

Street Lighting Based on Solar Panels for Night Learning of Santri of Madrasah Aliyah Mambaul 'Ulum

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ABSTRACT

The unavailability of adequate street lighting is the main problem in implementing night learning at the Masjid under the Tahfidz program at Madrasah Aliyah Mambaul 'Ulum (MAMU) Bengkulu Tengah. This limitation of street lighting is linked to self-financing and the high cost of supplying electricity from the national electricity company. On the other hand, Bengkulu is located near the equator with renewable energy potential, one of which is solar energy, abundant all day throughout the year. Moreover, technological developments are also impacting the availability of solar panel based solar-to-electricity conversion systems at relatively low costs. The limitation of knowledge and skill in using solar panels as a lighting source is one issue that has yet to utilize the potential of this alternative energy. Therefore, in this community service activity, a series of activities have been carried out to provide solutions to MAMU's lighting problems. The targets of this activity are the students of the Tahfidz program at MAMU. The stages of the activities carried out begin with the preparation in the laboratory, the coordination with the school, the implementation of the community service, the installation of the systems, and the verification of the installed systems. In setting up the service, the activities begin with completing the initial questionnaire, presentations, demonstrations on the use of solar panels, completion of the final questionnaire, questions and answers, door prizes, and group pictures. During the presentation about solar panel technologies, the students showed great enthusiasm. The questionnaire results also showed increased participants' knowledge of the activities. Also, when checking out after the system's installation, the students are satisfied with the solar panel-based lighting that has been installed and promotes learning at night.

Keywords: MAMU, Renewable Energy, Solar Panels for street lighting, community service.

INTRODUCTION

The development of science, technology and modern lifestyles cannot be separated from the need for electric power in terms of quality and quantity. On the other hand, Indonesia's primary electric power availability still depends on fossil energy (Jonan, 2018), which availability continues to be low and harms the environment (Cheng et al., 2020; Ko et al., 2015; Yuliza et al., 2021). In addition, the costs that must be incurred for the supply of electrical energy also continue to increase (Oh and Park, 2019). Therefore, the government encourages using renewable energy sources such as solar power, wave energy, wind energy, hydropower, etc. However, the use of various alternative energy sources still needs to be improved in terms of providing technology, education, efficiency, knowledge, and skill for using this alternative energy system.

The development of alternative energies using solar energy is one of the potentials to meet the demand for electrical energy in the Province of Bengkulu. The average solar power output in Bengkulu is from 4.5 to 5.2 kWh/m² (Rumbayan et al., 2012; Sofianita et al., 2019). In addition, the results of research by Yuliza et al. (2021) regarding the characteristics of solar energy harvesting using solar panels on different building rooftop designs show the excellent potential of using solar panels. On the other hand, various public facilities in the Bengkulu area have limited electric lighting, including the Madrasah Aliyah Mambaul 'Ulum (MAMU) Central

Bengkulu. MAMU is a private high school located in Bengkulu and established independently for the lower middle-class economic community. This school also offers special facilities, namely dorms with the primary curriculum, i.e., Tahfidz Quran. However, the main problem in implementing the Tahfidz program is the limited public lighting from the dormitory to the Masjid for learning at night. The primary source of street lighting to and from the dormitory is the floodlights in front of the dormitory. Besides, the terrain students use to get to the dormitory is grass and bumpy terrain, as shown in Figure 1.



Figure 1. (a) female student dormitory, (b) male student dormitory, (c) access road to the mosque

The lighting problems at MAMU are related to the limited facilities and the high costs that must be incurred to provide electricity. On the other hand, this area has the potential to use renewable energy based on solar panels (Sofianita et al., 2019). However, the limited knowledge and skills in harnessing solar energy into electrical energy using solar panels are one of the reasons why this potential has yet to be appropriately utilized (Sari et al., 2020). Therefore, advisory and training activities on solar panel technology should be carried out (Widiyandari, et al., 2023). In addition to solving the problem of limited lighting, this activity can encourage the creativity of the target audience regarding the availability of various forms of solar panels for multiple purposes.

