare (2010), the inclusion of engineering into STEM Education can be justified by the mere fact that young children tend to be engineers first; building, making and doing projects long before they can explore scientific principles that allow their buildings to stand or "canals" between puddles to carry water.

STEM is a tool for the economic, social, and political development of a nation. The contribution of STEM to the social, industrial and economic life of the world in general and Nigeria in particular has been felt in all phases of human life (Ikeobi, 2010). The knowledge of STEM has enabled the provision of good water, food, and healthcare delivery, various materials for construction in industries, roads, automobiles, and houses. STEM-related subjects are used in solving problems resulting from human interaction with the environment like water and pollution (Ugo & Akpoghol 2016).

**Challenges facing STEM-Education in Tertiary Education in Nigeria:**

There are many challenges militating against the development of STEM education in tertiary institutions in Nigeria. Some of these challenges include the following:

i. **Poor Funding for STEM Education:** Poor funding of STEM education in tertiary institutions in Nigeria is a very big problem for the development of STEM education. Science education is very expensive to implement in tertiary institutions because it requires a lot of financial resources. The funding needed for the smooth running of science education programmes in Nigerian tertiary institutions is not provided by the government and other stakeholders in the higher institutions. The budgetary allocation to education especially tertiary education is not enough. Udida et al. (2009) maintained that the major issue in educational development is a shortage of funds. One of the most serious problems threatening the survival of the educational system is that of dwindling level of public funding in the face of rising demands and hence rising cost of higher education. This shortage of funds affects job performance and the growth of the institution. Higher educational institutions cannot perform optimally without funding. This situation calls for increased funding initiatives from both the government and educational stakeholders to sustain the tempo and growth of the education industry. The inability of the Nigerian government to objectively accept and implement the 26% funding formula for education recommended by UNESCO impact negatively on the performance and sustainability of higher education. Thus, it has become obvious that Nigeria's neglect of the funding formula is detrimental to higher educational institution performance and development aspiration as quality performance is the veritable instrument for the sustenance of the education system. This neglect has further precipitated crises in the entire higher educational system as effective teaching, research and service are no longer taking place mysteriously. On this note, Akinola (1990) was worried about the funding situation and Noted that our higher institution education systems are in dire need of money to cater for both their capital and recurrent needs. For a few years past, the budget has been cut back from year to year by the federal government. This cutback has affected both capital and recurrent expenditures. In many higher institutions capital projects embarked upon are few years ago, are yet to be completed due to lack of adequate funds". STEM education implementation in the Nigerian education system is facing the problem of poor funding (Kola, n. d., Umoh, 2016).

ii. **Shortage of Science Academic Staff:** Another major problem affecting the implementation of STEM education in tertiary institutions in Nigeria is a shortage of science lecturers or academics. Somadina et al. (2023) defined Science Academics as professional lecturers with specialization in the field of sciences. Science Academics are science teachers who specialise in programmes like Biology, Chemistry, Physics, Mathematics, Environmental science, Biochemistry, Biotechnology, Zoology, Botany, agricultural science, Geology, physics, statistics, computer science and so on. A science academic is an individual who has been trained and certified by various tertiary institutions to practice in the field of sciences. Somadina et al. (2023) asserted that many tertiary institutions in the

country do not have adequate science lecturers and this is affecting the teaching and learning of science education. Ogunode & Aiyedun (2020) stated that another problem facing the administration of science programmes in Nigerian higher institutions is the challenge of inadequate science lecturers. NEEDS (2014) submitted that data from the NUC revealed that universities experience an acute shortage of teaching staff in computer science and technology-based disciplines, but teaching staff shortage is very acute in disciplines such as law, engineering, medicine and surgery. These shortages are attributed to several reasons, such as poor incentives for serving teachers, inadequate turnout of teachers in these subjects by teacher-training institutions in the country, and the exodus of lecturers to Western countries in search of greener pastures.

