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Cognitive Skills Required by Electrical Engineering Graduates of Universities for Effective Performance in Industries of Kano and Kaduna States, Nigeria

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ABSTRACT

Motivation: Electrical engineering programmes in our institutions have the burden of training efficient, competent and skilled graduates to understand, plan, design, operate and maintain the various electrical processes and systems involved in the modern technology. However, recent advancements in electrical engineering that are so important for our industrial development are not captured in the current electrical engineering programme of study.

Purpose: This study therefore, aims to identify recent advances in cognitive skills required by electrical engineering graduates of universities for effective performance in industries of Kano and Kaduna States, Nigeria.

Methodology: The researchers employed descriptive research design for the study. The target population was 669 subjects, and simple random sampling was used to select 49 lecturers, and 161 graduates, while purposive sampling was used to select 106 engineers, making 316 respondents. A 69-item structured questionnaire developed by researcher was used in collecting data from the respondents.

Findings: The findings of the study revealed that 11 out of 13 cognitive skills in improvement in electrical power quality are required, 11 out of 12 skills in advances in electrical motor torque control are required, 13 out of 14 skills in modern patents in ultra wide band antenna are required, 13 out of 14 skills in the use of modern wireless sensors are required, and 6 out of 15 skills in patents on corrosion control and leak detection schemes in boilers are required.

Research limitation/Implication: The authors limit the scope of the study to five areas/components of electrical/electronic engineering. Also, the study was limited to only eligible respondent in 2 states in Nigeria. As such, conclusions derived using quantitative approach from the respondents relies on the genuineness of the information provided by them.

Practical Implication: The findings provide the electrical engineering programmes in the Nigerian universities with a basis for programme evaluation and improvement, and National University Commission (NUC) with a basis to new criteria for programme accreditation.

Keywords: Cognitive Skill, Electrical power quality, Electric motor torque control, Wireless sensors

1. Background of the Study

The concept of skill and skill development happens to be the widely intense, deliberated construct in vocational/technical education. The importance of skill has been driven in part by comprehensive transformations in society and the working world, in addition to the improved globalisation, the dawn of knowledge-based society and the basic reorganisation of job (Rauner and Mclean, 2009). Cognitive skill is one of the principal areas of occupational or employability competences which form the basis of developing programme of study in engineering and technology education (Olaitan, 1999). Other areas include operational skills and occupational ethics. Cognitive skills in electrical engineering are the mental capabilities needed to successfully learn academic subjects. Basic cognitive skills must function well to efficiently enable an electrical engineering graduate to read, think, prioritize, understand, plan, remember and solve problems (Kofoworola, 2003). Selecting and applying appropriate knowledge of electrical principles to models and analyzing systems is an example of cognitive skill. Cognitive skills give electrical engineering graduates an understanding of the fundamental concepts of electricity and magnetism, and the theory and operation underpinning electrical machines. It also develops their concepts of signal measurement and instrumentation, and applying mathematical methods to electrical/electronic models. Cognitive skills are inevitably related to psychomotor skills in that they are learnt first theoretically before being applied practically in the workshop, laboratory or workplace.

These cognitive skills are provided to electrical engineering students in the university through the programme. The objectives of electrical engineering programme as contained in the National University Commission (NUC) (2007) documents are:

- Provide learning environment that leads to the production of high caliber manpower in the area of Electrical Engineering and technology;

- Carry out relevant research in Electrical Engineering and technology for the total advancement of our society and to render such other services to the community as may be relevant from time to time;
- Train Electrical Engineers capable of meeting the challenges for the sustained technological development in Nigeria;
- Provide educational training and skills necessary for understanding, planning, designing, operating and maintaining the various processes and systems involved in modern technology;
- Provide opportunity for personal maturity and intellectual growth, for the attainment of professional competence for the development of social responsibility; and
- Provide skilled Electrical Engineering manpower which is regarded as a principal factor for economic development and the prosperity of any nation

Successful attainment of the above mentioned objectives of electrical engineering programme as outlined by N.U.C (2007) leads to the graduation of competent electrical engineering personnel that will serve effectively in industries. Such electrical engineers according to Whitaker (1999) should be able to specify, design, construct, analyze and test electrical components and systems. In support of this view Olatoyibo and Alawode (2005) reported that these electrical engineering personnel work with systems that generate, transmit, distribute, store, control or use electromagnetic energy or electrically coded information. It can be inferred therefore, that electrical engineering personnel are engaged in the development, production, or utilization of an extensive type of electrical and electronics devices, circuits, systems, products and equipment. Electrical engineering programme is one of the sources through which industries can get their steady supply of trained manpower. Trained electrical engineers equipped with key cognitive skills are inevitable for the sustained development of industries. Even with abundant material resources, the nation’s industrial sector cannot perform effectively without skilled electrical engineering graduates. It is generally believed that the acquisition of requisite cognitive skills by these graduates is a means of increasing the productive power of a nation’s industrial sector (Atsumbe, 2002). Moreover, a periodically reviewed and improved programmme of study in electrical engineering is needed in order to catch up with the present day realities, which in turn will empower graduates with new cognitive skills that could put the economy on the path of growth and development in line with the objectives of the programme.

