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Bridging the engineering skill gap in Nigeria: Preliminary findings and recommendations of the E4I survey

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Abstract

The paper presents the key findings and recommendations of an evidence-based survey report on the engineering skill gap among young engineering graduates in Nigeria. The outcome of the study highlighted the lack of technical, problem-solving, research and development, and management skills in the country's young engineering graduates. Integrating emerging technologies like artificial intelligence, additive manufacturing, virtual reality, computer programming, computer-aided manufacturing, and computer-aided design into the curriculum was strongly recommended for the training of young engineering students in Nigerian higher education institutions. Other recommendations for skill augmentation include; enabling young graduates to develop their optimisation, modelling, simulation, design, creativity, technical, practical, machining, operation, and management skills to boost their hands-on engineering proficiencies. Strong emphasis was also on the importance of a one-year post-graduation internship program to upskill all young engineering graduates and provide a head-start in industrial settings. Lastly, adopting an outcome-based education (OBE) engineering training curriculum was recognised as crucial for addressing the skills gap.

Keywords: Engineering skill gap; Emerging technologies; Curriculum enhancement; Internship; Outcome-based education.

1. Introduction

The unsatisfactory employability rates among new engineering graduates and the absence of globally recognized top-tier engineering institutions emphasize the worrying state of engineering education in Nigeria. Consequently, there's a growing acknowledgement that enhancing the quality of engineering education necessitates a shift in focus towards defining "quality" based on "Learning Outcomes" rather than solely on grades, and this would subsequently require assessing education based on these outcomes.

The 2019 Global Engineering Capability Review critically evaluated engineering skills across various nations, revealing Nigeria's poor standings in crucial assessment domains such as the labour workforce, knowledge base, engineering industry, infrastructure, and safety standards [1]. The report extensively scrutinized six key indicators of global engineering capability. These encompassed the strength and advancement of a country's engineering industry, the diversity and accessibility of its engineering workforce, knowledge accumulation, infrastructure development, digital

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infrastructure, and safety standards. Furthermore, it examined the barriers impeding safe and innovative engineering practices on a global scale. During the survey, safety evaluation in sectors reliant on engineering comprised two key indicators: the rate of fatal injuries per 100,000 workers within these sectors and the UL Safety Index for 99 countries. The findings indicated Nigeria's placement in the 3rd category concerning the engineering knowledge base, securing a ranking between 49 and 71. However, Nigeria encountered difficulties translating this knowledge into a competent engineering labour force, landing in the 4th category with a ranking between 49 and 64. Furthermore, Nigeria's adherence to expected safety standards also fell within the 4th category, achieving a ranking between 70 and 92 (see Figures 1, 2, and 3).

Based on the preceding information, it's evident that there's a significant skill gap requiring attention. This emphasizes the necessity to enhance the labour force and ensure safe engineering standards by implementing robust capacity-building methods in curriculum development. Improving the quality of engineering education is crucial, given employers' concerns about the lack of essential technical and soft skills, which has led to job underperformance. Engineering education skills are identified as the foremost critical challenge among recent engineering graduates and require priority focus. [2].

