CARMIN
Journal of Community Service
Vol. 5 No. 2 2025

The Training on The Making of Simple Renewable Energy Media: Attempt to Enhance Energy Literacy Among Students at Junior High School

Ketang Wiyono[1]*, Kistiono[1], Evelina Astra Patriot[1], Frendi Ihwan Syamsudin[1], Nor Farahwahidah[2], Noor Dayana Abd Halim[2], Nita Arrum Sari[1], and Roro Aisyah Purbasari[1]

[1]Physics education study program, Faculty of Teacher Training and Education, Universitas Sriwijaya, Palembang, Indonesia
[2]Universiti Teknologi Malaysia, Johor Bahru, Malaysia
*ketang_wiyono@fkip.unsri.ac.id

ABSTRACT

This community service activity aims to train students' energy literacy through training in the creation of simple STEM-based renewable energy learning media at SMP Negeri 5Indralaya Utara. The method used was Participatory Action Research (PAR) involving 25 eighth-grade students. The stages of the activity included a preliminary survey, presentation of renewable energy and STEM material, discussion, practice in making simple renewable energy media, group presentations, pre-test, and post-tests of energy literacy. The instruments used were multiple-choice tests and observation sheets of student activities. The results of the analysis showed an average N-Gain value of 0.71 in the high category, indicating that the training was effective in improving students' energy literacy. In addition, the activity developed students' collaboration, communication, creativity, and problem-solving skills through project activities and group presentations.

Keywords: energy literacy, renewable energy, STEM, learning media, community service

How to cite:
Wiyono, K., Kistiono, K., Patriot, E. A., Syamsudin, F. I., Farahwahidah, N., Halim, N. D. A., Sari, N. A., & Purbasari, R. A. (2025). The training on the making of simple renewable energy media: Attempt to enhance energy literacy among students at junior high school. *Carmin: Journal of Community Service*, *5*(2), 84-99.

INTRODUCTION

The rapid development of science and technology in the 21st century requires students to have critical, creative, collaborative, and communicative thinking skills, as well as good energy literacy (Sakti et al., 2023; Nguyen et al., 2025). In the context of science learning, mastery of energy concepts and their application in everyday life is a crucial aspect in building environmental awareness and scientific thinking skills (Maspul, 2024; Andriani et al., 2020). One relevant approach to achieving these goals is the STEM (Science, Technology, Engineering, and Mathematics) approach, which emphasizes integrating science and technology to solve real-world problems (Maspul, 2024; Sinambela & Pratiwi, 2024).

The chosen location for the community service activity is SMP Negeri 5 Indralaya Utara. This is supported by observations of regional conditions, SMP Negeri 5 Indralaya Utara is located in Tanjung Baru Village, Indralaya Utara District, Ogan Ilir Regency, South Sumatra Province 30662. The school is approximately 5 km from Sriwijaya University, allowing the community service team to conduct activities more intensively. Basically, the environment around SMP Negeri 5 Indralaya Utara has abundant natural

potential, including rice fields, open land with high solar radiation, and water sources from canals and small rivers near the school.

Interview results indicate that the main problem faced by SMP Negeri 9 Indralaya Utara is the limited availability of simple STEM-based learning media. The available media are not yet capable of representing STEM concepts in an integrative manner, especially in the context of Renewable Energy. Teachers tend to rely on conventional media and have not utilized the potential of natural resources (SDA) around the school as material for designing contextual learning media. As a result, learning remains theoretical and fails to provide students with meaningful experiences (Gladwin et al., 2022; Lee et al., 2022).

Furthermore, students' energy literacy remains low. Students are not widely involved in exploring energy phenomena in their environment or engaging in hands-on practice related to renewable energy technologies. This condition makes energy concepts abstract, difficult to understand, and not deeply embedded in their learning experience. Low energy literacy affects environmental awareness and hinders students' ability to connect energy concepts to real-world problem-solving.

Judging from the availability of learning facilities at SMP Negeri 5 Indralaya, they are relatively adequate, but their utilization has not been optimally directed to support interactive STEM-based learning. Most of the material is delivered through conventional methods, such as lectures and textbooks. Based on interview results, one of the main causes is teachers' limited knowledge of how to apply the components of the STEM approach in learning. This indicates a gap between the availability of facilities and classroom learning practices. In addition, the availability of special learning media that integrate Renewable Energy content is still very limited, so students are not facilitated to explore concepts in depth. This condition affects low energy literacy and the underdevelopment of students' 21st-century skills (Zhao et al., 2020; Watson et al., 2016).