More importantly, electrical engineering graduates are always in constant need to update their knowledge, skills, and abilities in tune with the recent advances in electrical engineering, because the industries are dynamic organizations whose ever-changing needs of technology, machines, materials and products cannot be over-emphasized. Currently advances in electrical engineering include amongst others: improvement in electrical power quality, advances in electrical engineering materials, improvement in motor torque control, recent advances in telecommunication, and sensing and measurement. These advances are undoubtedly critical to the industries vis –a-vis their growth and development.

The structure of electrical engineering encompasses research, development, design and operation of electrical and electronic systems and their components. This program leads to a Bachelor of engineering in electrical engineering. The basic components of electrical engineering programme are: Basic sciences, Mathematics, Modeling and Programming, Electrical Power, Electronics/Mechatronics, Signals and Communications, Control, Engineering Management, Engineering Project and industrial training. These components of electrical engineering are directly related to the objectives of the programme.

Many electrical engineering graduates are produced over the years from the Nigerian universities, and many are employed in the manufacturing industries across the country. However, some studies, for example, Onwuka (2009) revealed that these graduates are performing below expectation in their industrial assignments. Manufacturers Association of Nigeria (MAN) also reported that majority of industries in Nigeria retrain new electrical engineering graduates before assigning them responsibilities (Banjoko, Iwuji, and Bagshaw, 2012). Moreover evidences showed that there are considerable incidences of electrical engineering graduates' unemployment in the country (Atsumbe, 2009). Also Chijioke and Benchuks (2012) stressed that there is high rate of unemployment in Nigeria, but there is acute shortage of manpower in majority of the industries as a result of lack of trained engineers. It is against this background, that this study is set up to identify appropriate cognitive skills required by Electrical Engineering graduates of Universities for effective performances in industries of Kano and Kaduna states, Nigeria.

2. Problem Statement

Electrical engineering programmes in Nigerian universities are saddled with the responsibilities of producing efficient, competent and skilled electrical engineering graduates to understand, plan, design, operate and maintain a number of processes and systems entailed in the contemporary technology in consonance with the objectives of the programme (NUC, 2007). However, recent advances in electrical engineering that are so important for our industrial development are not captured in the current electrical engineering programme of study (Onwuka, 2009). In addition to this, Manufacturers Association of Nigeria (MAN) asserted that manufacturing organizations that employ new engineering personnel always have to undergo re-training prior to assuming full work responsibilities.

This clearly indicates that electrical engineering graduates being produced by the universities lack proper cognitive skills in diverse areas and components that form electrical engineering programme of study. This view is also supported with the work of Alaba (2004) who inferred that electrical engineering graduates lack some aspect of practical functioning of electrical engineering that are widespread in present modern industries. For example, wireless sensors are developed to replace old version wired sensors as the wireless sensors are flexible and can be easily reconfigured. Also, new methods of monitoring electrical power quality have been devised to reduce effects on equipment, and process operations such as malfunction, damage, process disruption and other anomalies. If recent advances and developments in the field of electrical engineering are captured adequately in our electrical engineering programme of study, there will be a regular turn out of skilled electrical engineers for the industries. This implies that the electrical engineering graduates will readily fit in to our industries, employment of expatriate will be at minimal, unemployment rate will be reduced, social vices also will be at its barest minimum and the entire country will witness a lasting peace.

Most of electrical engineering programmes in Nigerian universities were last reviewed in 2006 (NUC, 2007), and there are recent advances in the skills, knowledge and abilities that emerged as a result of rapid technological development in the field. Meanwhile the current programme of study of electrical engineering has been criticized for not capturing and reflecting these new developments and advances (Onwuka, 2009). These criticisms are perhaps as a result of lack of reviewing for a long period of time. This, therefore, resulted in a great mis-match between the work force produced by the universities and the input demanded by the industries. Consequently, the problem tackled by this study raised as a question is what are the cognitive skills required by Electrical Engineering graduates of Universities for effective performance in industries of Kano and Kaduna states, Nigeria?

