



Competencies Needed for Retraining Technical Teachers in Solar Power System to Mitigate the Impact of Climate Change in Enugu State

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Abstract

The study aimed at determining the competencies needed for retraining technical teachers in solar power system. Three research questions guided the study. Three null hypotheses were formulated and tested at 0.05 level of significance. The study adopted descriptive survey research design. There were 34 respondents, (19 technical teachers and 15 Technical Education students) from University of Nigeria Nsukka and Enugu State University of Science and Technology respectively. There was no sampling because the total population was used. The instrument used for data collection was a structured questionnaire faced validated by three experts; two from Technology Education and one from Measurement and evaluation, all from ESUT. A reliability coefficient of 0.71 was obtained using Cronbach Alpha method. The data collected was analyzed using mean with standard deviation and t-test statistic. Recommendations were made among others that industries should be involved in retraining of technical teachers in solar power system.

Keywords: Competencies, Retraining, Technical Teachers, Solar Power System and Climate Change

Introduction

As carbon and other greenhouse gas (GHG) emissions have increased dramatically in the past few decades, the threat of climate change has also grown with enormous demand to mitigate the impact through construction, installation, repairs and maintenance of a solar power system. Solar energy is a renewable, carbon-free resource available in every geopolitical zone of the country Nigeria, with potential to reduce our nation's GHG emissions. Any market or policy proposal to address climate change should include significant development of solar power system to power a clean and affordable economic future. Solar power system technologies are a crucial component of our nationwide effort to curb emissions and achieve ambitious climate goals (Chukwunta, 2017). Solar power system is not just a solution that can help mitigate our impact on the climate; it also contributes to the resilience and reliability of our electric grid, making Nigeria more energy secure in the face of increased natural disasters and powerful storms that become more frequent in a changing climate. Moreover; solar jobs have risen rapidly in the last decade which help in training a prepared and skilled workforce that enables the solar industry to meet growing deployment demands and this has to start with technical teachers in order to gain necessary competencies for training

their respective students in solar power system Immanuel (2020). However, it is not certain that technical teachers possessed the necessary competencies needed for training students in solar power system which has resulted in making their graduate students lack the requisite competencies needed for construction, installation, repairs and maintenance of a solar power system, Enugu state is already facing food shortage due to poor agricultural yields as a result of climate change arising from incessant carbon emission and poor electricity power supply that is free from carbon emission(Chukwunta, 2017). Though, technical college graduates, vocational and technical teachers are among good consumer of solar power system; in agriculture, they use solar power system for teaching and practice of irrigation farming, in electrical/electronic technology, they also use solar power system for teaching and practice of renewable energy generation and utility. Furthermore, in automotive, they use solar power system for teaching and practice of solar power mechanics. Solar power system cars, solar home and industrial powered equipment's have been produced to meet up with the new technological revolution (clean energy) and the quest to mitigate the effect of climate change.

Today technical teachers are known as vocational and technical education teachers, instructing



students in practical career skills in technical colleges and postsecondary educational institutions (Bashir, 2014). In VTE, courses of instruction include Agric education, Business Education, Computer and Robotic education, home economics and Hospitality Management Education, Industrial and Technical education, Entrepreneurship education (Faculty of VTE, University of Nigeria Nsukka 2022). In VTE also, vocational classes are highly focused on a specific career path to develop students' skills and preparation for the workforce due to the fact that expert-level skill in their subject is essential for vocational teachers. Moreover, the ability to communicate well with the age group of their students is also very important. In addition, younger students will need more of a supervisory instructor, while older students will often need mentoring or counseling depending on the grade level taught, that would help the vocational teacher to impart an increasingly detailed level of knowledge and the goal of a career and technical education teacher is to equip students with the skills and tools they will need to enter a particular occupation (solar power system) Umar (2014). It is important to note that climate change is a global problem and Enugu state is not in exception. The use of clean energy (solar power system) will help to mitigate the impact of climate change but unfortunately, there is a smaller number of retrained technical teachers in solar power construction, installations, maintenance and repair. Technical Teachers require the competence for proper training of their students in solar power system, the same applicable to students on completion of the training. Technical colleges need competent technical teachers in solar power construction, installations, maintenance and repair. Therefore, it became imperative to identify the competences for retraining technical teachers in solar power system to mitigate the impact of climate change in Enugu state.

