



Enhancing Engineering Development in Nigerian Institutions

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Author's contribution

The sole author designed, analysed, interpreted and prepared the manuscript.

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ABSTRACT

Technical development comprises the learning of professional skills, as well as theoretical and practical engineering knowledge. Engineering departments of different universities and polytechnics in Nigeria were investigated using Pareto Analysis to understand the major causes of poor engineering development in Nigerian Institutions and ways to enhance it. The findings indicate that the major causes of poor engineering developments were poor funding, a lack of a functional policy framework, non utilization of existing laboratories, poor teaching skills, a lack of functional workshop facilities, an unstable engineering road map, a poor curriculum, decay in educational infrastructure, non-implementation of the educational budget, and poor collaboration between industries and institutions. After the analysis of all the problems hampering engineering development in Nigerian Institution using Pareto Analysis of 20/80 Rules, the result shows that the seven major causes, which mostly affected the engineering development are; Collaboration between engineering department and industries, poor teaching method, non-maximum utilization laboratories, non study of existing products and functions, lack of functional laboratories, inadequate of professional and experienced teachers, non utilization of research findings. Tackling those seven problems head-on will bring significant improvement in the development of engineering in Nigerian Institutions. Other various methods for enhancing engineering development in Nigerian institutions were stated.

Keywords: Engineering development; engineering; education; national development.

1. INTRODUCTION

Attending Technical Institutions, Colleges, Polytechnics, and Universities can help you get engineering abilities. Any nation's technological, economic, and societal progress is dependent on engineering. Engineering, according to Drucker [1], is a method or means of completing a task. In the 1940s, the first Nigerian engineer to receive official training was at the Yaba College of Technology, and in 1948, at the University of Ibadan. Nigerians were funded to study engineering at British universities. Today, the National University Commission has certified engineering faculties at federal, state, and private institutions across Nigeria (NUC). Engineering education, according to Danko [2], is a sort of education in which students learn about engineering procedures and knowledge in order to address engineering problems.

Again, as a subject of study, it encompasses the human ability to manipulate tools and techniques to shape and transform the physical world to fulfill human needs. Olunwa [3] stated that any nation wishing to achieve tremendous heights in national development must prioritize citizen education, particularly in science and engineering.

2. LITERATURE REVIEW

2.1 History of Engineering Education in Nigeria

According to Okojie [4], the first higher engineering education institute in Nigeria was created in 1932, when the Yaba College of Technology was founded. In 1977, the Nautical College of Nigeria, now the Maritime Academy of Nigeria Oron, and the College of Aviation Technology Kaduna founded two more monotechnics. Until the 1980s, when four Federal Universities of Technology were formed, Nigeria lacked a Federal University of Technology. Federal University of Technology Minna, Federal University of Technology Akure, Federal University of Technology Yola, and Federal University of Technology Owerri are the four universities involved. Nigeria is going in arithmetic progression in engineering education as a result of a negative impression of engineering. Before British engagement in Nigeria and the formation of official educational institutions in the late nineteenth and early twentieth centuries, education in Nigeria was mostly vocational and technological in nature,

according to Okoro [5]. One of education's main goals was to teach individuals to make a living as skilled producers of commodities and services. Young men learned the basics of a trade from their parents or from master artisans to whom they were apprenticed. Technology and Vocational Education ensured the production of commodities and services required for society's survival. Engineering education also ensured that agricultural, construction, medicine, and technical knowledge were passed down from generation to generation.

2.2 Main Problems of Engineering Development in Nigerian Institutions

According to Uwaifo [6], a country is said to have a setback in engineering educational development when engineering Institutions are unable to produce capital goods such as tractors, lathe machines, electrical and electronics devices, drilling machines, cars, iron and steel, train and other earth moving equipment, as well as being unable to exploit her natural resources without the assistance of foreigners who will normally provide the engineering skills and expertise. The issue that hinders effective technology development is summarized as follows:

2.2.1 Obsolete Curricula

The issue of curriculum design is the biggest roadblock to effective Engineering development in Nigeria. According to Onwuka [7], the Engineering education curriculum in Nigerian institutions is outdated, and it is necessary to redesign the Engineering education curriculum to meet the present needs of Nigeria's technological progress. The immediate technological demands are to focus more on practical research and to ensure that research findings are used by individuals, organizations, and the government. The Nigerian Engineering Regulation Council is responsible for accrediting engineering facilities at Nigerian institutions. Though the Nigerian Society of Engineers (NSE) and the Council for Regulation of Engineering in Nigeria (COREN) have been active in this field, but sadly, their efforts have not so far brought any major improvement to the state of engineering development in Nigeria. This is because of council's inability to involve Nigerian students in government projects, industrial projects and research collaboration between industries. Nigerian institutions should create curricula that will fully involve students with the

practical knowledge rather than engaged more on the theoretical knowledge.

2.2.2 Students Lack of Exposure to Industrial Practice

The primary traits of a competent engineer, according to Olorunfemi and Ashaolu [8] are technical skill, imagination, good teaching methods, industrial partnership, and strong judgment. Technical abilities, they claimed, are dependent on technical knowledge. Regrettably, engineering institutions have not been able to secure industry support for the Students Industrial Work Experience Scheme (SIWES). Industrial attachment positions are tough to come by for students. Students should be assisted in securing industrial attachment based on the area of specialization and such student should be monitored frequently and graded by the industries.

3. METHODOLOGY

The engineering faculty of ten federal universities and polytechnics were investigated. Hundred people including students and lecturers were interviewed on the possible causes of poor engineering development in Nigerian institutions. The causes as identified by the group include; Collaboration between engineering department and industries, poor teaching method, maximum utilization laboratories, non study of existing products and functions, lack of functional laboratories, inadequate of professional and experience teachers, non utilization of research findings, poor curriculum, lack of mini industries on campus, Non utilization of engineering budget, student self learning and mode of admission. The Pareto Analysis is used in Fig. 1 to explain the outcome of the investigations.

