

Skills Required for Effective Utilization of Solar Energy for Sustainable Self Employment of Electrical/Electronics Technology Education Graduates in Enugu Urban

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Abstract: In the quest for alternative source of power that could be renewable, sustainable, environment friendly, pollution free and above all, energy that meet the demand of the whole world has led to the discovery of solar energy which is radiant light and heat from the sun that is harnessed using a range of ever-evolving technologies. The objective of this study was to determine the practical and entrepreneurial skills required by E/E technology education graduates for effective utilization of solar energy for sustainable power supply in Enugu Urban. Two research questions and two null hypotheses guided the study. The population of the study consisted of 29 technicians and 55 technologists located in Enugu Urban and were entirely used as there was no sampling. A structured five point scale and weighted questionnaire was used for data collection, validated by 3-experts while the reliability was determined using Cronbach Alpha and it yielded an index of 0.87. Mean and standard deviation were used to answer the research questions while t-test was employed to test the hypotheses formulated at 0.05 level of significance. Based on the research findings, the technicians and technologists agreed that entrepreneurial skills like record keeping skills, good accountancy skills, good work attitudinal skills are very highly required for effective utilization of solar energy in Enugu state while practical skills like ability to detect faults, production and assemblage of solar components and the likes are highly required for the utilization of solar energy. The study recommends that funding of solar technology research and development initiatives in Nigerian universities, polytechnics, colleges of Education (Technical) and research institutes should be encouraged for the development and utilization of efficient solar components; More training and emphasis on solar skills should be placed in teaching and learning of solar system in Nigerian institutions on the advantages derivable from solar energy technology for effective utilization for sustainable self employment of electrical/electronic technology education graduates.

Keywords: Solar Energy, be renewable, sustainable, environment friendly.

INTRODUCTION

Innovations in technology had contributed immensely to the development of man and few can imagine living without technology. Technology as a key component of human life that shapes the future and makes it compatible with nature through the discovery of more efficient methods and processes for the simplification of living. As a result of innovations in technology, transportation, communication, etc. have been made easy and lately, in the quest for alternative sources of power that could be renewable, sustainable, environmentally friendly, pollution free and above all, energy that meets the demand of the whole world, solar energy system was discovered.

Solar energy is radiant light and heat from the sun that can be harnessed using a range of ever-evolving technologies like solar photovoltaic and solar thermal energy [1]. Solar energy system has not only

emerged as a renewable energy source but it has generated large job opportunities in Enugu state and the Nation at large in the design, harvesting, installation and maintenance of solar energy system.

Enugu state is one of the states located at the south-Eastern part of Nigeria which enjoys average sunshine of about 6 hours daily with a population of over 1 million according to year 2015 estimates [2]. The state, irrespective of her natural endowments (sunshine of about 6hrs daily), faces epileptic power supply and chronic unemployment of youths.

Olubunmi [19] pointed out that many jobs can be created through solar installation and running of solar energy system. According to Abubakar and Oscarline [3], the government has planned to use solar energy to boost employment for thousands of youths in Nigeria and the agency has been involved in

environmental scanning to address unemployment over the years. Steps had been taken in training of youths in renewable energy. Specifically, the need for solar energy system cannot be overlooked due to energy crisis confronting Nigeria as a nation. In the same vein, National Directorate of Employment [4] submits that there is need for capacity building at industrial, institutional and personal levels for acquiring technical, organizational and managerial skills for increased development in renewable energy and sustainable self employment. According to Wikipedia [2], sustainable employment is an employment which meets the needs of the present without compromising the ability of the future generations to meet their own needs. Sustainability is critically an important goal for human activity and development. Sustainability in the area of self employment is of great importance as it employs the condition where social, environmental and economic satisfactions are met. These could be obtainable through technical education. Federal Republic of Nigeria [5] stated that one of the goals of education is the acquisition of appropriate skill and development of mental, physical and social abilities and competencies and equipment for the individual to live and contribute to the development of his society. In view of the above, technical education is a programme in Nigeria given the mandate to produce craftsmen or middle level manpower that will acquire practical skills in utilization of technological devices. Technical education according to FRN [6] is the education offered in technical colleges, Universities, Monotechnics, polytechnics and colleges of education (Technical) for the production of high skilled manpower who can apply scientific knowledge to solve environmental problems, provide goods and services for the convenience of man. Thus, the national policy on education FRN [6] summarized the goals of technical education among others to:

- Provide trained manpower in applied science, technology and commerce particularly at sub-professional grades.
- Provides technical knowledge and vocational skills necessary for Agricultural, Industrial, commercial and economic development.
- Give training and impart necessary skill leading to the production of craftsmen, technician and skilled personnel who will be enterprising and self reliant [6].