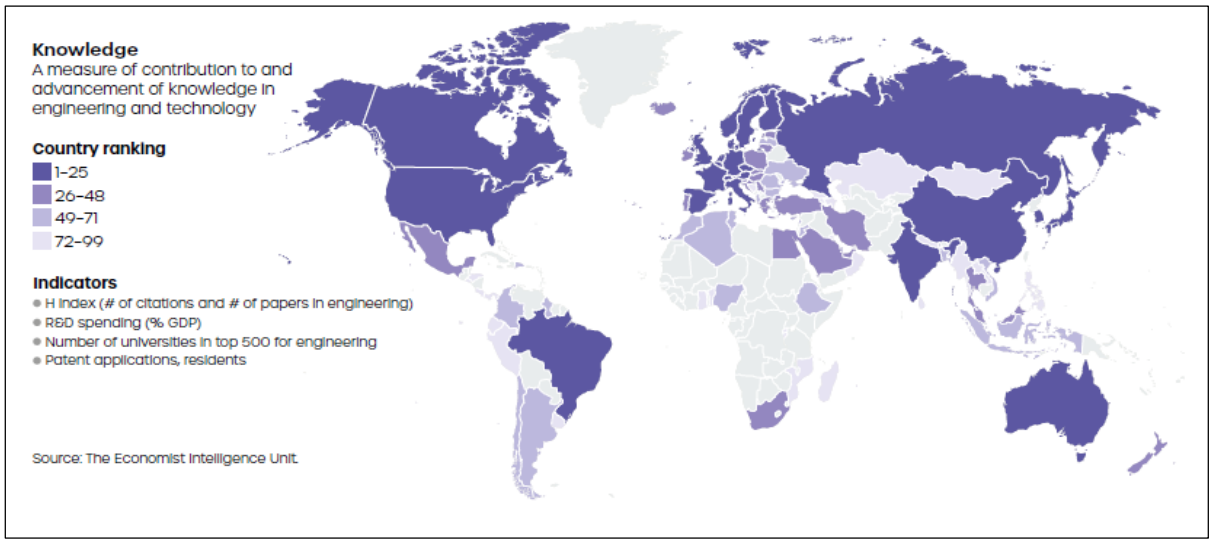


Figure 1 Country ranking based on knowledge

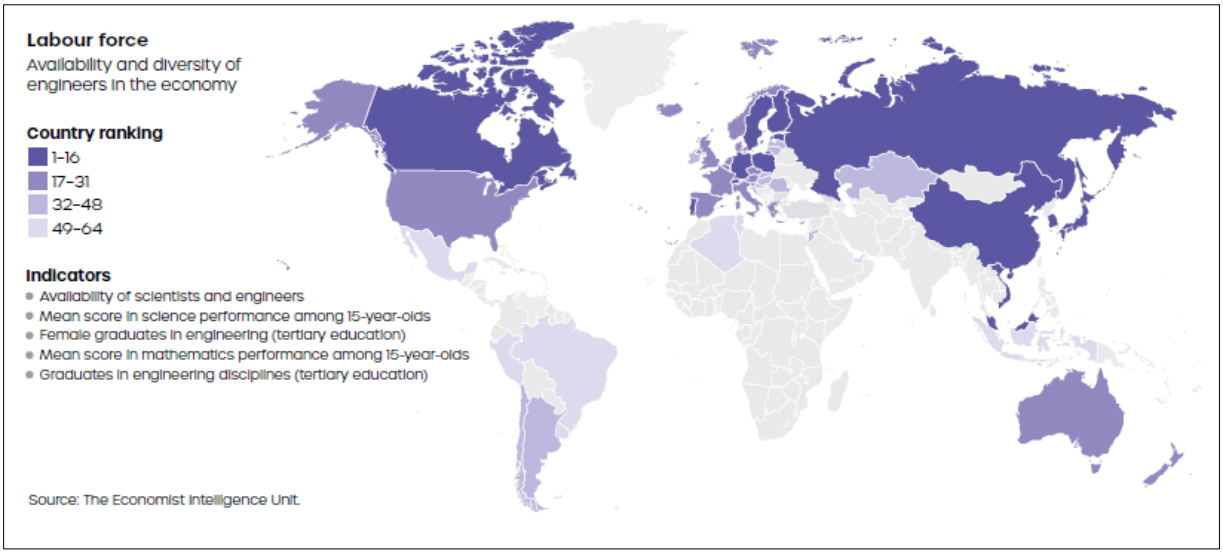


Figure 2 Country ranking based on labour force standard

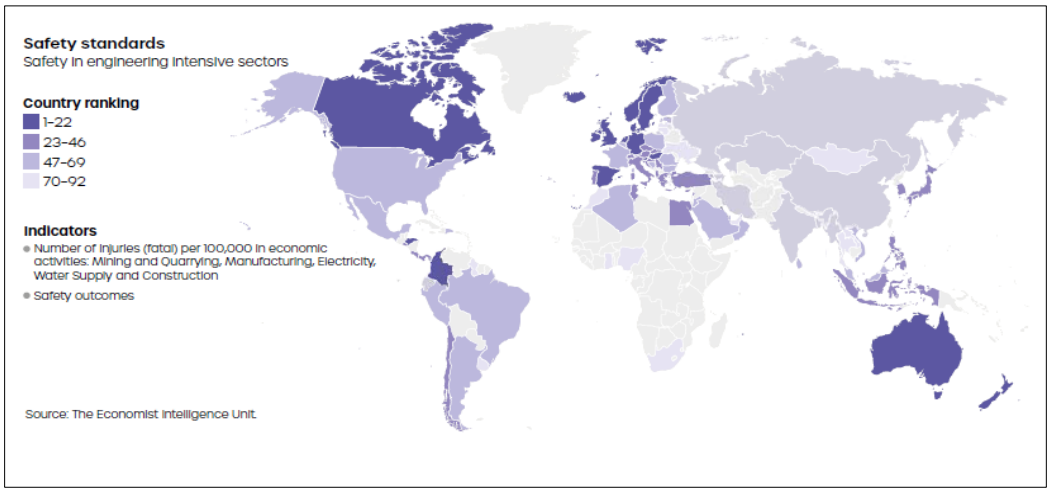


Figure 3 Country ranking based on safety standard

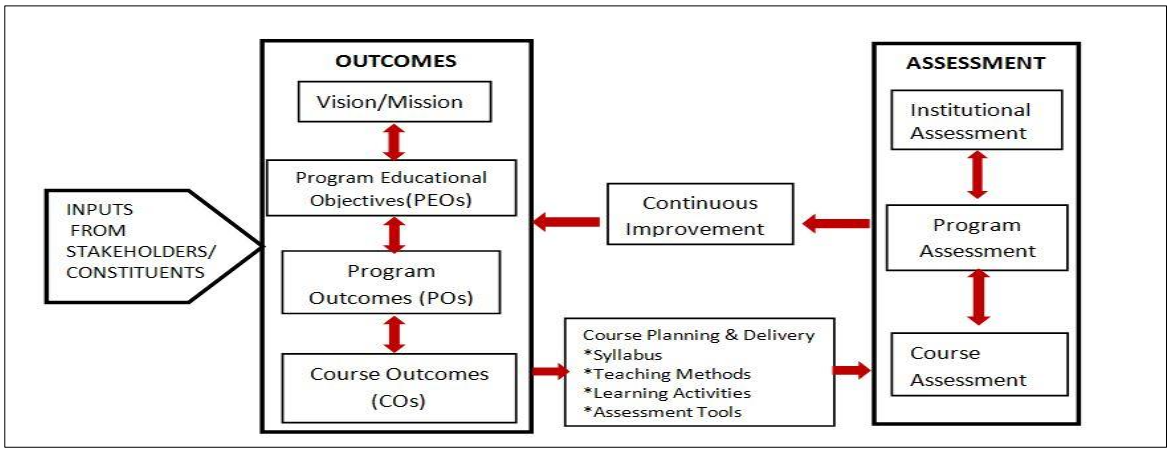
1.1 Challenges of Engineering Education in Nigeria

In Nigerian higher education institutions (HEIs), engineering education faces persistent challenges that hinder students from meeting modern workplace demands and societal needs. The following are the most visible challenges [3].

Firstly, the engineering curriculum lacks the necessary updates to align with global standards, rendering Nigerian graduates less competitive on the international labour market. The need for frequent industry re-training signifies significant curriculum deficiencies, demanding more adaptability and regular assessment [4,5]; Secondly, many engineering graduates lack hands-on experience with tools, impacting their practical skills. Exposing students to advanced technology during industrial experiences could substantially enhance their workplace competence [6,7]; Thirdly, deteriorating laboratories and outdated equipment in Nigerian institutions pose a significant concern, limiting the quality of practical education provided to engineering students [8]; Furthermore, the lack of collaboration between universities and industries in Nigeria impedes practical education and industry exposure essential for engineering students [9,10]. Moreover, insufficient funding for education negatively impacts the quality and quantity of tertiary education, affecting engineering programs [10]; The shortages of senior lecturers and an imbalance in the ranks of teaching staff, alongside issues of commitment and leadership within professional bodies, further strain engineering education [6,11,8]. Lastly, limited resources for practical training led to predominantly traditional teaching methods, hindering the quality of graduates produced [8]. However, advancements in technology, such as ICT, are gradually shifting towards more self-directed learning approaches [5].

In addition, an examination of the current engineering training curriculum in Nigerian universities further supports the need for enhanced training content in emerging technologies. These technologies encompass virtual reality, augmented reality, artificial intelligence, additive manufacturing/3D printing, and gamification, aiming to advance the teaching and comprehension of engineering science and design principles [12].