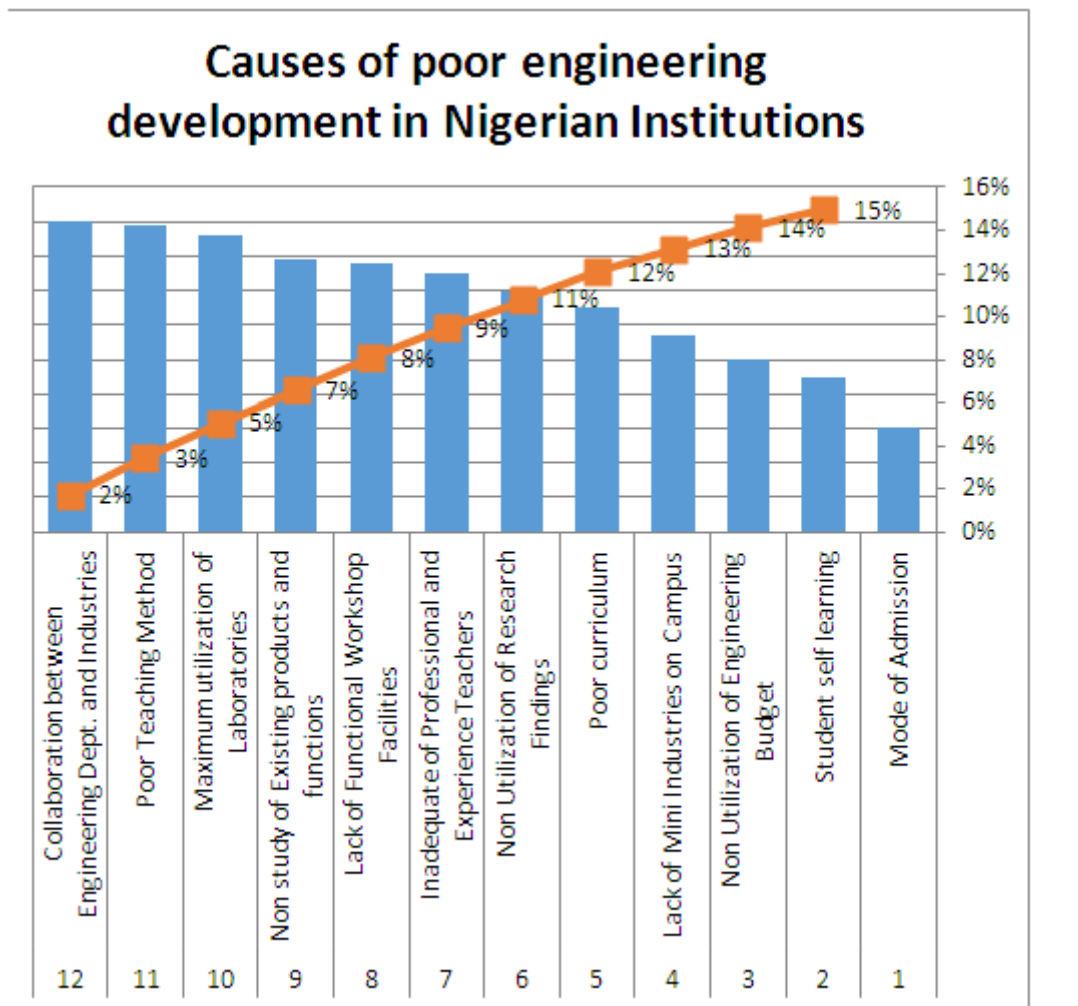


Fig. 1. Causes of poor engineering development in Nigerian institutions

4. FINDINGS

4.1 Poor Method of Teaching and Non-Utilization of Existing Laboratories

- (a) There is a problem of cohesion between theoretical learning and practical learning in Nigerian Institutions. Students hardly explore laboratories during their educational training. Most laboratories in Nigerian institutions are serving as monuments; students hardly carry out their practices in the laboratories. The curriculum is structured to have more theoretical learning than practical approach to a problem. Students memorize engineering components for the purpose of passing exams without even seeing such components and know how it works. Without, cohesion of theoretical and practical knowledge, it becomes difficult for students to practice engineering after their graduations.
- (b) In Nigerian institutions, lecture halls are separated from laboratories with no projectors and magnifying lenses. Projectors display videos of the application of the subject or courses to make it interactive. Lecture halls with projectors and small laboratories will be more interactive in teaching and learning as most of the courses will be displayed on the projectors and short practices carried out while the lecture is on-going. A computer installed in lecture halls with all the videos and practices on each course should be accessible by lecturers to display practical applications of the course while lectures are on-going.
- (c) Training of lecturers on the applications of courses will be the utmost priority of the faculty of Engineering and departments. A method of teaching should be adopted by the university after a thorough research on the most interactive way of teaching and learning in the institutions.

4.2 Problem of Staff Qualification and Experience

There is an insufficient percentage of senior lecturers with a PhD. The majority of engineering schools are inundated with teachers who lack a PhD or professional status. According to Alabe [9] the government should pay attention to

engineering programs by sponsoring training and retraining of engineering workers in order for engineering education to take its appropriate place in the country.

4.3 Inadequate Funding of Education

When the formal education sector, which drives technology, is underfunded, no nation can progress technologically. Okoro [10] claimed that the Federal Government's annual contribution to the education sector has been far below average over the years. According to Ekundayo [11] the Nigerian government has failed to meet the United Nations Educational, Scientific, and Cultural Organization (UNESCO) recommendation of 26 percent of the overall budget over the years. Adeyemi (2011); Oseni [12] Aina (2007) (2012). They claimed that education is still a low priority for the government, and that a perceived lack of finances available to educational institutions has resulted in diminishing library facilities and laboratories in recent years.