By the views of Aina, Ogundele and Olanipekun [7], technical education is an aspect of education which leads to the acquisition of practical, basic scientific knowledge, which involves special manipulative skills, creative minds and attitude relating to occupations in various sections of the economic and social life. Electrical/electronic (E/E) technology education is an area of specialization in technology education, therefore Carribean [8] pointed out that E/E

technology education is a field of study that provides both theoretical and hands-on-knowledge of electrical/electronic devices and circuits. Hence, E/E technology education syllabus is designed to provide its students the necessary skills, fundamental knowledge, both practically and experimentally for a lifelong career in the field of Electrical/electronics. It can be known that technology is paramount to all aspect of human life as it refers to the use of products of creativity, inventions and scientific research in the services of man.

Further more, the teaching and learning of E/E specialized area as a field of study in technical and vocational education departments as offered in different institutions of learning in Nigeria is vital in the production of workforce with great understanding in diverse skills in the design, development, production, management and utilization of trending electrical/electronics devices and circuit. According to the National Board for Technical Education Programme, E/E offers trade in;

- Appliances maintenance and repairs.
- Electrical installation and maintenance works.
- Instrument mechanics.
- Radio, television and electronics work.

Anaele [9] pointed out that the quality of any educational programme is a measure of the extent to which the students have acquired skills, knowledge and abilities. In the view of Osinemand [20], skill is an individual capacity and feeling within a specified context and task domain. The place of skill acquisition can not be over emphasized in the rapid development of education, technology and other sectors of the economy. With the same mindset, Ogundele [10] maintained that skill acquisition helps people already on a job and those intending to work in any of the varieties of occupations needed by the society; Ogundele concludes that there is no job that does not require manpower development. Okoro [11], Opines that our industries need skilled and well-trained workers to ensure that goods manufactured in Nigeria are as good as those manufactured in other parts of the world. In the words of Harvey and Browers-brown [2], employers want employees who can use their abilities and skill to evolve the organization. Alio [13] asserts that the accelerating pace of technology development has made a large number of jobs and skills obsolete. In view of the above, E/E technology education plays prominent role in nation building as the skills acquired from this type of education has been useful in entrepreneurial development and sustainable self employments; Hence, there is need to integrate solar system practical, entrepreneurial skills and competences into the E/E technology curriculum for its effective utilization by E/E Technicians and technology education students, thus gaps created in the field would be filled by E/E

technicians and technologists who are occupationally competent. For an E/E technology graduate to fill the gap and be sustainably self employed through the utilization of solar energy, he should be practically and entrepreneurially competent. Anaele [9] opines that practical skill is a manual dexterity through repetitive performance of an operation. Skill in a particular field requires cognitive and psychomotor behaviours for proficiency. Furthermore, entrepreneurial skills according to Onoh [14] are fundamental values that forms the basis for building and inbue craftsmen entrepreneurs a favorable disposition to prudently manage their enterprises in the most profitable way.

Technicians in the context of this study refers to workers in the field of technology with relevant practical skills and techniques with ordinary national diploma certificates from Institutions of higher learning while technologists are technology specialists with higher national diploma and degree certificates in technology from Institutions of higher learning.

STATEMENT OF THE PROBLEM

Solar energy system which has emerged as a renewable energy source have suffered great challenges as its technologies have been inefficient and hence, not effectively utilized in Enugu state. The sector lacked adequate trained and competent manpower in its design, development, installation and maintenance which has affected the in-service life of solar, capacity, components, the growth and development of solar system as renewable and sustainable energy source. Wider opportunities should be given to the E/E graduates in the area mentioned as it will contribute towards reducing the high rate of unemployment of E/E technology graduates in Enugu State and any investment in solar energy harnessing, processing and utilization would be a gateway towards overcoming the epileptic nature of power supply been witnessed in the countrys energy supply for some decades now.

