PERFORMANCE AND ACCEPTABILITY OF SOLAR POWER STAND-ALONE SYSTEM TRAINER

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Article History: **Received:** 27.05.2023 **Revised:** 10.06.2023 **Accepted:** 31.07.2023

Abstract:

Enhancing the usage of solar energy has become a crucial target for achieving a sustainable energy supply, as the sun emits immensely powerful energy from the center of the solar system. Advancements in solar PV technology have further paved the way for success in the solar energy industry. However, theory alone is insufficient for developing practical skills among students. The lack of instructional devices can hinder hands-on training and learning. To address this issue, a research study was conducted at Bohol Island State University–Main Campus, Tagbilaran City, during the Academic Year 2021-2022. The objective of the study was to develop a Solar Power Stand-Alone System Trainer and assess its performance level and acceptability. The experimental design was employed in the study. Data relevant to the acceptability of the trainer were collected through a questionnaire, while the performance level was determined using an observation guide. Twenty (20) students pursuing BS Electrical Engineering and BS Electrical Technology underwent a skill test to evaluate the effectiveness of the Solar Power Stand-Alone System Trainer. Additionally, thirty (30) technical experts were involved to validate the performance level and assess the acceptability of the device. The results of the study showed that the use of the trainer led to a significant increase of 34.99% in students' performance ratings. It was also found that the trainer served as an effective instructional tool for subjects related to BS Electrical Engineering and BS Electrical Technology. The trainer received high ratings for its effectiveness and performance, making it a valuable asset in the workshop environment. By utilizing the Solar Power Stand-Alone System Trainer, students' skill competencies can be enhanced, and the overall quality of instruction in the workshop setting can be improved. This research contributes to the advancement of solar energy education and provides a practical solution to overcome the challenges associated with hands-on training in the field. As a result, the pursuit of sustainable energy solutions can be further strengthened.

Keywords: Solar, Trainer, Performance, Acceptability, Effectiveness.

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DOI: 10.31838/ecb/2023.12.s3.778

1. INTRODUCTION

Technology has become an integral part of our lives, permeating every aspect with the use of electricity to power non-living entities like robots and machines. In today's world, electricity has become commonplace, and its widespread use is admired by many (Durham, 2011) [1]. Among the various ways to generate electricity, solar power stands out as a key player in achieving a sustainable energy supply. The continuous advancements in solar photovoltaic (PV) technology hold great promise for the success of the solar energy industry. While theoretical knowledge is important, practical skills development is equally vital for students.

The significance of solar technology is multifaceted, akin to the various types of generators available in the market. One of its essential benefits is its role in preparedness during power shortages, as it enables power supply to locations that lack access to the traditional power grid (McKenney, 2010) [2]. By harnessing the immensely powerful energy emitted by the sun, solar technology can provide electricity to consumers, especially those residing in remote areas far from conventional power sources. This presents a substantial advantage as it eliminates the need to purchase fuel or gas to operate devices, requiring only exposure to sunlight for the solar panels to function.

The development of the Solar Power Stand-Alone System Trainer represents a significant leap in solar technology. This system can efficiently generate electricity by harnessing solar energy, which is then passed through the power control and inverter to convert 12 volts D.C. into 220 A.C. (Nof, 2010) [3]. This Solar Generator not only saves energy but also relieves people from the burden of paying high electric bills. By relying on abundant, free, and environmentally friendly sunlight, this generator operates without causing any harmful effects. The research conducted to create this Solar Power Stand-Alone System Trainer could potentially bring us closer to a future where electric generation facilities are not only economically viable and reliable but also safe and environmentally friendly.

In conclusion, the ever-expanding reach of technology, particularly in harnessing solar energy, has revolutionized the way we generate and utilize electricity. Solar technology not only contributes to a sustainable energy supply but also empowers individuals and communities by providing access to electricity even in remote areas. The Solar Power Stand-Alone System Trainer is a tangible embodiment of this progress, offering an efficient and eco-friendly way to generate electricity and paving the way for a more promising future in the realm of electric power generation.

2. METHODS

The research study utilized a pre-skill test and post-skill test experimental design to assess the impact of the intervention, which involved the assembly and use of the Solar Power Stand-Alone System Trainer. This design measured the changes in outcomes before and after the intervention was implemented, with the aim of determining if the treatment would enhance the participants' learning. The performance of the Solar Power Stand-Alone System Trainer was evaluated using an observation guide during the experiment.

Following the experiment, a questionnaire was developed to collect data necessary for determining the acceptability level of the Solar Power Stand-Alone System Trainer. This information would provide valuable insights into how well the device was received by the participants and technical experts.

The study was carried out at Bohol Island State University Main-Campus during the academic year 2021-2022. The university is situated along #76 Carlos P. Garcia North Avenue, Tagbilaran City and is the sole State University in the province of Bohol offering Technical courses, including Electrical and Electronics Technology and Engineering.