There's a specific interest in exploring the potential for teaching and learning additive manufacturing/3D printing within Nigerian engineering undergraduate programs. This exploration involves designing an outcome-based education (OBE) curriculum within an acceptable framework (refer to Figure 4). The objective is to create a curriculum that aligns with employability outcomes, market demands, knowledge enhancement, and the development of skills and character, as advocated by the Council for the Regulation of Engineering Practice in Nigeria (COREN). The intent is to enhance the quality of engineers trained in Nigeria [13].



Source: [14].

Figure 4 A framework of an outcome-based education (OBE) curriculum.

Creating a technology-centred engineering curriculum holds the potential to elevate the skills of undergraduate engineering students, ensuring they stay current with modern advancements and enabling them to develop engineering project prototypes. These technologies, increasingly accessible to students in more advanced nations, can also be leveraged to animate engineering concepts in Nigeria and sub-Saharan Africa. However, it is a bid to address some of these critical technical manpower training challenges in Nigeria that the Engineering for Industry (E4I) grants under the remit of the Royal Academy of Engineering were provided to; bridge the safety and engineering skills gap in Nigeria, equip engineering students and lecturers with essential industry skills, and facilitate the safe adoption of emerging technologies for national development.

Hence, the primary aim of this review paper is to investigate and tackle the engineering skills gap challenges prevalent in Nigeria, and on a more specific note, this review aims to provide an evidence-based resource for developing specialized courses for training both engineering students and professionals in state-of-the-art technologies to build engineering capacities and equip same with vital technical and soft skills to bridge the divide between educational offerings and the demands of the industry.

2. Methodology

The research methodology incorporated essential components aimed at understanding the country's global engineering position, addressing curriculum gaps, assessing policies, engaging stakeholders, and presenting data-backed suggestions for enhancement. Customized questionnaires were formulated, and tailored to suit a diverse audience. This was followed by a pivotal Inception meeting, gathering literature and engaging extensively with key stakeholders such as universities, engineering societies, regulatory bodies, and industry players. This meeting summarized evidence-based audit results to potentially improve the curriculum. Further steps involved meticulous document scrutiny, including an extensive review of literature encompassing journal publications and existing engineering curricula across Nigerian higher education institutions (HEIs), juxtaposed with global trends. Concurrently, interviews were conducted with members of significant engineering societies to understand how to address skills gaps and devise future strategies.

In addition, a hybrid survey method—blending online and offline approaches—was employed to engage respondents nationwide, capturing diverse perspectives and industrial skill challenges, especially in refining engineering student training to match industry demands. The study employed hybrid surveys, combining online and offline methods, to gather opinions from a broad spectrum of respondents, ensuring a comprehensive sample. Finally, a rigorous analysis of the collected data facilitated the synthesis of findings, forming the basis for comprehensive recommendations to enhance engineering skills development in Nigeria.

2.1. Limitations

While striving for inclusiveness, this study acknowledges several constraints. Primarily, it heavily leaned on online survey responses (83%), with minimal in-person interaction (17%), potentially introducing biases that could influence the outcomes. Secondly, during the desk review phase, limited access to specific internal documents might have hindered a comprehensive analysis, leading to reliance on available documentation and affecting the depth of insights.

Thirdly, the limited representation of engineering regulators in the survey poses a challenge, potentially limiting the breadth of regulatory perspectives.

Moreover, the study's participatory methodology, emphasizing qualitative data collection, necessitates a careful interpretation of findings considering the nature of the data. Finally, time constraints due to busy schedules might have affected the depth of interviews and overall engagement, potentially impacting the study's breadth. Nonetheless, this study provides a glimpse into Nigeria's engineering skill development landscape.

3. Result and Discussion

3.1. A Review of Nigerian University Engineering Curriculum.

A critical review conducted by the National Universities Commission (NUC) in 2000 revealed significant inadequacies within university curricula, specifically within engineering programs [15]. William's 2004 report illuminated pressing concerns within these programs, highlighting the lack of practical design experiences for students [16]. Moreover, despite an emphasis on engineering science and technical courses, a noticeable gap existed between theoretical knowledge and its practical application in real-world industrial contexts. The assessment further exposed deficiencies among graduates, particularly in communication skills, teamwork experiences, and an understanding of broader societal, environmental, economic, and legal aspects relevant to contemporary engineering practice. Compounding these issues was the dearth of practical experience among faculties and graduates, hindering their ability to effectively bridge theoretical concepts with practical applications. The review also identified outdated teaching and learning strategies, calling for a shift towards more student-centred approaches within engineering programs [17].

Subsequently, in response to the evolving landscape of academic knowledge and the transformative impact of Information and Communication Technologies (ICTs) on education, the NUC undertook a comprehensive revision of university standards. Initially crafting the Minimum Academic Standard (MAS) in collaboration with universities in 1989, the NUC recognized the need for a fundamental overhaul by 2001. This revision resulted in the formulation of the benchmark minimum academic standards (BMAS), addressing changing skill demands amidst challenges posed by globalization.

The transformative journey from MAS to BMAS sought to adapt to global advancements and evolving skill requisites. It aimed to integrate emerging subjects like entrepreneurial and peace studies into diverse disciplines, aligning education with societal needs and global competitiveness. However, while the BMAS represented a significant leap forward, it notably lacked integration of modern technologies like artificial intelligence, additive manufacturing, and virtual reality in the engineering curriculum, highlighting areas ripe for improvement. The evolution of standards underscored the NUC's commitment to enhancing academic programs and aligning them with the demands of the labour market. Through needs assessment surveys, the NUC strived to ensure graduates possess the necessary skills for both national and global economic demands. The journey from MAS to BMAS demonstrates a concerted effort toward a standardized yet adaptable framework for academic program development in Nigerian universities, yet calls for continued improvements to embrace emerging technological advancements remain evident [12].

3.2. A Cursory Analysis of Some Extant Policies of Government.

The examination of pivotal policies and legislations driving engineering skills advancement in Nigeria unravelled critical directives. The National Policy on Education, originating in 1981 and later revised in 1998, underscores the paramount role of science, technology, and engineering in national progress [18,19]. Similarly, the Nigerian Content Development and Monitoring Board (NCDMB) Act of 2010 prioritizes fortifying indigenous content within the oil and gas domain, specifically accentuating the augmentation of engineering competencies [20]. Concurrently, the Industrial Training Fund (ITF) Act of 2011 mandates employer contributions toward the training of Nigerian graduates and apprentices, highlighting the pivotal role of engineering training across diverse sectors [21].