3. Objective/Research Questions

The main purpose of this study is to identify recent advances in cognitive skills required by electrical engineering graduates of universities for effective performance in industries of Kano and Kaduna States, Nigeria. Specifically, the study answered the following question:

1. What cognitive skills do electrical engineering graduates of Nigerian universities require in:
    i. Electrical power quality?
    ii. Electric motor torque control
    iii. Modern patents of ultra wide band antenna?
    iv. Modern wireless sensors?
    v. Patents on corrosion control and leak detection schemes in boilers?

4. Hypothesis

The following null hypothesis was formulated and tested at 0.05 levels of significance.

1. H_{O1}: There is no significant difference in the mean responses of lecturers, graduates, and engineers with respect to their opinion on the required cognitive skills of electrical engineering graduates.

5. Research Methodology

This research used a survey design method. The target population consists of 669 subjects who include 319 engineers in industries, 57 lecturers in electrical engineering departments and 293 electrical engineering graduates. The researchers used purposive sampling technique to select 106 engineers, as well as simple random sampling technique to select 49 lecturers and 161 graduates. The instrument used was a 69-item structured questionnaire developed by the authors for eliciting the information from the respondents. The initial draft of the questionnaire was presented to 4 lecturers in the electrical engineering department, Federal University of Technology, Minna, Nigeria, to check the face and content validity of the instrument. Based on their necessary suggestions and observations, the final draft of the questionnaire was produced. The reliability of the instrument was later established through pilot-testing the questionnaire on 36 staff and students of electrical engineering of the same institution, as well as 8 electrical engineers working in industries in Niger State, Nigeria. The reliability coefficient was computed with the aid of SPSS statistical software version 20, using cronbach's Alpha method to ascertain the extent of the homogeneity of the items. The reliability coefficient of the questionnaire was found to be 0.764, which indicates that the items in the questionnaire are internally consistent in measuring what was intended to be measured for the study. The researchers used mean and standard deviation in analyzing the research data and answering the research question, as well as one-way analysis of variance in testing the formulated hypothesis. Any item with mean value of 2.50 and above is accepted while items with a mean value below 2.50 are rejected.

6. Results

The result of the data collected was analyzed and presented according to the research question and hypothesis that guided the study.

6.1 Research Question: What cognitive skills are required by electrical engineering graduates of Universities for effective performance in industries of Kano and Kaduna States, Nigeria?

Table 6.1: Mean Responses of Respondents on Cognitive Skills Required by Electrical Engineering Graduates in Electrical Power Quality

			N_1=49	N_2=106	N_3=161	
S/No	**Items**	$\bar{x}_1$	$\bar{x}_2$	$\bar{x}_3$	$\bar{x}_t$	**Remark**
1	Understand principles of electrical power quality.	2.75	2.37	3.00	2.70	Required
2	Explain reasons for monitoring electrical power quality, such as economic damage, effects on equipment and process operations.	3.25	2.00	2.50	2.58	Required

3	Identify several monitoring techniques required for the enhancement of electrical power quality.	3.00	2.50	3.50	3.00	Required
4	Describe the main vital power quality tribulations in manufacturing installation, such as voltage sags, harmonics, interruptions and high frequency noise.	3.75	3.25	4.00	3.66	Required
5	List and explain a number of random factors that are engaged in the examination of voltage sag.	3.50	2.25	2.25	2.66	Required
6	Understand the effect of voltage sag on the quality of electrical power and several industrial's equipment.	2.50	2.00	3.25	2.58	Required
7	Describe steps involved in the process of power quality analysis.	3.00	2.50	3.75	3.08	Required
8	Differentiate between symmetrical and unsymmetrical voltage sags in 3- phase supply.	3.66	2.60	2.75	3.00	Required
9	Explain the techniques of optimal placement of voltage sag monitors.	2.91	2.60	2.56	2.69	Required
10	Understand and interprets the specifications of monitoring instrument, such as sampling rate, accuracy, resolution, anti-aliasing filter etc.	2.66	2.33	2.87	2.73	Required
11	List and explain the common causes of voltage sag in induction motors.	2.25	2.13	2.68	2.35	Not Required
12	Define quantities used in electric power systems under non sinusoidal conditions	3.00	2.33	2.87	2.73	Required
13	Identify several means of achieving sag magnitude from the rms voltage	2.41	2.40	2.50	2.43	Not Required

KEY: N_1, N_2 and N_3=Number of Lecturers, Engineers and Graduates respectively. $\bar{X}_1$= Mean responses of Lecturers $\bar{X}_2$= Mean responses of Engineers $\bar{X}_3$= Mean responses of Graduates, $\bar{X}_t$= Mean responses of all respondents

Table 6.1 shows the mean responses of the three set of respondents which disclosed that 11 of the 13 statements addressing required cognitive skills in electrical power quality are considered required with a grand mean rating ranging from 2.58 – 3.66. Together the three groups rejected 2 other items presented indicating that they are not required by the electrical engineering graduates.