METHODS

The training and mentoring activities were implemented using the Participatory Action Research (PAR) approach. This approach aims to foster learning in addressing problems and meeting practical community needs, as well as producing (Hebebci & Usta, 2022). This approach emphasizes active community involvement throughout the program process, from planning to evaluation. Through active participation, the community becomes not only an object but also a subject, playing a crucial role in determining the direction and outcomes of the community service program (Ermawati et al., 2022).

Participants involved in this community service activity were 25 eighth-grade students at SMP Negeri 5 Indralaya Utara. The training implementation consisted of several stages, namely; 1) initial planning, 2) socialization of training activities to partner schools, 3) delivery of material by resource persons regarding learning media and renewable energy, 4) discussion between resource persons and training participants, and 5) assistance in creating learning media in the form of simple renewable energy media by the implementation team. The steps for implementing this community service activity will be explained.

RESULT AND DISCUSSION

Preliminary Survey

The initial phase of the activity began with a preliminary survey conducted through an interview with the Principal of SMP N 5 Indralaya Utara on Thursday, June 26, 2025. The results showed that the school still lacked contextual learning materials on renewable

energy, and students' energy literacy remained low. After conducting the preliminary survey, the community service team met with the school to discuss training needs. Based on these findings, the team designed a training on creating simple, applicable, affordable, and STEM-based learning media.

Initial Test Implementation

The main activity took place on Monday, September 22, 2025, at SMP Negeri 5 Indralaya Utara. The event was opened by the Head of the Physics Education Community Service Team from the Faculty of Teacher Training and Education, Universitas Sriwijaya (UNSRI), along with representatives from the Ogan Ilir Regency Education Office, along with the Principal, teachers, and students of SMP Negeri 5 Indralaya Utara. The community service activity began with an initial test for students. This was conducted to determine the initial energy literacy skills of SMP Negeri 5 Indralaya Utara students. The test consisted of 20 multiple-choice questions covering renewable energy. The initial test proceeded smoothly, and students completed it independently.

Presentation of Material on the Concept of Renewable Energy

The community service team explained the concept of renewable energy and the urgency of its application in science lessons, emphasizing the importance of utilizing clean energy for environmental sustainability. Through interactive explanations and contextual examples, students who initially lacked a clear understanding of the sources and benefits of renewable energy began to demonstrate a better understanding. They were able to relate the concept of clean energy to everyday life and recognized the importance of utilizing environmentally friendly energy for sustainability.

Students actively engaged in a question-and-answer discussion with the resource person regarding renewable energy and its use in STEM-based learning media. The renewable energy implemented in this community service activity included solar power plants (PLTS), hydroelectric power plants (PLTA), and wind power plants (PLTB). The resource person also presented examples of simple STEM-based Renewable Energy learning media. The resource person's presentation of the material is shown in Figure 1.

Figure 1. Presentation of material by the resource person

The core training was filled by other speakers, namely Dr. Nor Farahwahidah and Prof. Madya Ts. Dr. Dayana Farzeeha Binti Ali (UTM), who guided on making simple STEM-based media. The session was continued by the community service team with direct practice in making miniature thermal, water, and wind energy power plants from simple materials. Participants then worked independently to design their own media. Students were enthusiastic in preparing tools and materials, exchanging ideas, and collaborating in small groups to design their own innovative media. With guidance from the community

service team, students produced a variety of creative works that reflected a genuine understanding of renewable energy.

This activity aligns with the STEM-based learning approach, which emphasizes active engagement, collaboration, and creativity to strengthen understanding of scientific concepts (Wiyono et al., 2024; Syamsudin, 2022). Through intensive interaction and intergroup discussions, students not only produce innovative products but also develop 21st-century skills such as problem-solving, communication, and critical thinking (Wiyono et al., 2024; Patriot et al., 2025). Thus, this activity plays a crucial role in improving energy literacy while fostering interest in renewable energy issues.

This is highly relevant to previous research on STEM learning in renewable energy. Previous findings suggest that STEM-based micro-hydro power plants (MHP) projects enhance students' understanding of energy concepts and creative thinking (Liarakou et al., 2021). Furthermore, STEM-based activities have been shown to enhance students' critical thinking skills in renewable energy topics. Studies show that when students are fully engaged in designing and building renewable energy projects, not only does their conceptual understanding grow, but also 21st-century skills such as collaboration, communication, and creativity (Koç & Kanadlı, 2025; Colmenares-Quintero et al., 2022).