Other contributing policies encompass the National Science, Technology, and Innovation Policy (NSTIP) of 2012, championing STEM education and sustainable development through innovation [22]. Furthermore, the National Automotive Policy of 2013 also aims to foster domestic vehicle and auto parts production while spotlighting the enhancement of engineering skills within the automotive sector [23]. Additionally, the National Research and Innovation Council (NRIC) Act of 2018 concentrates on coordinating research and innovation endeavours, particularly in engineering [24]. Finally, Presidential Executive Order 5 of 2018 directs preferences for Nigerian professionals and firms in contract allocation within engineering and related arenas [25].

In unison, these policies endorse a varied approach to engineering skills development in the country. They advocate for a national engineering curriculum aligned with minimum standards and domestic requirements. Moreover, the policies underscore the importance of; augmented governmental investment in engineering education, the promotion of professional certification for practising engineers, encouragement of private sector collaborations for skill augmentation, nurturing research and development initiatives, and fostering more job opportunities within the engineering space through entrepreneurship and local content fortification.

Data Analysis and interpretation of findings.

The conducted Engineering Skills Gap Survey in Nigeria revealed insightful data, offering a comprehensive understanding of the current state of the engineering sector in the country. The analysis and interpretation of the findings are discussed below:

3.2.1. Employment Landscape

From Figure 5, the survey unveiled that only 32% of respondents reported employment vacancies in their organizations. The majority (68%) indicated the absence of current positions to fill. Interestingly, employment opportunities

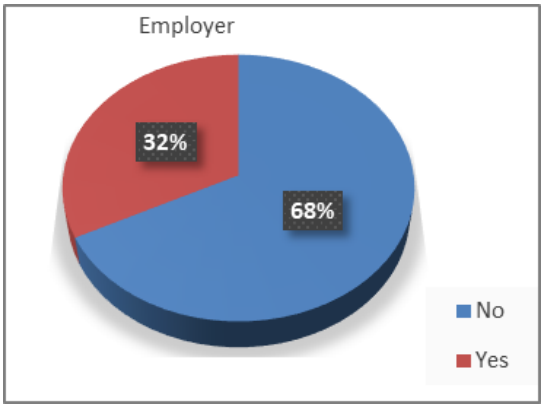


Figure 5 Distribution of employers with vacancies

predominantly emanated from Professional Engineering Institutions (PEIs), industrial stakeholders, informed public members, engineering educators, and engineering regulators. This suggests a diversified source of employment, contributing to a dynamic landscape within the engineering sector.

It could be seen that Figure 6 delineates the reasons for unfilled vacancies, with 37.2% attributing the gap to a dearth of suitably skilled individuals. Other significant factors include poor pay (9.3%) and miscellaneous reasons (53.3%). The latter category encompasses multifaceted issues such as government policies, employment embargoes, and bureaucratic bottlenecks. These findings underscore the multifactorial nature of challenges in talent acquisition within the engineering sector.

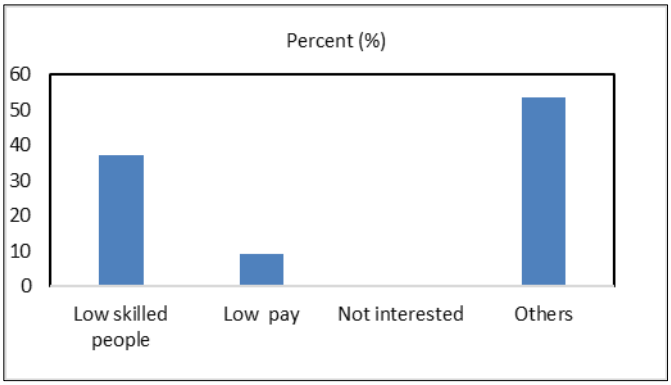


Figure 6 Reasons for the unfilled vacancies

Figure 7 portrays the tangible consequences of non-recruitment, including loss of business opportunities, decline in service quality, restrictions in business growth, increased running costs, reduced efficiency, and other losses. This emphasizes the critical impact of the engineering skills gap on organizational performance and overall industry dynamics.

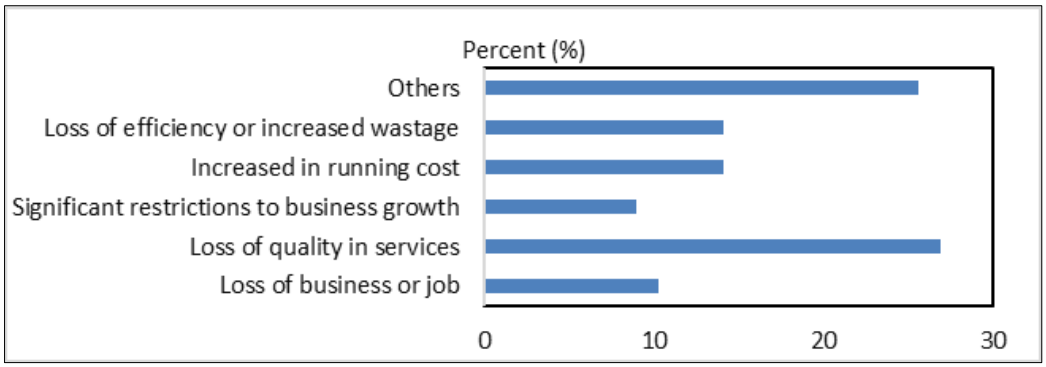


Figure 7 Losses consequent on non-employment

3.2.2. Respondents' demographics.

From the study, Figure 8 illustrates the diverse segments of respondents, with engineering educators comprising the largest group at 47%. The inclusion of perspectives from the engineering student community, professional engineering institutions, the informed public, industrial stakeholders, and engineering regulators provides a well-rounded representation of critical stakeholders in Nigerian society, and this diversity enhances the robustness of the survey outcomes.