4.4 Lack of Functional Workshop

The nation's technical industry/firms, polytechnics, and universities, which are supposed to train skilled Technicians, Technologists, and Engineers, are presently brimming with obsolete and, in many cases, non-functional equipment. According to Sofolohan [13], the lack of workshops and laboratories at technological institutions makes it difficult to achieve the goals and objectives of the technology education curriculum. Due to space constraints, vital equipment for teaching technological topics is unable to be installed, which impedes its successful implementation and the student's level of achievement. In technological institutes, laboratory workshops are becoming obsolete. Usually, they aren't serving the function for which they were constructed. As a result of the inadequate nature of the learning environment, engineering advancement is hampered. Engineering Education Programs' workshops and laboratories should be of high quality, as the program's goal and strength is to provide rigorous training in a range of workshop situations. According to a survey of most Nigerian technical colleges, their workshop and laboratory facilities are insufficient, resulting in an unsuitable teaching and learning environment for both teachers and students. According to Asele [14], the low quality of instruction is due to the gross inadequacy of workshops and classrooms

for pedagogic activities, irregular power supply, and a lack of materials for students' psychomotor learning.

4.5 Infrastructural Challenges

According to Wodi [15], the educational system is a subsystem that is influenced by other problematic sectors (such as energy, financial institutions, politics, and other socioeconomic issues); it cannot work in isolation. Engineering education, for example, cannot function effectively without a reliable power supply to run the different laboratories, machinery, computers, telecommunications, thermodynamics, soil, water, and hydrology when they are accessible. In technological institutes, Internet services are insufficient.

4.6 Discouragement of Technical Education

Until the second half of the nineteenth century, colonial masters did not teach technical education in schools. The colonialists, according to Akaninwor [16] hindered further development of Nigerian technology since it posed a danger to the seamless marketing of commodities imported from Europe.

4.7 Poorly Equipped Educational Institutions

Universities, Polytechnics, and Technical Colleges in Nigeria, which are designed to educate competent engineers, technologists, and technicians, are today brimming with outmoded and non-functional equipment.

4.8 Colonial Education

General education and grammar were taught to Nigerians in order to produce clerks and translators, but no technical or vocational education was provided.

5. RESULTS

The result shows that solving the following seven major problems will significantly improve the engineering development in Nigerian Institutions according to Pareto Analysis of 20/80 rules. The following major problems include; Collaboration between engineering department and industries, poor teaching method, maximum utilization laboratories, non study of existing products and functions, lack of functional laboratories, inadequate of professional and experienced teachers, non utilization of research findings.

5.1 Solutions to Engineering Development in Nigerian Institutions

5.1.1 Use of engineering tools in training and learning

Nigerian technology can thrive if the government is able to offer the right framework to promote interest and support engineering training. Craftsmen, technicians, technologists, and engineers can all find work depending on their level of expertise. According to Ekhovbiye [17] engineering and technology students should conduct an industrial market survey. This is accomplished by replicating things already on the market for laboratory component examination and the construction of prototypes or similar items to be manufactured. In terms of the occupation being prepared in the school system, engineering should be repositioned and fashioned in the same way, with the same operations, using the same tools and machines. The training received by students in technical and vocational education should be the same as what they will encounter after graduation. Technical and vocational education, according to Abdurahaman [18] is a tool that fosters national development when the environment in which the trainee is prepared resembles the environment in which the trainee will be employed, which means the individual is trained directly and specifically in the thinking and manipulative habits required in the desired occupation. The plan entails establishing micro industries on college campuses where students may learn firsthand what they will encounter in the workplace after graduation.

Espionage by students is another way to improve technology. Ekhovbiye [17] claims that highly technical knowledge is guided by its owners, and that secrets can only be discovered through espionage. Technology spies are frequently deployed to gather top-secret information and company documents needed to produce such items, which they then pass on to their sponsor.

In addition, Umunadi [19] asserted that energy production and engineering curriculum innovation are critical to engineering progress. The existing technology curriculum should be updated with relevant technology that reflects the people's culture and meets Nigerians' technological demands and aspirations. According to Okereke [20] the government should institutionalize Educational framework and strategy for actualization of industrial growth in institutions in

order for engineering education to take its rightful place in the country. According to Lawal [21], the government should employ technical and vocational education as a vehicle for national development in order for Nigeria to advance technologically.

5.1.2 Lack of coordination between research institutes and industries

The majority of discoveries and inventions were never put into practice by the government, organizations, or businesses. Rather than developing our own technology, the government chooses to buy already developed technologies from other countries. This was due to the fact that manufacturing companies worked independently with little or no information exchange. According to Wodi [22] there were no clear aims for R&D and no understanding of the necessity of R&D merely for scientific purposes, and trained employees, engineers, scientists, technicians, and managerial personnel were in limited supply [23].