PURPOSE OF THE STUDY

The main purpose of this study was to determine the skills for effective utilization of solar energy for sustainable self employment of E/E technology education graduates in Enugu State, but the study specifically sought to determine the extent of;

1. practical skills required for effective utilization of solar energy for sustainable self employment of E/E technology graduates in Enugu Urban.
2. entrepreneurial skills required for effective utilization of solar energy for sustainable self employment of E/E technology graduates in Enugu Urban.

RESEARCH QUESTIONS

The following research questions guided the study:

1. To what are the practical skills required for effective utilization of solar energy for sustainable self employment of E/E technology graduates in Enugu Urban?
2. To what are the entrepreneurial skills required for effective utilization of solar energy for sustainable self employment of E/E technology graduates in Enugu Urban?

HYPOTHESES

The following hypotheses formulated and tested at 0.05 level of significance guided the study.

H01: There is no significant difference between the mean ratings of solar technicians and technologists on the extent practical skills are required for effective utilization of solar energy for sustainable self employment of E/E technology education graduates in Enugu Urban.

H02: There is no significant difference between the mean ratings of solar technicians and technologists on the extent entrepreneurial skills are required for effective utilization of solar energy for sustainable self employment of E/E technology education graduates in Enugu Urban.

METHODS

Survey research design was adopted since the purpose of the study was to obtain data by the use of questionnaire. A survey research design is one which involves the assessment of public opinion using questionnaire and sampling methods [13]. The study was carried out in Enugu Urban which included Enugu North, Enugu South and Enugu East Local Government Areas. The choice of the area was as a result of solar establishments located in the area. The population of the study comprised 29 technicians and 55 technologists from solar firms in Ogui road, Achara Layouts, Zik avenue, Uwani, GRA and Obiagu respectively. The entire population was used as the population size was manageable. Data was collected using a structured five point weighted 28-items questionnaire developed by the researchers with sections A and B, scaled Very Highly Required (VHR), Highly Required (HR), Required (R), Less Required (LR) and Not Required (NR) with norminal values of 5, 4, 3, 2 & 1 respectively. The instrument was validated facially by three experts; one industrial training professional and two lecturers from Department of Technology and Vocational Education ESUT Enugu. The reliability of the instrument was established using Cronbach Alpha which gave a reliability co-efficient result of 0.87. Cronbach Alpha is used to estimate the reliability coefficient, the coefficient was appropriate because the instrument was dichotomously scored, Uzoagulu [15].

Mean and standard deviation were used to analyze the data obtained. Upper and lower limits of the mean were used for decision making as follows;

Very Highly Required	4.50 – 5.00
Highly Required	3.50 – 4.49
Required	2.50 – 3.49
Less Required	1.50 – 2.49
Not Required	0.50 – 1.49

The null hypotheses were tested using t-test at 0.05 level of significance. The decision was that null

hypotheses will be rejected if t-cal is greater than t-critical and not rejected when t-cal is less than t-critical.

RESULTS

The results are presented in line with the research questions and hypotheses that guided the study.

Research Question 1

To what extent are the practical skills required for effective utilization of solar energy for sustainable self-employment of E/E technology graduates in Enugu Urban?

Table 1: Mean and standard deviation scores of the practical skills required by E/E technology education graduates for effective utilization of solar energy for sustainable self-employment

