

INTENSIFYING THE STANDARD OF ENGINEERING EDUCATION THROUGH SKILL DEVELOPMENTS FOR PROMOTING INNOVATIONS IN NIGERIA

by

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Abstract

Engineering is a profession of highly talented few in a society. Engineering and Innovations are the main instruments to improve peoples' needs and culture; leading to the growth and development of a nation. One of the benefits of higher education is to provide society with an opportunity to reflect on social, economic, moral, cultural, and critical issues. Intensifying the standard of engineering education through skills development will help to increase the invention of new technologies that will improve the growth and development of our country, Nigeria. The study dwells on the problems that engineering graduates in Nigeria face which are compounded by government underfunding; resulting in poor equipment facilities, obsolete curriculum and weak university-industry partnerships. The various strategies adopted to intensify the standard of engineering education will contribute to national development through the dissemination of specialized knowledge and skills. This will yield better-trained engineers, improved training methods and facilities as well as reduction in the failure of infrastructure.

Keywords: Engineering Education, Innovation, Nigeria, Skills Development, Standard.

I. INTRODUCTION

Engineering Education is the act of teaching knowledge and principles to the professional practice of engineering. It includes an initial education and any advanced education and specializations that follow. Engineering education is usually accompanied by additional post-graduate examinations and supervised training as the requirements for obtaining a license to practice as a professional engineer.

The Primary aim of engineering education is to develop the skills and knowledge related to a core foundation across the areas of science and mathematics, as well as engineering analysis, design and practice (Philbin, 2020). It is the responsibility of teachers in various engineering departments to educate the students in becoming "ready to engineer"; which means that they possess deep knowledge of technical fundamentals and theories in engineering (Crawley et.al, 2014).

Skills development refers to the productive capabilities acquired through all levels of learning and training, occurring in formal, non-formal, informal, and on-the-job settings. This enables individuals to become fully independent and productively engaged in livelihoods, to have the opportunity to adapt their capabilities to meet the changing demands and opportunities of the economy and labor market; thereby leading to more growth and improvement in a nation. The acquisition of such capabilities depends on many factors, including a quality lifelong learning system and a supportive learning environment. This study tends to explain how to intensify the standard of engineering education through skills development for promoting innovations in Nigeria. The problems of Engineering Education in Nigeria include the following (Kehdinga, 2020):

ICT Facilities

Most technical education departments in Nigeria Universities do not have laboratories or workshop space let alone usable equipment and facilities and where they exist, they are grossly inadequate, as the laboratories only have the items or equipment that were provided when the d who departments were established. The end

results that are ill-prepared graduates and lack the tools for driving the technological and socio-economic development of the nation. There is also a shortage of ICT facilities for the training of students. The high cost of computer and teaching aids ownership is a major constraint to the acquisition of the items Uwaifo (2009).

Staff Training and Retention

Uwaifo (2009) opines that usually, local training within the nation is cheaper but more strenuous because of inadequate facilities, literature and distractions arising from the need to meet the necessary demands. Overseas training requires a lot of foreign exchange, but the enabling environment exists to achieve success in record time. However, it has become increasingly difficult to get the trainees back to their respective countries after the completion of their studies.

Academic Corruption and Fraud

While corruption is a covert activity that is difficult to measure, Nigeria scores low on the global “Corruption Perceptions Index” published by the organization Transparency International. The 2018 report ranks Nigeria 27th out of 180 countries. Nigeria’s education sector is particularly vulnerable to corruption. Osipian (2013) noted that limited access to education no doubt contributed to the use of bribes and personal connections to gain coveted places at universities, with some admissions officials reportedly working with agents to obtain bribes from students. In 2013, Transparency International reported that about 30 percent of Nigerians surveyed said they had paid a bribe in the education sector. According to WENR, the West African Examinations Council (WAEC) has deemed it necessary to start using biometric fingerprint technology when admitting students to SSC examinations. In 2015, WAEC stated that Nigeria had the highest number of cheating incidents of all five countries in which the Council operates. the following year, WAEC ceased recognizing 113 Nigerian secondary schools implicated in examination malpractice and annulled the results of some 30, 654 candidates who sat for the 2012 SSCE exams. The extent of fraud in university applications has caused the Council to develop an elaborate