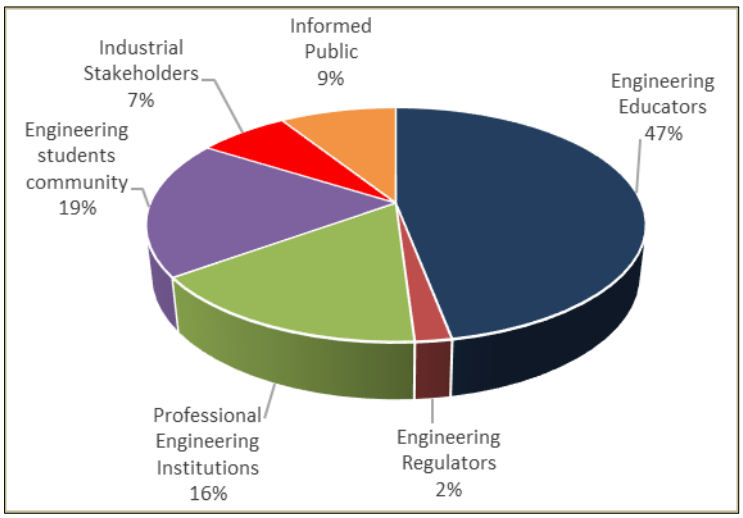


Figure 8 Sample population of different segments of respondents

3.2.3. Skills gap and training needs

Figure 9 sheds light on the perceived skills lacking among Nigerian engineering graduates, with a notable concern for self-discipline/personal development, research and development skills, problem-solving skills, and practical or technical skills. The interpretation of this data presents a notable concern about the proficiency of Nigerian engineering graduates in various essential skills, highlights areas in need of improvement, and further underscores the urgency of addressing skill deficiencies to ensure the competitiveness and competence of engineering graduates in the workforce.

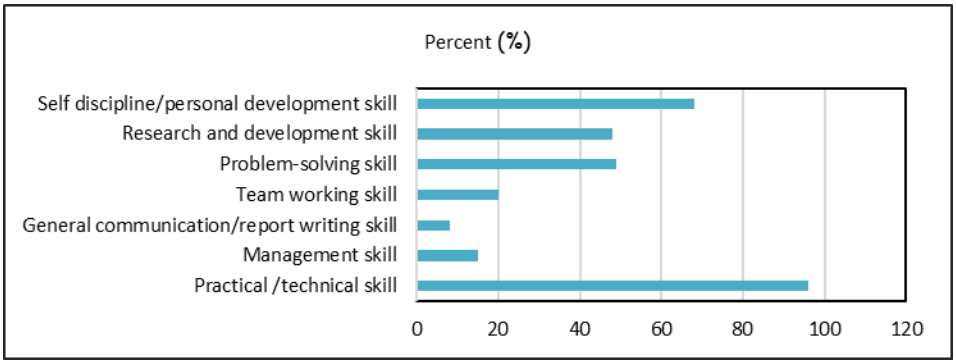


Figure 9 Skills Lacking in Nigerian Engineering Graduates

3.2.4. Skills improvement need

Figure 10 unanimously reflects the consensus among respondents spanning all categories of the sample population, that Nigerian higher education institutions (HEIs) need to enhance the skill levels of their students and graduates. This resonates with the imperative to align academic curricula with industry demands, emphasizing the need for more robust engineering skill training content.

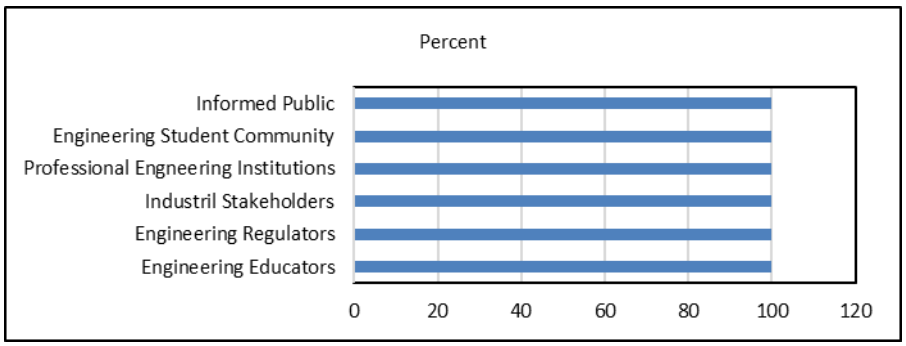


Figure 10 The need for skills improvement by Nigerian HEIs

3.2.5. Inclusion of Emerging Technology Contents

In the course of the survey, distinct biases in favour of specific emerging technologies were also revealed. Figure 11 outlines the preferences for the inclusion of emerging technologies in engineering training curricula, and artificial intelligence, additive manufacturing, and virtual reality emerged as the most favoured technologies across various respondent categories, highlighting the industry's demand for graduates proficient in cutting-edge technologies.

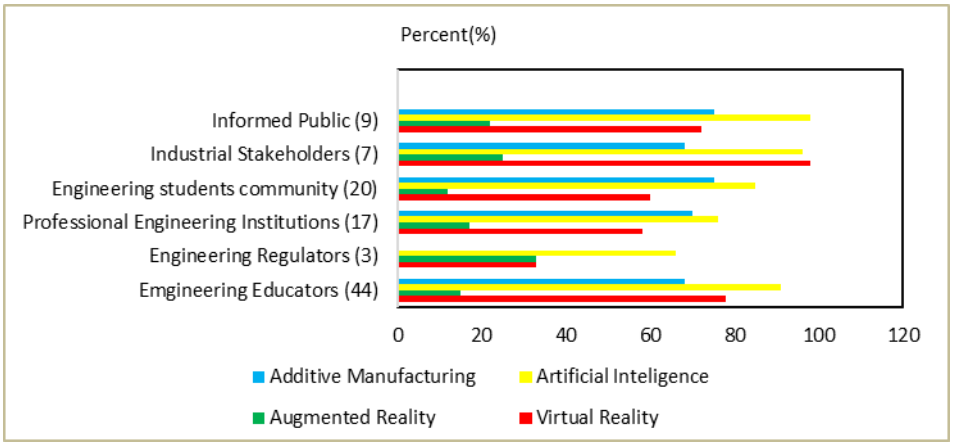


Figure 11 Emerging technologies for Nigerian engineering curricula

3.2.6. Inclusion of modern technologies

Figure 12 provides a nuanced perspective on the need for modern technologies in the Nigerian engineering training curriculum. Computer programming, computer-aided manufacturing, and computer-aided design stand out as the top three choices, reflecting the industry's emphasis on practical and technical skills aligned with contemporary demands.

