
***INTEGRATION OF FUNCTIONAL EDUCATION AND
ENTREPRENEURSHIP WITHIN ENGINEERING PROGRAMMES FOR
NATIONAL DEVELOPMENT IN NIGERIA***

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ABSTRACT

This is a review paper that examines the critical role of engineering entrepreneurship in driving national development in Nigeria, focusing on the integration of functional education and entrepreneurship within engineering programmes. The introduction outlines the significance of this integration, emphasizing the need for educational reforms that align engineering curricula with practical, real-world applications and entrepreneurial skills to better prepare graduates for the modern economy. The methodology involves a comprehensive review of empirical studies and theoretical models related to engineering education, entrepreneurship, and functional education, particularly in the Nigerian context. The results highlight both the successes and challenges of integrating entrepreneurship into engineering education in Nigeria, noting systemic barriers such as outdated curricula, resource limitations, and insufficient faculty expertise. The paper concludes by stressing the potential of engineering entrepreneurship to contribute to economic growth and job creation, offering practical recommendations for policymakers and educators. These include revising curricula, enhancing industry partnerships, and supporting faculty development. The paper also identifies gaps in the literature and suggests future research directions, particularly in evaluating the long-term impact of these educational strategies and exploring scalable models for their broader implementation across Nigeria.

Keywords: Engineering Education, Entrepreneurship, National Development, Functional Education, Nigeria

1.0 Introduction

1.1 The Background

The linking of engineering and entrepreneurship has emerged as a crucial driver of national development, particularly in the context of developing countries like Nigeria. Engineering, traditionally associated with problem-solving and innovation, plays a vital role in addressing critical infrastructure, energy, and technological challenges (Shakou, et al, 2019). When combined with entrepreneurship, which is the capacity to transform ideas into viable economic opportunities, this synergy can catalyze economic growth, create employment, and foster sustainable development.

In recent years, the importance of entrepreneurship has been increasingly recognized as a key mechanism for stimulating economic development and reducing poverty (Sutter, et al, 2019). This is particularly relevant in Nigeria, where the youth population is burgeoning, and unemployment

rates remain high. The integration of entrepreneurship within engineering education is seen as a strategic approach to equipping graduates with not only technical skills but also the ability to innovate, create, and manage new business ventures (Snihur, et al, 2021). This dual capability is essential for fostering a generation of engineers who are not just job seekers but job creators.

Functional education, which emphasizes practical, real-world applications of knowledge, is central to this approach (Ezeonwumelu, et al, 2021). In the Nigerian context, functional education is seen as a means to bridge the gap between theoretical knowledge and practical skills, ensuring that engineering graduates are adequately prepared to meet the demands of the job market and contribute meaningfully to national development. The traditional education system in Nigeria has often been criticized for its overemphasis on rote learning and theoretical knowledge at the expense of practical skills (Jimoh, 2021). As a result, many engineering graduates find themselves ill-equipped to tackle the complex challenges of the modern economy or to leverage opportunities in the entrepreneurial space.

The need for a more dynamic and responsive education system that integrates entrepreneurship with engineering training in Nigeria has never been more urgent (Okori, et al 2019). By fostering an entrepreneurial mindset among engineers, educational institutions can play a pivotal role in driving innovation, economic diversification, and sustainable development in Nigeria. This is particularly important given the country's reliance on oil and the need to diversify its economy through the development of other sectors, including technology and manufacturing.

Furthermore, the role of entrepreneurship in national development is well documented. Entrepreneurs are often the engines of economic growth, driving innovation, creating jobs, and generating wealth (Mitra, 2019). In the context of engineering, entrepreneurship can lead to the development of new technologies and solutions that address pressing societal challenges, such as energy access, infrastructure development, and environmental sustainability. For Nigeria, which faces significant challenges in these areas, the promotion of engineering entrepreneurship could have transformative effects on its economy and society (Juliana, et al 2021).

This review paper aims to explore the linkage between engineering education, functional education, and entrepreneurship, with a focus on how these elements can be effectively integrated to drive national development in Nigeria. By examining existing literature, this study seeks to identify the current state of engineering education in Nigeria, the challenges and opportunities in

integrating entrepreneurship into the curriculum, and the potential impact on national development. Through this analysis, the paper will provide insights into how Nigeria can harness the power of engineering entrepreneurship to achieve sustainable economic growth and development.