scratch-card system that utilizes an online pin-code verification method to verify the authenticity of exam results. Nigeria is also home to a substantial number of diploma mills and institutions of dubious quality. The prevalence of fraud is apparent in credential reviews at WES; forged Nigerian degrees and other credentials are, by comparison to documents received from many other countries, relatively common. For this reason, WES goes to great lengths to verify the authenticity of academic documents from Nigeria.

Obsolete Curricular and Inadequate Infrastructure

According to Afe Babalola former Pro-Chancellor and Chairman of Council of the University of Lagos between 2000 and 2007 and founder of Afe Babalola University, Nigeria’s entire engineering curriculum remains what was bequeathed to us at independence without any effort to modify the colonial curriculum. Equally distressing is the dilapidation of laboratories and the lack of, or obsolete equipment for training in Nigeria stemming from no disbursement of funds, mismanagement or diversion of funds.

Poor Quality of Teaching Staff and Paucity of Requisite Experience

Many universities are fraught with lecturers without Ph.Ds. The NUC should make it mandatory that unless a candidate has a PhD and the requisite professional qualifications, he/she cannot rise beyond certain specified limits within the profession.

Lack of Coordination between Research Institutes and Production Enterprise

In advanced countries, there is an unbreakable nexus between universities and industrial concern. This is largely because the academia works hand-in-hand with the industries in that the universities do the research while the industries translate the research findings into visible machines and services for the use of all. In Nigeria there is a gap between the academia and the industries, inventions and discoveries are rarely translated into goods and services. This lack of symbiosis is one the reasons why truly skilled engineering workers, engineers, scientists,

technicians, and managerial personnel will continually be in short supply (Wodi, 2012).

Shortage of Skilled Engineers to Train New Ones and Accreditation Inconsistencies

Shortage of senior engineers meant that they were seriously overworked and had little time to train junior engineers. This situation created a vicious circle: “herein lies a conundrum: it is only possible to develop capacity if there is sufficient capacity to develop this capacity” (Lawless, 2005). Accreditation exercise is an exercise that ought to expose the true status and quality of an Engineering program. Often times Engineering departments pretend to have facilities needed to run engineering program. They go as far as hiring equipment, manpower and office space to give an impression that standards are kept. This covers the actual need for such equipment.

Short Duration of Project Design and Participation

Intense academic project work is always given a serious look at the last semester of the final year which is not enough time to initiate and execute a well thought out and truly innovative project. This often ends in rushed design projects which is often unoriginal and error prone (Azubuike, 2016).

Underfunding

One of the most pressing problems for Nigeria’s higher education system remains the severe underfunding of its universities. The Punch (2019) states that government which is responsible for sustaining public universities, has over the past decade not significantly increased the share of the government budget dedicated to education, despite exploding student numbers. Between 2003 and 2013 education spending fluctuated from 8.21 percent of the total budget in 2003 to 6.42 percent in 2009 and to 8.7 percent in 2013. In 2014, the government significantly increased education spending to 10.7 percent of the total budget. The country budgeted N 398 billion on education in 2017, in 2018, the president initially proposed N496.9 billion, but it was later raised to about N 605.8 billion by the National Assembly (Kehdinga, 2020).

NYSC Posting of Engineering Graduates to Secondary and Primary Schools

National Youth Service Corps is a Nigerian federal Government Organization in charge of organizing one-year compulsory service to the nation by all graduates below the age of 30 years. There is arguably Very little to be gained in terms of practical experience by engineering graduates from teaching in secondary and primary schools. Azubuike (2016) opines that a nation desirous of industrialization should not be relegating its young engineering manpower to classrooms but to industries, ministries, private engineering firms to gain practical experience and hone their skills.

