Vol. 5 No. 2 (2022) 105 – 113 | doi.org/10.33116/ije.v5i2.113

IJE | INDONESIAN JOURNAL OF ENERGY
P-ISSN: 2549-1016 | E-ISSN: 2549-760X
available online at www.ije-pyc.org

Published by: The Purnomo Yusgiantoro Center

The Role of Energy Literacy in Supporting Energy Conservation: Perspective from Indonesian Citizens

Laurentius K. Hendinata [1,*], Tantri Ardiwinata [2], Filipus K. T. Pratama [3]

[1] Department of Nuclear Engineering and Engineering Physics, Faculty of Engineering, Universitas Gadjah Mada, Jl. Grafika No. 2, Senolowo, Sinduadi, Kec. Mlati, Kabupaten Sleman, Daerah Istimewa Yogyakarta 55281, Indonesia
[2] Faculty of Biotechnology, Universitas Surabaya, Jl. Raya Kalirungkut, Kali Rungkut, Kec. Rungkut, Surabaya, Jawa Timur 60293, Indonesia
[3] Study Program of Environmental Science, Faculty of Mathematics and Natural Sciences, Universitas Sebelas Maret, Jl. Ir. Sutami No.36, Kentingan, Kec. Jebres, Surakarta, Jawa Tengah 57126, Indonesia

*Corresponding Author: kevinhendinata@mail.ugm.ac.id

Article History

Received 17 June 2021
Accepted 29 August 2022
Available 31 August 2022

Abstract

Energy plays a strategic role in human life today. In this case, energy is an interdisciplinary concept from the concepts of science and the environment to global social problems. One aspect of energy development is energy conservation, where efficient and rational use of energy is carried out without reducing energy use performance. To increase public awareness and participation on energy issues, especially those related to energy conservation, it is necessary to increase knowledge about energy in the wider community, one of which is through energy literacy. This is because knowing energy will empower people to make wise decisions and take responsible action regarding energy use. Energy literacy here can be obtained through formal and informal education. This study investigates the condition of energy literacy in Indonesian society in general through a sampling method, and it is found that the level of energy literacy in Indonesian society is on a moderate scale, but it is still not enough to reach the expected level of energy literacy, while the energy literacy level is less. Energy literacy and energy conservation will also be increasingly hampered. Therefore, it is hoped that an increase in education or energy literacy related to formal and non-formal education so that people are more familiar with and apply energy conservation in their daily lives.

Keywords:
energy conservation, energy literacy, education

1. Introduction

Energy plays a strategic role in achieving social, economic and environmental goals in sustainable development. As an interdisciplinary topic, energy issues can be studied from the perspective of science and environmental concepts at the domestic level to a worldwide social point of view (Lee et al., 2015). In line with its development, energy demand, both global and regional, is expected to increase as a result of population and economic growth (Gielen et al., 2019; van Ruijven et al., 2019). Any disruption in the supply of energy in a country will directly affect economic growth and development (Stern et al., 2019; Szustak et al., 2022). Therefore, each country has a specific energy strategy to secure its national development. By paying attention to energy conditions and their problems, especially in Indonesia, it is necessary to take concrete steps to overcome energy problems, one of which is through energy literacy.

One of the aspects that are the focus of the energy problem is to improve and seek energy conservation in various ways. Energy conservation itself is an effort to use rational energy efficiently without reducing the energy use needed in all aspects (Utami et al., 2018). Energy efficiency here relates to measuring the relationship between energy input and output through comparisons (Türkoğlu & Kardogan, 2017). Energy efficiency and conservation are important instruments to stem the growth of energy demand, provide cost savings for households and companies due to reduced energy use, and reduce greenhouse gas emissions, thus acting as an essential element of international policies addressing pollution, global warming, and depletion of fossil fuels (Ayoo, 2020; Brounen et al., 2013).