iii. **Inadequate infrastructure facilities:** Many tertiary institutions in Nigeria do not have adequate infrastructure facilities to implement the education programme in the various tertiary institutions. Infrastructure facilities according to Lawinsider (2020) are any works, structures, or improvements on land or water, excluding Ancillary Project Area Infrastructure. These facilities, whether directly or indirectly, provide services or other benefits to the general public; or the Island community. This includes offices, depots, and staff housing for or on behalf of the Commonwealth of Australia, the State, any local government, statutory authority, or government-owned corporation; electricity generation, distribution, or transmission facilities; public education facilities; public health facilities; police facilities; emergency facilities; transport facilities such as pedestrian paths, cycleways, transfer facilities, freight storage and logistics areas, bus stops and layovers, ferry stops, taxi stops; sewage pump stations and sewerage treatment facilities; solid waste transfer and treatment facilities; water supply pump stations, raw water storage, clear water storage, dams, weirs, bore field infrastructure; items listed in section 24KA(2) of the Native Title Act to the extent that they are not Ancillary Project Area Infrastructure; and any IBIS Store. However, this definition excludes Social Housing.

The importance of infrastructural facilities in the implementation of STEM education according to Ogunode & Agwor (2021) includes; aiding the effective delivery of administrative functions in schools; making the delivery of services fast and reliable; enabling teachers to deliver lessons fast; infrastructural facilities provide a conducive working environment for both teachers and students; infrastructural facilities enable learners to learn at ease and learn well; infrastructural facilities enable the teachers to teach well, prepare their lessons, and deliver them online (ICT). The importance of school infrastructural facilities in the realization of educational goals cannot be underestimated. School facilities aid the delivery of the teaching and learning process in the schools. The school offices provide a conducive working environment for teachers, the classrooms help the learners to learn while the school fence protects students, the teachers, and school administrators from criminals. The school plant protects the entire human resources from the sun, rain, heat cold, and snow (Ogunode & Agwor, 2021).

In the area of modern laboratories, Somadina et al. (2023) pointed out that science academics in Nigerian public universities are faced with the problem of a lack of modern laboratories to conduct research and implement teaching

programmes. Most public universities spread across the countries do not have modern laboratories where advanced research can be carried out. This has put stress on many science academics working in various public universities. Though some newly established universities have modern laboratories while many others do not. Echono (n. d) noted that most of the laboratories are dilapidated and relevant equipment is lacking and where they are available, inadequate equipment makes them non-functional and obsolete. Sometimes, the laboratories double as lecture rooms which are not conducive to teaching and learning. In the words of Echono, (n. d) and Ebehikhalu and Dawam (2017), the provision of ventilation is very poor with inadequate lighting, overcrowded and stuffy. At the main campus, there was only one central, inadequately equipped engineering workshop for eight programmes. Ezechi & Ogbu (2017) submitted that the majority of Nigerian schools lack laboratory spaces, and those who have spaces lack the equipment and necessary infrastructure for proper teaching and learning of science. Science, therefore, is not a miracle where something happens out of nothing. There are several challenges arising from the lack of infrastructure according to (Echono, 2023; Echono, 2022; Echono, (n.d) and; Ogunode & Ayoko, 2022). These include:

- **Inadequate laboratory facilities**: Research, especially in fields such as science, engineering, and medicine, heavily relies on well-equipped laboratories. The absence of state-of-the-art laboratory facilities limits researchers' ability to conduct experiments, analyze data, and make breakthroughs. Second,
- **Limited access to information**: The lack of modern libraries and online resources limits researchers' access to up-to-date information, hindering their ability to review existing literature, build upon previous studies, and remain at the forefront of their fields.
- **Unreliable electricity supply:** Frequent power outages disrupt research activities and pose challenges for running experiments, storing sensitive samples, and maintaining essential equipment.
- **Inadequate Internet connectivity**: Access to high-speed Internet is crucial for collaboration, data sharing, and communication with the global scientific community. Slow or unreliable internet connections hinder researchers' ability to engage in international research networks.
- **Poor transportation systems**: Poor transportation systems make it difficult for researchers to travel to conferences, workshops, and collaborative meetings. This isolation limits exposure to new ideas and impedes knowledge exchange (Echono, 2023). Shortage of infrastructure facilities is a challenge to the implementation of education in tertiary institutions in Nigeria (Chinwe, 2008)

