

Energy Literacy-Based Learning Activities On Female Students

Lingga Nico Pradana, Andri Putra Kesmawan, Swasti Maharani

Abstract—Energy resources an important topic to be explored and become national issues. Education has become an important sector in overcoming energy problems. This study aims to enhance student' energy literacy in energy literacy-based learning activities. The study involved 47 vocational school female student. The activities had been held 10 weeks (90 minutes each week). Energy literacy in the activities focus to improve knowledge of scientific facts, knowledge of issues related to energy sources and resources, awareness of the importance of energy, understanding of the impact energy on society, understanding of the impact energy on the environment, and cognitive skills. Energy literacy-based learning implemented by student' research on energy issues. The result of this study shows that energy literacy-based learning activities improve student' energy literacy. Moreover, student have ability to assimilate and resolve current problems relevant to energy problems, analyze and assess information relevant to energy issues, and evaluate energy costs and benefits related consumer purchases.

Index Terms—Energy literacy, energy literacy-based learning, vocational school.

1 INTRODUCTION

Recently, energy is a defining issue. The objectives of energy management are based on the Kebijakan Energi Nasional (KEN) compiled by the National Energy Council and determined by the Government through Peraturan Pemerintah No. 79 Tahun 2014 are: (i) achieving independence in energy management, (ii) ensuring optimal, integrated and sustainable management of energy resources, (iii) achieving improved access for the poor and / or those living in remote areas to energy (iv) the achievement of the development of the ability of the domestic energy and energy services industry to be independent and enhance the professionalism of human resources (v) the creation of employment opportunities, and (vi) the preservation of environmental functions. Achieving that goal cannot be carried out by the government itself but rather requires the cooperation of all elements of society. Energy is about decision-making; hence, energy literacy had an important role in age because the knowledgeable people can supporting implementation of smart and forward-looking policies [1]. Knowledge about energy is required to make people citizens understanding about energy saving [2]. Energy savings will not only reduce the level of threats to the planet because of anthropogenic carbon emissions, but also economic health and sustainability and even national security. Energy-literacy citizens who can be involved in the decision-making process and are committed to action, helping to realize a successful paradigm shift in terms of energy use [3].

Energy literacy is not only about knowledge (cognitive) but also aspects related to influence and behavior. There are three aspects in energy literacy, namely cognitive, affective, and behavior [4–6]. People with energy literacy are expected to

take responsible action in accordance with their knowledge that assimilates and values that are built [7]. As mentioned above, with basic awareness or knowledge, the attitude taken, responsible behavior can be expected to increase the reduction of unnecessary energy use.

The example of national issue about energy consumption is electrical energy. For the last three years, the consumption of electrical energy increase divided by six categories (residential, industrial, business, social, gov. office building, public street lighting). As a present from Graphic 1, the consumption of electrical energy increases especially in residential category. Residential category is the people who using electrical energy at home. This category is the least productive category than the others. If the increasing trend continues, then electrical energy become expensive. Based on this problem, people need to be educated to use electrical energy since early stage.

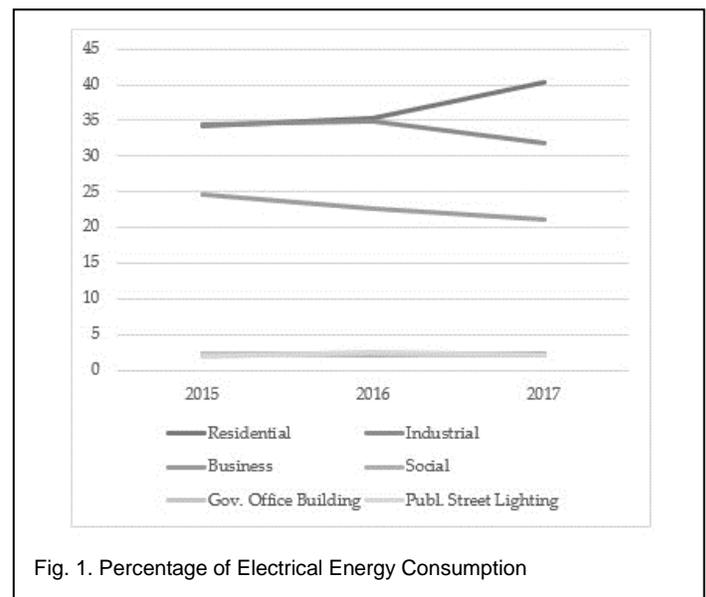


Fig. 1. Percentage of Electrical Energy Consumption

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Women play various roles in several renewable energy activities. First, women as energy consumers and beneficiaries, women have contributed to the completion of technology and household energy projects. Better than better stove programs