In the context of striving for energy conservation, energy education can play a total role in instilling energy thrift and efficient behavior and attitudes in society (Jennings & Lund, 2001; Zografakis et al., 2008). Education is an important part of raising awareness about sustainable energy issues. As such, it has a role to play in developing activities in this area that enable the dissemination of existing information and programs and promotes best practices for increasing energy awareness (Sendegeya & Gope, 2016; Zografakis et al., 2008). Energy literacy is also a part of social and natural science literacy where related issues cannot be understood only by using a science or technology approach that calls for comprehensive consideration of common citizenship, history, economics, sociology, psychology and politics, along with science, math and engineering (Lee et al., 2015). Energy literate people will understand how energy is used every day, how it is produced and influenced, and how its consumption affects the environment and society. Thus, energy literacy is very influential on decisions and actions related to energy in the global community, including the conservation and development of alternative energy sources. For this reason, measuring the energy literacy level of the Indonesian population is important to measure how much people know about energy. Later, various levels of formal education institutions, as well as non-formal education, can help increase energy literacy for the wider community from an early age to support the implementation of energy conservation.

2. Method

This research was conducted by publishing public opinion surveys on literacy and knowledge about energy and energy conservation. In this case, an energy education survey will be conducted using a web-based survey method designed for various groups, ranging from students and college students to those who are already working. This sample is classified by age, gender and occupation. The form data collection techniques is disseminated online in the form of questionnaires distributed through social media networks. This questionnaire contains several questions that will provide an overview of energy education in Indonesia.

To discuss energy literacy related to energy conservation, a framework would be very helpful. Adapted from Cole (2019) and Lee et al. (2015), the concept of literacy can be developed in three dimensions, namely cognitive, affective and behavioral. Here, cognitive, affective and behavioral domains were the foundation for in-depth exploration of what it means to be energy literate (Lee et al., 2015). These three dimensions of literacy can be adapted to be applied to energy concepts related to energy conservation. The division of the dimensions of energy conservation literacy is shown in Table 1.

Table 1. Cognitive, affective and behavioral components of energy literacy related to energy conservation (Cole, 2019; Lee et al., 2015).

Dimension	Subscale	Definition
Cognitive	1. Basic energy concepts	Understand the definitions and concepts of energy, energy units, energy generation and energy use
	2. Energy conservation concepts	Understand the basic concepts of energy conservation
	3. Energy conservation methods	Understand the method of doing energy conservation
Affective	1. Concern on energy issues	Acknowledge the seriousness of energy problems and their development efforts

	2. Positive attitudes and values related to energy	Potential to increase energy-friendly lifestyle to support energy conservation efforts
Behavior	1. Willingness to conserve energy	Want to do energy conservation in everyday life
	2. Willingness to increase energy literacy	Want to increase energy literacy through both formal and informal education

In addition, this study also conducts a further analysis of the community's culture and habits regarding energy conservation in order to obtain an overview of the conditions of knowledge about energy conservation in the community and makes a mapping of potential energy education that might be implemented to improve energy literacy in Indonesia.

3. Results and Discussions

3.1 Results

A public survey on energy literacy and energy conservation efforts was conducted using sampling methods among various groups of respondents. In this study, the number of respondents was 462 respondents from various regions in Indonesia. These respondents came from both student and adult backgrounds who work in various sectors. Of the 462 respondents who filled out the questionnaire, 445 respondents were taken who represented the majority of respondents' opinions.

The questionnaire instrument used begins by asking the respondent's reflection on the extent to which the respondent understands energy and energy conservation. This is represented by the questions “How well do you know about energy in Indonesia?” and “How much do you know about energy conservation?”. In these two questions, the quantization scale of the respondent's level of consent was used on a scale of 1 to 5, with a value of 1 indicating very unfamiliar, a value of 2 indicating unfamiliarity, a scale of 3 indicating neutral, a scale of 4 representing knowing and a scale of 5 representing very familiar. Based on these two initial questions, the results obtained are the mean of the data and the standard deviation for the sample as shown in Table 2.