iv. **Teaching of Large Classes:** It has been observed that classes of STEM-Education in most tertiary institutions are overfilled with science students resulting in the teaching of large classes which implies the quality of education. Ezechi & Ogbu, (2017) asserted that science academics are also faced with the problem of teaching large classes. Even when the National Universities Commission provided a

minimum academic standard for all science programmes. For instance, the NUC Benchmark Minimum Academic Standards (BMAS) of 2007 stipulated the following teacher/student ratio: 1:20 in science; 1:15 in Engineering and technology; 1:10 in medicine, veterinary medicine and pharmacy, 1:15 in agricultural and environmental sciences and 1:30 in education, management science, social science, law and arts. Due to high student enrolment, some of these policies on teacher-student ratio are not fully implemented in some public universities. The failure of some universities to implement these policies exposed science academics to teaching large classes which is not good for quality education and ranking purposes. The teaching of large classes by Science Academics is also traced to the shortages of Science Academic Staff in public universities across the country. Okwelogu et al. (2021) observed that it is unfortunate that as important as a science teacher is to the social, economic and technological advancement and development of society, the majority of the public higher institutions do not have adequate science lecturers in their various science departments and faculties and this result to the teaching of large classes. Ugo & Akpoghol (2016) noted that large class sizes do not allow free movement in the classroom resulting in ineffective classroom management and control. Also, individual students are denied close classroom interaction and prompt attention from the teacher. When students cannot get the attention they require for effective learning, they get frustrated and discouraged. All these contribute to low performance in Science, Technology, Engineering and Mathematics subjects. In addition, when there are large class sizes the weak students tend to hide under the cover of the brilliant ones (Idowu & Olatunde-Aiyedun, 2024).

v. **Brain-drain:** The problem of brain drain is affecting the implementation of STEM education in Nigerian tertiary institutions. Many science professionals are leaving tertiary institutions due to poor work environments and poor motivation. Ogunode & Musa (2021) view brain drain as the mass movement of professionals from developing countries to developed countries for better working conditions. Nigerian universities are facing the problem of brain drain because of poor motivation and poor working environment. Many lecturers have gone out of the Nigerian universities to other countries like South Africa and European countries. Among many factors responsible for the best brain of Nigerian lecturers going abroad the poor condition of service, strike actions, poor research, poor motivation and insecurity challenges (Ogunode et al., 2022d). The implication of brain drain in the effective management of Nigerian universities is huge; the capable hands that would help in administering the universities are let go, and this creates room for inexperienced and underqualified people to run the universities in the country. The mass movement of science lecturers in various tertiary institutions is affecting the quality of teaching and accreditation of academic programmes (Okwelogu et al., 2021).

vi. **Insecurity:** The insecurity in Nigeria is also militating against the development of STEM education in Nigerian tertiary institutions. Insecurity has led to the poor implementation of STEM education curricula. Ogunode & Aiyedun, (2020) and Ogunode (2020) submitted that this is an issue affecting the entire country especially the Northern part of Nigeria. Insecurity in the country has penetrated the

educational institutions since the school is a part and parcel of the society. The most worrisome of the insecurity is the school closure which has affected the academic calendar of different higher institutions in the Country. Nnamdi (2021), Ogunode et al., (2021b) and Ogunode & Kolo (2021) noted that a lot of faculties and departments cannot graduate their students due to insecurities. Universities closure affects the implementation of research and teaching (Nwosu et al., 2019). Many academic programmes like the STEM-related programme are affected due to the insecurity challenges facing the country. Insecurity in Nigeria and has it affected tertiary institutions has led to the disruption of the academic calendar, death of lecturers and students, poor investment in education and destruction of infrastructure facilities (Ogunode et al., 2021d; Adams et al., 2022; Ogunode, et al., 2022a).