1.2 Statement of the Problem

Nigeria faces significant challenges in fostering sustainable economic growth, reducing unemployment, and diversifying its economy beyond oil dependence. While engineering education holds the potential to produce skilled graduates capable of addressing these challenges, the current system in Nigeria is largely theoretical, with limited emphasis on practical skills, entrepreneurship, and innovation. As a result, many engineering graduates are ill-prepared for the demands of the labour market or entrepreneurial ventures, contributing to high levels of unemployment and underemployment. Moreover, the absence of functional education that prioritizes practical and real-world applications within engineering programs further exacerbates this issue. Additionally, the integration of entrepreneurship into engineering curricula remains inadequate, hindered by systemic barriers such as outdated teaching methods, limited resources, and insufficient industry collaboration. Despite the recognition of the importance of entrepreneurship for national development, there is a lack of comprehensive strategies that link engineering education to entrepreneurial skills development in Nigeria. This paper addresses the need for an in-depth review of the current state of engineering education in Nigeria, the challenges of integrating functional education and entrepreneurship, and the potential of these reforms to contribute to national development.

1.3 Aim and Objectives

The aim of this paper is to explore the integration of functional education and entrepreneurship within engineering programmes to promote national development in Nigeria.

The objectives of the paper are:

- a. To analyze the current state of engineering education in Nigeria.
- b. To examine the role of entrepreneurship in engineering education.
- c. To evaluate the implementation of functional education practices in engineering programmes.

- d. To identify the challenges and barriers to integrating entrepreneurship in engineering education.
- e. To propose recommendations and a conceptual framework for integrating functional education and entrepreneurship in engineering programmes.

2.0 Review of Related Literatures

The theoretical framework for this review paper explores the interconnection between engineering education, entrepreneurship, and functional education, emphasizing their collective impact on national development, particularly in Nigeria. Engineering education, defined as the structured process of imparting technical knowledge and problem-solving skills, has evolved significantly in Nigeria from a focus on basic technical training to an emphasis on innovation and practical application (Dabok, 2022). Historically, Nigerian engineering programmes were heavily theoretical, with limited practical components, resulting in graduates who were ill-prepared for industry demands (Alade, 2024). However, recent reforms have aimed to incorporate more hands-on experience and industry collaboration into curricula. Entrepreneurship, conceptualized as the process of creating and managing businesses, is widely recognized as a catalyst for national development, driving economic growth, job creation, and innovation (Mitra, 2019). In the Nigerian context, entrepreneurship is particularly critical due to high unemployment rates and the need for economic diversification beyond oil dependency (Usman, 2022). Functional education, which emphasizes practical skills and real-world problem-solving, is essential in bridging the gap between theoretical knowledge and its application in both engineering and entrepreneurship (Haverland, 2022). The integration of functional education within engineering curricula is proposed as a means to enhance the entrepreneurial capacities of engineering graduates, equipping them to innovate and create businesses that address local challenges. The theoretical models underpinning this integration suggest that a synergy between these fields can produce graduates who are not only technically proficient but also capable of driving economic development through entrepreneurial ventures (Fayomi, et al 2019).

Empirical studies on engineering education in Nigeria reveal significant challenges and opportunities related to the quality and effectiveness of programmes. Research indicates that while Nigerian engineering education has seen improvements in curriculum development and infrastructure, it still struggles with outdated teaching methods, insufficient industry collaboration,

and inadequate practical training. These issues contribute to a skills gap, where graduates are often unprepared to meet industry demands. Studies on entrepreneurship within engineering education highlight a growing recognition of its importance, yet actual implementation remains limited (Essia, 2012). Programs that integrate entrepreneurship are often constrained by a lack of resources, faculty expertise, and institutional support, leading to varying levels of success (Fiet, 2001). Functional education, which focuses on equipping students with practical, applicable skills, has been implemented sporadically in Nigeria, often as pilot programmes or through partnerships with private sector organizations. These efforts have shown promise, with students demonstrating improved problem-solving abilities and a greater capacity for innovation (Novak, 2003). However, scaling these initiatives remains a challenge due to systemic issues within the broader education system. The integration of entrepreneurship in engineering curricula has yielded mixed outcomes, with some studies reporting increased student engagement and entrepreneurial activity, while others highlight persistent barriers such as lack of funding and institutional inertia (Børte, et al 2023). Comparative analyses suggest that Nigeria lags behind other developing countries where engineering education and entrepreneurship are more seamlessly integrated, often supported by stronger policy frameworks and better educational resources (Targema-Takema, 2024). These findings underscore the need for comprehensive reforms to enhance the quality of engineering education in Nigeria, better integrate entrepreneurship, and ensure that functional education practices are more widely adopted, ultimately contributing to national development.