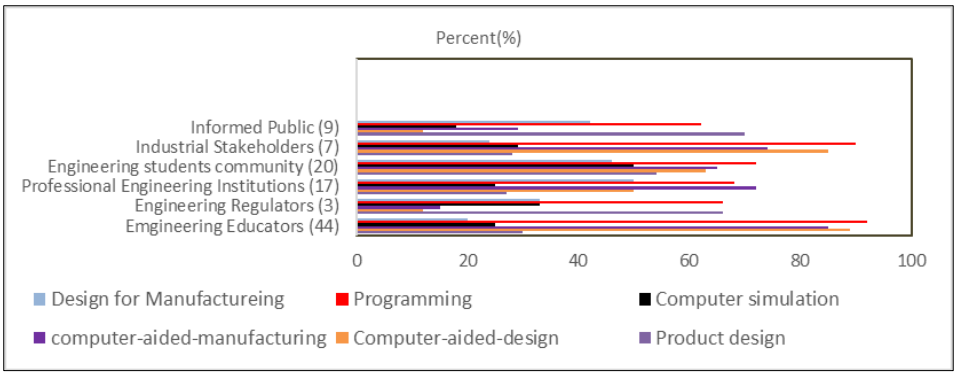


Figure 12 Modern technologies for Nigerian engineering curriculum

3.2.7. Top skills expected of Nigerian engineering graduates

Figure 13 identifies the top skills expected of engineering graduates, emphasizing the significance of optimization/modelling/simulation skills, design and creativity skills, technical/practical/machining/operation skills, and management skills. These findings underscore the evolving nature of engineering roles, requiring a diverse skill set beyond traditional technical expertise. Prioritizing the development of these most sought-after skill sets would help bridge the industry's skill gap.

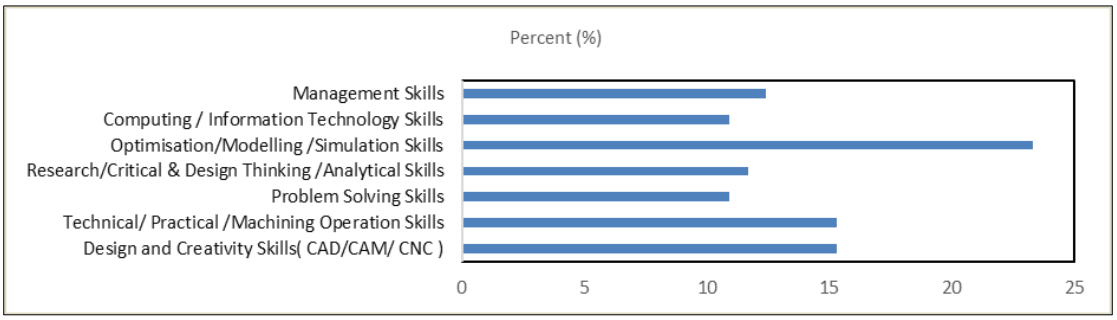


Figure 13 Top skills expected of engineering graduates.

3.2.8. Need for post-graduation internship training

Figure 14 reinforces the unanimous support for a one-year post-graduation internship, highlighting its perceived importance in bridging the gap between academic knowledge and industry demands. This aligns with the recognition of the practical applicability of skills gained during formal education.

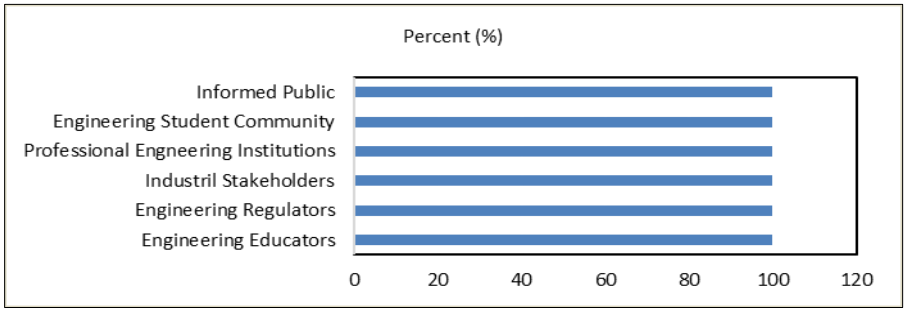


Figure 14 Need for post-graduation internship training

3.2.9. Need for outcome-based engineering education.

Figure 15 underscores overwhelming support for outcome-based education (OBE) in Nigerian HEIs, with over 98% of respondents advocating for its implementation. This endorsement signifies a collective belief in the efficacy of OBE in equipping engineering graduates with the requisite knowledge, skills, and character for professional success. According to COREN [13], OBE in engineering hinges on three fundamental parameters: knowledge, skill, and character. Character is emphasized as an essential aspect, without which human and societal progress is hindered. The development and cultivation of character are vital for driving societal progress and ensuring that individuals understand and fulfil their responsibilities effectively.

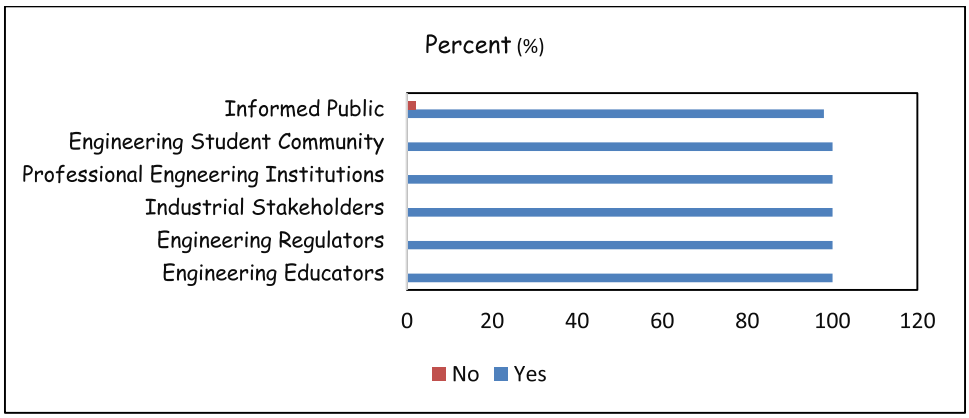


Figure 15 Need for outcome-based engineering education

3.3. Key Findings

The Engineering Skills Gap Survey highlighted several crucial points:

- Vacancies and Recruitment Challenges: Engineering graduates face difficulties in securing jobs due to skill shortages, low pay, and external factors despite numerous available employment sources.
- Skills Lacking Among Graduates: The survey identified deficiencies in self-discipline/personal development, research and development, and practical/technical skills among graduates.
- Preference for Emerging Technologies: Artificial Intelligence, additive manufacturing, and virtual reality are highly favoured for inclusion in engineering training programs.
- Importance of Modern Technologies: Computer programming, computer-aided manufacturing, and computer-aided design are deemed essential components for an engineering curriculum.
- Top Expected Graduate Skills: Nigerian engineering graduates are expected to prioritize optimization/modelling/simulation skills, design and creativity skills, technical/practical/machining/operation skills, and management skills.
- Post-Graduation Internship: There's unanimous support for a one-year post-graduation internship as it's seen as crucial for enhancing skills and preparing graduates for industry roles.
- Support for Outcome-Based Education: There's overwhelming agreement on the effectiveness of Outcome-Based Education in shaping well-rounded engineering graduates, thereby reflecting a consensus on its importance.