Table 2. Mean and standard deviation of the respondent’s energy literacy.

Items	Mean	Std.
Energy Knowledge	3.4482	0.8055
Energy Conservation Knowledge	3.3404	0.6229

In accordance with Table 2, respondents in this study were at the middle level of understanding energy literacy. This is indicated by the mean value regarding energy knowledge which is worth 3.4482 with a standard deviation of 0.8055, and the mean value regarding energy conservation knowledge which is worth 3.3404 with a standard deviation of 0.6229.

The next question is asked of the respondent about where the respondent knows basic literacy about energy and energy conservation. In this second section, sources of energy literacy are categorized into several categories: lessons in school; courses on campus; e-books, articles and websites; and from campaigns, leaflets and posters. The answers from respondents regarding this are shown in Figure 1.

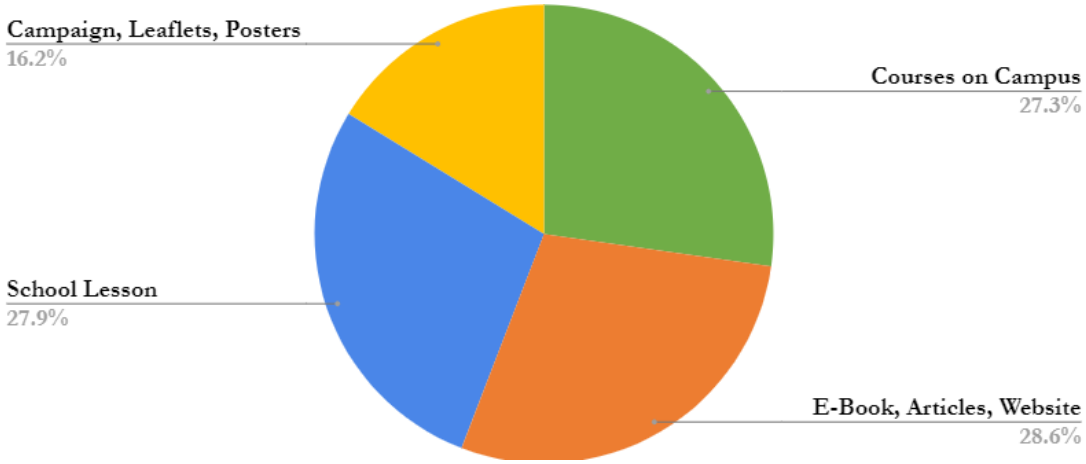

Figure 1. Response to the question on the source of the respondent's energy knowledge.

It was found that 55.2% of the respondents gained literacy about energy through formal education (27.9% at school and 27.3% on campus). Meanwhile, other respondents answered that 28.6% got energy literacy from digital literacy media (e-books, articles and websites) and 16.2% from campaigns, leaflets and posters.

Furthermore, to examine when the respondent received literacy about energy, questions were asked about at what level did the respondent first become acquainted with energy conservation. To make it easier, we divided them into clusters at the level of education, starting from elementary schools, junior high schools, high schools, universities to post-formal education. The responses from respondents regarding this question are shown in Figure 2.

