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Off-grid Solar Power Mock-up

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Abstract - *Learning is the key to success that provides a comfortable life to mankind. It opens the portal of advanced technology. It leads man to invent and develop devices that make life easier. Theory alone is not enough to develop skills among students. The lack of instructional devices becomes an obstacle for hands-on training of the learners. This research study aimed to design and develop an Off-grid Solar Power Mock-up and to determine the level of performance and the acceptability level of the device. The study was conducted at Bohol Island State University–Main Campus, Tagbilaran City in the Academic Year 2015-2016. The researcher made use of the experimental design and followed some procedure in the assembly of the device. Questionnaire was used in gathering the data relevant to the acceptability of the device. The performance level was obtained with the aid of an observation guide. The researcher chose twenty (20) technical experts to validate the performance level and to assess the acceptability level of the device. Twenty (20) BS Electrical Technology and BS Electrical Engineering students underwent the skill test to determine the level of effectiveness of the Off-grid Solar Power Mock-up. Based on the results of the study by using the device revealed that the students' performance rating was increased by 25.92%. It also revealed that the device is an effective tool for instruction in BS Electrical Technology and BS Electrical Engineering subject. The device got a high rate in the effectiveness level and performed well. Therefore, it could enhance the skill competency of the students and improve the quality of instruction in the workshop environment.*

Keywords – solar, mock-up, performance, acceptability, effectiveness

INTRODUCTION

Technology has been invading our lives today. Everything that moves without life such as robots, machines are operated with the use of electricity. Electricity has become quite common in today`s world (Durham, 2011) [1]. Everybody loves what it can do and loves the level at which it is being used. Solar power can supplies electricity to any electronic devices. Solar technology can supply electricity to consumers especially those who are far from the power grid. The advantage of using solar technology is that people don`t have to buy fuel or gas to operate instead to just expose the solar panel to the sunlight.

The reason why solar technology is essential is probably as diverse as the different types of generators on the market. It is also linked to preparedness where the event of a power shortage and the ability to carry power to a location where none is available (McKenney, 2010) [2].

This Off-grid Solar Power Mock-up can generate electricity by absorbing solar energy that passes to the power control and inverter that convert 12 volts D.C. to 220 A.C. (Nof, 2010) [3]. This Solar Generator helps to save energy and help people not to pay the electric bill. This generator operates with the use of sunlight which is very abundant, free, and with no harmful effects. Future's electric generation facilities which are economical, reliable, safe, and environment-friendly might be a step closer through this kind of study.

METHOD/S

The study employed the pre-skill test and post-skill test experimental design. After the assembly of the device, pre-skill test and post-skill test design was used in measuring the

change of the outcome before and after an intervention was implemented. The purpose in a pre-skill test and post-skill test experiment was to perceive if the treatment would improve the learning of the participants. The researcher tested the performance of the Off-grid Solar Power Mock-up through observation guide. After the experiment, a questionnaire was made for the gathering of data which is needed to obtain the necessary information in determining the acceptability level of the Off-grid Solar Power Mock-up. The study was conducted at Bohol Island State University Main-Campus in the academic year 2015-2016. The said institution is located along # 76 Carlos P. Garcia North Avenue, Tagbilaran City. It is the only State University in the Province of Bohol that offers Technical courses such as Electrical and Electronics Technology and Engineering.

The researcher chose twenty (20) technical experts to validate the performance level and to assess the acceptability level of the mock-up. Twenty (20) BS Electrical Technology and BS Electrical Engineering students underwent the skill test to determine the level of effectiveness of the Off-grid Solar Power Mock-up.

RESULTS AND DISCUSSION

This contains the presentation of data gathered by the researcher from the respondents. The results of the study were presented according to the specified questions. The presentation of data was supported with tables which illustrated the responses of the study to the performance of the Off-grid Solar Power Mock-up as well as its acceptability level.

The gathered data had undergone due process thru statistical treatment before it was interpreted. The following were the description of the Off-grid Solar Power Mock-up in term of its preparations, procedures, and materials.