Table 6.2: Mean Responses of Respondents on Cognitive Skills Required by Electrical Engineering Graduates in Electric Motor Torque Control

N_1=49 N_2=106
N_3=161

S/No	Items	$\bar{x}_1$	$\bar{x}_2$	$\bar{x}_3$	$\bar{x}_t$	Remark
14	Understand the principles of soft starters as devices for providing low voltage to electric motors.	2.91	2.60	2.75	2.75	Required
15	Explain the benefits of soft starting in their applications in electric motors.	2.50	2.86	3.18	2.84	Required
16	Describe techniques employed in controlling soft starters, such as voltage- ramp, current control etc.	2.73	2.53	3.12	2.79	Required
17	Calculate flux estimation from the motor voltage and current measurement.	2.08	2.23	2.87	2.42	Not Required
18	Identify sources of errors in induction motor voltage and current measurement.	3.33	2.66	2.75	2.91	Required
19	Describe the principles of generating constant starting torque	3.16	2.86	2.87	2.96	Required
20	Differentiate between pull out torque and starting torque in a typical induction motor.	3.25	2.73	3.43	2.52	Required
21	Understand the fundamental notion of the field-oriented current vector control of AC machines.	2.91	2.80	2.93	2.88	Required
22	Explain how Indirect Torque Control (ITC) can be realized by means of the space vectors of the electrical variables.	2.75	2.13	2.25	2.37	Not Required
23	Describe the attainment of several flux linkages from terminal frequencies such as voltages, currents, speed and position.	3.83	2.73	3.26	3.27	Required
24	Distinguish between direct flux linkages (DFLC) and direct torque control (PTC).	3.66	2.06	2.73	2.81	Required
25	Understand the processes of achieving an electric torque to close the torque control loop	3.08	2.75	3.18	3.00	Required

KEY: N_1, N_2 and N_3=Number of Lecturers, Engineers and Graduates respectively. $\bar{X}_1$= Mean responses of Lecturers $\bar{X}_2$= Mean responses of Engineers $\bar{X}_3$= Mean responses of Graduates, $\bar{X}_t$= Mean responses of all respondents

Table 6.2 shows the mean responses of the three groups of participants which showed that 10 of the 12 items addressing required cognitive skills in electrical motor torque control are considered required with a grand mean rating ranging from 2.52 – 3.27. Together the three groups rejected 2 other items presented indicating that they are not required by the electrical engineering graduates.

Table 6.3: Mean Responses of Respondents on Cognitive Skills Required by Electrical Engineering Graduates in Advances in Telecommunications (Ultra wide Band Antenna)

N_1=49 N_2=106 N_3=161

S/No	Items	$\bar{x}_1$	$\bar{x}_2$	$\bar{x}_3$	$\bar{x}_t$	Remark
26	Understand ultra wide band (uwb) technologies utilizing different modulation techniques, such as orthogonal frequency division multiplexing (OFDM), and pulse-based method.	2.75	2.86	3.12	2.91	Required
27	Compare requirements for uwb antennas using different schemes.	3.25	3.00	2.87	3.04	Required
28	Explain the simple construction of various antennas utilizing uwb frequency, such as patch antenna, horn antenna, Vivaldi antenna etc.	2.83	2.86	3.53	2.66	Required
29	List various patents filed on ultra wide band antennas with enhancing different properties.	2.91	2.40	2.87	2.72	Required
30	Explain uwb systems in providing high data rate for wireless communications, and accuracy in radar and geo-location systems.	2.75	2.91	2.93	2.86	Required
31	State the effect of various dielectric materials in used in ultra wide band antennas, such as fiberglass, air, Teflon, FR4 etc.	2.66	2.60	2.81	2.69	Required
32	Understand cannel coding and its influence in optimization of ultra wide band antenna.	3.25	2.66	2.81	2.90	Required
33	Identify predetermined angle that influence the bandwidth of the patch ultra wide band antenna.	2.33	2.20	2.56	2.36	Not Required
34	Define communication error rates in Vivaldi ultra wide band antenna.	2.75	2.53	3.00	2.76	Required
35	Illustrate various types of ultra wide band antennas.	2.50	2.73	2.66	2.63	Required
36	Understand ultra wide band antenna emitting of low and high frequency components from different portions of a geometry.	3.08	2.73	2.68	2.83	Required
37	Understand various specifications associated with uwb construction, such as physical profile, radiation efficiency, impedance bandwidth, phase, group delay, radiation pattern, beam width, directivity, etc.	3.33	3.20	3.25	3.26	Required
38	Describe methods of broadening the bandwidth of uwb antennas, such as thickening a dipole, bandwidth versus length to diameter ratio, etc.	2.83	2.60	2.81	2.74	Required
39	Describe processes in constructing various sub-components in uwb antennas, such as ground plane,	3.25	3.26	2.81	3.10	Required