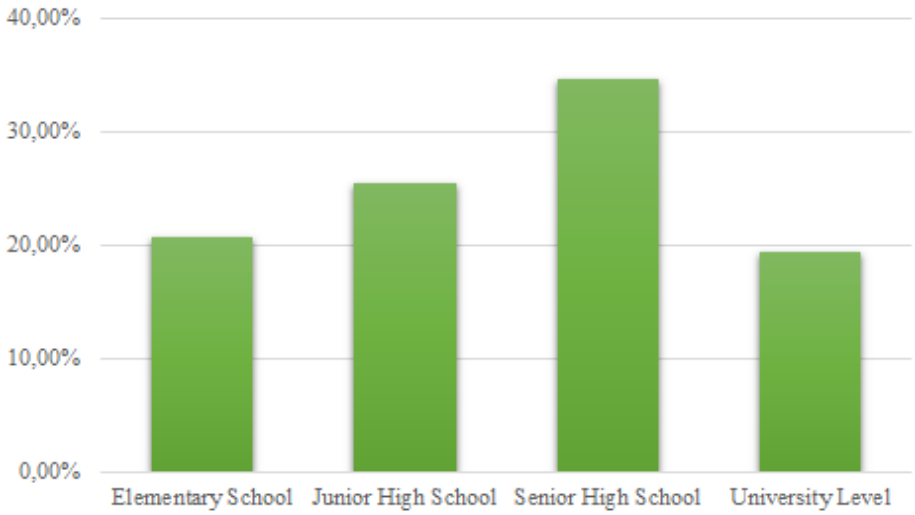

Figure 2. Responses to the question at what level do respondents know about energy conservation.

Of the total respondents, it was found that 20.61% of respondents had known energy conservation since primary education, 25.45% had known them since junior high school, 35.55% had known them since senior high school and 19.39% were new to the university level.

After knowing the respondent's level of knowledge about energy conservation, he was also asked about the application of energy conservation in everyday life. In this case, the respondent was asked the question, "To what extent do you apply energy savings in your daily life?" In this question, the quantization scale of the respondent's level of agreement was used on a scale of 1 to 5, with a value of 1 indicating never doing, a value of 2 indicating rarely doing, scale 3 indicating neutral, scale 4 representing frequently doing and scale 5 representing always doing. Based on this question, the mean value was 3.4303 and the standard deviation was 0.8641.

Furthermore, to get an idea of what the respondent is doing in conserving energy, further questions in the form of what efforts are being made are asked. In this case, 89.69% of respondents switched off electronic devices when not in use, 76.36% of respondents opened the water tap sufficiently, 65.45% of respondents optimized natural lighting (daylighting), 63.03% of respondents took off their gadget chargers when they finished charging their gadgets, 40% of respondents planned travel routes before driving, 39.39% respondents used energy-efficient lamps and 15.15% of respondents use air conditioner equipped with an inverter. These results are shown in Figure 3.

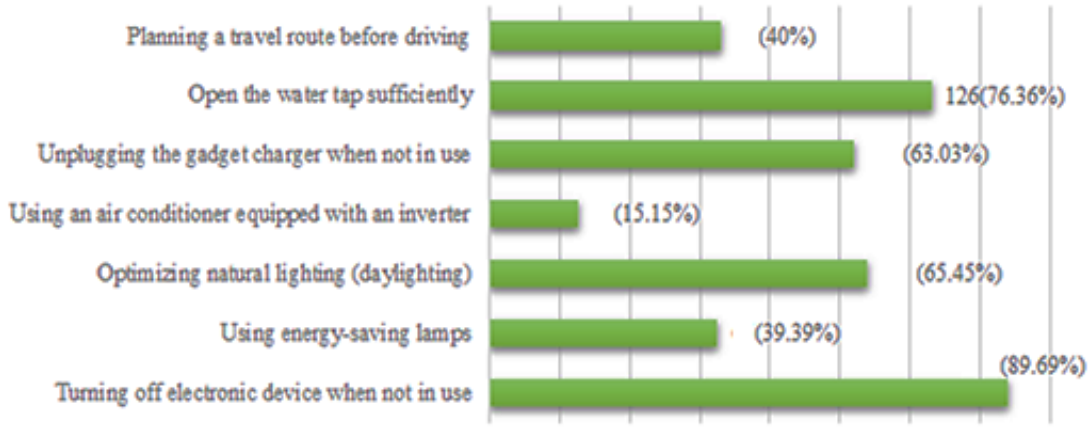

Figure 3. Responses to the question about energy conservation implementation in daily life.