Importantly, retraining is the redevelopment of one's capabilities on a job or chosen occupation, retraining, according to Umar (2014), means reequipping individuals with saleable skills in order to be self-employable. Indeed, technical teachers have helped to absorb thousands of Nigerian youths, especially the illiterates and some school drop-outs into useful employment. Consequently, these technical teachers are very useful in the developmental needs of the society. According to Robert (2015) Americans

depended primarily upon the competences of the technical teachers. This is because the technical teachers are viable in their job performances when they have gotten the required competencies. Observation revealed that 53 percent of the technical teachers in Enugu state lack the relevant competencies needed for installation, repair and maintenance of a solar power system (Chukwunta, 2017). Moreover, training of technical teachers started when Nigeria signed a bilateral agreement with the government of United States in 1981 to train 500 technical teachers annually for a period of 10 years and the agreement was reviewed after running the programme for six years and the training commenced locally in selected universities in the country with the Department of Technology, Science and vocational Education. Since then, new technologies (Renewable energies) continue to emerge without updated retraining of technical teachers; the involvement of industries in retraining technical teachers remains a missing link in Nigeria technical and vocational education, subject units like solar power system installation, repair and maintenance that falls under electrical installation and maintenance were neglected totally and thought with deficient competencies due to lack of updated retraining by experts from the industries Robert (2015).

Competency is a standardized requirement for an individual to properly perform a specific job. Competences are ability to possess suitable and sufficient skills, knowledge and experience for carrying out a particular task (Olaitan, 2010). Olaitan further stated that competency is the knowledge, skills, attitude and judgment which one requires in order to perform successfully at a specified proficiency in any given work. In the context of this study, competency is the capacity of a technical teacher to effectively design, construct, install, maintain and repair a solar power system. In this study, technical teachers are expected to possess the skills and knowledge required for constructing, installing, maintaining and repairing a solar power system; where this is lacking, competencies are needed. This could be the reason why the area under review/study experiences the lesser use of clean and alternative energy in the delivery of vocational and technical education programme and other sectors in Enugu state as a precaution to mitigate the impact of climate change. It therefore follows that technical teacher require the following competencies:

1. Construction of solar power system
2. Installation of solar power system
3. Repair and Maintenance of solar power system

Notably, solar power system technologies harness the energy of solar irradiance to produce electricity. Currently, there are principally two technologies employed: photovoltaic (PV) and concentrating solar power (CSP) technologies. PV generates electricity using the conducting properties of certain chemicals most importantly silicon, through the photo-electric effect. CSP makes use of reflectors to focus sunlight on a small area, in order to generate steam that powers a thermal electric plant. In addition to electricity generation, solar power is employed to produce thermal energy like heating or cooling, either through passive or active means, to meet direct lighting needs and potentially, to produce fuels that might be used for transport and other purposes. Solar energy as a course of studies is yet to be introduced in departments and faculties of vocational and technical education in Enugu state; this makes it more difficult to produce competent technical teachers to meet up with the global quest for mitigation of climate change through the use of clean energy like solar power system. Amadi & Izuegbunam (2016) confirmed that the temporal profile of solar energy output correlates relatively well with energy demands.

Thus, the general purpose of the study was to determine the competencies needed for retraining technical teachers in solar power system to mitigate the impact of climate change in Enugu State. Specifically, the study sought identifies competencies needed in:

1. solar power system construction;
2. solar power system installation
3. solar power system repair and maintenance

Research Questions

The following research questions guided the study

1. What are the competencies needed by technical education teachers in solar power system construction?
2. What are the competencies needed by technical education teachers in solar power system installation?
3. What are competencies needed by technical education teachers in solar power system repair and maintenance?

Hypotheses

The following null hypotheses were formulated and tested at 0.05 level of significance.

1. There is no significant difference between the mean ratings of technical education teachers and technical education students on the competency needs of technical teachers in solar power system construction.
2. There is no significant difference between the mean ratings of technical education teachers and technical education students on the competency needs of technical teachers in solar power system installation.
3. There is no significant difference between the mean ratings of technical education teachers and technical education students on the competency needs of technical teachers in solar power system repair and maintenance.

Method

The study aimed at determining the competencies needed for retraining technical teachers in solar power system to mitigate the impact of climate change in Enugu State. Three research questions guided the study. Three null hypotheses were formulated and tested at 0.05 level of significance. The study adopted descriptive survey research design because the researcher needed the opinion of technical education teachers and students on construction of solar power system, installation, repair and maintenance. There were **34** respondents, (**19** Technical Education Teachers and **15** Technical Education students) from University of Nigeria Nsukka and Enugu State University of Science and Technology respectively. The choice of selecting the two universities in Enugu is because they have department/faculty of vocational and technical education representing the position of state government owned institution and federal as well. The instrument used for data collection was a questionnaire titled: Competencies in Solar power System Construction, Installation, Repair and Maintenance (CSPSCIRM), the items statements was structured in a four-point rating scale of Highly Needed (HN), Moderately Needed (MN), Needed (N) and Not Needed (NN) with weighting values 4,3,2, and 1 point respectively. The instrument contains three sections with eight clusters each. The instruments were validated by three experts; two from Technology and Vocational Education Department and one from Measurement and evaluation option of