3.0 Challenges and Barriers

The integration of engineering entrepreneurship into Nigeria's educational system faces several systemic challenges that have been well-documented in the literature. A key issue is the rigidity of the educational system, which is heavily focused on traditional, theory-based teaching methods with little emphasis on practical and entrepreneurial skills (Dai, et al 2021). This approach leaves graduates ill-prepared for the demands of the modern economy, where innovation and entrepreneurship are critical. Moreover, the curriculum often fails to incorporate entrepreneurship education effectively, treating it as an add-on rather than an integral part of engineering training. This disconnect is exacerbated by a lack of qualified faculty who can teach entrepreneurship from an engineering perspective, with most instructors being more comfortable with technical subjects rather than business or innovation (Bosman, et al 2018). Additionally, resource limitations, including inadequate funding for educational institutions, insufficient laboratory facilities, and

outdated equipment, further hinder the ability to provide a well-rounded, practical education that includes entrepreneurship. These systemic issues create a significant barrier to developing the entrepreneurial capabilities of engineering students in Nigeria.

Institutional barriers are also a significant challenge to the integration of entrepreneurship in engineering education in Nigeria. Many Nigerian universities and polytechnics operate within a framework that is resistant to change, with entrenched bureaucracies that slow down curriculum reforms and innovation (Balogun, 2015). The lack of autonomy in curriculum design, coupled with the centralized control of educational content by regulatory bodies, limits the ability of institutions to swiftly adapt to the evolving needs of the economy. Socioeconomic factors also play a critical role, as many students come from backgrounds where the primary goal of education is securing employment rather than creating new ventures, which diminishes the emphasis on entrepreneurship. Additionally, the broader economic environment, characterized by instability and limited access to capital, makes entrepreneurship a less attractive and viable option for many engineering graduates (Shane, 2004). Policy and governance issues further compound these challenges. While there have been initiatives to promote entrepreneurship education, the lack of coherent and consistent policy implementation has limited their effectiveness (Henry, et al 2017). Policies are often poorly communicated, and there is a disconnection between government objectives and the actual practices within educational institutions. The lack of coordinated efforts between the government, educational institutions, and the private sector has resulted in fragmented initiatives that fail to achieve their intended impact. These challenges highlight the need for a more holistic approach to reforming engineering education in Nigeria, with a focus on addressing systemic, institutional, and policy-related barriers to fostering entrepreneurship.

4.0 Opportunities and Best Practices

Despite the challenges, several successful models and case studies demonstrate the potential for integrating functional education and entrepreneurship within engineering programs. In Nigeria, initiatives such as the Centre for Entrepreneurship Development at the Federal University of Technology, Akure (FUTA), have shown promise in fostering entrepreneurial skills among engineering students by combining technical education with business training and mentorship (Ewim, 2023). These programs emphasize real-world problem-solving, encouraging students to develop innovative solutions that address local challenges, which has led to the creation of start-

ups and small enterprises. Internationally, models such as the Engineering Entrepreneurship Program at North Carolina State University (NCSU) have been lauded for their hands-on approach, where students engage in product development, business planning, and market analysis, providing a comprehensive entrepreneurial education that could be adapted to the Nigerian context (Ewim, 2023). These examples highlight the effectiveness of integrating entrepreneurship into engineering curricula, suggesting that similar approaches could be scaled up in Nigeria to enhance the employability and innovation potential of engineering graduates.

Innovative educational practices have also proven effective in other contexts and offer valuable lessons for Nigeria. For example, project-based learning, where students work on industry-sponsored projects, has been successful in bridging the gap between theory and practice in engineering education. This method not only enhances technical skills but also fosters an entrepreneurial mindset by requiring students to consider the commercial viability of their projects (DeCoito, et al 2023). Additionally, interdisciplinary collaboration, where engineering students work alongside business and design students, has been effective in cultivating a holistic understanding of product development and market needs (Van den Beemt, et al 2020). To support these initiatives, policy recommendations from the literature emphasize the need for government and institutional support, including funding for entrepreneurial programs, incentives for industry collaboration, and the establishment of innovation hubs within universities (Nawaz, et al 2020). Emerging trends, such as the increasing focus on sustainable engineering and social entrepreneurship, offer further opportunities for integrating entrepreneurship into engineering education in Nigeria. By aligning educational programs with these global trends, Nigeria can better prepare its engineering graduates to address both local and global challenges, thereby driving national development in the process.