II. LITERATURE REVIEW

Generally, the main aim of engineering education is to prepare students for the workplace which is influenced by the broader context, as well as technological drivers. Teaching students with regular curriculum will no longer be effective until they have additional skills development with new tools to compete in the industry as per the fast technology development. Studies show that effective, sustainable approaches to workforce development and employment must improve a combination of skills for employability of individuals and a sustainable system for improved private-sector competitiveness.

Considering our country Nigeria, there is severe shortage of skilled and experienced engineers; which is a substantive obstacle to achieving almost all the development goals. Also, we have notable levels of unemployment among engineering graduates because engineers are graduating without the necessary skills and experience to be employable. Other problems include: low level of public investment in engineering infrastructures and facilities, absence of regulatory laws to compel foreign companies to effect transfer of knowledge to local engineers, limited laboratory equipment, scant internship experience and poor salaries for professional engineers (Kehdinga, 2020).

Generally, technical innovation often manifests itself through the engineering process; when the problem being solved is of a technical or scientific nature. Innovation is the practical

implementation of ideas that result in the introduction of new goods and services. The problems encountered by engineering graduates, which led to their inability to excel well in their various specializations can be controlled by promoting the use of local manufactured goods with the help innovations.

III. RESEARCH ANALYSES

There is need to discuss the various strategies in which the standard of engineering education can be intensified through skills development can help in promoting innovations in Nigeria. The immediate future of engineering education all over the world is changing, there is a movement towards a more practical based learning approach, teamwork development, open-ended problem solving, experimental learning and active research. Most of these cannot be found in the educational system in Nigeria. To meet up with the demand of the industry and to be able to compete favorably internationally, a number of changes have to be implemented to improve the quality of engineering education in Nigeria (Kehdinga, 2020). There is, first of all, an urgent need to upgrade the infrastructure and laboratories of the existing institutions. Publicly funded African tertiary education institutions have for several decades suffered from lack of investment and maintenance and this has led to a deterioration of their infrastructure. The curricula of engineering courses also need to be revised. Most of them have been copied from universities in Europe or the United States, have not been updated, and are not necessarily relevant to African situations (Goolam, 2014).

Goolam (2014) posits that teaching methodology needs to be improved as well. Because of large student numbers, the subjects are mostly taught by the magisterial mode with hardly any opportunity for the students to discuss and interact with the lecturer or among themselves. It has been suggested that the Problem Based Learning approach in engineering education could result in noticeable improvement in the students' ability to solve problems and, in addition, help them acquire certain "soft" skills such as good communication, team spirit, creativity and adaptability- all key requirements for graduate employability.

Goolam (2014) opined that closely linked to improving teaching methodology is the need for pedagogical training of engineering lecturers. Many of whom, although they may have a doctorate degree in their field, are ill-equipped to help students to learn using appropriate pedagogical techniques. All the studies highlight the importance of strong university-industry linkages. These linkages can take different forms: involving industry in advising on curricula reform; inviting representatives from industry to serve on the Faculty of Engineering board or even on the higher administrative bodies of the institution; and using professionals from business and industry as adjunct professors.

Bridging the skills gap and building the right talent for Africa's future cannot be left to the government alone. The private sector needs to adopt a more collaborative and concerted approach to help drive initiatives that will build capacity at the scale and speed required.

The followings are the various strategies that can be adopted to intensify standard of engineering education through skills development for promoting innovation in Nigeria.

Funding

The extensive restructuring required by the system requires a level of continuous funding that cannot be left to the government solely. The Nigerian government has continuously under budgeted and underfunded the education sector against the better advice of UNESCO and concerned experts as observed above. Consequently, there is an urgent need for industries and organizations to chip in as well if the transformation agenda is to succeed.