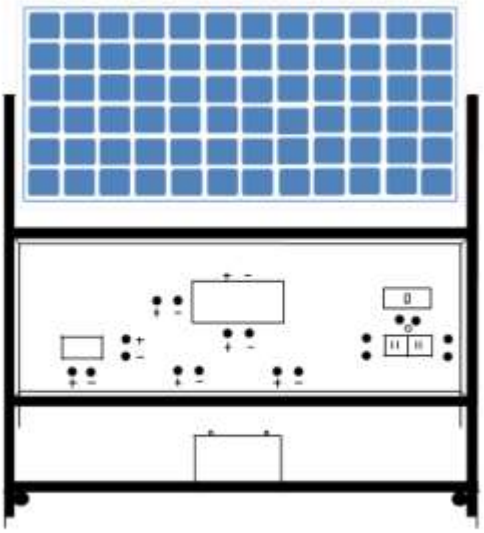

Figure 1. Perspective View of the Off-grid Solar Power Mock-up

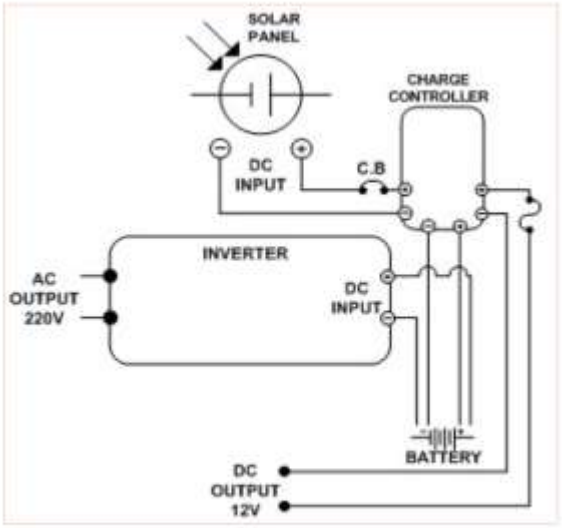

Figure 2. Schematic diagram of the Off-grid Solar Power Mock-up

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The Performance of the Off-grid Solar Power Mock-up

Table 1. Time of charging 30Ah Deep Cycle Battery in different weather condition

Trials	Type of Weather	Time of the day	Solar Panel max. voltage output	Charge controller max. voltage output	Hours of charging 30Ah battery	Interpretation
1	Cloudy	7:30 am- 10:30 pm	17.2V	12.4	10	Functional
		12:00 pm - 1:00 pm	17.4V	12.4	7	Functional
		1:30 pm - 4:30 pm	17.4V	12.4	9	Functional
	Sunny	7:30 am - 10:30am	17.3V	12.4	9	Functional
		12:00 pm - 1:00 pm	17.5V	12.4	6	Functional
		1:30 pm - 4:30 pm	17.4V	12.4	9	Functional
2	Cloudy	8:00 am - 11:00 am	17.3V	12.4	9	Functional
		12:00 pm - 1:00 pm	17.5V	12.4	7	Functional
		1:00 pm - 4:00 pm	17.4V	12.4	9	Functional
	Sunny	8:00 am - 11:00 am	17.4V	12.4	9	Functional
		12:00 pm - 1:00pm	17.5V	12.4	6	Functional
		1:00 pm- 4:00 pm	17.5V	12.4	9	Functional
3	Cloudy	7:30 am - 10:30 am	17.3V	12.4	10	Functional
		12:00 pm - 1:00 pm	17.4V	12.4	7	Functional
		1:30 pm - 4:30 pm	17.4V	12.4	9	Functional
	Sunny	7:30 am - 10:30 am	17.4V	12.4	9	Functional
		12:00 pm - 1:00 pm	17.5V	12.4	6	Functional
		1:30 pm - 4:30 pm	17.4V	12.4	9	Functional

Table 1 shows the functionality of the Off-grid Solar Power Mock-up in terms of charging the 30 Ah deep cycle battery in different weather conditions.

In the first trial, the researcher tested the maximum output voltage of the Solar panel using a Voltmeter and tested in different weather conditions. In a cloudy day, the device was tested in three different sessions, morning, noon and afternoon, the output of the solar panel is 17.2V,17.4V and 17.4V respectively. In a sunny day, in the morning, the maximum output voltage of the solar panel is 17.3V, in the noontime 17.5V and in the afternoon was 17.4V. The researcher was not yet convinced on the first trial. That is why the researcher made a second and third trial. The researcher found out that the result in the second and the third trial was almost the same with the first trial. The researcher concluded that the solar panel was functional.

The researcher tested the time of charging the 30 Ah battery. Thus, in the first trial, the researcher tested the charging rating in two different weather conditions which was a cloudy and sunny day. During the first trial, the researcher observed that the hours of charging of the battery were different. It was found out that it takes 7 to10 hours of charging during the cloudy day while 6 to 9 hours during a sunny day. The researcher again made a second and third trial, and the results were still the same from the first trial where the hours of charging of the battery were fully charged in two different conditions. So, the researcher concluded that the number of hours in charging the battery depends on the weather condition.

The Level of the Effectiveness of the Off-grid Solar Power Mock-up

To determine the degree of effectiveness of the Off-grid Solar Power Mock-up, a pre skill test and post skill test were administered to twenty (20) students.

A rubric is simply a scoring tool that identifies the various criteria relevant to an assignment or a learning outcome and explicitly states the possible levels of achievement along a continuum. Rubric was used by the researcher to identify the learning outcome of the respondents and to explicitly state the possible level of achievement from good to very good.