METHOD

The community service program for using solar panel technology for street lighting follows discussions regarding the problems at MAMU and the role of the Bengkulu University community in providing solutions to the issues that exist in society, especially in Bengkulu province. The head of MAMU School explained that MAMU is a private school of the Al Mutaqqin Foundation which was independently established with the help of donors in 2016 to provide school facilities for the economic community of the lower middle class. As a newly established school, school facilities are, of course, minimal, one of which is related to the availability of electricity and street lighting. Next, the research results from the community

service team show the potential of using solar energy for electricity in Bengkulu. Therefore, the team design was carried out to overcome the problem of limited street lighting at night in MAMU by using the potential of renewable energy using solar panels. Moreover, with the development of solar panel technology, where various shapes and types of solar panels are available, it can trigger the creativity of the target audience to use it for multiple purposes. In addition, this activity is also expected to increase the ability of the target audience to install solar panel devices for various goals. To achieve this goal, four main steps are carried out: preparation, presentation of materials and demonstrations, installation training, and installation of street lights based on solar panels as shown in Figure 2.

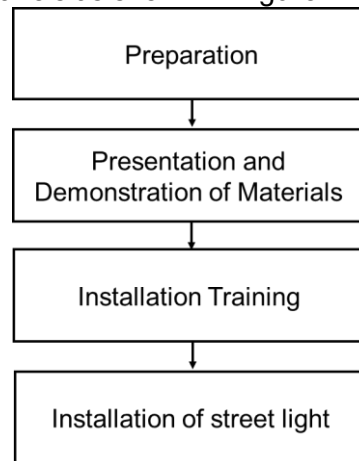


Figure 2. Flowchart for community service activity

The first step of this service is the preparation which consists of a location study and the preparation of the materials and equipment to be used. The theme of this service activity is the application of the research results of the service team concerning the use of solar energy as an alternative source of electrical energy. To implement this activity, the community service team conducted a survey and visited MAMU to manage the implementation, participants, date of implementation, installation of panel-based solar lighting, and other issues. During this investigation and visit, the service team was welcomed by the head of MAMU and the teachers' council, as shown in Figure 3.



Figure 3. Community service team coordination with target audience parties

In addition to coordinating the implementation of activities, equipment was also prepared for delivery during the preparatory phase at the presentation, demonstration, and installation of equipment. The material prepared includes solar panels, presentation material, and questionnaires for participants in the activities. Questionnaires will be distributed before and after the presentation of the material and the training in installing the solar panels. This condition aims to determine the evolution of knowledge before and after exposure and training. At the same time, the second stage of this service activity is the presentation of materials and

demonstrations. The presentation and demonstration activities of the material were preceded by the opening of the community service at MAMU. Then there was a presentation of material related to solar panel technology and demonstrations of using solar panels. This presentation and demonstration activity ended with a question-and-answer session and door prizes related to the material that had been presented. The third step of this service is training in installing solar panels. Then, the last step is the installation of streetlights based on solar panels in areas that have been agreed upon the Head school of MAMU.

RESULTS AND DISCUSSIONS

Community service activities on the solar panel-based street lighting theme were carried out to solve the problem of limited street lighting for access to learning at night at MAMU. The target audience for this activity was the students of the MAMU Tahfidz program and several accompanying teachers. The selection of target audiences corresponds to the primary beneficiaries of this activity. Furthermore, introducing various types and shapes of solar panels should stimulate the creativity of the target audience in using solar panels where the cost of providing them is more affordable. The service activity begins with the opening by the community service team and the principal's remarks for implementing this activity, as depicted in Figure 4. The next activity is to share a questionnaire for the participants in this activity, which aims to know the participants' knowledge before being given regarding the technology of solar panels. Assistance in completing the questionnaire was assisted by students from the Department of Physics, Faculty of Mathematics and Natural Sciences, Bengkulu University, who participated in this activity.