In the next section, the respondents were asked about the reasons why the respondent wanted to conserve energy. This is an important question to get the general mindset of the respondents. It was found that 90.30% of respondents said that doing energy conservation can save costs, especially electricity bills, 69.69% of respondents said that doing energy conservation can support the sustainability of energy sources, 61.21% of respondents said that doing energy conservation could reduce environmental pollution and 59.39% of respondents said that doing energy conservation could anticipate the risk of global warming. These results are shown in Figure 4.

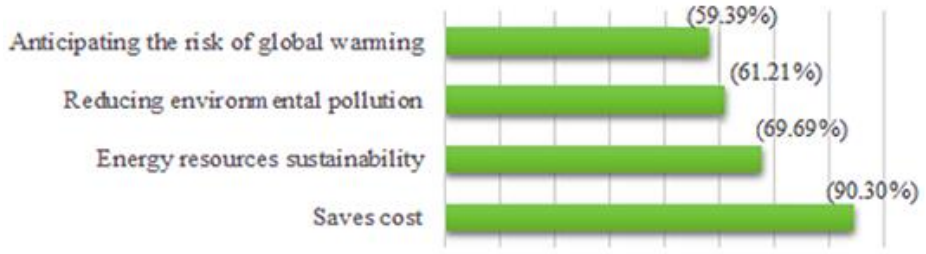

Figure 4. Responses to the question about the reasons for conserving energy.

At the end of the questionnaire, respondents were asked about their willingness to conserve energy and their willingness to increase their energy literacy. In these two sections, a quantization scale of the respondent's level of consent was used on a scale of 1 to 5, with a value of 1 indicating very disagree, a value of 2 indicating disagree, a scale of 3 indicating neutral, a scale of 4 representing agree and a scale of 5 representing very agree. The quantization means value of the willingness to conserve energy is 4.8955 from a maximum scale of 5 and the willingness to increase energy literacy is 4.8792 from a maximum scale of 5. The results obtained are in accordance with those shown in Table 3.

Table 3. Mean of the respondent's willingness.

Items	Mean
Willingness to conserve energy	4.8955
Willingness to increase energy literacy	4.8792

3.2 Discussion

Energy literacy in society greatly affects the level of community participation in energy conservation. Energy literacy is not just knowledge but is interrelated until its application. Several questions regarding the respondent's level of recognition of energy and energy conservation can be categorized into cognitive, affective and behavioral dimensions (as in Table 1).

The cognitive component is the first to be investigated because this component is the basis for the affective and behavioral components. This dimension includes the basic concept of energy, energy conservation and energy conservation methods. According to the data, the mean and the deviation standard, the respondents pretty much understand energy and its conservation. The mean from the data is 3.4482 for the knowledge about energy and 3.3404 for the knowledge about energy conservation which belongs to the cognitive domain. These two numbers are located in the range 3 to 4, which is considered a 'neutral' answer for recognizing conservation energy. In other words, if the respondent is assumed to represent the opinion of the Indonesian people as a whole, it can be shown that the cognitive energy level in the community is in the middle category, which states that they are somewhat familiar with energy knowledge. It is not bad, but it certainly still needs to be improved to reach a higher level of energy understanding.

Energy-related knowledge, which is categorized as a cognitive domain, is closely related to educational institutions. In this case, formal education institutions usually provide a cognitive understanding of energy and its conservation efforts. Then, as shown in Figure 1, formal education, like studying at school or university level, is more dominant even not too much non-formal education, so both aspects can be improved. Besides that, as shown in Figure 2, some people know about energy conservation from the elementary level, but some people also know about it when at the university level. It will be better for schools and the government to introduce it earlier, considering that energy conservation is one of the important topics for sustainable development in the future. From this study, it was also found that none of the respondents were new to energy when they finished formal education. This shows the role of formal education institutions that have contributed well by introducing basic knowledge about energy during the formal education level.