Previous research has shown that STEM-PjBL significantly improves students' scientific communication and problem-solving skills in alternative energy (Maspul, 2024; Delima et al., 2023). Previous research has provided empirical evidence that collaborative activities, such as creating renewable energy-based learning media, not only foster students' creativity but also strengthen their energy literacy, both in terms of conceptual understanding and communicative and collaborative competencies (Patriot et al., 2023; Bulu & Tanggur, 2021). The delivery of "Spinning Murukku" material is shown in Figure 2.

Figure 2. Delivery of "Spinning Murukku" material

The spinning murukku experiment in Figure 2 is a simple science experiment that uses a murukku as an object to demonstrate the principles of rotation, moment of inertia, and spin stability. In this experiment, the murukku is spun like a top on a flat surface, and its spiral shape is observed as it spins. This experiment is commonly used to teach the concepts of rotation, balance, and mass distribution, demonstrate how the shape of an object affects its physical behavior, and make science fun, especially for students.

Students were then divided into groups of 4-5 people to practice directly creating renewable energy learning media. This STEM-based media creation practice was given a two-week timeframe. Research by Hasan et al. (2023) showed that collaborative activities in small groups enabled students to develop scientific communication and problem-solving skills when designing renewable energy projects. A study by Gladwin et al. (2022) also

found that hands-on practice in alternative energy projects fostered deeper conceptual understanding than lecture-based instruction.

This activity provides students with an opportunity to explore and innovate using the learning tools and materials provided by the community service team. This activity will continue with presentations by each group, which will be assessed based on the team's preparation. Project presentations in STEM-based learning enhance students' sense of responsibility, scientific communication skills, and scientific literacy, as they must systematically explain the manufacturing process and results of their innovations.

Group Presentation

The practice of making tools and group presentations is shown in Figure 3.

Figure 3. Tool-making practice and group presentation

The agenda continued on October 22, 2025, with a presentation of students' media creations. In this session, each group confidently explained the working principles of the media they designed, from the concept of energy conversion to the application of simple STEM-based technology. Students also demonstrated a deep understanding of the functions and benefits of the media they had created, explained their advantages and disadvantages, and answered questions from the community service team with logical, coherent scientific arguments (Patriot & Jannah, 2022).

Group presentation activities can train students in collaboration and improve communication skills. This certainly has a positive impact on students' continued improvement in their literacy skills as they present the learning media produced by each group. This is relevant to previous research that stated that structured group work encourages students to exchange ideas, build shared understanding, and actively participate in discussions, thereby improving their communication skills. Furthermore, a study by Andriani et al. (2023) found that project presentations encourage students to organize information, explain arguments logically, and communicate scientific concepts more clearly, thereby improving scientific literacy.

Similar findings were reported by Aliftika et al. (2021), who found that project-based learning allows students to develop confidence in presenting group work results and enhances collaborative skills. Research by Bybee (2010) also confirmed that presentation activities in STEM learning provide students with a space to practice authentic scientific communication while strengthening their conceptual understanding through peer dialogue and explanation. Thus, group presentation activities have proven to be an important strategy in developing students' collaboration, communication, and literacy.

Implementation of Final Test and Activity Reflection

The community service activity concluded with a final test consisting of 10 questions to be completed independently. This activity aimed to determine the final energy literacy abilities of students after receiving the material and also practicing making learning media on renewable energy material. The implementation of the community service activity continued with a reflection involving students. This reflection activity aimed to obtain feedback from training participants regarding the implementation and sustainability of the community service. In general, the school responded very well to the series of community service activities. This activity has provided profound benefits for training participants in creating learning media on renewable energy materials. Specifically, it can be implemented in the school environment to utilize available energy. The graph of the results of the initial and final tests is represented in Figure 4.