Figure 4. Opening Activities

In general, the material presented in this activity relates to the basic principles of solar panels associated with the subject of physics in high school. In addition, it also describes the development of solar panel technology in terms of size, shape, designation, estimated power, and costs that must be incurred to use the system. The students showed great enthusiasm for this activity. It can be seen with the participation of the participants during the opening of the question-and-answer session and a short quiz with prizes of solar panels designated for wall lights/garden lights, as shown in Figure 5. In this question-and-answer session, the students asked questions related to the performance of the solar panel system when the weather is cloudy, the resistance of the electrical system, supply costs, etc.

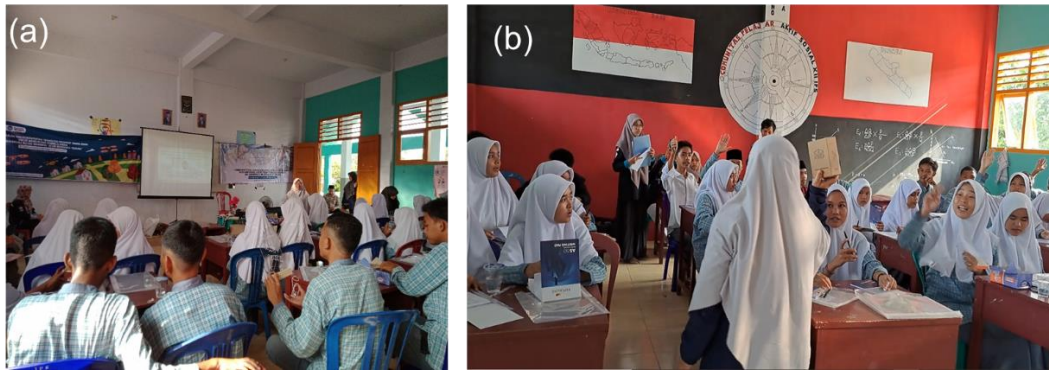


Figure 5. (a) Material presentation, (b) question-answer

Then, the activity continued with demonstrations of the use of different types of solar panels as displayed in Figure 6. In general, there are two types of solar panels that are demonstrated, namely integrated and non-integrated solar panel systems. The integrated solar panel system consists of solar panels, batteries, control systems, and luminaires, which are already in the form of a single device. This integrated solar panel system, it usually can be directly used for street lights, garden lights, wall lights, etc. In addition, this integrated system already has certain functions. While the non-integrated system is the opposite of the integrated system, in this system, solar panels, batteries/batteries, and control systems are not connected to each other. So, you need the knowledge to use this system. However, the advantage of using a non-integrated system is that the power can be greater and can be used for various purposes depending on the size of the panel used. Thus, for cases of limited lighting, an integrated system can be used. In addition, this demonstration also showcased the application of a solar panel system to provide lighting in the student dormitory environment at MAMU.



Figure 6. Demo using solar panels

In general, to assess the usefulness of the exposure made to the target audience, questionnaires were administered before and after the exposure. The questions of the questionnaire are related to increasing the understanding of the public regarding the use of solar panel systems, as shown in Table 1. The results of the given questionnaires are shown in Figure 7. Based on the given questionnaires, there was an increase in participants' knowledge and understanding of the material presented. In addition, the limited time for implementation, so the installation skills have not increased significantly. Therefore, in the future, installation-oriented activities can only be carried out.

Table 1. List of questions from the submitted questionnaire

| No | Questions |
|----|---|
| 1 | Do you know that sunlight can be used as electrical energy? |
| 2 | Have you ever heard or known about solar panels/solar cells? |
| 3 | Did you know that sunlight can be used to generate electricity using solar panels? |
| 4 | Did you know that electrical energy generated using solar panels can be used at any time, including at night? |

| No | Questions |
|----|--|
| 5 | Have you ever used solar panels? |
| 6 | Do you know how to install and use solar panels to produce electrical energy such as electricity from state electricity company? |
| 7 | Did you know that solar panels come in many forms and variations? |
| 8 | Are you interested in using and developing solar panels? |