Ideally, knowledge about energy conservation in society should be applied to everyday life. This is a balanced combination of what is known (cognitive) and what one wants to do (affective behavior). The respondents already did some activities that related to energy conservation based on Figure 3. Most of the respondents did the easiest thing to do, and that is to turn off the electronic device when it is not used. Turning off the electronic device indeed conserved the energy because it cut the electricity flow so it could not be absorbed by the device. The awareness to turn off unused electronic devices is very good because public housing occupied approximately 60% of overall consumption while private properties accounted for about 40%, with 76% of the building's total energy consumption being used by air-conditioners, water heaters and refrigerators (Bhati et al., 2017). Then, open the water tap sufficiently to reduce the power consumption of the water pump and minimize wasted water (Marmer, 2018). Using natural lighting is also interesting to apply, for example, by using window openings that can be used to provide lighting supply to the space, especially considering that Indonesia, which is in the tropics, gets natural lighting throughout the year (Fitriaty et al., 2019). Removing the charger from an electronic device after charging is also done with the awareness that the plug in the charger still consumes power, even in a small amount. Meanwhile, respondents did not use energy-saving technologies such as energy-saving lamps and inverter air conditioners. Some of the reasons some respondents do not use energy-efficient technology are due to a lack of knowledge about the use value

of technology, which creates a gap between users and technology, and actually requires higher costs for its procurement (Cattaneo, 2019; Vasseur & Marique, 2019).

Looking at Figure 4, most of the respondents agree that conserved energy will reduce the outcome of electricity bills (90.30%). The other options also have more than half the proportion, but the difference between them and the saving electricity cost is almost 30%. It shows that Indonesian people need to understand more about energy sustainability and other problems like global warming. They should know that the risks can be reduced by conserving energy which they have done before. If this is linked to the literacy domain (Table 2), it is the affective domain that contributes. This domain brings concern to energy and environmental issues and gives good attitudes to an energy-friendly lifestyle. In this section, it becomes attractive because the dominant reason for energy conservation is the financial aspect. People have a tendency to save costs rather than save energy. In this case, cost savings can be obtained from savings in monthly electricity costs. This energy-saving effort in the financial aspect reflects a person's ability to make energy-efficient decisions financially and multifaceted energy literacy (Broek, 2019). The point of view of energy economics through macro and micro economic issues is interesting to apply, considering that energy consumption is one of the events that can be seen from an economic point of view which is reflected in the perspective of energy finance. This energy financial literacy is supported by the assumption that people act rationally and make economic decisions related to energy savings that reflect the knowledge, skills, confidence and motivation to manage money effectively. In its application, energy efficiency and energy conservation must be pursued as a strategy to utilize scarce resources in a sustainable manner to ensure economic benefits for consumers (Sendegeya & Gope, 2016). However, besides that, awareness of the environment is also another dominant factor. Most of the respondents are aware that waste of energy is one of the biggest causes of environmental damage. With better energy use, the environment will be more preserved, and with environmental sustainability, the concept of sustainability will also be increasingly applied.

Furthermore, behavioral aspects can be interpreted through the level of willingness of respondents to conserve energy and increase energy literacy, as shown in Table 3. This domain reflects personal awareness by evaluating the impact of daily actions (Martins et al., 2020). In this case, the level of respondents' willingness to conserve energy and increase energy literacy represents a willingness to take concrete action as a result of cognitive and affective domains. The high number in the behavioral domain with the average quantization value of the willingness to conserve the energy of 4.8955 and the willingness to increase energy literacy of 4.8792 from a maximum scale of 5 reflects a fairly good understanding of the importance of conserving energy and increasing related literacy.

