EMERGING ELECTRICAL/ELECTRONIC TECHNOLOGIES FOR SUSTAINABLE DEVELOPMENT OF POLYTECHNIC STUDENTS IN PREVAILING ECONOMIC UNCERTAINTY IN RIVERS

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Abstract
The study explores the emerging electrical and electronic technologies for sustainable development of polytechnic students in prevailing economic uncertainty in Rivers state. The study had two objectives, two research questions and two hypotheses which guided the study. The study adopts survey design. The population for the study was 96 respondents, comprising of 66 Electrical lecturers and 30 Technologist from the three (3) government polytechnics in Rivers State. The study was a census as the entire population was used for the study. The study was a census as the entire population was used for the study. The data used in the study were collected through questionnaires. The research instrument was structured on 5 point Likert scales. The internal consistency of the instrument was determined by using Cronbach's Alpha reliability coefficient method and the instrument has an overall internal consistency of .75. Ninety six (96) copies of the 20 items questionnaire were administered by the researchers on the respondents. Eighty copies which represent 83% of the administered questionnaires were retrieved and analyzed. It found out that the electrical/electronic lecturers and technologists agreed that the internet of things and smart grid system technologies for sustainable development of polytechnic students in prevailing economic uncertainty in Rivers state. Based on the findings of the study it was recommended that Polytechnic management should organized workshops on internet of things technologies for electrical/electronic technology lecturers and the National Board for Technical Education should incorporate smart grid system technologies into higher national diploma curriculum.

Keywords

Smart Grid System, Sustainable Workforce Development, Internet of things, Economic Uncertainty.

1. Introduction

Polytechnic education is the substratum of technological and industrial liberation of Nigeria. The programmes of the polytechnics in Nigeria are divided into two categories namely; National Diploma and Higher National Diploma Programmes. Students who finished National Diploma Programme or courses are awarded National diploma (ND) certificates while those who successfully completed Higher National Diploma Programme are awarded Higher National Diploma (HND) Certificates (Okoro, 2006). The technological programmes offered in polytechnics in Nigeria include but not limited to engineering programme in Mechanical Technology and Electrical/Electronic Engineering Technology among others.

Electrical/Electronic Technology is a branch of Engineering Technology programme which include a diverse range of sub disciplines such as applied design, embedded system, control system, instrumentation, telecommunication,

power systems and electronic (accreditation board for Engineering and Technology [ABET] 2010). Electronic which uses is an essential part of technology needed for human and societal development, is an occupation that makes use of devices that depend on flow of electrons through semiconductors and vacuum (Ovundah, 2023). Electronic technology is the use of scientific theories and principles in the design, production, installation, testing, service, use, and control of electrical and electronic parts, equipment and systems. Electrical/electronic technology is one of the technological courses in polytechnics where students are expected to acquire knowledge and practical skills for paid or self-employment after graduation. The polytechnic curriculum by National Board for Technical Education (NBTE, 2014), for electrical/electronic Engineering technology stressed that, at completion of the programme, the technologists should be able to install, maintain, and diagnose electronic equipment and appliances. Equally, the curriculum of Polytechnics for electrical/electronic technology and electronic courses, but NBTE has not included new skills in emerging electrical/electronic technologies, for trouble-shooting trending electrical/electronic system in the curriculum. Higher National Diploma in electrical/electronic engineering technology used for training future technologists that specialize in electronic equipment installations or maintenance, there appears to be gap between the training acquired by technologists and the practical skills required for the new technologies in Electrical/Electronic Engineering Technology, as indicated in the curriculum of NBTE (2014). However, polytechnics graduates need skills for troubleshooting, install and maintenance of emerging electrical/electronic systems among others.