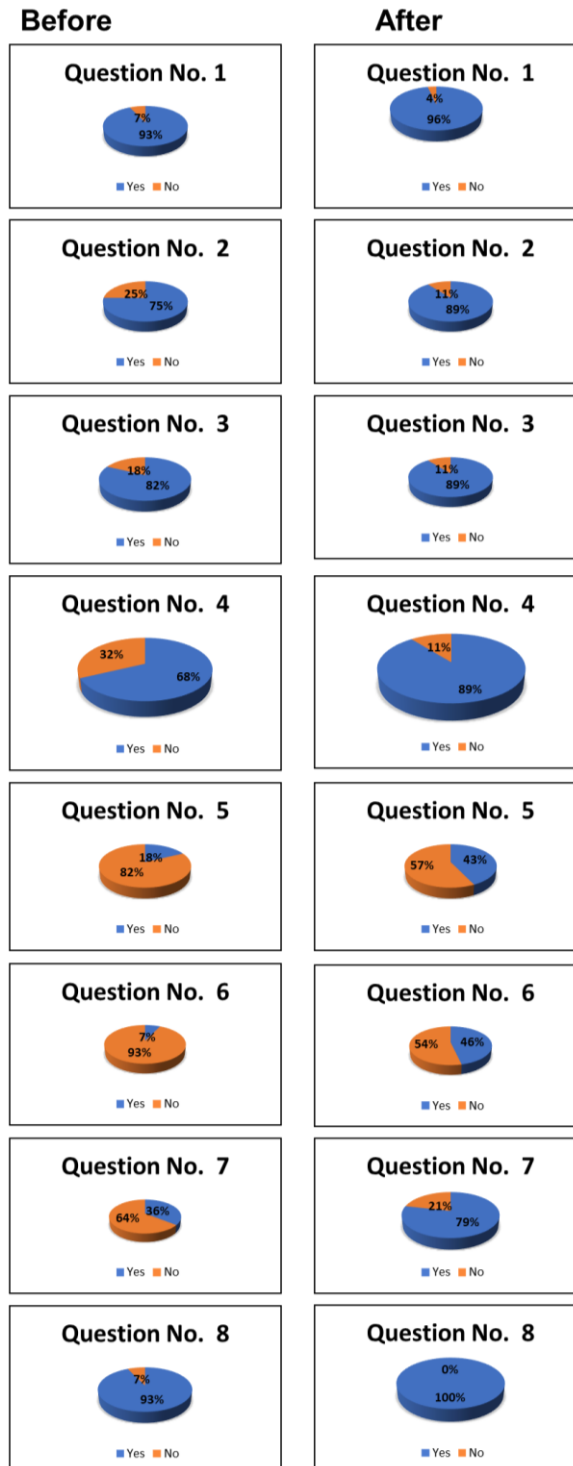


Figure 7. Questioner results

The next step that is carried out is the installation of street lights with solar panels on the road that the students pass from the girls' dormitory to the mosque, as shown in Figure 8.



Figure 8. Solar panel lighting installation

In general, the installed system worked well. The day after the system was installed, the dormitory manager sent a video of the performance of the lighting system which had been installed, as shown in Figure 9.



Figure 9. Lighting system performance at night

The community service team also visited MAMU to check the installed system's performance. During this visit, the team met students who had just returned from school to the dormitory. They said the lighting system worked well and was "sophisticated" because the light intensity increased when a moving object passed through the lamp. They are pleased and grateful for installing this system because it is beneficial for accessing the evening classes at the Masjid.



Figure 10. State of the system during the control visit

CONCLUSION AND RECOMMENDATION

This research-based community service activity was carried out at Mambaul Aliyah Madrasa "Ulum Bengkulu Tengah on August 9, 2022. The participants were students who "interned" in the MAMU dormitory. This activity begins with coordinating with the school director, preparing the necessary equipment, and carrying out the activities. During the implementation, the participants showed great enthusiasm for discovering the solar panels. The activity ended with installing solar panel lighting to facilitate student access to night activities. Analysis of the questionnaire before and after the training this activity increases knowledge related to solar panels. In the future, to improve community skills, activities focused on solar panel installation techniques are needed.

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