radiating elements SMA connector etc

KEY: N_1, N_2 and N_3=Number of Lecturers, Engineers and Graduates respectively. $\bar{X}_1$= Mean responses of Lecturers $\bar{X}_2$= Mean responses of Engineers $\bar{X}_3$= Mean responses of Graduates, $\bar{X}_t$= Mean responses of all respondents

Table 6.3 shows the mean responses of the 3 categories of respondents which uncovered that 13 of the 14 items addressing required cognitive skills in advances in telecommunications (ultra wide band antenna) are considered required with a grand mean rating ranging from 2.63 – 3.10. Together the three groups rejected item 33 indicating that it is not required by the electrical engineering graduates.

Table 6.4: Mean Responses of Respondents on Cognitive Skills Required by Electrical Engineering Graduates on Advances in Modern Wireless Sensors

N_1=49 N_2=106 N_3=161

S/No	Items	$\bar{x}_1$	$\bar{x}_2$	$\bar{x}_3$	$\bar{x}_t$	Remark
40	Explain the static and dynamic properties of a wireless sensor	2.91	2.80	3.31	3.00	Required
41	Describe various static characteristics of sensor, such as its accuracy, error bands, spam and zero, resolution of measurement, sensitivity, repeatability, bias and drift, dead band, saturation and hysteresis	3.08	2.60	2.75	2.81	Required
42	Describe various dynamic characteristics of a sensor, such as delay, rise time, overshot and setting time.	2.00	3.06	3.18	2.74	Required
43	Understand tasks performed by wireless sensors, such as measuring relevant quantities, monitoring and collecting data assessing and evaluating the information, formulating a meaningful user display, performing decision-making and alarm functions	2.41	2.66	3.46	2.82	Required
44	Differentiate between data acquisition network (DAN), and data distribution network (DDN)	2.50	2.80	3.37	2.89	Required
45	Explain various communication techniques used by wireless sensors, such as Wi-Fi, Bluetooth, Zig-Bee etc.	2.75	3.00	2.37	2.70	Required
46	Describe various network topologies, such as star, ring bus, tree etc.	2.92	2.60	2.81	2.77	Required
47	Understand the technique of Code Blue in implementing wireless network	3.16	2.86	2.81	2.94	Required
48	Understand power generation, power conservation and power management and their roles in extending the lifetime of the motes	3.16	2.86	2.81	2.94	Required

49	Explain the effect of software power management techniques in decreasing the power consumed by RF sensor notes.	2.33	2.40	2.50	2.41	Not Required
50	Understand wireless system's measurement of physiological parameters, as blood such pressure, heart rate, body temperature, body weight and blood glucose levels.	2.83	2.33	3.00	2.72	Required
51	State the advantages of wireless sensor over wired sensor	3.00	3.46	2.62	3.02	Required
52	Explain the function of a repeater hub, processing unit, base station controller and management centre	2.75	2.40	2.75	2.63	Required
53	Define terms such as quality of service, message delay, bit	3.33	2.66	2.87	2.95	Required

KEY: N_1, N_2 and N_3=Number of Lecturers, Engineers and Graduates respectively. $\bar{X}_1$= Mean responses of Lecturers $\bar{X}_2$= Mean responses of Engineers $\bar{X}_3$= Mean responses of Graduates, $\bar{X}_t$= Mean responses of all respondents

Table 6.4 shows the mean responses of the three groups of respondents which revealed that all the 14 items addressing required cognitive skills in advances in on in modern wireless sensors are adjudged required with a grand mean rating ranging from 2.63 – 3.02. Together the three groups rejected item 49 indicating that it is not required by graduates of universities for effective performance in industries of Kano and Kaduna States, Nigeria.

