

Energy Awareness Education for 5th Grade Female Students of SD Muhammadiyah Karangbendo to Promote Energy-Saving Behavior

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ABSTRACT

Energy awareness is an important aspect of sustainable development. However, elementary school students, especially females, often receive less education about energy. To facilitate this, community service was conducted at Muhammadiyah Karangbendo Elementary School, which included 23 female students from the 5th grade. This activity aims to enhance students' awareness of energy conservation and encourage them to adopt energy-saving behaviors both in their homes and at school. The program is carried out with an interactive lecturer, workshop, simple energy audit simulation, and also energy-saving campaign using creative media. The results show that there is a knowledge improvement in students (pre-test score average=2.65; post-test score average=2.75; Z - 2.353; p=0.019), along with an increase in their enthusiasm for energy-saving practice in daily life, and also poster making and energy-themed slogans.

INTRODUCTION

We are currently facing a significant energy crisis characterized by a rise in energy consumption alongside a decline in traditional energy sources such as coal, crude oil, and natural gas. Dependence on fossil fuels not only heightens the risk of energy shortages but also contributes to increased greenhouse gas emissions, which trigger climate change (Wang and Azam 2024).

In 2022, the Ministry of Energy and Mineral Resources (ESDM) reported that electricity consumption per capita in Indonesia reached 1,173 kWh. The country's electricity production is predominantly derived from coal (35.36%), natural gas (19.36%), and crude oil (34.38%), while new renewable energy sources (EBT) account for only 10.9%. This data highlights the urgent need to enhance the utilization of renewable energy in Indonesia. As such, it is essential to undertake decisive efforts to facilitate a clean and sustainable energy transition (Kementerian ESDM 2023).

Given the critical nature of the energy transition, the early implementation of energy education is a vital strategic initiative. Introducing the concepts of energy conservation and energy-saving behavior (EBT) to elementary school students is essential in fostering future energy-efficient behavior. Research indicates that incorporating energy education at the elementary level significantly enhances students' understanding of energy and promotes awareness of efficiency and renewable sources (Fitriani et al. 2024; Suryana, Muslim, and Amsor 2017). Fitriani et al. emphasize the importance of presenting the principles of energy conservation and renewable energy at an early age, with the objective of encouraging children to "recognize

straightforward methods of energy conservation" and apply these practices in their daily lives (Fitriani et al. 2024).

Energy education at the elementary level plays a crucial role in cultivating a sense of environmental stewardship and fostering energy-saving behaviors among students in the future (Irawati, Kartikasari, and Tarigan 2021). Through various educational activities—beyond formal classroom instruction—students have the opportunity to enhance their holistic development, encompassing cognitive, emotional, and social dimensions. This includes the promotion of creativity, teamwork, responsibility, and an increased awareness of environmental issues (Latifah et al. 2023).

An innovative approach to learning has shown considerable effectiveness, particularly in the context of gamification within natural science (IPA) education. This method has the potential to enhance students' energy literacy and foster environmentally responsible behaviors from an early age (Artini 2025). By equipping elementary school students with knowledge related to energy, we aim to instill energy-saving behavior that can be sustained throughout their lives. Various educational activities focused on energy literacy—including counseling and the use of interactive media—have proven successful in raising awareness among both teachers and students regarding energy efficiency. These initiatives also promote the practical implementation of energy-saving practices in everyday life (Hartati et al. 2024). Through such efforts, we aspire to cultivate a culture of energy conservation within the school environment and among the younger generation, ultimately contributing to a more environmentally conscious society (Artini 2025).

The local context provides a strong foundation for this activity. Muhammadiyah Karangbendo Elementary School, situated in the Special Region of Yogyakarta Province, operates as a private institution under the auspices of the Muhammadiyah organization and has achieved an A accreditation. The school is equipped with essential facilities, including electricity supplied by the State Electricity Company (PLN) and reliable internet access. This infrastructure supports the effective implementation of energy-based educational activities. Given these favorable conditions, the development of energy awareness educational programs for 5th-grade students emerges as a timely and strategic approach to instill energy-saving behaviors from an early age within the elementary school environment. Such programs are vital in fostering a generation of responsible energy consumers who are prepared to make informed, sustainable choices in their everyday lives.

This energy awareness education program is closely aligned with several Sustainable Development Goals (SDGs), specifically Goal 7: Clean and Affordable Energy and Goal 12: Responsible Consumption and Production. SDG 7 highlights the critical need for access to affordable, reliable, sustainable, and modern energy. Concurrently, SDG 12 advocates for sustainable consumption and production practices. Through the instruction of renewable energy concepts and energy-saving practices in elementary schools, this program effectively raises students' awareness regarding the significance of energy efficiency (target 7.3) and promotes the adoption of environmentally responsible lifestyles (target 12.8) ("Sustainable Development Goals - Localize SDGs Indonesia," 2025). Therefore, this initiative not only enhances students' understanding and encourages energy-saving behaviors but also contributes to the broader objectives of sustainable development by fostering a generation that is conscious of energy use and committed to environmental sustainability.