Collaboration

There is an urgent need for collaboration between engineering faculties and industries to achieve industry-based training which is vital for the purposes of stimulating and sustaining the economy through hiring of students, sponsorship of research and grants. Stakeholders of industries should also be made advisory board members in a number of universities. Industries should suggest and sponsor training for graduate engineers and technologists where emphasis will be placed on marrying classroom training with industrial practical requirements.

Skill development, Continuous evaluation and modification of the curriculum

Skill development and acquisition centers should be established in different parts of the country to strengthen the engineering profession. To meet current and future technological demands and accommodate the rapid technological changes now being experienced the curricula has to be constantly updated (Oloyede, 2017). Teamwork should also be encouraged to tackle complex processes systems engineers would have to conceive, create and operate. Curricula should be reviewed and harmonized to ensure quality standard is maintained across board in the engineering syllabus countrywide.

Well-equipped research institutions

Wodi (2012) stressed the importance of the development of high-quality research institutions to improve capacity for technological innovation in engineering. He suggested that one approach to resource constraints would be for countries to pool resources to create regional institutions. The technological innovation facilitated by such institutions would generate opportunities for economic growth, and would facilitate the development of African solutions to African challenges, such as the need for affordable, decentralized, renewable energy to meet the dual challenges of climate change and modern energy provision in rural areas.

1. Adoption of result or outcome-based learning methods and internships

There is a need for the interaction and reinforcement of the essential fundamentals an engineer would need when on the field. Africa's educational system must adapt to the practical-based teaching methodology now being practiced in developed countries. Research must be done to identify and resolve real life problems and scenarios that are faced by tech industries and everywhere technological solution are needed. Internships are offered as temporary positions by engineering companies. They provide a way for companies to recruit and get familiar with individual students as potential full-time employment after graduation. Students who have practical engineering experience are

considered to be more attractive to engineering employers.

2. Innovative approach to teaching and learning

Quality assurance test results reveal 96% of respondents who studied engineering abroad are satisfied with the quality of education they received, while only 14% their Nigeria-trained counterparts were satisfied with the quality of education they received in Nigeria; necessitating the need for a thorough over haulage of the syllabus and entire teaching system (Oloyede (2017).

3. Degree specialization and an option to spend a full year in the industry

The present 5-year engineering learning structure without specialization will not meet the need of future engineers. There is a need to breakdown the areas of specialization and reduce the number of years spent in the classroom to allow for a full year to be spent as part of the degree in the industry (Oloyede 2017).

Module Structure and Delivery

The module is delivered over 13 weeks as part of a full semester in the academic year. This includes lectures and combined tutorial sessions for weeks 1-10, followed by student presentations in weeks 11-12 and feedback is provided to students in week 13. The module's overall aim is to ensure that engineering students from M.Sc. and final year M.Eng. courses undertake research and project work in both a professional and ethical manner, and are able to effectively communicate research proposals. Additionally, students are provided with support to enhance their technical and analytical background across a range of areas related to the professional engineering discipline, including project management, risk management, sustainability, engineering design, systems engineering and lean engineering. Consequently, the lectures include engineering content and theory across these areas, which provide students with the necessary background to enable the planning for their masters' level research project. The diagram in figure 1 provides details on the main components of the module and the content covered in the lectures.