vii. **Corruption:** Another problem militating against the development of STEM education in tertiary institutions in Nigeria is corruption. Oladele (2019); concluded that our tertiary institutions which include Universities, Polytechnics, Monotechnics, Schools of Nursing and Health Technologies, Nigerian Defence Academy, and Colleges of Education appear not to be functioning effectively. There are cases of students being exploited by staff; and recruitment and promotion of staff being based on political patronage instead of merit. There are cases of abuse of office by those in authority. Other vices include admission racketeering, hostel profiteering, sorting, examination malpractice, sexual harassment, etc. All these social vices are signs of a big rot in our tertiary institutions and portend danger for the entire Nigerian nation. It shows an absolute lack of credibility in our tertiary institutions' service delivery (Okobi, 1997). Corruption in Nigeria's education system is also a factor. Ministries and government agencies entrusted with overseeing the day-to-day affairs of the education industry in the form of procuring the necessary equipment and teaching materials, construction of buildings, supply of teaching aid etc. easily inflate vouchers and in most cases claim monies when nothing has been supplied or provided (Nwaokugha & Ezeugwu, 2017) ; Ogunode, & Josiah, & Ajape, 2021a). This has in many ways crippled the educational system in general as these same corrupt practices have crept into the schools' governing bodies, thereby resulting in a stunted growth in the educational system nationwide. STEM education requires much financial input and in situations where the finances have been mismanaged as a result of selfish interest by people, STEM education is affected (Fomunyam, 2019). Corruption in the management of tertiary institutions has led to poor implementation of programmes such as step education (Ogunode, & Stephen, 2021; Ogunode et al., 2021a; Kanibin, 2019; Ahmodu & Sofoluwe, 2018).

viii. **Strike Actions:** Strike actions in the Nigerian educational institutions especially the tertiary institutions affect the smooth implementation of education in Nigerian tertiary institutions. Okoli, Ogbondah & Ewor (2018) and Olatunde-Aiyedun & Ogunode (2021) noted that it has become a known fact that students across various universities in Nigeria are constantly faced with industrial actions embarked upon by the Academic and Non-Academic Staff Unions of various institutions. The disagreement or lack of understanding between government and unions arising from the non-implementation of an agreement reached often results in deadlock

that usually disrupts the academic calendar. As academic activities are suspended for a long period, the student's reading abilities fall. Even the previous knowledge acquired is forgotten by some students. This mostly turns some students into certificate seekers rather than knowledge seekers. Ololube (2016) opined that strike actions are the only music that unions play and the government listens to. The inadequacy of government funding has been a bone of contention in almost all the conflicts between the federal government and staff unions. This situation has been like this for decades and has caused disruptions in the academic calendar of institutions of higher education. According to Okojie (2008), the ability to maintain a stable academic calendar has been a major problem in Nigerian universities. The series of strikes or threats has been so frequent that it has been a source of major concern to government, business leaders, politicians, students, parents and stakeholders. Strike action in the Nigerian higher institutions is hampering the development of education in Nigeria (Ojebiyi & Sunday 2014; Lawan & Ogunode 2021)

## Conclusion:

In conclusion, this paper has identified and examined the significant challenges hindering the development of STEM education in Nigerian tertiary institutions. Factors such as poor funding, a shortage of science academics, inadequate infrastructure, large class sizes, brain drain, insecurity, corruption, and frequent strike actions have been recognized as formidable obstacles.

## Recommendations:

To address these challenges and foster the advancement of STEM education in Nigerian tertiary institutions, several recommendations are proposed. Firstly, there is a critical need for increased funding dedicated specifically to STEM education, aimed at improving resources, facilities, and research opportunities within these institutions. Secondly, enhancing infrastructure to support modern teaching and research methodologies is essential for creating a conducive learning environment. Thirdly, ensuring adequate security measures on campuses is paramount to safeguarding both students and faculty, thereby promoting uninterrupted academic activities. Additionally, it is recommended to consider revising the remuneration structures for academic staff, particularly in STEM fields, to attract and retain qualified professionals. Finally, leveraging advanced technologies in the management of tertiary institutions can enhance transparency and accountability, thereby mitigating corruption and ensuring efficient resource allocation.

By implementing these recommendations, Nigerian tertiary institutions can overcome existing challenges and cultivate a thriving environment for STEM education. This proactive approach not only addresses immediate obstacles but also paves the way for sustainable development and global competitiveness in science and technology education.

## References

Adams, S. O., Zubair, M. A., & Olatunde-Aiyedun, T. G. (2022). Effects of project (infrastructure facilities) abandonment in public tertiary education in Nigeria and the way forward *EGNES, 1*(2), 41-46. https://doi.org/10.26480/egnes.02.2022.41.48

Ahmodu, O. L., & Sofoluwe, A. O. (2018). Combating corruption in Nigerian universities through treasury single account policy. *Research Journal of Business and Economic Management, 2*(4).