METHOD

This program was conducted at Muhammadiyah Karangbendo Elementary School, situated in Banguntapan District, Bantul City, and included the participation of 23 female 5th-grade students. The initiative commenced with a pre-observation and a pre-test designed to evaluate the students' foundational knowledge of electrical energy. Following this assessment, an educational workshop was conducted, featuring an interactive presentation on various types of electricity, including alternating current (AC) and direct current (DC). The workshop also introduced students to prominent inventors in the field of electricity and energy, complemented by practical demonstrations utilizing balloons to illustrate principles of static electricity. Further, discussions were held with the students regarding the application of electricity in daily life, specifically in the context of household appliances and school facilities. The program included simple energy audit simulations that enabled students to observe electrical operations in lamps, fans, and other devices, while also identifying instances of unnecessary energy consumption. The program concluded with a post-test and a reflection segment to assess the students' knowledge enhancement and the cultivation of energy-saving behaviors. A distinctive feature of this program was its child-centered learning approach, which employed interactive games and engaging visual media to facilitate a comprehensive understanding of electricity and energy in an enjoyable and memorable manner.

RESULTS AND DISCUSSION

In this energy awareness educational program, a comparative analysis between pre- and post-tests is carried out to measure the effectiveness of the improvement in students' knowledge. The average, mean difference, and statistical analysis of the Wilcoxon Signed Rank Test are presented in Table 1.

The study results indicate an improvement in students' knowledge following the implementation of the energy awareness program. The average pre-test score was 2.65, which increased to 2.75 in the post-test, reflecting a difference of 0.10 points. The Wilcoxon Signed Rank Test yielded a Z value of -2.353 with a p-value of 0.019 ($p < 0.05$), indicating a significant difference between the pre-test and post-test results. These findings suggest that the energy awareness educational program effectively improved the knowledge of the 5th-grade students at Muhammadiyah Karangbendo Elementary School. Furthermore, these results are consistent with prior research indicating that the implementation of interactive media and creative learning approaches can enhance students' motivation and academic performance (Disa Sahra et al. 2025; Gumelar, Widiastuti, and Wijayanto 2019).

To support the results, the documentations of the program are presented in Figure 1 and 2. These figures demonstrate student enthusiasm and active participation during educational activities, including the educational presentation, educational games, and simple classroom energy audit simulations.

Table 1. Students' knowledge measurement results

	Mean	Mean Difference	P-value	Z
Pretest	2.65			
Posttest	2.75	0.10	0.019	-2.353



Fig. 1. Documentation of energy awareness education



Fig. 1. Documentation of activities with speakers and team

This program empowers students to communicate energy-saving messages through creative channels, thereby deepening their understanding of energy concepts. Evidence indicates that interactive methods, such as illustrated lectures, storytelling, and educational games, are effective in promoting

environmental awareness among children at a young age (Sagena et al. 2022). The program employs a child-centered learning approach that integrates visual media and educational games. This approach is particularly significant, as elementary school-aged children learn most effectively through hands-on activities and play (Disa Sahra et al. 2025; Fauzi, Naila, and Afiani 2024).

Instilling energy conservation awareness from an early age also has positive implications for sustainable development goals. This program aligns with the "SDGs Class for Kids" educational initiative, which integrates energy and environmental themes for elementary school students (Sagena et al. 2022). Improving energy literacy among students is expected to support the achievement of SDGs 7 (clean and affordable energy) and SDG 12 (responsible consumption and production), as students can carry these energy-saving behavior into their homes and communities. The success of this program encourages recommendations for the continued integration of energy-saving education into the elementary school curriculum and parental involvement, so that energy-saving behavior becomes not just knowledge but also a habit internalized in everyday life.

According to Sa'ban et al. , public awareness is a process that begins with a sense of responsibility so that it can foster awareness (Sa'ban, Sadat, and Nazar 2020). Energy conservation, or energy saving, is the act of reducing the amount of energy used. Energy savings can be achieved by using energy efficiently, that is, by obtaining the same benefits with less energy, or by reducing consumption and activities that use energy (Firdaus, Karim, and Imran 2021). Thus, energy awareness education programs at elementary school age are a strategic step to foster sustainable behavior from an early age, which ultimately supports the achievement of SDGs Goals 7 and 12.

CONCLUSION

The energy awareness education program at Muhammadiyah Karangbendo Elementary School significantly improved the knowledge and energy-saving behavior of 5th-grade students. Through interactive methods and a child-centered approach, students became more aware of energy use in their daily lives. This activity supports the achievement of SDGs Goal 7 (Affordable and Clean Energy) and Goal 12 (Responsible Consumption and Production) by fostering energy-saving habits and a sustainable lifestyle from an early age.

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