Enhancing Teaching and Learning of Electrical Power Engineering in the Nigerian Tertiary Institutions

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***Abstract*—The paper carried out a review of relevant literature and observed that Nigerian graduates in electrical power engineering are strongly affected by unwanted factors such as inadequate provision for the massive admission of students, inadequate period for students' practical, shortage of academic staff, lack of collaboration between schools and the industries, all of which constitute variables that are potentially controllable. Four gaps were identified between the industries as the major problems arising from the unwanted condition. It is concluded that electrical power engineering education can only be enhanced through provision of adequate facilities in our institutions, adequate teaching staff,continuous professional development program, adequate time for students' practical and improve relationship between educational institutions and industries. In addition, the paper recommended that the curriculum should be modified to include a combination of the traditional teaching and inquiry methods of teaching through the use of virtual laboratory.**

***Index Terms*—virtual laboratory, inquiry teaching method, traditional method of teaching**

I. Introduction

Teaching is planned for the purpose of supporting learning, and therefore it must take into account some principles of human learning specifically under the condition it occurs. [1] opined that, teacher cannot impart knowledge but rather facilitate learning through the provision of conducive environment that would allow the learner attain perception.

The traditional method of instruction to students is prevalent in Higher Education Institutions (HEIs) in Nigeria.This traditional method is textbook-based instruction and practical, hands-on lessons. The textbook-based lessons are often complemented with practical lessons in which students can build electrical circuits and carry out measurements. These practical lessons can assist students in developing skills and experience when working with real equipment. However, practical lessons also have limitations that in general keep students from developing a proper conceptual understanding, for example, in practical lessons students tend to focus on making their circuits work rather than on trying to understand the causal relations between variables and outcomes [2]. The old learning and teaching strategies are no longer suitable for the students. What students should learn are not only the knowledge but more useful skills, such as lifelong learning skills, problem solving skills, critical-thinking skills, self-directed learning, cooperation and communication skills [3].

Better training of electrical engineering students through systematic reform of teaching methods is the mainfocus of this paper. Any attempt to improveteaching and learning may have to address two fundamental issues: Firstly, the full set of knowledge, skills, and attitudes that these students should possess as they leave at the institutions and the level ofproficiency required as contained in the curriculum. The Second issue is how todo better on guaranteeing that these students learn theskills.Quality teaching is the essential ingredient that can guarantee student learning skills and conceptual understanding as supported by [4] who emphasized that the quality of teachers is the single most important factor affecting students achievement, and that countries which score highly on international test have multiple policies in place to ensure that the teachers they employ are as effective as possible in the use of e-learning materials and must be highly qualified.

The study is going to be focus on institutions of Higher learning in Nigeria.

II. Power Engineering Education under the National Policy on Education

The National Policy on Education defines the institutions where tertiary education is offered to include Universities, Colleges of Education and Polytechnics. Electrical engineering programmes run at the universities and the Polytechnics are regulated by the Government through the National University Commission (NUC) and the National Board for Technical Education (NBTE) respectively.

The Universities produce Electrical engineers at degrees and post graduate levels, while the Polytechnics produce Electrical Technologists at the Higher National Diploma levels.They also graduate Electrical Technicians

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at the lower (National Diploma) levels. In the University, electrical engineering is a straight five year course distributed through ten semesters. The 10th is carried out of school on Industrial training attachment. The Polytechnics ran a 2- year (4semester) programme with 3 months Industrial training between the second and the third semester for the National diploma. At the Higher National Diploma (HND), the programme is also a 2-year (4 semester programme) but there is prerequisite that candidates should have done a compulsory one year industrial service.

Bachelor's degree in electrical engineering programme that is run at the Nigerian universities operates academic curricula that are tailored along the stipulations contained in the National University Commission (NUC), Benchmark Minimum Academic Standards(BMAS) and as required by the Council for the Regulation of Engineering in Nigeria, (COREN). According to the BMAS document, the general philosophy is to produce graduates with high academic standard and adequate practical background for self-employment, as well as being of immediate value to industry and the community in general [5].