To ensure the reliability and validity of the results, the researcher selected thirty (30) technical experts to validate the performance level of the Solar Power Stand-Alone System Trainer and assess its acceptability. Additionally, twenty (20) students pursuing BS Electrical Technology and BS Electrical

Engineering participated in the skill test to evaluate the effectiveness of the trainer.

By employing a pre-skill test and post-skill test experimental design, conducting observations, and utilizing questionnaires, the study sought to provide evidence of the Solar Power Stand-Alone System Trainer's impact on learning outcomes and its acceptance among both technical experts and students. The research at Bohol Island State University contributes to the advancement of solar energy education and the enhancement of practical skills development in the field of electrical technology and engineering.

3. 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 Solar Power Stand-Alone System Trainer 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 Solar Power Stand-Alone System Trainer in term of its preparations, procedures, and materials.

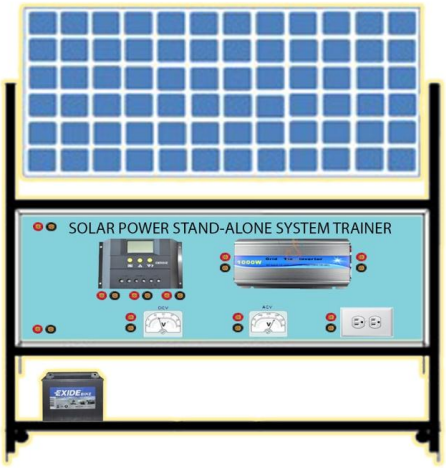

Figure 1. Front View of the Solar Power Stand –Alone System Trainer

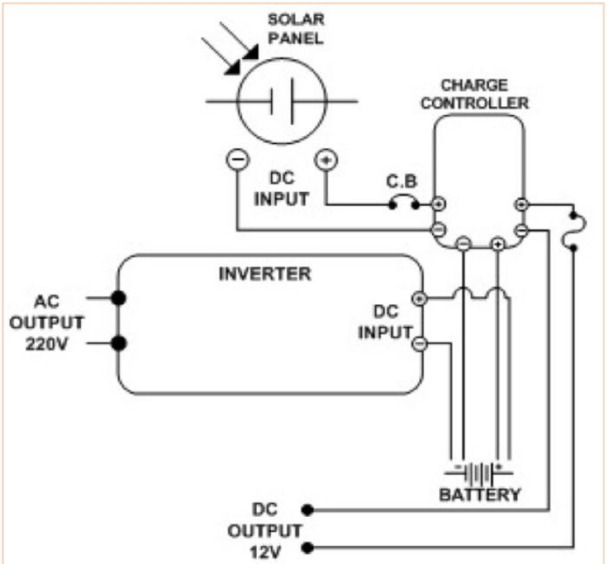

Figure 2. Schematic Diagram of the Solar Power Stand-Alone System Trainer

The Performance of the Solar Power Stand-Alone System Trainer

Table 1. Time of charging 60Ah 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 Solar Power Stand-Alone System Trainer in terms of charging the 30 Ah deep cycle battery in different weather conditions.

In the initial trial, the researcher conducted tests on the Solar Power Stand-Alone System Trainer to determine its maximum output voltage. The researcher used a Voltmeter and tested the device under various weather conditions. During a cloudy day, the solar panel's output voltage was measured at 17.2V in the morning, 17.4V at noon, and 17.4V in the afternoon. On a sunny day, the solar panel yielded 17.3V in the morning, 17.5V at noon, and 17.4V in the afternoon. However, the researcher was not completely convinced with the results of the first trial and decided to conduct second and third trials to validate the findings. Surprisingly, the results from the subsequent trials closely mirrored those of the first trial, leading the researcher to confidently conclude that the solar panel was indeed functional.

Another aspect the researcher investigated was the time required to charge the 30 Ah battery using the Solar Power Stand-Alone System Trainer. The first trial involved testing the charging rate in two different weather conditions: cloudy and sunny days. It was observed that the charging duration of the battery varied depending on the weather condition. During a cloudy day, the battery took 7 to 10 hours to charge fully, whereas on a sunny day, it took 6 to 9 hours. To ensure the accuracy of the findings, the researcher conducted second and third trials, which consistently confirmed the results from the first trial. Therefore, the researcher concluded that the time taken to charge the battery is influenced by the prevailing weather conditions.

By conducting thorough and repeatable experiments, the researcher was able to gather reliable data on the performance of the Solar Power Stand-Alone System Trainer. The results indicated that the solar panel functioned effectively and that the charging time of the

battery varied depending on the weather conditions. This information is valuable for further optimizing and utilizing the solar technology effectively, contributing to the advancement of sustainable energy solutions.