4. Challenges

Undoubtedly, the utilization of hybrid surveys as a methodological tool for data collection brought forth a spectrum of advantages in engaging a diverse participant pool. However, the intellectual journey of this study was not without its share of challenges. The intricacies encountered during the project are briefly discussed below:

4.1. Selection of participants

Selecting participants willing to engage in both online and offline survey components emerged as a nuanced challenge. The imperative of ensuring the representativeness of the target population accentuated the complexity of this task. Striking a balance between online and offline participation while maintaining demographic diversity necessitated meticulous consideration.

4.2. Recruitment for online surveys

While recruiting participants for online surveys was comparatively forthright, the challenge lay in garnering commensurate participation for the offline component. Addressing this imbalance required an additional layer of effort to ensure a robust and well-rounded dataset, reflective of the study's overarching objectives.

4.3. Data quality

The potential pitfalls associated with data quality were obvious in all incomplete or inconsistent responses, missing data, and respondent bias. In response, the project team implemented stringent procedures to mitigate these issues, underscoring the commitment to data integrity and the validity of survey outcomes.

4.4. Management of survey modes

The inherent complexity of managing different modes of administration for hybrid surveys posed a challenge. The working group overseeing the project diligently instituted measures to ensure uniformity across various modes, thereby fostering inclusivity and accessibility for all participants.

4.5. Cost implications

Hybrid surveys, while potent in their reach and inclusivity, presented a financial challenge. The incorporation of both online and offline components added a layer of expense, notably considering the costs associated with the printing and distribution of paper for surveys. Navigating this financial terrain required strategic resource allocation.

Moving beyond these methodological challenges, the study delved into an exploration of multifaceted barriers hindering modern engineering skills development in Nigerian Higher Education Institutions (HEIs). The synthesis of these challenges, sourced from extensive document reviews, is itemized and briefly discussed as follows:

4.5.1. Poor curriculum

The current engineering curriculum in Nigeria, as explained in sources [26, 27, 28], stands indicted for its obsolescence and misalignment with global standards. A clarion call from COREN advocates for the adoption of an outcome-based education curriculum to strengthen the training contents of Nigerian HEIs to produce top-notch engineering graduates for global competitiveness. A comprehensive curriculum overhaul is deemed imperative to imbue students with sufficient practical skills in tandem with contemporary trends.

4.5.2. Lack of industrial experience

A palpable challenge surfaces in the form of insufficient industrial exposure and experience among engineering graduates. The dearth of practical training or internships within industries impedes the seamless transition of graduates from academia to the workplace, therefore compromising their overall preparedness and competitiveness in the professional arena and world of work.

4.5.3. Inadequate funding

The spectre of inadequate funding looms large, with the Nigerian government's investment in modern engineering skill development falling short of international benchmarks. Allocations for education hover below the UNESCO-recommended threshold of 26% of the national budget. This financial shortfall hampers the provision of modern equipment, facilities, and infrastructure in engineering schools, constraining students' acquisition of practical skills.

4.5.4. Brain drain

A perennial challenge confronting the Nigerian engineering sector is the exodus of skilled engineers seeking greener pastures abroad. This brain drain engenders a chronic shortage of skilled professionals within the Nigerian engineering landscape, posing a formidable obstacle to sustainable skill development.

4.5.5. Poor infrastructure

The state of infrastructure in Nigeria, characterized by unreliable power supply and erratic internet connectivity, compounds the challenges faced in engineering skill development. These infrastructural deficiencies impede the delivery of quality education and training to engineering students, stunting their skill growth and hindering their ability to meet the dynamic demands of the industrial landscape.

5. Conclusion

The intricate landscape of challenges impeding engineering skill development in Nigeria necessitates urgent and comprehensive interventions. The Nigerian government and key stakeholders in the engineering sector must embark on proactive measures to address these challenges. The recommended steps include a thorough review of the engineering curriculum, augmented funding for education and skill development, retention of skilled professionals, provision of practical experience to graduates, fostering collaboration among stakeholders, and infrastructural development.

The burgeoning advocacy for updating and upskilling engineering practitioners to align with modern innovations has gained momentum. The resounding call for the inclusion of emerging and modern technology courses in the engineering training curriculum for Nigerian HEIs has become imperative. This is critical to ensuring that Nigerian-trained engineers possess the latest knowledge and skills, remain globally competitive, and contribute significantly to the development of the nation's engineering sector.

However, addressing these challenges holds the key to Nigeria overcoming the obstacles bedeviling engineering skill development and positioning itself as a hub for innovation and technological advancement in the sub-region. This requires a collaborative effort from all stakeholders, prioritizing the long-term success of engineering education and practice, and building a robust and sustainable engineering workforce that meets the demands of the citizens and modern society.

5.1. Recommendations

To enhance the quality of engineering education and address the substantial barriers that hinder engineering skills development in Nigerian HEIs, it is crucial to take into account the following suggestions:

The curriculum for engineering skills training in Nigeria should undergo a thorough review and update to align with current industry needs and technological advancements. This process, as already initiated by the National Universities Commission should be expedited by incorporating input from industry and academic stakeholders to ensure students are equipped with up-to-date skills and knowledge [29].

The perennial challenge of poor funding in engineering education necessitates a substantial increase in financial support from both the government and the private sector. This entails allocating more resources to engineering schools and providing better equipment, tools, and facilities for practical training. The current disparity, with only 7% of the total budget allocated to education in 2021, should be rectified to attract qualified teaching staff and enhance research opportunities [30].

Promoting collaboration between engineering institutions and industry players is essential to align training with industry needs. This collaboration ensures that students are trained in relevant skills demanded by the industry, exposing them to real-world challenges. The World Economic Forum's report highlighting a significant untapped potential in collaboration between businesses and educational institutions underscores the need for growth in this area [31].

Prioritizing practical training over theoretical knowledge is crucial to bridging the gap between academia and industry, producing graduates ready for employment. The establishment of engineering workshops, training centres, and tech hubs supported by both the government and the organized private sector, can provide more opportunities for practical training. The current scenario, where only 5% of engineering graduates are deemed employable, underscores the need for expanded practical training opportunities in engineering education in Nigeria [32].