5.1.3 Overhauling of engineering curriculum and method of teaching

- (1) There should be cohesion between theoretical learning and practical learning in Nigerian Institutions. Students should explore laboratories during their educational training. The curriculum should be structured to have more practical learning than theoretical approach to a problem. Teaching should be focused on practical analysis of existing engineering products to enable students have in depth knowledge of theoretical and practical application of engineering components.
- (2) In Nigerian institutions, a single lecture halls should have a projector, magnifying lenses, installed computer and mini laboratories to display engineering applications of the taught course. Interactive learning is a way of motivating students to choose engineering as their career after graduation. A lecture halls with projectors and mini laboratories will be more interactive in teaching and learning as most of the courses will be displayed on the projectors and short practices carried out while the lecture is ongoing.
- (3) Training of lecturers on the applications of courses will be the utmost priority of the faculty of Engineering and departments. A

method of teaching should be adopted by the university after a thorough research on the most interactive way of teaching and learning in the university.

5.2 Study of Products and Functions

Series of engineering components should be studied by students and modification made to encourage innovation and creative among the engineering students. In doing so, students will gain in depth knowledge of products, components and applications, which will enhance their desire in pursuing engineering career after graduation.

5.3 Building Mini Industries and Manufacturing Firms in University Campuses

Government should finance the building of industries in campus and mandate government departments to use all the local products produced by engineering students. Funding of the mini companies by university and sourcing for contract from individual organizations and companies outside and within the state will encourage technological innovation and self reliance among engineering students after graduations.

6. CONCLUSION

Finally, Engineering Education in Nigeria must strive to contribute to the country's progress by preserving flexibility in educational programs and adjusting to technology advances on a continuous basis. Our programs must include extensive academic work that provides students with a strong theoretical and practical foundation, as well as research projects that apply modern scientific approaches to a practical approach. As a result, engineering education, should be prioritized, and engineers should be given the opportunity to receive suitable training and certification. There should be appropriate mechanisms in place for inter and intra-engineering transfer. Engineers, like their counterparts in other professions, should be assigned national engineering objectives, as well as repositioning Engineering Education for long-term industrial growth. This will be achievable if the government allocates adequate funding to education, adequate funding and execution of research discoveries, improved infrastructural facilities, engineering teacher training and retraining, and engineering institution

laboratories and libraries. Today, countries are rethinking their economic strategy in order to thrive rather than just survive in a global market. At the heart of this transformation is a growing consensus among government, business, and higher education leaders about the need to develop and attract a highly skilled and competitive workforce that contributes to a national economic infrastructure that is sustainable, renewable, and responsive to market shifts. The role of Engineering Education in Nigerian institutions is to achieve competitive advantage should be at the center of discussion. If the government is ready to fund engineering education and engineers are patriotic enough to put their knowledge to good use, Nigerian institution will develop in engineering innovations and compete globally.

7. RECOMMENDATIONS

A rethinking of Nigeria's traditional approach to engineering education, which includes forming partnerships between universities and industries to promote engineering knowledge transfer.

The following recommendations are made:

- The country's current engineering curriculum should be redesigned to fulfill Nigerians' technical needs.
- Appropriate funding and management of the Federal Ministry of Science and Technology's graduate internship and skills acquisition program.
- Policy decisions about Engineering Education and the nation's technical growth should be made by the nation's indigenous engineering family rather than politicians.
- To boost teaching and research, the government should offer modern technology laboratories to the nation's universities, polytechnics, and technical institutions. The Federal Government, through the National Universities Commission (NUC) and the National Board for Technical Education (NBTE), should engage in public education to raise awareness of the potential contribution of engineering education to national economic development.
- Lecturers should be trained and retrained on applications relating to the courses being

handled by the Faculty of Engineering and Engineering Department.

- Lecturers should be hired as part time from Industries to teach students at various institutions.

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COMPETING INTERESTS

Author has declared that no competing interests exist.

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