Table 6.5: Mean Responses of Respondents on Cognitive Skills Required by Electrical Engineering Graduates on Advances in Modern Wireless Sensors

N_1=49 N_2=106 N_3=161

S/No	Items	$\bar{x}_1$	$\bar{x}_2$	$\bar{x}_3$	$\bar{x}_t$	Remark
1	Understand the role of boilers in the plant operation for industrial processes	2.41	2.33	2.43	2.39	Not Required
2	Outline factors that cause corrosion, slag precipitation and leaks in different component of boilers	2.00	2.06	2.81	2.29	Not Required
3	Identify and describe all parts of a steam boiler system i.e. the fire side, the electrical side	3.00	3.20	3.31	3.17	Required
4	Understand the principle of rankine cycle in the operation of a power plant.	2.33	2.13	3.06	2.50	Required
5	Differentiate between steam boilers utilizing fossil fuel and waste to energy (WTE boilers utilizing solid waste	2.33	2.06	2.80	2.39	Not Required
6	Explain the effect of refused derived fuel (RDF) in WTE boilers	1.91	2.20	2.05	2.05	Not Required
7	Describe the principle of operation of black liquor recovery boiler	2.75	2.06	2.56	2.45	Not Required
8	Explain theories on why corrosion occurs on high	3.66	2.73	2.81	3.06	Required

	temperature surface.					
9	Calculate droplet Momentum required to inject chemicals to the desired slagging locations	2.08	1.93	2.43	2.14	Not Required
10	Describe the causes of shrinking and swelling of the drum in boilers.	2.50	2.06	1.75	2.10	Not Required
11	Describe the model-based, Knowledge-based and the statistical analysis method as approaches to fault detection in boilers.	3.25	3.06	3.18	3.16	Required
12	Understand the effect of disturbances, instruments, errors, and process fault to the operation of boilers in industrial system.	2..25	2.40	2.87	2.50	Required
13	Differentiate between the principal component analysis (PCA) and partial-least squares (PLS) analysis as popular statistical processes of monitoring techniques.	1.75	3.53	2.56	2.61	Required
14	Explain the effect of change boiler loads to leak detection in boiler system.	2.00	1.80	3.60	2.46	Not Required
15	Identify and write different types of maintenance reports for industrial processes.	1.83	2.26	2.06	2.05	Not Required

KEY: N_1, N_2 and N_3=Number of Lecturers, Engineers and Graduates respectively. $\bar{X}_1$= Mean responses of Lecturers $\bar{X}_2$= Mean responses of Engineers $\bar{X}_3$= Mean responses of Graduates, $\bar{X}_t$= Mean responses of all respondents

Table 6.5 shows the mean responses of the three groups of respondents which revealed that all the 14 items addressing required cognitive skills in advances in on in modern wireless sensors are adjudged required with a grand mean rating ranging from 2.63 – 3.02. Together the three groups rejected item 49 indicating that it is not required by graduates of universities for effective performance in industries of Kano and Kaduna States, Nigeria.

7. Hypothesis

$H0_1$: There is no significant difference among the mean responses of Lecturers, Engineers and Graduates with respect to cognitive skills required by electrical engineering graduates of universities for effective performance in industries of Kano and Kaduna states, Nigeria.

Table 4.6: One- way Analysis of Variance (anova) of the Mean Responses of Respondents on the Required Cognitive Skills of Electrical Engineering Graduates of Universities

Source of	Sum of squares	df	Mean squares	f.cal	f. critical	Decision

variation						
Between Group	395.46	2	197.73			
Within Group	11,408.44	313	36.45	5.42	3.00	S*
Total	11,803.9	315				

* Significant

The result of analysis as presented in table 4.6 shows that there is significant difference ($p<0.05$) between the responses of lecturers, engineers and graduates on the cognitive skills required by Electrical Engineering graduates of Universities for effective performance in Industries of Kano and Kaduna States, Nigeria. Hence, the null hypothesis is rejected since the critical f-value is less than the calculated F- ratio value.