Akinola, J. A. (1990). *Issues of standard in higher education; A perpetual problem*. A paper presented at the 2nd National Workshop on Supervisory and Inspectorate Services in the 6-3-3-4 system of Education at the University of Ilorin.

Álvarez, A. J., & Olatunde-Aiyedun, T. G. (2024). Systematic literature review on STEAM Pre-service and in-service teacher education for sustainability: Are teachers ready? *Eurasia Journal of Mathematics, Science and Technology Education. 3(5), 47-57*

Chinwe, N. (2008). Science, Technology and Mathematics (STM) Curriculum Development: Focus on problems and prospects of biology curriculum delivery. *Proceedings of the 49th Annual Conference of STAN*. Pp. 77-81.

Clinchy, E. (1994). Higher education: The albatross around the neck of our public schools. *Phi Delta Kappan, 75(*10).

David, E., Dallatu, Y. R., & Yusuf, A. (2018). Science, Technology, Engineering and Mathematics (STEM) education for sustainable national economic growth. *59th Annual Conference Proceedings, STAN*, 33-40.

Ebehikhalu, N. O., & Dawam, P. (2017). Inadequacy of Teaching and Learning Infrastructure: Reason Nigerian Universities cannot Drive Innovations. *Australian Journal of Education and Learning Research SCIE Journals, 1*(5), 45-54.

Echono, S. T. (2022). *Funding public tertiary education: roles of tertiary education trust fund (Tetfund) and its future for sustainable development.* A paper presented by the Executive Secretary of the Tertiary Education Trust Fund (TETFund) at the Ahmadu Bello University Zaria Alumni Lecture in October 2022.

Echono, S. T. (2023). *Funding research in a developing economy.* Text of 21st convocation lecture of the Nigerian Defence Academy in honour of graduating cadets of 70 regular course and postgraduate students delivered on Thursday 14th September 2023

Ezechi, N. E., & Ogbu, C. C. (2017). Science education in Nigeria: challenges and the way forward. *International Journal of Progressive and Alternative Education, 4*(1), 1-11.

Fomunyam, K. G. (2019). Teaching STEM Education in Nigeria: Challenges and Recommendations. *International Journal of Mechanical Engineering and Technology, 10*(12), 85-93.

Ibrahim, S. (2017). Tertiary Education Trust Fund (TETFund), research and development and Nigeria's Higher Education. *European Journal of Education Studies, 3*(7), 799-816.

Idowu, O. M., & Olatunde-Aiyedun, T. G. (2024). Plant management in tertiary institutions in Nigeria.*American Journal of Political Science and Leadership Studies, 1*(1), 22-26. https://semantjournals.org/index.php/AJPSLS/article/download/50/44

Ikeobi, I. O. (2010). *Beyond the stereotype: Thoughts and reflections on education.* Yaba: the CIBN Press Limited.

Kanibin, M. A. (2019). Effect of corruption on the educational system in Nigeria. *British Journal of Education, 7*(11), 41-49.

Kola, A. J. (n. d). STEM education in Nigeria: Development and challenges. *Current Research in Language, Literature and Education, 3*, 52-60.

Lawan, A., & Ogunode, N. J. (2021). Strike actions in Nigerian higher institutions: Meaning, causes, effects, achievement and way forward. *Scholarly Publishing discourse*, *1*(1), 1-30.

Lawinsider. (2023). Definitions and meaning of infrastructure facilities. *JMS*, *2*(2), 23-30. https://www.lawinsider.com/dictionary/infrastructure/facility#:~:text=Infrastructure%20facility%20means%20any%20publicly,%2C%20energy%2C%20fuel%20or%20communications

NEEDS. (2014). *Needs assessment in the Nigerian education sector*. International organization for migration, Abuja, Nigeria. 23-35.

Nnamdi, O. (2021). *halting repeated school kidnappings in Nigeria.* https://www.crisisgroup.org/africa/west-africa/nigeria/halting-repeated-school-kidnappings

Nwaokugha, D. O., & Ezeugwu, M. C. (2017). Corruption in the education industry in Nigeria, Implications for national development. *European Journal of Training and Development Studies*, *4*(1), 1-17.