Adopting and putting these suggestions into practice demands Nigeria to undertake a transformative path leading to an internationally competitive engineering education system. This system should promote innovation and make a substantial contribution to the country's progress. Achieving this goal necessitates the collaboration and dedication of all stakeholders to implement these suggestions and pave the way for a resilient and enduring future for engineering education in Nigeria.

Compliance with ethical standards

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Disclosure of Conflict of Interest

The authors have declared that no competing interests exist.

References

[1] 2019 Global Engineering Capability Review .https://www.raeng.org.uk/global/international-partnerships/engineering x_/engineering skills/global-engineering-capability-review

[2] https://www.raeng.org.uk/publications/other/call-for-ideas-report-2019

[3] Idris, A. and Rajuddin, A. (2012). The Trend of Engineering Education in Nigerian Tertiary Institutions of Learning Towards Achieving Technological Development. Procedia - Social and Behavioral Sciences 56:730 – 736

[4] Kofoworola, O.F. (2003). Engineering Education in Nigeria Present Learning Systems and Challenges for the Future. Australasian Journal of Engineering Education 2-7.The Australasian Association for Engineering Education Inc.

[5] Onwuka, E.N.(2009).Reshaping engineering education curriculum to accommodate the current needs of Nigeria. Educational Research and Review, 4 (7), PP. 334-339. Available online at http://www.academicjournals.org/.

[6] Adedokun, S.T. (2011). What are they made up of today? A look at Engineering Education in Developing Nations with Nigeria as a Case Study. Journal of Emerging Trends in Engineering and Applied Sciences (JETEAS) 2 (2), PP 308-313. Scholarlink Research Institute Journals.

[7] Atsumbe, B.N and Saba, T.M. (2008). A Study on Affective Work Skills Needs of Engineering and Technology Education Students of Universities in the North Central States of Nigeria. Bayero Journal of Pure and Applied Sciences, 1(1) PP 95 – 98.

[8] Owolabi, R.U. and Rafiu, L. (2010). Chemical Engineering Education in Nigeria: Challenges and Prospects. International Journal of Chemical Engineering and Applications, 1, (2), P 138-141.

[9] Silveira, M.A, (2006): in YE, W. and LU, W. (2011). Case Study on CDIO-based Engineering Education Mode through College-Industry Linkages. Advanced Materials Research, Vols. 217-218, PP 819-823.

[10] Akintoye, I.R. (2008). Optimising Output from Tertiary Educational Institutions Via Adequate Funding: A Lesson from Nigeria. International Research Journal of Finance and Economics. Issue 14, PP 359-368. EuroJournals Publishing, Inc.

[11] Shu'ara, J. (2010). Higher Education Statistics-Nigeria Experience in Data Collection. Paper Presented at the UNESCO Institute of Statistics Workshop on Education Statistics in Anglophone Countries, Windhoek 17th – 21st October 2010.

[12] NUC (2014). National Universities Commission Benchmark Minimum Academic Standards For Undergraduate Programmes In Nigerian Universities (Draft Copy) Engineering And Technology November 2014.https://nuc.edu.ng/wp-content/uploads/2015/09/Engrg%20and%20Tech%20Draft%20BMAS.pdf

[13] COREN (2021). COREN adopts OBE to train prospective engineers. Punch Newspaper, 13th October 2021. https://punchng.com/coren-adopts-obe-to-train-prospective-engineers/

[14] ulsafetyindex.org/; www.visionzero.global

[15] Emumejaye, K. and Osiga-Aibangbee, D. (2011) Basic Sciences and Curricula Review for Engineering Education In Nigeria To Meet Global Standards. Multidisciplinary Journal of Research Development Volume 17 No 3 September, 2011

[16] William, S., Hartnett, TY.A & Strassner, E., (2004). Higher Education in Nigeria – A status report. World Education News & Review.

[17] Mills, J.E. and Treagust, D.F. (2003). Engineering education - is a problem–based or project–based learning the answer? Australasian Journal of Engineering Education Inc.

[18] FRN (1981). National Policy on Education. Lagos: The Federal Republic of Nigeria. NERC Press.

[19] FRN (1998). Revised National Policy on Education. Abuja: The Federal Republic of Nigeria. NERDC Press.

[20] NCDMB (2010). Nigerian Content Act. Lagos:

[21] Industrial Training Fund. (2011). Industrial Training Fund Act. Lagos: The Federal Republic of Nigeria.

[22] NCDMB FMS&T (2012). National Science, Technology and Innovation Policy. Abuja: The Federal Republic of Nigeria. FMST Press.

[23] FRN (2013). National Automotive Policy. Abuja: Federal Ministry of Industry, Trade and Investment. The Federal Republic of Nigeria.

[24] NRIC (2018). National Research and Innovation Council (NRIC) Act. Abuja: Federal Republic of Nigeria.

[25] Presidential Executive Order 5 for Planning and Execution of Projects, Promotion of Nigerian Content in Contracts and Science, Engineering and Technology."https://scienceandtech.gov.ng/presidential-executive-order-5-for-planning-and-execution-of-projects-promotion-of-nigerian-content-in-contracts-and-science-engineering-and-technology/

[26] Adoghe, A. U. (2019). Challenges of engineering education in Nigeria. International Journal of Engineering Research and General Science, 7(6), 72-76.

[27] Anigbogu, T. U. (2020). Engineering education in Nigeria: challenges, prospects, and solutions. European Journal of Education Studies, 7(6), 134-146.

[28] Ume, L. O., Nwokoye, N. G., and Ezugwu, A. E. (2018). Challenges of engineering education in Nigeria: a review. International Journal of Engineering and Management Research, 8(1), 79-85.

[29] National Universities Commission. (n.d.). Quality Assurance in Nigerian Universities. Retrieved from https://www.nuc.edu.ng/nigerian-universities/quality-assurance-in-nigerian-universities/

[30] Despite promises, FG's budgetary allocations to education remain low. https://guardian.ng/features/education/despite-promises-fgs-budgetary-allocations-to-education-remain-low/

[31] World Economic Forum. (2017). Africa Competitiveness Report 2017. Page 130. Retrieved from http://www3.weforum.org/docs/WEF_ACR_2017_web_0401.pdf

[32] National Bureau of Statistics. (2019). Unemployment/Underemployment Report Q4 2018. Retrieved from https://www.nigerianstat.gov.ng/pdfuploads/Q4_2018_Unemployment_Report.pdf