Department of Science and Computer, all from ESUT. A reliability co-efficient of 0.71 was obtained using Cronbach Alpha. Copies of questionnaire were distributed, completed and returned, hence representing 100 percent return rate. Mean and standard deviation were used to answer the research questions while t-test statistics was used to test the null hypotheses at 0.05 level of significance; Thus, for research questions, any item with a mean score of 2.50 and above was regarded as moderately needed

while items with mean score below 2.50 was regarded as not needed. For the null hypothesis, when the t-calculated value was equal to or greater than the t-critical value, the null hypotheses was rejected, otherwise it was not rejected.

Results

The results are presented in tables according to research questions and hypotheses.

Table 1: mean ratings with standard deviation of the respondents on competencies needed by technical education teachers in solar power system construction.

S/N	Item Statements	19 Technical Education Teachers			15 Technical Education Students		
		X	SD	Decision	X	SD	Decision
		1	Choosing the right solar panel frame	2.58	0.71	MN	2.80
2	Measuring appropriate size of the solar panel frame	3.00	0.82	MN	2.88	0.46	MN
3	Appropriate Cutting, framing, reverting or welding of the solar panel frame	2.97	0.54	MN	3.01	0.70	MN
4	Safety against electric shock during welding	2.66	0.91	MN	2.60	0.41	MN
5	Appropriate Mounting of the solar panel frame	2.78	0.93	MN	2.85	0.96	MN
6	Safety in climbing the solar panel frame	3.05	0.82	MN	3.02	0.89	MN
7	Safety in mounting the solar panel	2.55	0.86	MN	2.79	0.51	MN
8	Appropriate use of tools	2.93	0.94	MN	2.83	0.95	MN
	Cluster mean	2.86	0.82	MN	2.85	0.67	MN

The data presented in Table 1 showed that all the eight items had mean score above the cut off mean of 2.50 indicating that all item statement in table 1 is

competencies needed by technical education teachers in solar power system construction. The values of their standard deviation are also homogenous.

Table 2: Mean ratings with standard deviation of the respondents on the competencies needed by technical education teachers in solar power system installation

S/N	Item Statements	19 Technical Education Teachers			15 Technical Education Students		
		X	SD	Decision	X	SD	Decision
		1	Design the solar system actual and real power	2.58	0.71	MN	2.80
2	Calculated the charging efficiency	3.00	0.82	MN	2.88	0.46	MN
3	Calculate load efficiency	2.97	0.54	MN	3.01	0.70	MN
4	Include protective circuits	2.66	0.91	MN	2.60	0.41	MN
5	Choosing the right solar panel, batteries, racket, inverter and charge controller	2.78	0.93	MN	2.85	0.96	MN
6	Connecting batteries to the charge controllers through the solar panel according to specified voltage of the inverter	3.05	0.82	MN	3.02	0.89	MN
7	Safety against short-circuit damage	2.55	0.86	MN	2.79	0.51	MN
8	Confirm the input and output voltage with a multi-meter	2.93	0.94	MN	2.83	0.95	MN
	Cluster mean	2.86	0.82	MN	2.85	0.67	MN

The data presented in Table 2 showed that all the eight items had mean score above the cut off mean of 2.50 indicating that all item statement in table 2 is

competencies needed by technical education teachers in solar power system installation. The values of their standard deviation are also homogenous.

Table 3: mean ratings with standard deviation of the respondents on competencies needed by technical education teachers in solar power system repair and maintenance.

S/N	Item Statements	19 Technical Education Teachers			15 Technical Education Students		
		X	SD	Decision	X	SD	Decision
		1	Off the solar power system for maintenance	2.58	0.71	MN	2.80
2	Clean the solar panels with appropriate tools	3.00	0.82	MN	2.88	0.46	MN
3	Trace the charging voltage with a multi-meter	2.97	0.54	MN	3.01	0.70	MN
4	Evaluate the batteries with life tester	2.66	0.91	MN	2.60	0.41	MN
5	Replace faulty components	2.78	0.93	MN	2.85	0.96	MN
6	Detect fault and cause with diagnostic instruments	3.05	0.82	MN	3.02	0.89	MN
7	Reset the charge controller appropriately	2.55	0.86	MN	2.79	0.51	MN
8	Reinstall the whole solar power system to obtain the initial parameters	2.93	0.94	MN	2.83	0.95	MN
Cluster mean		2.86	0.82	MN	2.85	0.67	MN

The data presented in Table 3 showed that all the eight items had mean score above the cut off mean of 2.50 indicating that all item statement in table 3 is competencies needed by technical education teachers in solar power system installation. The values of their standard deviation are also homogenous.