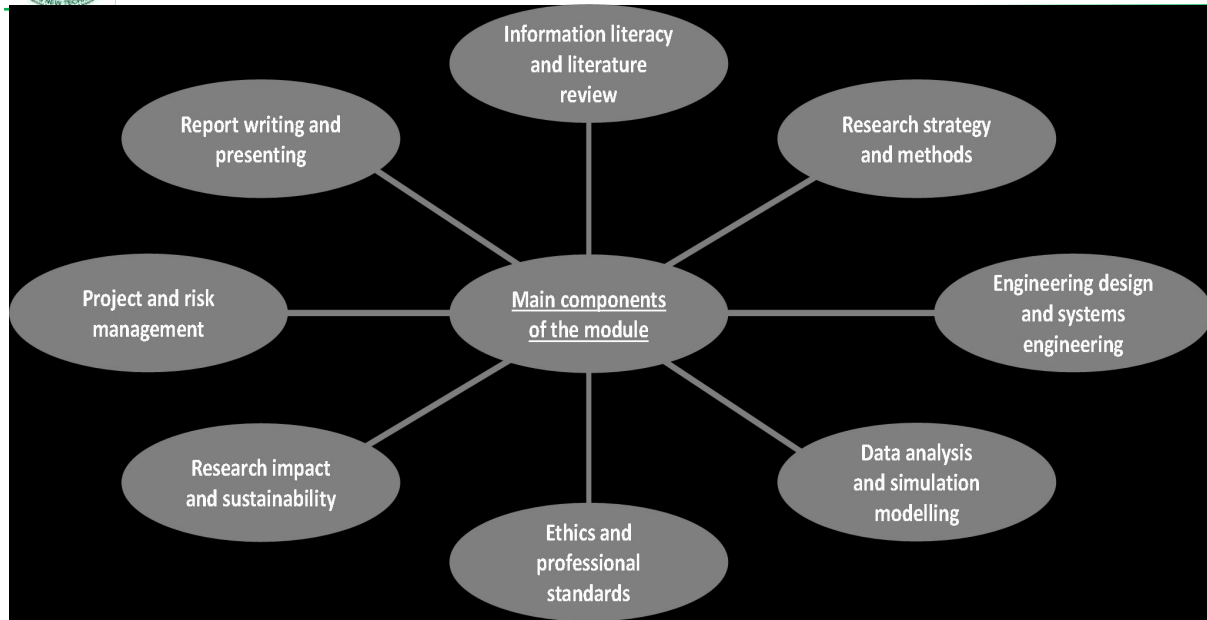


Figure 1: Main Components of the Module

IV. RESULTS AND DISCUSSION

The study observed a very weak link between the school training programme, the curricula and the industrial activities. The curricula are not structured to meet the changing trend in engineering education especially in the areas of electronics engineering, ICT Skills, information technology, computer and control engineering, etc. The applied technologies in major multi-national companies in Nigeria lack strong local content and indigenous participation. The observed teaching methods have not succeeded in impacting positively on practical engineering training in schools. These training methods include traditional lecture delivery based on strong theoretical background, students industrial work experience scheme (SIWES). Necessary modifications of these methods are very imperative to meet the present industrial challenges. Most of the foreign companies in Nigeria source their fundamental and scientific research expertise and facilities from their home countries with little or no input from the local scientific research. The major institutions

training facilities are obsolete and inadequate making practical training difficult to meet the modern trend. The industries in Nigeria do not have much stake in training, funding and curricula development of training institutions, which are the hallmark of industrialization in the developed world (Oduola, 2002). There is no direct relationship and interaction between the industries and institutions in research activities and manufacturing. The identified poor elementary foundation in science subjects affects the students learning approach to engineering principles and applications. The incessant violence in various campuses has been connected to so much idle time resulting into low quality of training since the workload do not reflect in -depth practical training. The practical class period on the timetable is spent on unfruitful exercise. Student learning becomes inefficient when the basic principles are not understood thereby leading to poor motivation (Kolani, et.al, 2006). The figure 2 shows the diagram of Educational System.