5.0 Discussions

The synthesis of findings from various studies reveals that the integration of functional education and entrepreneurship within engineering programmes in Nigeria is both essential and challenging. Key themes include the need for a curriculum overhaul that prioritizes practical skills and entrepreneurial thinking, the importance of institutional support and resources, and the role of industry collaboration in bridging the gap between education and market demands. The successful models and case studies from Nigeria and other contexts demonstrate that when engineering

education is aligned with entrepreneurship, students become better equipped to innovate and address local challenges, thereby contributing to economic growth and job creation (Ezepue, et al 2012). However, the persistence of systemic barriers, such as outdated curricula, insufficient faculty expertise, and limited access to funding, continues to hinder the widespread adoption of these approaches in Nigeria.

The implications for national development are significant. By fostering a new generation of engineers who are also entrepreneurs, Nigeria can diversify its economy, reduce unemployment, and promote sustainable development. Engineering entrepreneurship aligns with broader national development goals, such as the Economic Recovery and Growth Plan (ERGP), by driving innovation in critical sectors like technology, energy, and infrastructure (Babalola, 2022). Despite these potential benefits, gaps in the literature remain, particularly in understanding the long-term impact of integrated engineering and entrepreneurship education on economic outcomes and how these programmes can be effectively scaled across diverse educational contexts in Nigeria. A proposed conceptual framework for future research could focus on a holistic approach, incorporating curriculum development, faculty training, industry partnerships, and policy support to fully integrate functional education and entrepreneurship within engineering programmes, thereby maximizing their impact on national development.

6.0 Conclusion & Recommendations

This review has highlighted the critical role that the integration of functional education and entrepreneurship within engineering programmes can play in fostering national development in Nigeria. Key insights include the importance of aligning engineering education with practical, real-world applications and entrepreneurial skills to better prepare graduates for the demands of the modern economy. The review also underscored the challenges posed by systemic barriers, including outdated curricula, insufficient faculty expertise, and limited resources, which hinder the effective implementation of these educational reforms.

To address these challenges, it is recommended that:

- Policymakers should prioritize the revision of engineering curricula to incorporate entrepreneurship as a core component, supported by adequate funding and resources (Akeel, 2018).

- Educational institutions should foster stronger partnerships with industry to provide students with hands-on experience and exposure to real-world challenges.
- Faculty development programmes are essential to equip educators with the skills necessary to teach entrepreneurship effectively.
- Future research should focus on evaluating the long-term impact of integrated engineering and entrepreneurship education on economic outcomes in Nigeria and exploring scalable models for widespread adoption.
- Further studies are also needed to understand how these educational strategies can be tailored to different regions and institutions within Nigeria, ensuring broad and equitable access to the benefits of engineering entrepreneurship (Oloyede, et al 2017).

References

- Boustras, G., Reniers, G., Shakou, L. M. & Wybo, J. L. (2019). Developing an innovative framework for enhancing the resilience of critical infrastructure to climate change. *Safety science*, 118, 364-378.
- Bruton, G. D., Chen, J., & Sutter, C. (2019). Entrepreneurship as a solution to extreme poverty: A review and future research directions. *Journal of business venturing*, 34(1), 197-214.
- Lamine, W., Snihur, Y., & Wright, M. (2021). Educating engineers to develop new business models: Exploiting entrepreneurial opportunities in technology-based firms. *Technological Forecasting and Social Change*, 164, 119518.
- Ezeonwumelu, V. U., & Okoro, C. C. (2021). A dynamic curriculum for functional education in Nigeria: Some lessons from COVID 19 and implications for entrepreneurial self-efficacy. *Changing landscape in educational practice*. Enugu: Times Printing and Publishing Company.
- Jimoh, R. J. (2021). *Effect of Mastering Learning Approach on Senior Secondary School Students Achievement and Motivation in Chemistry in Chanchaga Local Government Area of Niger State* (Doctoral dissertation).
- Ebere, O. J. & Okori, O. A. (2019). Science and mathematics education as tools for developing entrepreneurship skills among secondary school students in cross river state, Nigeria. *Global Journal of Educational Research*, 18(1), 34-45.
- Mitra, J. (2019). *Entrepreneurship, innovation and regional development: an introduction*. Routledge, New York.