Discussion

The result of the study revealed that technical teachers in Enugu State required eight (8) competency items to enable them train their students in solar power system construction. Certainly, construction is a necessary process in solar power system which involves a very strong technical skill in fabrication of the solar panel frame, safety in reverting or welding and lots more. Findings on construction as a competence in solar power system and its corresponding items were in agreement with the view of Olaitan, (2010) that all the identified corresponding items are based on skill acquired. Similarly, the result of the study revealed that technical teachers in Enugu State required eight (8) competency items to enable them train their students in solar power system installation. Actually, installation of solar power system is a necessary process which comes after the construction stage. It involves assembling of all the solar power system parts using the constructed platform. Findings on installation as a competence in solar power system and its corresponding items were in agreement with

the view of Chukwunta, (2017) that all the identified corresponding items are the reason 53 percent of the technical teachers in Enugu state lack the relevant competencies needed for installation, repair and maintenance of a solar power system.

Also, the result of the study revealed that technical teachers in Enugu State required eight (8) competency items to enable them train their students in solar power system repair and maintenance. Factually, repair and maintenance in solar power system is a necessary process which comes after all other processes. It involves a routine prevention of faults and malfunctioning of the system via a systematic repairs and maintenance culture. Findings on repair and maintenance as a competence in solar power system and its corresponding items were in agreement with the view of Amadi and Izuegbunam (2016) that all the identified corresponding items ensures the temporal profile of solar energy output correlates relatively well with energy demands due to availability of well-trained experts to take up repair and maintenance challenges manifesting after construction and installations.

Conclusion

Most technical teachers in Enugu State focused on other areas of Electrical Installation and Maintenance thereby neglecting the teaching of solar power system construction, installation, repair and maintenance as an integral part of Electrical Installation and



Maintenance due to lack of requisite skills as a result of little or no updated training in solar power system construction, installation, repair and maintenance.

Recommendations

1. As a special problem area, government should revisit the curriculum of technical colleges and other tertiary institutions that produces technical teachers to ensure that the teaching of solar power system construction, installation, repair and maintenance is been implemented by the technical teachers in Enugu state.
2. Saying by doing conforms to skills, process and knowledge in solar power system, trainer should possess these competencies as identified in this study
3. It is time for government and all the stake holders in vocational and technical education (VTE) to establish a well-structured policy that will enable industries and vocational centers to participate in the retraining of technical teachers in Enugu State.

References

- Amadi,U.A. and Izuegbunam, S.T.(2016). Skills needed by youths in plant service and maintenance in abia state metropolis. "Vocational and Technical educators of Nigeria" (JAVTEN) 20, (2),
- Bashir, S. N. (2014) *Strategies for teaching transformer winding and installation*. Enugu: Pan-Africa Publishers.
- Chukwunta, O.U. (2017). Mechanism for improving alternative energy in Enugu State Metropolis.

Vocational and Technical Educators of Nigeria (JAVTEN) 20(3).

Faculty of Vocational Technical Education, University of Nigeria Nsukka. (2022) Departmental Courses and Programmes

Blueprint Online Newspaper (2009). Retrieved from <https://www.blueprint.ng/%EF%BB%BFfg-resuscitates-technical-teacher-training-programme/> 8-9

Oliatan, S.O. (2010). *Vocational and technical education in Nigeria-Issues and analysis*:Onitsha. Noble graphic press.

Orji, M.A (2008). *New approaches to technical and vocational Education*. Presented being a paper at ETF zonal sensitization workshops on the importance of technical and vocational education (TVE). Kano. Feb. 3rd and 7th

Robert, A. E. (2015). Job skills required by youths in renewable energy in anambra state. Journal of Association of Vocational and Technical Educators of Nigeria (JAVTEN), 20(1), August 2015.

Umar, C.N. (2014). *Competencies required for construction of integrated electricity supply for irrigation farming in Enugu North Local Area*. *American Journal of Educational Research*.2.

Immanuel N.M. (2020). Competences required for training artisans in transformer windings: Academia in perspective. *Multidisciplinary journal of academic research* 5(1), ISSN: 2545-5001 Published by forum of academics for educational advancement and initiative in Nigeria (FAFEAIN) page 123-137