8. Discussion

The findings in tables 4.1 – 4.5 provide answer to the research question. The findings revealed that most of the questionnaire items on cognitive skills posed were adjudged required by electrical engineering graduates of universities for effective performance in industries of Kano and Kaduna states, Nigeria. This finding is in line with the assertion of Kofoworola (2003) that cognitive skills enable electrical engineering graduates to read, think, prioritize, understand, plan, remember and solve problems in electrical related industries. In support of this view, Olatoyibo and Alawode (2005) reported that the cognitive skills are essentials in the development, manufacture and application of a wide variety of electrical devices, circuits, systems, products and equipment. It was observed that industries remain the most powerful engines for economic growth, as such new developments in the field of electrical engineering have to be identified and captured in our electrical engineering programme of study in the universities. This will certainly improve the quality of products from our industries as well as transform the economic structures of the country.

The findings from Table 4.1 showed that 11 out of 13 items that address cognitive skills in electrical power quality are rated as required. The opinion of the respondents is in accordance with the results of Mazlumi (2011) who discovered that electrical power quality has turn out to be a vital subject when lots of industries around the planet experience difficulty in meeting the energy demands. This results in load shedding and power quality troubles. Similarly, Grisby (2001) noted that cognitive skills in electrical power quality are important for industrial development since these skills help in understanding techniques for monitoring power quality such as detection, classification, characterization and location. It is important to emphasize here that nearly all electrical power quality problems stem from within the consumer (industrial) facility. Effective monitoring ensures optimal power system performance and effective energy management.

Also detailed analysis of Table 4.2 revealed that 10 out of 12 items on cognitive skills in advances in electrical motor torque control are considered required. This outcome is consistent with work of Leonhard (1988) who maintained that those electric motors are responsible for 45% of electricity consumption around the world. He further stressed that the manufacturers ventured immensely in the energy efficiency of their products. Gritten, et al (2000), are of the opinion that cognitive skills in motor torque control are necessary to electrical engineering graduates in order to provide technological advancement that permit the use of induction motors in variable speed drives to replace DC motors and permit enhanced control of the induction motor starting and stopping process.

The researchers observed with interest that energy performs a significant part in the paradigm of sustainable development. Currently energy utilization is among the crucial attributes to measure the development of a nation. This shows the effect electric motors engender on electric energy expenditure. The study further revealed that cognitive skills in advances in ultrawide band antenna (Table 4.3) are required for effective performance in industries. This result is in line with the findings of Alkadgli, Ozdemir and Yamacli (2007), who stressed that ultrawide band antenna systems provide high data rates for wireless communications, accurate radar and geo-location systems. Schantz (2003) stated that advanced methods of telecommunications systems enable the electrical engineer to proceed in the direction that would have been totally impossible only a few years ago. Therefore in view of these new advanced technologies, Atsumbe (2002), posited that engineering base training institutes should keep abreast with these developments.

Moreover, the finding revealed that the electrical engineering graduates require cognitive skills in the modern wireless sensors (Table 4.4). This is not coming as a surprise because Lewis (2004) found out that wireless sensors are more advantageous than wired sensors. This is because of their flexibility and ease of reconfiguration. Wireless sensors can also be utilized in places geographically distant apart to observe activities tenuously and commonly consume fewer power. Similarly, the findings are in line with the assertion of Mukhopadhyay, Gaddam and Gupta (2007), who stated that the advancement of science and technology are dependent upon parallel progress in sensing and measurement techniques. As science and technology move ahead, new phenomena and relationships are discovered and these advances make new types of sensing and measurement imperative.

Furthermore analysis of results in Table 4.5 indicates that only 6 out of 15 items are adjudged required. Swarnakar (2007), in his work described industrial boilers as extremely unified, whose chief duty is to produce steam for generating electricity as well as exporting the ensuing electrical power to the grid. This could be the reasons why the three groups of respondents rejected most items in this sub-section. The researchers noted with interest that industries mainly in Kano and Kaduna states have little or nothing to do with electricity generation using steam boilers, as such items posed are rejected.

The hypothesis compared the mean responses of lecturers engineers, and graduates on the cognitive skills required by electrical engineering graduates of universities for effective performance in industries. Analysis on Table 4.6 disclosed that significant difference exists in their responses. This could be attributed to the fact that lecturers in electrical engineering field with higher academic qualifications have a deeper and wider scope of cognitive skills than graduates and engineers whose work- scope are limited to their industrial assignments.

9. Conclusion

A variety of industries across the globe rely heavily on electrical engineers for manpower, such as installing machines and maintaining such machines and equipment. Electrical engineers can be rightly described as the catalyst of any meaningful development and transformation of industrial sector. Evident from this study are the following conclusions:

1. Recent advances in cognitive skills are required by electrical engineering graduates of universities and need to be captured in the current electrical engineering programme of study for effective performance in industries of Kano and Kaduna states, Nigeria

2. Differences of opinions exist among the respondents on the variety of skills needed by electrical engineering graduates of universities for effective performances in industries.