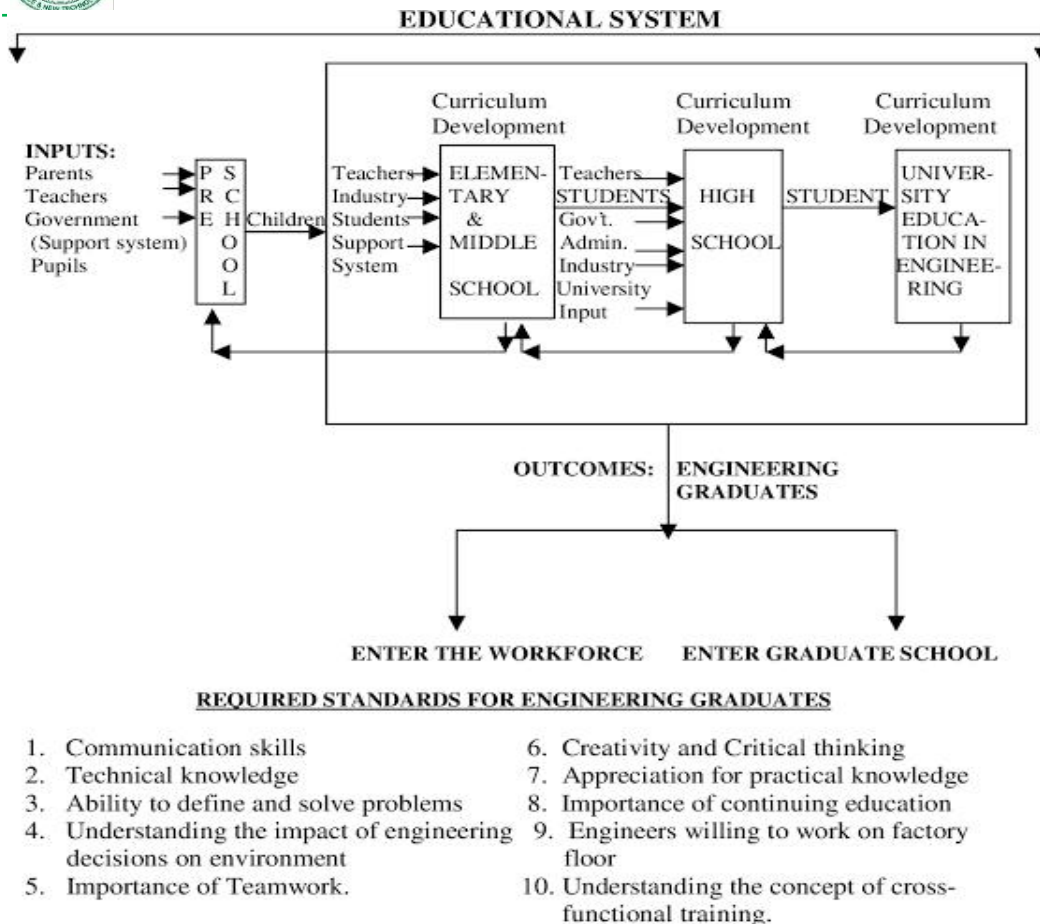


Figure 2: Educational System

V. CONCLUSION

Engineering is one of the areas requiring the most attention especially as it serves a key role of providing highly skilled personnel for technological and industrial development. The actualization of an educational overhaul, however, faces a number of challenges earlier identified; these challenges need to be addressed jointly by governments, educational institutions, representatives of industry and the private sector. It is imperative the right decisions are made, supported by generous funding, controls, facilities and favorable policies. Education and training, especially in STEM subjects are necessary tools for the continent to unlock its potential.

This study concludes that the training of engineering graduates is incomplete, and suggests the establishment of a single body to administer mandatory post-graduate exams as a

pre-requisite for receiving the engineering degree certificate on completion of their degree programme, which will be a prerequisite for employment as an engineer. Also, a centralized accreditation body should be established that carries out regular quality control checks on engineering facilities and faculties to ensure they meet the set standard. For economic development and technological advancement to happen in Nigeria, the problems confronting engineering education must be recognized and fought vigorously. A comprehensive reform plan and modern ICT support is the necessary first step on the road to economic recovery and global competitiveness. Adoption of best practices, on-the-job training and curriculum updated to reflect industrial requirements are also imperative.

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