Emerging electrical/electronic technology refer to the latest innovations and advancements in the field of electronics that are currently in development or have recently been introduced to the market (Brader et al 2017). It was also stated in Brader et al (2017), that emerging electronic technologies have a transformative role in society by driving innovation, solving challenges, enhancing efficiency, and improving various aspects of human life. These technologies have the potential to revolutionize various industries and have a significant impact on our daily lives if the contents are included in the body of knowledge. In the view of Rotolo et al (2015), Emerging Technologies in Electrical/Electronic herald a new era of innovation, shaping the future of technology and its impact on society. The field of Electrical/Electronic technology has entered an exciting phase of evolution driven by the rapid emergence of innovative technologies. These emerging technologies have the potential to redefine the way we interact with and harness electrical and electronic systems, ushering in a new era of connectivity, efficiency, and capability (Leonard & Hommais 2017). However, the current landscape is characterized by the convergence of multiple transformative trends, including quantum computing, Robotics, biomedical electronics, artificial intelligence, Embedded system, Silicon carbide electronics system, Cyber security system, 5G networks, Internet of Things (IoT) and smart grid system among others. This study on emerging electrical/electronic technologies contents for sustainable workforce development among polytechnic students in Rivers state will focus only on embedded system, internet of things (IoT), Robotics, flexible electronics, augmented reality and smart grid system contents.

A smart grid system is an electricity network that uses digital and other advanced technologies to monitor and manage the transport of electricity from all generation sources to meet the varying electricity demands of end users. It refers to an advanced electricity distribution network that incorporates modern communication, sensing, and control technologies to efficiently manage and optimize the generation, distribution, and consumption of electricity (Fuller, 2013). Smart grid is an enhanced version of the traditional electrical grid that enables two-way communication between the utility and the consumers, allowing for real-time monitoring, analysis, and control of electricity flows. However, smart grid system is needed in this computer driven age to effectively computerize our homes and other gadgets with Internet of Things.

The Internet of Things (IoT) refers to the network of physical devices, vehicles, home appliances, and other items embedded with sensors, software, and connectivity that enables them to connect and exchange data over the internet (Ovidiu & peter 2015). It ranges from everyday household objects to complex industrial machines. According to Karen et al (2015), these interconnected objects have data regularly collected, analyzed and used to initiate action, providing a wealth of intelligence for planning, management and decision making. This is the world of the Internet of Things. It involves the use of web enabled smart devices with several enabling technologies such as microcontrollers, sensors, wireless communications, micro-electromechanical system and communication hardware to collect, send and act on data they acquire from the environment. Internet of things (IoT) is a global infrastructure for the information society, enabling advanced services by interconnecting (physical and virtual) things based on existing and evolving interoperable information and communication technologies. With the Internet of Things the communication is extended via Internet to all the things that surround us. Utilizing developing technologies in electrical/electronic is crucial for providing students with the necessary skills, knowledge, and mindset to succeed in a world that is heavily influenced by technology. However, Augmented reality technologies, Flexible electronics,

embedded system, Internet of Things (IoT), Robotics and smart grid system contents are needed for sustainable workforce development in the 21st century.

Sustainable workforce development involves creating and implementing strategies to make sure a business has the talent it needs to thrive long term. Sustainable workforce development in this study involves creating a skilled workforce capable of adapting to and leveraging the latest technological advancements while also addressing environmental, social, and economic sustainability concerns. Sustainability refers to the capacity to maintain or improve certain processes or systems over the long term without depleting the resources they depend on or causing harm to the environment. As noted by Usman, et al (2016) sustainable workforce development in the era of emerging electronic technologies requires a comprehensive approach that focuses on building skills, promoting diversity and inclusion, and prioritizing environmental sustainability. No wonder Thiagarajan and Baul, (2014) stated that, as electronic technologies continue to evolve at a rapid pace, organizations and institutions need to focus on developing a workforce that can harness the power of these technologies in a way that benefits both the industry and society as a whole. Conversely, polytechnic graduates need to develop skills in areas such as flexible electronics, embedded system, Internet of Things (IoT), Robotics and smart grid system to navigate the digital landscape responsibly and securely. There is need for electrical/electronic technology lecturers and technologists to be knowledgeable of the emerging electronics technology. Electrical/electronic technology lecturers are teachers at a polytechnic or university whose duties are to plan and deliver teaching on their specialist subject to students. They deliver practical contents with help of workshops technologists. Hence, polytechnics play an important role in the education system by providing students with industry-relevant education that prepares them for successful careers and helps to drive innovation even in prevailing economic uncertainty. Economic uncertainty is when the indices that enhance economic growth and development are capricious and unclear. Economic uncertainty according to Colak, et al, (2020), is a situation when the outlook of the economy is inconsistent with the indices of economics being negatively askew and when economists are unable to predict the consequences of their decisions and policies.