Table 2. Pre-skill Test and Post Skill Test Result of the students using Off-grid Solar Power Mock-up

N = 20

Score	**Description**	**Pre skill Test**			**Post Skill Test**		
		f	**%**	**Rank**	**f**	**%**	**Rank**
23-30	Very Good	0	00.00%		15	75.00%	1
15-22	Good	18	90.00%	1	5	25.00%	2
07-14	Fair	02	10.00%	2	0	00.00%	
00-06	Poor	00	00.00%		0	00.00%	
Average Rating		**17.15 Good**			**23.15 Very Good**		

Table 2 shows the frequency and percentage of the performance of the students before and after the manipulation of the Off-grid Solar Power Mock-up. It shows that 18 out of 20 or 90.00% of the student's pre skill test performance were described as "good". Two (2) students or 10.00% of total respondents were described as "fair". Likewise, none were described "Very Good" and "Poor". The average rating of this group is 17.15, which was described as "Good".

After the treatment was employed, the post skill tests were performed. The respondents got higher results compared to pre skill test. Fifteen(15) out of twenty(20) or 75.00% of the respondents performance were rated "Very Good" and were ranked first in the group. Five (5) out of thirty (30) or 25.00% of the respondents were described "Good". The students got a total average rating of 23.15, which was interpreted as "Very Good". Clearly, it was found out that the post skill test of the students who used the Off-grid Solar Power Mock-up got higher scores and was shown to be effective for the improvement of learning competencies of students through actual and hands-on demonstration.

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Table 3. Acceptability level of the Off-grid Solar Power Mock-up

Acceptability Level	WM	Description	Rank
3.1 Performance			
1. The device was able to charge the battery.	3.69	Very high	
2. The device output voltage from the charge controller was stable.	3.6	Very high	3
3. The panel board was able to supply power.	3.2	Very high	
Average	**3.49**	Very high	
3.2 Durability			
1.The gadget can continuously operate in a longer period of time.	3.68	Very high	
2. The device has a protective covering from external damage.	3.58	Very high	1
Average	**3.63**	Very high	
3.3 Safety			
1. The parts are insulated and covered properly.	3.71	Very high	
2. The device has a circuit breaker and fuse for protection from short circuit.	3.70	Very high	2
3. The construction of the device follows the technical plan.	3.2	Very high	
Average	**3.53**	Very high	
3.4 Convenience of use			
1. The device used a banana plug and jack to perform wiring.	3.4	Very high	
2. Installation of the system was properly observed.	3.8	Very high	
3. The device is easy to use.	3.30	Very high	4
Average	**3.5**	Very high	
3.5 The cost of the Off-grid Solar Power Mock-up is Php.17, 538.00	**3.0**	High	5
Total Average	**3.42**	Very high	

Table 3 shows the summary of the acceptability level of Off-grid Solar Power Mock-up in terms of performance, durability, safety, convenience and the cost. With the use of the Weighted Arithmetic Mean test, the researcher found out that " Durability " got the highest rank and has the average weighted mean of 3.63 and described as " very high ". It means that the respondents observed that the gadget could continuously operate longer period of time because of the functionality of the gadget in terms of operating.

The "cost " of the gadget got the lowest rank, but it was described as "high" and obtained an average weighted mean of 3.0. It implies that in assembling the gadget, the materials and components are expensive especially the solar panel, charge controller, inverter, battery, and materials of making the frame, the design and printing the tarpaulin because making this kind of gadget expensive but ins useful to those who are leaving in no supply of electricity.

CONCLUSION

The Off-grid Solar Power Mock-up is an effective tool for instruction in BS Electrical Technology and BS Electrical Engineering students. The device got a high rate in the effectiveness level and performed well the solar panel technology. It could enhance the skill competency of the students and improving the quality instruction in the workshop environment.

RECOMMENDATION

Based on the findings the following recommendations were given:

1. The shop instructors shall use the Off-grid Solar Power Mock-up for BS Electrical Engineering and BS Electrical Technology courses to assist the learning of the students. It will be used particularly in curriculum related with industrial system automation.
2. School administrators shall encourage their instructors to construct instructional devices that can replicate the actual functions of the machines or devices found in the industry.
3. To the future researchers, the related study may be made for the improvement of the Off-grid Solar Power Mock-up.

REFERENCES

[1] Durham, R., & Durham, M. (2011). *Lightning, grounding, and protection for control and communications system*: Re-evaluated. InPetroleum and Chemical Industry Conference Europe Conference Proceedings (PCIC EUROPE). 9pp. 1-11). IEE

[2] McKenney, K., Guesrnsey, M., Ponoum, R., & Rosenfeld, J. (2010). ***Commercial miscellaneous electric loads:*** Energy Consumption characterization and savings potential in 2008 by building type. TIAX LLC, Lexington, MA, Tech. Rep. D, 49, 224

[3] Nof, S.Y. (2010). ***Automation: What it means to us around the world.In springer*** Handbook of Automation (pp. 13-52).Springer Berlin Heidelberg.