Nwosu, C. A., Joseph, U., Chukwuka, E., & Ukwunna, G. C. (2019). *Insecurity and the Nigeria school system: The securitization option for sustainable development.* Presented At: The 2nd International Conference of Unizik Business School.

Ogunode, N. J. (2020). Administration of public universities in Nigeria: problems and solutions. *JurnalSinestesia*, *10*(2), 86-93.

Ogunode, N. J., & Aiyedun, T. G. (2020). Administration of science programme in Nigerian higher institutions: issues, challenges and ways forward. *Middle European Scientific Bulletin, 6*, 94-102.

Ogunode, N. J., & Ayoko, V. O. (2022). The implication of unstable power (energy) on the administration of tertiary institutions in Nigeria. *European Multidisciplinary Journal of Modern Science, 6*, 10-18. https://emjms.academicjournal.io/index.php/

Ogunode, N. J., & Josiah, H. F., & Ajape, T. S. (2021a) Effects of Corruption on Public Universities Administration in Nigeria. *Journal of Educational Discoveries and Lifelong, 2*(7), 5-18.

Ogunode, N. J., & Kolo, F. (2021). Effects of insecurity on basic education in northern Nigeria. *International Journal of Discoveries and Innovations in Applied Science, 1*(7), 1-8.

Ogunode, N. J., & Mcbrown, R. I. (2022). Committee system in Nigerian public tertiary institutions: Problems and the way forward. *International Journal on Integrated Education*, 5(5), 1-9.

Ogunode, N. J., & Musa, L. (2024). Entrepreneurial education programme in tertiary education in Nigeria. *JSS, 2*(3), 4-10.

Ogunode, N. J., & Stephen, S. A. (2021). Effects of Corruption on Basic Education Administration in Nigeria and the Way Forward. *International Journal on Integrated Education, 4*(10), 11- 19.

Ogunode, N. J., Ahaotu, G. N. & Obi-E, U. (2021b). Effects of Insecurity on School Administration in Nigeria. *Middle European Scientific Bulletin, 13*, 94-102.

Ogunode, N. J., Audu, E. I., & Olatunde-Aiyedun, T. G. (2022a). Community service programme of Nigerian public tertiary institutions: problems and the way forward. Spanish *Journal of Innovation and Integrity, 5* 1-9. http://sjii.indexedresearch.org/index.php/sjii/article/view/64

Ogunode, N. J., Edinoh, K., & Okolie, R. C. (2023a). Public-private partnership model and implementation of tertiary education program in Nigeria. *American Journal of Science on Integration and Human Development*, *1*(6), 1-12.

Ogunode, N. J., Edinoh, K., & Olatunde-Aiyedun, T. G. (2023b). Staff training in schools. *Journal of Innovation in Educational and Social Research, 1*(3), 192-207. https://journals.proindex.uz/index.php/jiesr/issue/view/19

Ogunode, N. J., Godwin, A. N., & Unoaku, O. C. (2021c). Effects of insecurity on school administration in Nigeria. *Middle European Scientific Bulletin, 13.* https://cejsr.academicjournal.io/index.php/journal/article/view/628/572

Ogunode, N. J., Jegede, D., Olamoyegun, S. O., Akinjobi, F. N., & Olatunde-Aiyedun, T. G. (2022b). *Effects of project (infrastructure facilities) abandonment in public tertiary education in Nigeria and the way forward.* http://erjbehaviouralsciences.com/wp-content/uploads/2022/09/3.-effects-of-project.pdf

Ogunode, N. J., Okwelogu, I. S., Enyinnaya, O., & Yahaya, D. (2021d). Academic staff of tertiary institutions in Nigeria and the problem of insecurity. *Middle European Scientific Bulletin, 18*, 206- 217.