S/N	The practical skills required by E/E technology education graduates for effective utilization of solar energy for sustainable self employment include	Techni. (29)	Techno. (55)	Aggregate		Decision
		Mean I	Mean II	Mean	SD	
12	ability to draw and interpret designed drawings	4.91	4.89	4.90	0.33	VHR
13	ability to carry out repairs	4.77	4.83	4.80	0.40	VHR
14	ability to install solar equipments	3.89	4.19	4.04	0.63	HR
15	ability manipulate various solar components	4.45	4.51	4.48	0.50	HR
16	ability to maintain safe working environment	3.84	4.20	4.02	0.52	HR
17	ability to detect faults	4.88	4.94	4.91	0.34	HR
18	ability to analyze solar energy system	4.23	4.45	4.34	0.47	HR
19	ability to operate solar system	4.43	3.99	3.21	0.45	HR
20	ability to maintain solar system components	3.57	4.03	3.80	0.67	HR
21	Skills in production and assemblage of solar system components	4.57	4.15	4.36	0.52	HR
22	System voltage check	4.65	4.63	4.64	0.45	VHR
23	Inverter troubleshooting and services	4.63	4.67	4.65	0.53	VHR
24	Modules and string wiring	4.58	4.48	4.53	0.62	VHR
25	Diagnosing and testing for law power production	4.68	4.78	4.73	0.46	VHR
26	Infrared camera inspection	4.15	4.17	4.16	0.65	HR
27	Mega ohmmeter testing	3.76	4.02	3.89	0.56	HR
28	Fuse checks	4.03	3.83	3.93	0.62	HR
	Cluster Mean	4.35	4.39	4.37	0.51	HR

Results presented in Table 1 show that the mean ratings of solar technicians and technologists ranges from 3.57 to 4.91 and 3.83 to 4.94 respectively with aggregate mean ranges of 3.80 to 4.91 while standard deviations aggregate ranged from 0.33 to 0.67. The mean ratings show that seven practical skills in items 12,22,23,24 & 25 are very highly required while Ten skills in items 13,14,15,16,17,18,19,20,21,26,27 & 28 are highly required for effective utilization of solar

energy for self-employment by E/E technology education graduates in Enugu Urban.

Research Question 2

To what extent are entrepreneurial skills required for effective utilization of solar energy for sustainable self employment of E/E technology graduates in Enugu Urban?

Table 2: Mean and standard deviation scores of entrepreneurial skills required for effective utilization of solar energy for sustainable self employment of E/E technology graduates in Enugu Urban.

S/N	The entrepreneurial skills required for effective utilization of solar energy for sustainable self employment of E/E technology graduates in Enugu State include;	Techni. (29)	Techno. (55)	Aggregate		Decision
		Mean I	Mean II	Mean	SD	
1	Ability to set out goals	3.60	4.00	3.95	0.85	HR
2	Good managerial skills	4.58	4.80	4.69	0.40	VHR
3	Innovative skills	4.61	4.59	4.60	0.26	VHR
4	Good work attitudinal skills	4.80	4.82	4.81	0.33	VHR
5	Material costs	4.38	4.52	4.45	0.58	VHR
6	Ability to desing and accommodate essential needs	3.82	3.90	3.86	0.87	HR
7	Good marketing skills	3.90	3.92	3.91	0.94	HR
8	Good accountancy skills	4.86	4.90	4.88	0.39	VHR
9	Record keeping skills	4.66	4.82	4.74	0.30	VHR
10	Right choice of material.	4.71	4.77	4.74	0.58	VHR
11	Willingness to take risk	3.97	4.49	4.23	0.82	VHR
	CLUSTER MEAN	4.35	4.50	4.44	0.67	HR

The result of table 2 showed that the mean ratings of technicians and technologists on the extent entrepreneurial skills are required by E/E technology graduates ranged from 3.60 to 4.86 and 3.61 to 4.90 respectively. The aggregate mean responses ranged from, 3.91 to 4.88 while the aggregate of standard deviation ranged from 0.26 to 0.94. Hence the result shows that the mean ratings of the items 2,3,4,5,8,9 & 10 were very highly required while items 1, 6 & 7 were highly required as entrepreneurial skills for effective utilization of solar energy for sustainable self employment of E/E technology education graduates in

Enugu Urban. The cluster standard deviation of 0.67 shows that the disparity in the opinion of the respondents on the items is slim.

Hypotheses

H01 There is no significant difference in the mean ratings of ratings of technicians and technologist on the extent of practical skills required for effective utilization of solar energy for sustainable self employment of E/E technology education graduates in Enugu Urban.