The Federal government in an attempt to improve the quality of power engineering graduates and prepare grounds for the privatization of the power sector established the National Power Training Institute of Nigeria (NAPTIN). It was established on 23rd March 2009 and commenced full operation in September, 2009. The primary purpose for its establishment is to provide training for University/Polytechnic graduates power sector personnel and coordinate training activities in the sector, under its Graduates Skills Development Program.

These entire programs operate within the framework of the National Policy on Education (NPE). The NPE was hailed as one of the best educational policies ever produced by Nigeria, but the present general opinion is that NPE implementation is haphazard, lacking innovative planning, devoid of political will and under-nourished through sustainable financial support and accountability in resources management [6]. Nigerian universities and other tertiary institutions are expected to produce the right type of manpower in quantity and quality for national development only when the NPE is fully implemented. [6] Observed that if the Nigerian education is to meet with the needs of the 21st century it must be revolutionized. Nigeria cannot meet its needs by chance, but by changing the way things are done.

III. Products of Power Engineering Education

The general objective of technical education as contained in the Nigerian education policy is to prepare learners for independent living. The need to attain this objective is more critical today, in the face of economic, environmental and social challenges [7], he further suggests that Nigerian children of today can meet future challenges if their schooling and informal learning activities prepare them for the adult roles as citizens, employees, managers, parents, volunteers and entrepreneurs. For these children to achieve in power engineering their full potential as adults, they need to develop a range of skills and knowledge that would facilitate mastery in electrical power engineering, under the guidance of the teacher. In an effort to improve the quality of power engineering graduates and pave way for the privatization of the power industry federal government established the National power training institute of Nigeria (NAPTIN).

Unfortunately, the performance of Power engineering graduates is observed to be inadequate. The establishment of NAPTIN by the government is a pointer to the failure of these graduates to fit into the power sector directly. This is supported by [8] who conducted survey among engineering University graduates in Nigeria. The study revealed that: (a) graduates are poorly trained and unproductive on the job; (b) their skills have deteriorated over the past decade; and shortcomings are particularly severe in oral and written communication, and in applied technical skills.

[8] Further presented a conceptual model which describes the problems facing Engineering education from a perspective of gaps between industry and higher education institutions (HEIs).

The gaps were defined as;

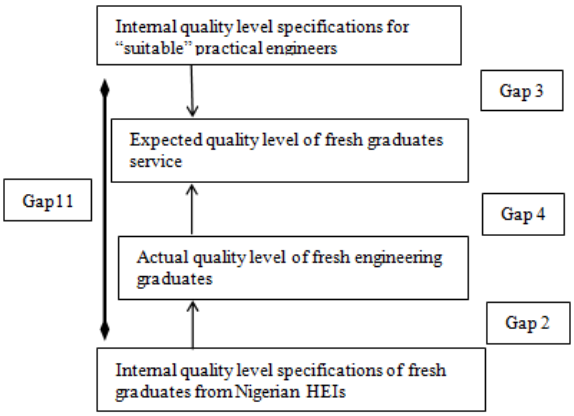

Figure 1. Conceptual model of major communication gaps

Gap 1: Nigerian universities hardly know what the industries actually want.

Gap 2: University graduates fall short of acquiring university specified quality standards.

Gap 3: Dissonance exists between industrial expectations and reality.

Gap 4: Promises do not match delivery.

Ideally, the learning outcomes of students in this program should be set in a way that reflects the interests of all stakeholder groups, namely the society, students, industry and university. It may not be out of point if one observes here that recent establishment of NAPTIN by the Federal government of Nigeria is in realization of the fact that the power engineering graduates are not properly equipped with the necessary skills to fit directly into the power sector.

IV. What Went Wrong?

So many factors have been associated with the inability of the Nigerian institutions of higher learning to

produce graduates with knowledge and skills necessary for the 21st century work place. These according to [9] are:

1) Unplanned expansion, leading to a very rapid increase in the number of institutions from 1995 onwards;
2) Unnecessary duplication of courses and programmes;
3) Deterioration of physical facilities;
4) Near absolute lack of teaching- learning and research facilities;
5) Overstretching of teaching, research and managerial capacities;
6) Massive number of student;
7) An upsurge of various forms of social ills: examination malpractices, falsification of certificate, cultism and commercialization of the entire system;
8) Universities scuttling for avenues for extra income, often-through approaches that tend to rubbish the cherished traditions of the academia;
9) Internal and external personal hemorrhage among the intellectual class; and
10) Loss of faith in the entire system.