2. Statement of the Problem

Electrical/Electronic Technology is one of the technological courses in Polytechnics where students are expected to acquire knowledge attitudes and skills for paid or self-employment after graduation. The diploma programme which is Electrical/Electronic Engineering Technology is designed to impart on the students specialized and useable skills in the field of technology. However, the curriculum of Polytechnics for Electrical/ Electronic Engineering Technology courses, by NBTE has not included new technological contents in, trouble-shooting, installation and maintenance of emerging electronics system in the curriculum for Higher National Diploma in Electrical/Electronic Engineering Technology used for training future technologists that specialize in electronic equipment installations or maintenance (Kpabep, 2015 cited in ovundah 2023). There appears to be gap between the training acquired by technologists and the skills required for the new technologies in Electrical/Electronic Engineering Technology, as indicated in the curriculum of NBTE (2014). Also the existing NBTE curriculum of polytechnic programmes such as electrical/electronic technology, do not impart the emerging skills to graduates as required for contemporary industries. This position was confirmed by Oluwale et al, (2018) citing a World Bank report (2016) which estimated that about 40 million Nigerians are unemployed and that employers find it difficult to absorb young graduates because they do not possess the modern electronics skills needed in the 21st century economy. This could be attributed to one of the reasons why electrical/electronic technology graduates roam the street without been employed or come employers of labor. Hence, emerging electrical and electronic technologies for sustainable development of polytechnic students in prevailing economic uncertainty in Rivers state.

3. Purpose of the Study

The main purpose of this study is to determine emerging electrical and electronic technologies for sustainable development of polytechnic students in prevailing economic uncertainty in Rivers state. The study is sought to achieve the following objectives:

Internet of things technologies for sustainable development of polytechnic students in prevailing economic uncertainty in Rivers state.

Smart grid system technologies for sustainable development of polytechnic students in prevailing economic uncertainty in Rivers state.

Research Questions

The following research questions guided the study:

To what extent are internet of things technologies needed for sustainable development of polytechnic students in prevailing economic uncertainty in Rivers state.

To what extent are smart grid system technologies needed for sustainable development of polytechnic students in prevailing economic uncertainty in Rivers state.

Hypothesis

The following Null hypotheses were tested at .05 level of significance:

HO1: There is no significant deference between the mean responses of electrical/electronic lecturers and technologists on the extent internet of things technologies are needed for sustainable development of polytechnic students in prevailing economic uncertainty in Rivers state.

HO2: There is no significant deference between the mean responses of electrical/electronic technology lecturers and technologists on the extent smart grid system technologies are needed for sustainable development of polytechnic students in prevailing economic uncertainty in Rivers state.

