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# Developing Competences for Retraining Technical Teachers in Solar Energy (Power) System: Impact on Technical Education Curriculum

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**Abstract:** *The study aimed at developing the competences for retraining technical teachers in solar power system to mitigate the impact of climate change in Abia State. Three research questions guided the study, descriptive survey design using an un-sampled total population of thirty four (34) expert workers of fine brothers Nigeria Limited in Abia State was used. Structural questionnaire comprising twenty four (24) question items which was face validated by three experts, two from technology and vocational education department and one from measurement and evaluation was used for data collection. The reliability coefficient using cronbatch Alpha method was established at 0.71. The data was analyzed using differential statistics of mean and standard deviation. The result revealed that all the competences for retraining on solar power system recorded a cluster mean of 2.86 above 2.50 and found out that technical teachers in the area studied require those competencies for construction, installation and maintenance of solar power system while neglecting the teaching and developing those competencies due to dearth of requisite skills and recommended a revisit of the technical education curriculum designers to include those skills, experiences and competencies needed for effective teaching of solar power system construction*.

**Keywords:** Competencies, retraining and solar power system.

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## INTRODUCTION

Green house gas emission has drastically increased in the past decade, causing threat on the climate change. Solar energy is a renewable carbon free resources available in every geo-political zones in the country.

Nigeria with its enormous potential to reducing nation's Green House Gas (GHG) emissions, any market or policy proposal to address climatic changes should integrate cogent development of solar power system to power a clean and affordable economic future. Solar energy technologies are crucial component of national efforts to curbing emissions and achieve much needed technical developmental goals. Solar power contributes to resilience and reliability of our electric grid, making Nigeria energy secure in an increased natural disasters, storms that become more frequent in climatic changes.

Recently solar job opportunities are rapidly increasing to train and develop competences in technical teachers, this call for technical education curriculum planners to develop content that will pre-dispose the teachers to gain the needed competences to educate their students in that direction.

Training and preparing skill work force enables solar industries to meet growing deployment demands, that starts with developing necessary competences in technical teachers for training their respective students in solar energy system. Some southeast states of Nigeria are facing food shortage due to climatic changes, shortage of forest reserves and carbon emission resulting from human activities rising to unclean energy. Technical College graduates, vocational and Technical Teachers are among consumers of power in agriculture, (Irrigation farming), electrical/ electronics technology, teaching, practice of renewable energy generation, utility

automotive and mechanics. Developing competences in solar energy system to produce cars, solar homes and Industrial power/Industrial prowess requirement have become necessary to meet up with the new technological revolution (clean energy) and en pass on technical education curriculum. Technical teachers have opined with Bashair (2014) are also known as vocational and technical education (VTE), Teachers instructing students in practical career skills in technical colleges and post educational institutions. courses of instruction including electrical installations, maintenance, auto repair, welding, agricultural education (food storage), cosmetology, business, agric business, computer technology and more.

Technical education classes are highly focused on a specific career path to develop student's skill and preparation for work force. Naturally, vocational education warrants essential expert level communication skills to interact with varying age groups, is of utmost important during supervisory, counseling and mentoring activities. The goal of a career and technical education teacher is to equip students with the skills and needed tools to enter solar power system as an occupation. It is worthy to note that global warming is a global problem, the use of clean energy (solar power system) helps to mitigate the impact of climate change, unfortunately there is less number of re-trained technical teachers in solar power design, construction, installation, maintenance and repair.

Technical teachers require the adequate competences to properly train their students in solar power system, the same applicable to student in completion of the training. Technical colleges needed competent teachers in solar power design, construction, installation, maintenance and repair. Therefore it become imperative to identify and develop the competences for retraining technical teachers in solar power system to mitigate the inpact of climate change. Re-training is the re-developing of ones capacities on a job or chosen occupation, re-training according to Umar (2014) signifies, re-equipping individuals with sellable skills for safe employment. Actually technical teachers has helped to absorb thousand s of Nigerian youths especially the illiterates and some school drop-outs into useful employment. Consequently, these technical teachers are very useful in developmental needs of the society, similarly Robert (2015) opined that early Americas depended primarily on the competences of the viable technicians on their job performance having developed the required competences. Observations showed that 53% of the technical teachers in the Nigerian schools lack the relevant competences needed for installations, repair and maintenance of a solar power system as it was in the opinion of Chukwunta (2017). Training was orchestrated by Nigerian government, signing a bilateral agreement with United States government in 1981 to train 500 technical teachers annually for a periods of ten years, which was reviewed after six years. The programme commences with selected universities in the countries in the department of Technology, Science and Vocational Education. Thereafter new technologies (Renewable Energy) emerged without up-date retaining of technical teachers. The industries involved in retraining remains a missing link in Nigerian technical and vocational; education, subject units (solar power system installation, repair and maintenance) that falls under electrical installation and maintenance were aptly neglected or taught with deficient competences due to lack of up-date retraining of experts from industries.