So, from the developed literacy domain framework (as in Table 1), it can be analogized that the cognitive domain is the basis for the affective domain to carry out the behavioral domain. In other words, the three domains are interrelated. Especially in their daily application, these three domains influence each other and cannot be separated. Therefore, the level of participation in the implementation of energy conservation in everyday life is greatly supported by energy knowledge from the community (Demeo et al., 2013). The public's willingness to participate in conserving energy as a behavioral domain is driven by reasons that are based on the affective domain, and this reason develops from basic knowledge about energy and its conservation efforts in the cognitive domain.

With this literacy, it is expected that there will be an increase in public awareness about energy use and energy conservation (Martins et al., 2020). With this literacy, the wider community can also make savings and also efficient use, which will later strengthen finances due to efficient energy use. This education also aims to increase public awareness because energy conservation requires the role and participation of many people from all walks of life so that it can be realized and run well (Martins et al., 2020; Sovacool & Blyth, 2015). With increasing public awareness, the quality of the environment will also increase. This literacy is also expected to provide new insights and new insights that can be understood by the common people.

3.3 Recommendations

Seeing the condition and development of energy literacy in Indonesia, concrete steps to increase energy literacy need to be taken. Increasing energy literacy for the wider community can be carried out through formal and non-formal education (Cotton et al., 2015; Martins et al., 2020). Various efforts to increase literacy through formal education can be carried out as early as possible to impart energy knowledge and conservation efforts from the simplest and smallest steps.

Improving formal education to increase energy literacy can be done by adding views on energy and efficiency to various educational curricula in schools ranging from elementary to high school and college (Ikeyama et al., 2019). Energy literacy, in this case, can be inserted through the views of various subjects that may be taught in schools, especially those that can be correlated with the concept of energy. This learning is very likely to be included in scientific studies (for example technological developments and energy theory) and in the social sciences (for example energy economics and energy law). This learning can be done in the form of learning in theory or through visualization or experimentation that describes the concept of energy, especially sustainable energy and energy conservation.

Besides that, the non-formal education sector can also play an important role in promoting energy literacy in society (Greenhow & Lewin, 2015; Jonāne & Salītis, 2009). For example, through the use of social media and digital media to spread a deeper understanding of energy conservation efforts can be done by everyone. This includes the use of digital media for campaigns to intensify energy conservation in everyday life from the earliest possible steps (Sovacool & Blyth, 2015).

On the other hand, the government also needs to provide support to increase public contributions to energy conservation. Providing appropriate public information on energy conservation methods is one of the alternatives.

4. Conclusions

The level of knowledge about energy is closely related to community awareness and participation in energy conservation. There is a positive correlation between a lower level of energy literacy and lower public awareness of energy conservation. From the research and data collection, it can be seen that the level of literacy and understanding of the community is on a moderate scale, but it is still lacking to reach the level of energy literacy that is expected, while with a lack of energy literacy, energy conservation will also be increasingly hampered. In this study, it was also found that increasing education or energy literacy related to formal and non-formal education can make people more familiar with and implement energy conservation in everyday life.

5. Conclusions

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

References

Ayoo, C. (2020). *Towards energy security for the twenty-first century*. IntechOpen.

Bhati, A., Hansen, M., & Chan, C.M. (2017). Energy conservation through smart homes in a smart city: A lesson for Singapore households. *Energy Policy*, *104*, 230–239.

Broek, K.L. van den. (2019). Household energy literacy: A critical review and a conceptual typology. *Energy Research & Social Science*, *57*, 101256.

Brounen, D., Kok, N., & Quigley, J. (2013). Energy literacy, awareness, and conservation behavior of residential households. *Energy Economics*, *38*, 42–50.

Cattaneo, C. (2019). Internal and external barriers to energy efficiency: which role for policy interventions?. *Energy Efficiency*, *12*, 1293–1311.

Cole, L.B. (2019). Green building literacy: a framework for advancing green building education. *International Journal of STEM Education*, *6*, 18.

Cotton, D., Miller, W., Winter, J., Bailey, I., & Sterling, S. (2015). Developing students' energy literacy in higher education. *International Journal of Sustainability in Higher Education*, *16*, 456–473.