10. Recommendations

Based on the findings of this study and their implications, the following recommendations were made:

1. The National Universities commission (NUC) should include the identified cognitive skills in the subject review of the electrical engineering progamme of study
2. Industries should as a matter of fact be more responsible to the call of Universities in training the graduates. This should be done by establishing a cordial relationship between the institutions and the industries through adequately implementing recommendations made by many studies on school – industry partnership which is a authentic means for effective engineering education.
3. Individual philanthropist and communities should assist electrical engineering departments in the universities within their vicinities with modern tools, equipment and machineries to facilitate teaching, learning and research work.

References

Alaba, M. (2004). *Engineer in Society*. Kano: Sagagi Press Limited.

Alkadgli, A., Ozdemir, C., & Yamacli, S. (2007). A Review of Recent Patents on Ultrawide Band Antenna: *Recent Patents on Electrical Engineering*, 2008, 1 (1) 68-7

Atsumbe, B. (2002). Mechanisms for Improving Manpower Production in Vocational and Technical Education. *Akoka Journal of Education, 1*(2), 165-178.

Atsumbe, B.N. (2009). School-Industry Partnership. A Veritable Tool for Quality Technology Education. Journal of Research in Curriculum Teaching, 1(1), 39-47.

Banjoko, S. A., Iwuji, I., & Bagshaw, K. (2012). The performance of the Nigerian manufacturing sector: A 52-year analysis of growth and retrogression (1960-2012).

Chijioke, P.O & Benchuks, O (2012). Development and Validation of instrument for assessing practical skills in fault diagnoses and repairs of radio and television systems n Nigerian technical colleges.

Fischer, M., & Boreham, N. (2009). Occupational work and competence development. *Handbook of TVE Research. New York: Springer*, 439-444.

Grigsby, L.L. (2001*). The electric Power Engineering Handbook.* Florida: CRC Press. ISBN 978 -1-4200-3677-0.

Gritter, D., Wang, D & Habetler, T.G (2000). Soft Starter Inside Delta Motor Modeling and its Control. *Proceedings of Industry Applications Conferenc*e. Rome, October 2000. Italy

Kofoworola, O.F. (2003). Engineering Education in Nigeria Present Learning systems and Challenges for the Future. *Australasian Journal of Engineering Education 3 (1), 1-8*

Leonhard, W. (1988). Field-Orientation for Controlling A.C machines—Principles and Applications. *Third International Conference on Power Electronics and Variable-speed Drives.* London, July, 1988.

Lewis, F.L (2004). Wireless Sensors Networks in Smart Environments. In Cook, D.J and Das, S.K (eds). Technologies, Protocols and Applications. John-Wiley, New York 2004, 1-18.

Mazlumi, K. (2011). Electrical Power Quality Monitoring. In A.H Zobaa, M.M Carteli and R. Basel (eds*). Power Quality Monitoring, Analysis and Enhancement*. Janeza Trdine 9,51000, Rijeka, Croatia.

Mukhopadhyay, S.C., Gaddam, A. & Gupta, G.S (2007). Wireless Sensors for Home Monitoring. Recent Patents on Electrical Engineering, 2008, 1 (1), 32-39.

National University Commission (2007). Benchmark for Minimum Academic Standards for Engineering programmes. Abuja , N.U.C Publication.

Olaitan, S.O. (1999), The theory and practice of vocational education in Africa. Calabar; centaurPress.

Olatoyinbo, S.F., & Alawode, A.J. (2005). Repositioning Engineering Education and Training for Manpower Development. In O.K. Abubakre, E.N Onwuka and B.A. Alabada (eds). *Engineering and Technology for Wealth Creation in the Spirit of NEEDS.* The 6th Annual engineering conference proceedings. Federal University of Technology, Minna. June 15th-17th. 123-128.

Onwuka, E.N. (2009). Reshaping Engineering Education Curriculum to Accommodate the Current Needs of Nigeria. *Educational Research and Review*. 4 (7), 334-339

Rauner, F., & Mclean, R. (2009). Areas of TVET Research. *Handbook of TVE Research. New York: Springer*, 439-444.

Swarnakar, A. (2007). Recent Patents on Corrosion Control and Leak Detection Schemes in Boilers. *Recent patents on Electrical Engineering*, 2008, 1(1), 76-83.

Whitaker, J.C (1999*). A.C Power System Handbook (2nd ed).* London: C.R.C Press, 62