Competence is a standardized requirement for an individual to properly perform a specific job. It is the ability to possess suitable and sufficient skills, knowledge's and experiences for carrying out a particular task Olaitan (2010), further stated that competences are knowledge, skills, attitudes and judgment one requires to successfully perform with specified proficiency in a given task. Within the edge of this paper, competences is needed capacity of a technical teacher to effectively design, construct, install, maintain and repair a solar power circuit. Technical teachers are expected to possess the skills and needed knowledge for designing, redesigning, constructing, installing, maintenance and repairs a solar power system. Obviously, the lack makes Nigerian society experience the lesser use of clean and alternative energy in the delivery of vocational and technical education programmes to mitigate the climatic impact. It is expedient that technical tutors require to develop the underlisted competences in the construction of solar power system installation, solar power system repairs and maintenance.

Technologies in solar power system harness the energy of solar irradiance to produce electricity. Presently there are two principal technologies employed; photo voltanic (PV) and concentrating solar power (CSP), Photo voltanic uses the conducting properties of chemicals like silicon to generate electricity through the photo electric effect; while CSP used reflectors targeting on sun light in a designated area to generate steams to power a thermal electric plant. Electricity generation, solar power is effectively employed to produce terminal energy (heating or cooling through passive or activeness) to meet the lighting needs and potentially produce fuel. Solar energy according to Amadi and Izuegbulam (2016) is variable to some degree unpredictable and solar irradiance significantly varies with geographical locations, however the temporal profile of solar out-put relatively correlates well with energy demands.

## STATEMENT OF THE PROBLEM

Competences are standardized requirement for an individual to properly perform a specific job, the ability to possess suitable, sufficient skills, knowledges and experiences for carryout a particular task as in the opinion of Olaiton (2010), it is the knowledge, skills, attitude and judgment required to successfully perform with certified proficiency in designing, constructing, installing and

maintenance of solar power circuit which is needed in solar energy production, this may account for the Nigerian less use of clean and alternative energy in the delivery of vocational and technical education programmes. Obviously, the technical teachers needed the competences in construction, maintenance and repairs in solar power system to train technical teachers to produce the efficient trainee to meet the lighting needs and the potentially produced fuel solar energy that would correlate well with energy demands. Do the technical teachers had the needed competences to retrain teachers? Is the curriculum content adequate for developing the competences? The problem therefore is how to equip and develop the technical teachers, the adequate competences in solar power to able to retrain the teachers in solar power system.

**PURPOSE OF STUDY:**

The study is targeted to develop competences for retraining technical teachers in solar power system to mitigate the climatic impact in the society. Specifically, the study sought to develop the three competences for retraining technical teachers in construction, installation, repairs and maintenance in solar power system.

**RESEARCH QUESTIONS:**

The following research questions were posited

- What is the competency for construction of solar power system?
- What is the competency for installation of solar power system?
- What is the competency for the repairs and maintenance of solar power system.