Demeo, A.E., Feldman, D.P., & Peterson, M.L. (2013). A human ecological approach to energy literacy through hands-on projects: An essential component of effectively addressing climate change. *The Journal of Sustainability Education*, *4*, 16.

Fitriaty, P., Shen, Z., & Achsan, A. (2019). Daylighting strategies in tropical coastal area a lesson from Vernacular Houses. *International Review for Spatial Planning and Sustainable Development*, *7*, 75–91.

Gielen, D., Boshell, F., Saygin, D., Bazilian, M.D., Wagner, N., & Gorini, R. (2019). The role of renewable energy in the global energy transformation. *Energy Strategy Reviews*, *24*, 38–50.

Greenhow, C., & Lewin, C. (2015). Social media and education: Reconceptualizing the boundaries of formal and informal learning. *Learning, Media and Technology*, *41*, 1–25.

Ikeyama, Y., Sumiyoshi, D., Choi, Y., Tanoue, S., & Shimoji, T. (2019). Study on energy education method for elementary school students to internalize energy conservation behavior. *IOP Conference Series: Earth and Environmental Science*, *294*, 012077.

Jennings, P., & Lund, C. (2001). Renewable energy education for sustainable development. *Renewable Energy*, *22*, 113–118.

Jonāne, L., & Salītis, A. (2009). Non-formal energy education in the context of sustainability: Perspective of Latvian educators. *Journal of Teacher Education for Sustainability*, *11*, 65–74.

Lee, L.-S., Lee, Y.-F., Altschuld, J.W., & Pan, Y.-J. (2015). Energy literacy: Evaluating knowledge, affect, and behavior of students in Taiwan. *Energy Policy*, *76*, 98–106.

Marmer, D. (2018). Water conservation equals energy conservation. *Energy Engineering*, *115*, 48–63.

Martins, A., Madaleno, M., & Dias, M.F. (2020). Energy literacy: What is out there to know? *Energy Reports, The 6th International Conference on Energy and Environment Research - Energy and environment: challenges towards circular economy*, *6*, 454–459.

Sendegeya, A.-M., & Gope, G. (2016). Capacity building for sustainable energy development: The role of the academia. *International Multi-Disciplinary Conference, Uganda*.

Sovacool, B.K., & Blyth, P.L. (2015). Energy and environmental attitudes in the green state of Denmark: Implications for energy democracy, low carbon transitions, and energy literacy. *Environmental Science & Policy*, *54*, 304–315.

Stern, D.I., Burke, P.J., & Bruns, S.B. (2019). The impact of electricity on economic development: A macroeconomic perspective. *International Review of Environmental and Resource Economic*, *12*, 85–127.

Szustak, G., Dąbrowski, P., Gradoń, W., & Szewczyk, Ł. (2022). The relationship between energy production and GDP: Evidence from selected European economies. *Energies*, *15*, 50.

Türkoğlu, S., & Kardogan, P.O. (2017). The role and importance of energy efficiency for sustainable development of the countries. *3rd International Sustainable Buildings Symposium*, 53–60.

Utami, S.S., Fela, R.F., Yanti, R.J., & Avoressi, D.D. (2018). *Menelusur jejak implementasi konsep bangunan hijau dan pintar di Kampus Biru.* UGM PRESS.

van Ruijven, B.J., De Cian, E., & Sue Wing, I. (2019). Amplification of future energy demand growth due to climate change. *Nature Communications*, *10*, 2762.

Vasseur, V., & Marique, A.-F. (2019). Households' willingness to adopt technological and behavioral energy savings measures: An empirical study in the Netherlands. *Energies*, *12*, 4294.

Zografakis, N., Menegaki, A.N., & Tsagarakis, K.P. (2008). Effective education for energy efficiency. *Energy Policy*, *36*, 3226–3232.