Table 2. Acceptability level of the Solar Power Stand-Alone System Trainer

Acceptability Level	WM	Description	Rank
2.1 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	
2.2 Durability			
1.The gadget can continuously operate in a longer period of time.	3.68	Very high	1
2. The device has a protective covering from external damage.	3.58	Very high	
Average	**3.63**	Very high	
2.3 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	
2.4 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	
2.5 The cost of the Solar Power Stand-Alone System Trainer is Php.17, 538.00	**3.0**	High	5
Total Average	**3.42**	Very high	

Table 2 provides an overview of the acceptability level of the Solar Power Stand-Alone System Trainer, assessing its performance, durability, safety, convenience, and cost. The researcher used the Weighted Arithmetic Mean test to analyze the data and draw conclusions.

According to the results, "Durability" received the highest rank, with an average weighted mean of 3.63, indicating a "very high" level of acceptability. This suggests that respondents observed the gadget's ability to operate continuously for extended periods due to its effective functionality.

On the other hand, the "cost" of the gadget obtained the lowest rank but still received a description of "high," with an average weighted mean of 3.0. This indicates that assembling the gadget involves expensive materials and components, including the solar panel, charge controller, inverter, battery, frame, and the design and printing of the tarpaulin. Despite its high cost, the gadget proves to be valuable, particularly for individuals living in areas without access to electricity.

In summary, Table 2 presents a comprehensive assessment of the Solar Power Stand-Alone System Trainer's acceptability across various important aspects. The Weighted Arithmetic Mean test enables valuable insights into the gadget's performance, durability, safety, convenience, and cost, guiding future

improvements and decisions regarding its development and practical application.

4. CONCLUSION

The Solar Power Stand-Alone System Trainer has proven to be a highly effective instructional tool for students pursuing BS Electrical Technology and BS Electrical Engineering. This device achieved a remarkable level of effectiveness, showcasing exceptional performance in the field of solar panel technology. Its use in the classroom has the potential to significantly enhance the skill competency of students and elevate the overall quality of instruction in the workshop environment.

By integrating the Solar Power Stand-Alone System Trainer into the curriculum, students have the opportunity to gain hands-on experience and practical knowledge related to solar energy and electrical systems. The device's excellent performance allows learners to grasp complex concepts and techniques more effectively, fostering a deeper understanding of renewable energy technologies.

With the trainer's ability to simulate real-world scenarios and provide a practical learning platform, students can develop problem-solving skills and critical thinking abilities, preparing them for the challenges they may encounter in the industry. Furthermore, as solar energy becomes increasingly important in sustainable energy solutions, incorporating this innovative training tool empowers students to become well-equipped and competent professionals in the field of electrical technology and engineering.

Beyond its educational benefits, the Solar Power Stand-Alone System Trainer also contributes to promoting environmental consciousness and sustainable practices. By utilizing solar energy to power the trainer, students witness firsthand the viability and eco-friendliness of renewable energy sources, inspiring them to champion greener solutions in their future endeavors.

In conclusion, the Solar Power Stand-Alone System Trainer stands as a powerful catalyst for elevating the learning experience in BS Electrical Technology and BS Electrical Engineering programs. Its effectiveness, impressive performance, and focus on solar technology offer students valuable skills, paving the way for a brighter and sustainable future in the realm of electrical engineering and renewable energy.

Recommendation

The study's findings have led to the formulation of the following valuable recommendations:

1. Shop instructors should actively incorporate the Solar Power Stand-Alone System Trainer into the teaching process for BS Electrical Engineering and BS Electrical Technology courses, especially those related to industrial system automation. By integrating this innovative instructional tool, instructors can enhance students' learning experiences and provide practical exposure to real-world applications of solar power and electrical systems.
2. School administrators play a pivotal role in fostering a conducive learning environment. To promote hands-on learning and bridge the gap between classroom education and industry demands, administrators should encourage instructors to create instructional devices that accurately replicate the functions of machines and devices commonly found in the professional field. This approach ensures that students are better prepared for their future careers by gaining practical skills and knowledge.
3. Future researchers are encouraged to explore further advancements and improvements for the Solar Power Stand-Alone System Trainer. Investigating additional features, refining its functionality, or exploring new applications can contribute to the continuous enhancement of this training tool. This research may open up new possibilities for the utilization of solar energy and improve the overall effectiveness of the trainer in facilitating student learning.

By implementing these recommendations, educational institutions can bolster their efforts in providing high-quality, industry-relevant education to students pursuing electrical engineering and technology courses. The integration of practical training tools like the Solar Power Stand-Alone System Trainer will not only enrich the learning experience but also foster a generation of skilled and knowledgeable professionals who can effectively contribute to the renewable energy sector and address the global need for sustainable solutions.

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