Ogunode, N. J., Olatunde-Aiyedun, T. G., & Mcbrown, R. I. (2022c). Perception of academic staff on reasons for the low patronage of Nigerian public universities by international students. *Modern Journal of Social Sciences and Humanities, 5,* 51–56. https://mjssh.academicjournal.io/index.php/mjssh/article/view/207

Ogunode, N. J., Umeora, A. M., & Olatunde-Aiyedun, T. G. (2022d). Impact of insecurity on the administration of post-basic education and career development in the southeast geo-political zone of Nigeria. *Spanish Journal of Innovation and Integrity, 8*, 56-64.

Ojebiyi, O. A., & Sunday, L. F. (2014). Historical survey of the development of science and technology education in *Nigeria. Academic Journal of Interdisciplinary Studies, 3*(6), 286-301.

Okobi, R. S. (1997). *The rot in the educational system*. Paper delivered at the Ikwere Youths Congress, Orakami, Benue State.

Okojie, B. S. (2008). Investments and strategies for human capacity development. In S. O. Akande and A. S. olomola (Eds). *Strategies and implementation of the seven-point agenda of President Yar'Adua* (pp. 163-197). Ibadan: Nigerian Institute of Social and Economic Research.

Okoli, N. J., Ogbondah, L., & Ewor, R. N. (2018). History and development of public universities in Nigeria since 1914. *International Journal of Education and Evaluation*, *2*(1), 60-73.

Okwelogu, I. S., Ogunode N. J., & Abayomi, A. O. (2021). Science education in Nigerian public universities: challenges and way forward. *International Journal on Economics, Finance, and Sustainable Development, 8,* 39-44.

Oladele, S. (2019). *Corruption in the educational sector in Nigeria. The continuous strike of the Academic Staff Union of Universities*. GRIN Verlag.

Olatunde-Aiyedun, T. G. (2024). Artificial intelligence (AI) in education: integration of AI into science education curriculum in Nigerian universities. *International Journal of Artificial Intelligence for Digital, 1*(1), 1-14. https://ssrn.com/abstract=4733349

Olatunde-Aiyedun, T. G., & Ogunode, N. J. (2021). School administration and effective teaching methods in science education in Nigeria. *International Journal on Integrated Education, 4*(2), 145- 161. http://dx.doi.org/10.13140/RG.2.2.11502.54080

Ololube, N. P. (2016). Education fund misappropriation and mismanagement and the provision of quality higher education in Nigeria. *International Journal of Scientific Research in Education, 9*(4), 333-349.

Olorundare, A. S. (2010). *Where is the STEM? Missing context in science, technology, engineering and Mathematics instructions.* A paper presented at the 15th Kwara State Conference of the Science Teachers Association of Nigeria, Ilorin.

Schrader-King, K. (2024). *Tertiary Education*. https://www.worldbank.org/en/topic/tertiaryeducation

Singh, M. (2015). In W "Introduction". *Global Perspectives on Recognising Non-formal and Informal Learning: Why Recognition Matters*. Technical and Vocational Education and Training: Issues, Concerns and Prospects, *21*. Springer. https://link.springer.com/book/10.1007/978-3-319-15278-3

Somadina, O. I., Ndayebom, A. J., & Ogunode, N. J. (2023). The plight of science academics in public Universities in Nigeria: implications for university administrators to make right decisions for University development and sustainability. *Horizon: Journal of Humanity and Artificial Intelligence, 2*(1), 1-9.

Svinicki, M. D. (1990). *The changing face of college teaching*. San Francisco, CA: Josey-Bass.

Udida, L. A., Bassey, U. U., Udofia, I. U., & Egbona, E. A. (2009). *System performance and sustainability of higher education in Nigeria*. Being a paper presented at the 11th International Conference of Educational Management Association of South Africa (EMASA) 7th-9th August 2009.

Ugo, E. A., & Akpoghol, T. V. (2016). Improving Science, Technology, Engineering and Mathematics (STEM) programme in secondary schools in Benue State, Nigeria: Challenges and prospects. *Asia Pacific Journal of Education, Arts and Sciences, 3*(3), 6-16.

Umoh, W. S. (2016). Problems and prospects of effective Science, Technology, Engineering and Mathematics (STEM) education delivery in Nigeria. *Knowledge Review, 35*(1), 2-13.

Wasagu, M. A. (2019). Keynote Address. 60th Annual Conference Proceedings, *STAN,* 1-16.