4. Methodology

The design employed in this study was descriptive survey research design. Survey design is a type of descriptive survey research whose purpose is to collect data from a large or manageable sample of a population so as to determine the distribution, occurrence and interaction of educational and sociological phenomena. This design will provide a quickly efficient and accurate means of getting information about a population of interest. The study was carried out in only government polytechnics in Rivers state which are as follows Ken Sarowiwa Polytechnic, Federal Polytechnic of Oil and Gas Bonny, Rivers State, and Port Harcourt Polytechnic (Elechi Amadi Polytechnic). The population for the study was 96 respondents, comprising of 66 Electrical lecturers and 30 Technologist from the three (3) government polytechnics in Rivers State. The study was a census as the entire population was used for the study. The data used in the study were collected through questionnaires. The questionnaires was structured on 5 point Likert scales of Very Highly Extent (VHE) – 5, Highly Extent (HN) – 4, Moderate Extent (N) – 3, low Extent (MN) – 2 and Very Low Extent (NN) – 1. The instrument was face-validated by three experts, two from Department of electrical/electronic engineering technology of Ken Sarowiwa Polytechnic, Rivers State. Cronbach Alpha reliability method was adopted to determine the internal consistency of the questionnaire items. The reliability coefficient obtained from questionnaires was .75. Ninety six (96) copies of the 20 items questionnaire were administered by the researchers on the respondents. Eighty copies which represent 83% of the administered questionnaires were retrieved and analyzed. The computation of the mean, standard deviation and t-test was carried out with Statistical Package for Social Science version 23.10 (SPSS). To answer research questions 1 and 2 questionnaire items within mean scores of 3.50 and above was uphold and questionnaire items within mean scores of 3.49 and below was rejected. the decision for null hypotheses was as follows: if the calculated value of the (t-cal) was less than the critical value of (t-crit), accept the null hypothesis but if the calculated value of the (t- cal) is greater than or equal to the critical value of (t-crit) at .05 level of significance, then reject the null hypothesis.

Result and Findings

Research Question 1: To what extent are internet of things technologies needed for sustainable development of polytechnic students in prevailing economic uncertainty in Rivers state

Table 1: Mean Responses of Electrical lecturers and Technologists on extent Internet of Things Technologies are needed for Sustainable Development of Polytechnic Students in Prevailing Economic Uncertainty

S/N	Items	Electrical lecturers			Technologists		
	Internet of Things	$\bar{x}$	SD	RMK	$\bar{x}$	SD	RMK
	Computer programming and network security	3.97	.816	Highly Extent	3.73	.778	Highly Extent
	IoT Architecture and Protocols	3.74	.913	Highly Extent	4.08	.688	Highly Extent
	Sensors and Actuators	4.10	.730	Highly Extent	3.81	.801	Highly Extent
	Embedded Systems for IoT	3.40	1.010	Moderate Extent	3.62	.898	Highly Extent
	Networking Basics for IoT	3.60	1.051	Highly Extent	3.73	.874	Highly Extent
	IoT Security	3.93	.770	Highly Extent	3.88	.816	Highly Extent
	IoT Development Platforms and Frameworks	3.77	.965	Highly Extent	3.81	.801	Highly Extent

Cloud Computing in IoT	3.56	.972	Highly Extent	3.77	.765	Highly Extent
Machine Learning and AI in IoT	3.70	1.009	Highly Extent	3.65	1.093	Highly Extent
IoT Applications and Case Studies	3.79	.897	Highly Extent	3.73	1.116	Highly Extent
`Grand Mean	3.756	.2882	Highly Extent	3.781	.2953	Highly Extent

Table 1 is the result of the mean responses of Electrical lecturers and Technologists on the internet of things technologies needed for sustainable development of polytechnic students in prevailing economic uncertainty in Rivers state. The table revealed that the mean responses of the Electrical lecturer's ranges from 3.40 to 4.10 while the mean responses of the Technologists ranges from 3.62 to 4.08. The grand mean of Electrical lecturers and Technologists were 3.756 and 3.781 respectively this exceeded the criterion mean of 3.50 thus the respondents agreed with the items in the questionnaire as the internet of things technologies needed for sustainable development of polytechnic students in prevailing economic uncertainty in Rivers state. The closeness of the standard deviation shows the homogeneity of the Electrical lecturers and Technologists.

Research Question 2: To what extent are smart grid system technologies needed for sustainable development of polytechnic students in prevailing economic uncertainty in Rivers state?