**METHODS**

The study aim at determine the competency for retraining technical teachers in solar power system to mitigate climate change and its implication for technical curriculum. Three research questions guided the study, while three null hypotheses were formulated and tested at 0.05 level of significance. Descriptive survey design was adopted and population comprise 19 solar power system experts working with blue planet engineering Limited in Abia State and 15 solar power system experts working with Fine Brothers Limited also in Abia State. The population of the study was 34, while instrument for data collection was a questionnaire for developing competences for retraining technical teachers (QDCRT$^2$) consisting structure items in a four point rating scale of strongly agree (SA), Agree (A), Disagree (D) and strongly Disagree (SD) waited at 4, 3, 2 and 1 points respectively. The instrument was validated by three experts, 2 from technology and professional educational department and one from measurement and evaluation, option of depart of computer science. A reliability co-efficient of 0.71 was obtained using Cronbach Alpha questionnaires were distributed, completed and all returned, representing 100% return rate. Mean with standard deviation was used to answer the research questions and t-test statistics was used to test hypothesis at 0.05 level of significance. Thus for technical questions, any item with a mean score of 2.50 and above was regarded as agreed while items with mean score below 2.50 was regarded as disagree. For the null hypothesis, when the t-calculated value was equal to or greater than the t-critical value, the null hypothesis was rejected otherwise it was accepted.

**RESULT PRESENTATION**

The results were presented in tables according to research questions and hypothesis.

**RESEARCH QUESTION 1:**

What is the competency for construction of Solar power system

**Table 1:** Mean rating with standard deviation of the respondent on construction competency of solar power system

| Solar power system construction competency | Solar power system experts | | | Technical teachers | | |
|---|---|---|---|---|---|---|
| | X | SD | DECISION | X | SD | DECISION |
| a. Choose the right solar panel frame | 2.88 | 0.71 | Agree | 2.80 | 0.50 | Agree |
| b. Measuring appropriate size of the solar panel frame | 3.00 | 0.82 | Agree | 2.88 | 0.46 | Agree |
| c. Appropriate cutting, framing, reverting or welding of the solar panel frame. | 2.97 | 0.54 | Agree | 3.01 | 0.70 | Agree |
| d. Safety against electric shock during welding | | | | | | |
| e. Appropriate mounting of solar panel frame. | 2.66 | 0.91 | Agree | 2.60 | 0.41 | Agree |
| f. Safety in climbing the solar panel frame. | 2.78 | 0.93 | Agree | 2.85 | 0.96 | Agree |
| g. Safety in mounting the solar power panel. | 3.05 | 0.82 | Agree | 3.02 | 0.89 | Agree |
| h. Appropriate use of tools. | 2.55 | 0.86 | Agree | 2.79 | 0.51 | Agree |
| i. Cluster mean | 2.93 | 0.94 | Agree | 2.83 | 0.95 | Agree |
| | 2.86 | 0.82 | Agree | 2.85 | 0.67 | Agree |

The above table showed that all the 8 items had mean score above cut-off mean score of 2.50 indicating that all items statement in table 1 on construction competency in solar power system, the value of standard deviation are homogeneous.

**RESEARCH QUESTION 2:**

What is the competency in solar power installation

**Table 1:** Competency in Solar Power Installation

| **Solar power system installation competency** | **Solar power system experts** | | | **Technical teachers** | | |
|---|---|---|---|---|---|---|
| | X | SD | DECISION | X | SD | DECISION |
| a. Design the solar system actual and real power | 2.58 | 0.71 | Agree | 2.80 | 0.05 | Agree |
| b. Calculated the charging efficiency. | 3.00 | 0.82 | Agree | 2.88 | 0.46 | Agree |
| c. Calculating the load efficiency | 2.97 | 0.54 | Agree | 3.01 | 0.70 | Agree |
| d. Include protective circuit. | 2.66 | 0.91 | Agree | 2.60 | 0.41 | Agree |
| e. Choosing the right solar panel batteries, racket, inverter and charge controller. | 2.78 | 0.93 | Agree | 2.85 | 0.96 | Agree |
| f. Connecting batteries to the charge controllers through the solar panels according to specified voltage of the inverter. | 3.05 | 0.82 | Agree | 3.02 | 0.89 | Agree |
| g. Safety against short-circuit damage. | 2.55 | 0.86 | Agree | 2.79 | 0.51 | Agree |
| h. Confirm the in-put and out-put voltage with multimeter. | 2.93 | 0.94 | Agree | 2.83 | 0.95 | Agree |
| i. Cluster mean | 2.86 | 0.82 | Agree | 2.85 | 0.67 | Agree |

**RESEARCH QUESTION 3**

What is the competency in the repairs and maintenance of solar power installation