Table 3: t-test analysis of mean ratings of technicians and technologists on the extent of practical skills required for effective utilization of solar energy for sustainable self employment of E/E technology education graduates in Enugu Urban

Respondents	No	Aggregate		Df	Lev. of signi.	t-cal	t-criti	Decision
		\bar{x}	SD					
Technicians	29	4.35	0.28	82	0.05	0.67	1.96	Not Signi.
Technologists	55	4.39	0.23					
Total	84							

Table 4 (t-test results) showed that t-calculated value of 0.67 is less than the t-cal value of 1.96 at 0.05 level of significance. These shows that the null hypothesis which stated that there is no significant difference in the mean scores of technicians and technologists show that there is no significant difference between the mean ratings of solar technicians and technologists on extent of practical skills required for effective utilization of solar energy for sustainable

self-employment of E/E technology education graduates in Enugu Urban is not rejected.

H0₂: There is no significant difference between the mean ratings of solar technicians and technologist on the extent entrepreneurial skills required for effective utilization of solar energy for sustainable self employment of E/E technology education graduates in Enugu Urban.

Table 4: T-test analysis between technicians and technologists on the extent entrepreneurial skills required for effective utilization of solar energy for sustainable self-employment of E/E technology graduates in Enugu Urban

Respondents	No	Aggregate		Df	Lev. of signi.	t - cal	t- criti	Decision
		\bar{x}	SD					
Technicians	29	4.50	0.37	82	0.05	0.57	1.96	Not signi.
Technologists	55	4.35	0.30					
Total	84							

Table 4 revealed that t-calculated value is 0.57 while t-critical is 1.96. Therefore since the calculated value is less than the critical t-value, the null hypothesis is not rejected. This implies that there is no significant difference in the mean scores of solar technicians and technologists on the extent entrepreneurial skills required for effective utilization of solar energy for sustainable self-employment of E/E technology graduates in Enugu Urban.

DISCUSSION OF FINDINGS

The findings of the study revealed that entrepreneurial skills like right choice of material, record keeping skills, good accountancy skills, ability to design and accommodate essential needs, material costs, good work attitudinal skills, innovative skills and good managerial skills are required for effective utilization of solar energy for sustainable self employment of E/E technology education graduates in Enugu Urban. These findings are in concordance with results of studies conducted by Agbogidi [21] on entrepreneurial skills required by auto mechanics technology students in technical colleges for establishing small and medium scale enterprise in Delta State. Chilakpu K.O [17], and Akinboro, Adejumbi & Makinde [16] conducted a research on Solar Energy Installation in Nigeria: Observations, projects, problems and solution, the results of research question two identified various skills required for effective utilization of solar energy to which the responses shows that seven skills are very highly required while ten skills are highly required. The analysis does not contradict the emphasis by international labour office [18] as practical skills are required for effective utilization of solar energy.

CONCLUSION

Based on the findings of this study, the technicians and technologists agreed that entrepreneurial skills like right choice of material, record keeping skills, good accountancy skills, ability to desing and accommodate essential needs, material costs, good work attitudinal skills, innovative skills and the likes are very highly required for effective utilization of solar. Secondly, both technicians and technologists agreed that practical skills like ability to draw and interpret designed drawings, ability to

carryout repairs, fault detection, troubleshooting and likes are highly required for effective utilization of solar energy. Therefore it is necessary to teach E/E technology students the practical skills and as well the entrepreneurial skills for solar energy to be effectively utilized for sustainable self employment of her graduates in Enugu Urban.

RECOMMENDATIONS

In view of the findings of this study, the following recommendations are made

1. Government should give more training on the advantages derivable from solar energy technology.
2. Government should fund solar technology researchers and development initiatives in Nigerian universities, polytechnics, colleges of Education (Technical) and research institutes should also be encouraged for the development of efficient solar components through adequate funding by the federal Government.
3. More emphasis on solar entpreneurial and practical skills should be placed in teaching and learning of solar system technology in Nigerian institutions by educational bodies.
4. Emphasis should be made by Government on the strategy for the implementation of solar system should be such as to discourage corruption through workshops and seminars.
5. Government and private individuals should encourage the development of solar system by the provision of finance associated with solar components production and assemblage.

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