Table 2: Mean Responses of Electrical lecturers and Technologists on the extent Smart Grid System Technologies are needed for Sustainable Development of Polytechnic Students in Prevailing Economic Uncertainty .

S/N	Items	Electrical lecturers			Technologists		
	Smart Grid System	$\bar{x}$	SD	RMK	$\bar{x}$	SD	RMK
	Advanced Metering Infrastructure	3.59	.984	Highly Extent	3.73	1.002	Highly Extent
	Demand Response	3.77	.979	Highly Extent	3.73	.874	Highly Extent
	Distributed Energy Resources	3.45	.987	Moderate Extent	3.54	1.272	Highly Extent
	Energy Management Systems	3.99	.825	Highly Extent	3.77	1.107	Highly Extent
	Supervisory Control and Data Acquisition	3.82	.903	Highly Extent	3.85	.732	Highly Extent
	Grid Sensors and Phasor Measurement Units	3.96	.889	Highly Extent	3.96	.999	Highly Extent
	Smart Grids Communication Networks.	4.05	.724	Highly Extent	3.81	.849	Highly Extent
	Demand Response Management	3.34	1.121	moderate Extent	4.00	.894	Highly Extent
	Microgrid Technologies	3.78	.932	Highly Extent	3.77	.908	Highly Extent
	Artificial Intelligence (AI) and Machine Learning	3.74	.866	Highly Extent	3.54	1.140	Highly Extent
	Grand Mean	3.749	.3051	Highly Extent	3.769	.2526	Highly Extent

Table 2 is the result of the mean responses of Electrical lecturers and Technologists on the smart grid system technologies needed for sustainable development of polytechnic students in prevailing economic uncertainty in Rivers state. The mean responses of the Electrical lecturers ranges from 3.45 to 3.99 while the mean responses of the Technologists ranges from 3.54to 4.00. The grand mean of Electrical lecturers and Technologists were 3.749 and 3.769 respectively which exceeded the criterion mean of 3.50 indicating the respondents agreed on all the items in the questionnaire as the smart grid system technologies needed for sustainable development of polytechnic students in prevailing economic uncertainty in Rivers state. The closeness of the standard deviation shows the homogeneity of the Electrical lecturers and Technologists.

Test of Hypothesis

HO1: There is no significant deference between the mean responses of electrical/electronic lecturers and technologists on the extent internet of things technologies are needed for sustainable development of polytechnic students in prevailing economic uncertainty in Rivers state.

Table 3: t-test analysis on the Mean Response of Electrical lecturers and Technologists on the extent Internet of Things Technologies are needed for Sustainable Development of Polytechnic Students in Prevailing Economic Uncertainty.

Respondents	N	$\bar{X}$	SD	Df	T	Sig	P	Decision
Electrical lecturers	66	3.756	.2882		371	.584	.05	Uphold
Technologists	30	3.781	.2953	94				

Table 3 is the result of an independent sample t-test comparing the mean responses between the mean response of Electrical lecturers and Technologists on the extent internet of things technologies are needed for sustainable development of polytechnic students in prevailing economic uncertainty in Rivers state. The data revealed that mean of Electrical lecturers is 3.756 and a standard deviation .2882. For Technologists the mean of 3.781 and a standard deviation of .2953 were obtained. The calculated t value is .371. Since the significant value (2-tailed) of .584 exceeded .05 (P>.05) the null hypothesis was uphold. Thus there is significant deference between the mean responses of electrical/electronic lecturers and technologists on the extent internet of things technologies are needed for sustainable development of polytechnic students in prevailing economic uncertainty in Rivers state.