In another study, [10] reported that our Universities are short staffed. Statistics from NUC showed that only 16, 856 (23%) out of 72, 705 workers in the Federal universities system are academic staff. Based on NUC minimum academic standards regarding teachers/students ratio, the federal Universities require about 21, 912 teachers, this means that, there is a deficit of 5, 056 teachers in the country, even the NPE [4] belief that no system of education can rise above the quality of its teachers.

V. Proposed Reform to Enhance Power Engineering Education in Nigeria

From the above discourse it becomes clear that graduates of power engineering are poorly trained, unproductive on the job and graduates skills have deteriorated [9]. It is also understood that communication skills among these graduates require certain attention. This paper uses holistic approach to address this problem. One of the ways is to integrate the traditional teaching method with an inquiry teaching method within a virtual laboratory andfor the government to provide all that is required in terms of man and material resources necessary for effective training.

Traditionally, laboratory experiment has been a central component of science instruction since the early 20th century [11]. It has been used to teach experimental methods and techniques that clarify and or validate existing scientific principles and theories and has typically been considered expository in nature. Expository environment utilizes rote procedures which inhibit students from forming a genuine understanding of the connections between the data they collect and the theories the data describe [12].

Today, in electrical and electronics engineering laboratory, technology has reached a threshold where virtual or simulated (learner-centered) approaches can formidably meet or exceed the learning outcomes of expository (teacher-centered) approaches. And research suggests that simulated laboratories can dramatically impact learning in positive ways [13].

In a study conducted by [11], the findings revealed that student's results, using simulated laboratories outperformed students who used expository laboratories. This suggests that there were learning differences between the two environments. Findings also showed that students can control the time, location, and pace of their interaction with the simulation than the expository. It also showed that the simulated laboratories can serve as a legitimate teaching aid and a 'bridge' to the "hands-on" laboratory and should be an integrated part of every professional course, not to substitute a practical laboratory.

In another study conducted at University of Twente, the Netherlands [2] suggest that vocational education teachers on electricity seeking to stimulate conceptual understanding should supplement or perhaps interweave their traditional approach with inquiry learning within a virtual lab. This study did not replace practical lessons with inquiry learning in a real laboratory, butprovides students with additional experimentation experience in a virtual lab. Handling real equipment in real laboratories is also necessary for these students, because they will work with similar equipment in their professional lives.

The observation that the acquisition of conceptual understanding in traditional vocational curricula is problematic suggests that this combination of textbook-based instruction and practical lessons does not provide students with optimal conditions for acquiring proper conceptual understanding of electricity and electrical circuits. If traditional vocational instruction is less than suitable for fostering the acquisition of conceptual understanding, adding learning opportunities that foster conceptual understanding to the curriculum seems a logical next step [2]. It is against this background that this study suggests the use of simulations e-learning infrastructures for teaching and learning in Higher Education Institutionsin addition to the traditional teaching.

VI. Conclusion

In the present time, survival of education in Nigeria depends on effective use of new teaching and learning technologies for instruction. Therefore best possible means to enhance the teaching and learning of electrical engineering courses is to interweave the traditional method of teaching with inquiry method of teaching that involves the use of computer simulation packages.

A. Recommendations

The use of Virtual laboratories should be incorporated in the curriculum and must be provided in each school.This will include various simulation packages such as multisim, Pspice, Verilog, VHDL etc.

- There should be continuous professional development programs for power engineering

teachers to update the knowledge and skills on the use of simulation software packages and acquaint them with techniques of assisting learners to optimize the acquisition functional skills and conceptual understanding.

- Massive recruitment and retention of qualified staff to meet up the benchmark student ratio of 1:15 staff/student ration.
- There should be collaboration between the institutions of higher learning and the industries.
- Machinery should be put in place to ensure systematic planned expansion, to match growth in higher education with the evolution of national resources and management capacity.
- Provisions of the National policy on education must be carefully and consistently implemented to achieve the desired results.

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