- Clement, M., Elvis, O. K., Hui, H. J., Juliana, N. O., & Solomon, E. N., (2021). The impact of creativity and innovation on entrepreneurship development: evidence from Nigeria. *Open Journal of Business and Management*, 9(4), 1743-1770.
- Dabok, M. M. (2022). *A training and skills development conceptual framework for construction technicians in Nigeria* (Doctoral dissertation, University of Central Lancashire).
- Alade, I. A. (2024). Economic maladies in African countries: A discourse on vocational and technical education curriculum in Nigeria for development. *UMYUK Journal of Economics and Development (UJED)*, 1(1), 37-54.
- Usman, Z. (2022). *Economic diversification in Nigeria: The Politics of building a post-oil economy* (p. 312). Bloomsbury Academic.
- Haverland, S. (2022). *Critical Success Factors for Reskilling and Upskilling Engineer Leaders in Customized Executive Education Programs* (Doctoral dissertation, Walden University).
- Arogundade, K. K., Fayomi, E. J., Fields, Z., Ganiyu, I. O., Ojugbele, H. O., & Ogundipe, F., (2019). Complementary approach to teaching and learning entrepreneurship in Nigerian universities: A conceptual framework. *Universal Journal of Management*, 7(2), 57-77.
- Essia, U. (2012). Entrepreneurial culturing of formal education programmes in Nigeria. *Journal of Sustainable Society*, 1(2), 52-62.
- Fiet, J. O. (2001). The theoretical side of teaching entrepreneurship. *Journal of business venturing*, 16(1), 1-24.
- Novak, J. D. (2003). The promise of new ideas and new technology for improving teaching and learning. *Cell biology education*, 2(2), 122-132.
- Børte, K., Lillejord, S. & Nesje, K., (2023). Barriers to student active learning in higher education. *Teaching in Higher Education*, 28(3), 597-615.
- Targema-Takema, R. N. (2024). *Developing a framework that supports the integration of learning technologies in primary education in Nigeria* (Doctoral dissertation, University of Portsmouth).
- Chen, F., & Dai, D. Y., (2021). *Paradigms of gifted education: A guide for theory-based, practice-focused research*. Routledge, New York.
- Bosman, L., Fernhaber, S., & SpringerLink (Online service). (2018). *Teaching the entrepreneurial mindset to engineers*. Switzerland: Springer International Publishing.

- Balogun, A. D. (2015). The effects of public sector corruption on educational development in Nigeria: challenges and alternative measures. *Research on Humanities and Social Sciences*, 5(9), 136-156.
- Shane, S. A. (2004). *Academic entrepreneurship: University spinoffs and wealth creation*. Edward Elgar Publishing Ltd., United Kingdom.
- Ewim, D. R. E. (2023). Integrating Business principles in STEM Education: fostering entrepreneurship in students and educators in the US and Nigeria. *IJEED (International Journal of Entrepreneurship and Business Development)*, 6(4), 590-605.
- Briona, L. K., & DeCoito, I., (2023). Fostering an entrepreneurial mindset through project-based learning and digital technologies in STEM teacher education. In *Enhancing entrepreneurial mindsets through STEM education* (pp. 195-222). Cham: Springer International Publishing.
- Boon, M., Klaassen, R., MacLeod, M., Van den Beemt, A., Van der Veen, J., Van de Ven, A., & Van Baalen, S., (2020). Interdisciplinary engineering education: A review of vision, teaching, and support. *Journal of engineering education*, 109(3), 508-555.
- Koç, M., & Nawaz, W., (2020). Industry, university and government partnerships for the sustainable development of knowledge-based society. *Springer*, 10, 978-3.
- Ezepue, P. O., & Ojo, A. (2012). Addressing economic development goals through innovative teaching of university statistics: a case study of statistical modelling in Nigeria. *International Journal of Mathematical Education in Science and Technology*, 43(8), 1013-1032.
- Babalola, A. (2022). *The role of the private sector in the development of Sub-Saharan Africa: why governance matters*. The University of Manchester (United Kingdom).
- Akeel, U. (2018). *Engineering sustainability: Devising a suitable sustainability education intervention for the Nigerian engineering curriculum* (Doctoral dissertation, UCL (University College London)).
- Ajimotoke, H. A., Faruk, N., & Oloyede, A. A., (2017). Embracing the future of engineering education in Nigeria: teaching and learning challenges. *Nigerian Journal of Technology*, 36(4), 991-1001.