HO2: There is no significant deference between the mean responses of electrical/electronic technology lecturers and technologists on the extent smart grid system technologies are needed for sustainable development of polytechnic students in prevailing economic uncertainty in Rivers state

Table 4: t-test analysis on the Mean Response of Electrical lecturers and Technologists on the extent Smart Grid Technologies are needed for Sustainable Development of Polytechnic Students in Prevailing Economic Uncertainty

Respondents	N	$\bar{X}$	SD	Df	T	Sig	P	Decision
Electrical lecturers	66	3.749	.3051		298	.766	.05	Uphold
Technologists	30	3.769	.2526	94				

Table 4 above is the result of an independent sample t-test comparing the mean responses between the mean response of Electrical lecturers and Technologists on extent smart grid system technologies are needed for sustainable development of polytechnic students in prevailing economic uncertainty in Rivers state. The data revealed that mean of Electrical lecturers is 3.749 and a standard deviation .3051 For Technologists the mean of 3.769 and a standard deviation of .2526 were obtained. The calculated t value of .298 since the significant value (2-tailed) of .766 was greater than .05 (P<.05) the null hypothesis was uphold. Thus, there is significant deference between the mean responses of electrical/electronic technology lecturers and technologists on the extent smart grid system technologies are needed for sustainable development of polytechnic students in prevailing economic uncertainty in Rivers state.

Summary of Findings

Research question 1 revealed that internet of things technologies are needed for sustainable development of polytechnic students in prevailing economic uncertainty in Rivers state. While hypotheses one revealed that there is no significant deference between the mean responses of electrical/electronic lecturers and technologists on the extent internet of things technologies are needed for sustainable development of polytechnic students in prevailing economic uncertainty in Rivers state.

Research question 2 revealed that smart grid system technologies are needed for sustainable development of polytechnic students in prevailing economic uncertainty in Rivers state. While hypotheses two revealed that there is no significant deference between the mean responses of electrical/electronic lecturers and technologists on the extent internet of smart grid system technologies are needed for sustainable development of polytechnic students in prevailing economic uncertainty in Rivers state.

Discussion of Finding

Research question 1 revealed that internet of things technologies are needed for sustainable development of polytechnic students in prevailing economic uncertainty in Rivers state. While hypotheses one revealed that there is no significant deference between the mean responses of electrical/electronic lecturers and technologists on the extent internet of things technologies are needed for sustainable development of polytechnic students in prevailing economic uncertainty in Rivers state. This finding is in consonance with Freelance map (2020), who affirmed that IOT personnel (graduates) must have an in-depth knowledge of computer programming and network security,

proficient knowledge of sensors, experience with custom build firm ware and hardware, expert knowledge of Linux OS. With the knowhow and skills in IOT systems, proper and adequate maintenance will be achieved.

Research question 2 revealed that smart grid system technologies are needed for sustainable development of polytechnic students in prevailing economic uncertainty in Rivers state. While hypotheses two revealed that there is no significant deference between the mean responses of electrical/electronic lecturers and technologists on the extent internet of smart grid system technologies are needed for sustainable development of polytechnic students in prevailing economic uncertainty in Rivers state. This finding is in line with Mittal (2014), what stated that Smart grid is an enhanced version of the traditional electrical grid that enables two-way communication between the utility and the consumers, allowing for real-time monitoring, analysis, and control of electricity flows. However, smart grid system contents are needed in this computer driven age to effectively computerize our homes and other gadgets.

5. Conclusion

The need for emerging electrical/electronic content in sustainable workforce development among polytechnic students in Rivers state arises from the rapid technological advancements and the increasing demand for skilled professionals in the electrical and electronics industries. As industries evolve, there is a remarkable shift towards automation, renewable energy, and smart technologies, necessitating modernized curricula that align with these trends. Many polytechnic institutions currently face challenges in providing education that meets industry standards. There is a critical skills gap, where students graduate without the practical knowledge needed for modern electrical and electronic applications. Emphasizing hands-on training and integrating new technologies such as Internet of Things (IoT), AI, and smart grid systems into the curriculum is essential. This prepares students for real-world applications and enhances employability.

6. Recommendation

Polytechnic management should organized workshops on internet of things technologies for electrical/electronic technology lecturers.

The National Board for Technical Education should incorporate smart grid system technologies into higher national diploma curriculum.

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