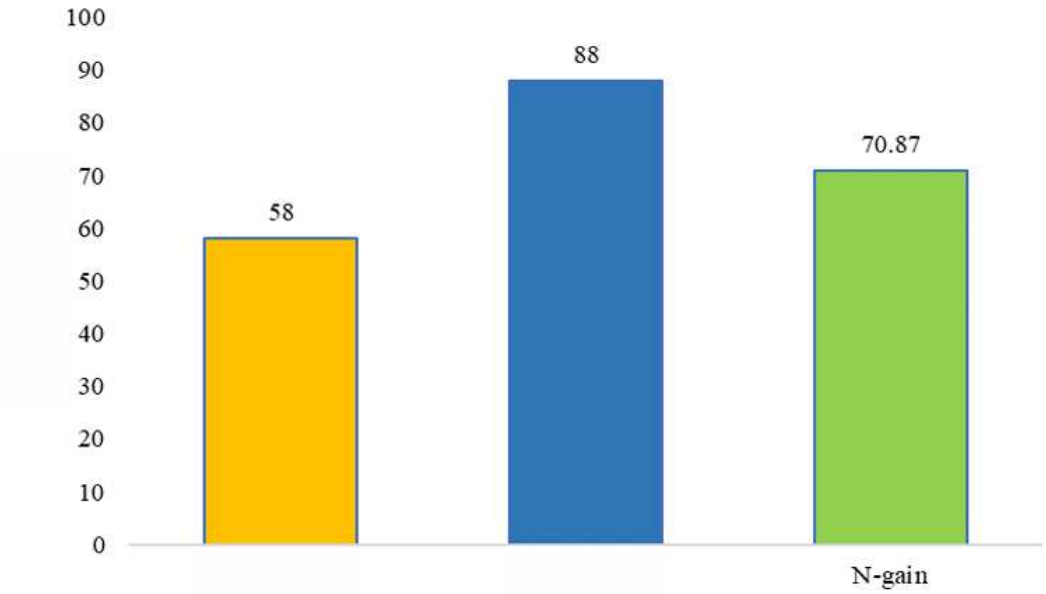

Figure 4. Initial, final and N-Gain test results

The results of the energy literacy test show that the average N-Gain is 0.71, which, according to Hake (1999), is categorized as high because the value is > 0.7, so that the training activity of making simple STEM-based Renewable Energy learning media is effective in training the Energy Literacy of students of SMP Negeri 5 Indralaya Utara in Tanjung Baru Village. This aligns with previous research indicating that student involvement in STEM-based activities can significantly improve understanding of energy concepts, problem-solving skills, and energy literacy. Research by Nugraha et al. (2023) shows that project-based learning in renewable energy provides authentic experiences that enable students to understand the relationships between energy concepts and their applications in everyday life.

Furthermore, a study by Aguilera et al. (2021) found that a STEM approach can improve scientific literacy and positive attitudes toward energy issues, especially when students are involved in designing and building simple prototypes. Another study by Ewar et al. (2023) also found that the use of renewable energy experiment-based learning media directly contributes to increased energy literacy by providing students with opportunities to explore energy concepts concretely.

Research by Delima et al. (2023b) confirmed that hands-on training and practice in creating renewable energy teaching aids helped students build conceptual and contextual knowledge, thereby enhancing their mastery of energy concepts in greater depth. Thus,

previous research findings are consistent with this study's findings, namely that STEM based activities involving independent creation of learning media have a positive impact on students' energy literacy. This training supports SDG 4 (Quality Education) by improving the quality of learning through the creation of innovative media and strengthening energy literacy, contributing to SDG 7 (Clean and Affordable Energy) by raising awareness of environmentally friendly alternative energy, and supporting SDG 9 (Industry, Innovation, and Infrastructure) through the development of simple STEM-based technology in education.

CONCLUSION

The training activity to create simple learning media on Renewable Energy using a STEM approach through the Participatory Action Research (PAR) method has been well implemented and has had a positive impact on students at SMP Negeri 5 Indralaya Utara. The training, which included material delivery, discussions, direct practice, and group presentations, improved students' understanding of renewable energy and 21st-century skills such as collaboration, communication, creativity, and problem-solving. The results of the initial and final tests showed a significant increase in energy literacy, indicated by an average N-Gain of 0.71, which falls within the high category. This finding indicates that the training activity is effective in practicing energy literacy through authentic STEM-based learning experiences. In addition, the media creation and group presentation activities provide students with opportunities to explore, innovate, and construct understanding independently and collaboratively.

ACKNOWLEDGEMENT

We would like to express our gratitude to all parties who support the implementation of this community service activity. The publication of this article was funded by Universitas Sriwijaya 2025. In accordance with the 0014/UN9/SK.LPPM.PM/2025, On September 17, 2025, Rector's Decree Number:

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