**Table** 3: Mean rating with standard deviation of the respondents on repair and maintenance competency in solar power system

| Solar power system repair and maintenance competency | Solar power system experts | | | Technical teachers | | |
|---|---|---|---|---|---|---|
| | X | SD | DECISION | X | SD | DECISION |
| a. Off the solar system for maintenance. | 2.58 | 0.71 | Agree | 2.80 | 0.05 | Agree |
| b. Clean the solar panel with appropriate tools. | 3.00 | 0.82 | Agree | 2.88 | 0.46 | Agree |
| c. Trace the charging voltage with multi-meter. | 2.97 | 0.54 | Agree | 3.01 | 0.70 | Agree |
| d. Evaluate the battery with life tester. | 2.66 | 0.91 | Agree | 2.60 | 0.41 | Agree |
| e. Replace faulty components. | 2.78 | 0.93 | Agree | 2.85 | 0.96 | Agree |
| f. Detect fault and cause with diagnostic instrument. | 3.05 | 0.82 | Agree | 3.02 | 0.89 | Agree |
| g. Rest the change controller appropriately. | 2.55 | 0.86 | Agree | 2.79 | 0.51 | Agree |
| h. Restore the whole solar power system to obtain the initial parameters. | 2.93 | 0.94 | Agree | 2.83 | 0.95 | Agree |
| i. Cluster mean | 2.86 | 0.82 | Agree | 2.85 | 0.67 | Agree |

The data presented and analyzed in table 3 above showed that all the eight items had the mean score above the cut-off mean of 2.50 indicating that all items statement in the table 3 above is needed competence in repairs and maintenance in the solar power system.

**DISCUSSION OF THE RESULTS**

**Construction competency.**

The result on research question 1 on construction competency revealed that technical teachers in Abia State require the eight (8) competent items to enable them train their students in solar system construction for sure, construction is necessary in solar power system that involves strong technical skills in fabrication of the solar panel frames, safety in reverting or welding. Findings on construction competency and its corresponding items are based on skills acquired.

**Installation Competency**

The result of the study reveals that technical teachers require the eight (8) competency items to aid them train students in solar power system installation. It is explicitly clear that installation is inevitable process that precedes construction stage involving assemblage of all the solar power system parts using the constructed platform.

Findings further showed that installation competence and its corresponding items were in tandem with the view of Chukwunta (2017); that all the identified corresponding items are the reason 35% of the technical teachers used for the study lack relevant competency required for installation, repairs and maintenance of solar power system.

**Repair and Maintenance Competency:**

The result of the study aptly showed that technical teachers required to develop eight (8) competence items to train students in solar power system, repair and maintenance. Repairs and maintenance competences are important process preceding all other processes and involves a routine prevention of faults and malfunctioning of system through a systematic repairs and maintenance culture.

Findings on the competence in solar power system were in agreement with the view of Amadi and Izuegbunam (2016); that all identified corresponding items ensured temporal profile of solar energy out-put correlates relatively well with energy demands due to available well trained experts to man the repair and maintenance challenges manifesting preceding construction and installation.

## CONCLUSION

Researcher mirrored from the findings and aptly concludes that most technical teachers in educational level where the subjects are domiciled, concentrated on other areas of the subject unit (electrical installation and maintenance) and abandoned the teaching of solar power system construction, installation and maintenance as an integral part of electrical installation and maintenance due to dearth of requisite skills.

## RECOMMENDATION:

Since this has been identified as a special curriculum problem, therefore the technical education curriculum planners at technical colleges and tertiary institutions should re-visit the process to ensure the inclusion of the learning experiences when acquired and developed would foster adequate technical education curriculum delivery and implementation on solar power system: construction, installation and maintenance in all levels of Nigerian schools to equip the technical teachers with necessary skills, knowledge, predisposing them to become trainer trainees in the competences as identified in the study.

The Government and stake holders, NGOs for form a policy-link with industries and vocational centres to participate in retaining of technical teachers and empowering the youths with entrepreneurial skill in construction, installation, repairs and maintenance of solar power system to create jobs for teeming unemployed youths. The recommendation is in tandem with Ogbonna (2020, 2021) in qualitative entrepreneurial programme; A Road map to fighting graduate un-employability in South east Nigeria and inclusive entrepreneurial ship education, post basic education, issues and challenges and solutions.

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