TABLE 1
MEANS AND STANDARD DEVIATIONS OF ELI TEST

ELI Test	Overall		Grade			
	M	SD	10 th grade		11 th grade	
			M	SD	M	SD
ELI test section 1	24.73	6.21	24.68	6.13	24.87	6.10
ELI test section 2	27.09	5.97	26.52	6.03	27.68	6.32

and more benefits from compilation obtained from women for product design and marketing and credit for women and men needed. Some solar stove projects have used similar approvals. Secondly, women as micro entrepreneurs, women have used renewable energy to increase profits and efficiency in their informal sector companies, and have proven themselves to provide labor and also build their own renewable energy technology, compilation provided with appropriate training and support. Women can become effective renewable energy entrepreneurs, because of their experiences as energy users in their own households and companies; in several countries women have successfully marketed solar home systems. Third, women as extension workers and caregivers, women have effective roles in the operation and maintenance of biogas, air power plants and solar power installations. Although some costs may be higher, because women's needs for training and their mobility are limited, others are lower, due to fewer staff turnover and greater displacement. Fourth, women as leaders, networkers and lobbyists, women have succeeded in influencing energy policy decisions at the local, national and international levels. Women do not need to be built, operated, or moved. More important are women who have a role in determining the use and benefits of the project and in these regulatory settings, and how they receive and control benefits [8].

The public, especially young people, are inseparable elements of the initial energy saving implementation process [9]. The youth can take a lot with people's excessive energy consumption and pollute the environment. Youth can be their own if they continue to lack knowledge about energy savings and vice versa will be an obstacle to the much need changes. Increasing the education level of young people and increasing environmental awareness will help create a responsible energy future [10]. For this reason, education, all life, has been determined as an effective method [10,11]. Education is an important element and the keystone for the development of any nation; it promotes scientific development, enhances life, and injects labor into the modern labor market. Indeed, education can be provided which is a jolt of a nation and is the most formidable needed to overcome unpleasant challenges. Education can help teenagers who are needed and are morally responsible for more and solving environmental problems, specifically those related to energy generation [9].

In addition to previous studies in energy literacy, Alp, Ertepinar, Tekkaya, & Yilmaz [12] showed statistically

significant differences based on gender in attitudes toward the environment, with female students showing more positive attitudes than male students [13]. A number of studies have shown that female students show more responsibility for the environment than male students [12,14,15]. Blocker & Eckberg [16] focus on discussing how women's social status and their role influence them on environmental issues. They stated that women preferred greater care than people because of their social and structural problems in society. Furthermore, Öztürk, Gökhan, & Teksöz argues that there is a difference between male and female attitudes towards reduced environmental problems, social status, economic strength, and beliefs where women are better than men [17]. Thus, female student should be more understanding about energy saving.

The complicated of energy issues need to be analyzed in a systematic way [1]. Knowledge related to energy is a major concern in many studies [5,6,18]. In some studies, general public perceptions and knowledge about energy have been examined by experts, with different reasons and objectives [19]. Behavioral models are also introduced and applied to related studies, linking the relationship between knowledge, attitudes, and behavior [20,21]. Previous study create renewable energy education programs in the formal education system and presenting the relationship between energy-environment-education and developing country policies [22-29]. Focusing on the potential for renewable energy education from their education systems at different levels and identifying education levels using various questionnaires and statistical models [30-33]. Energy education programs must be developed and take place at all levels of the education system [34]. Thus, this research bringing the energy literacy to the learning.

2 RESEARCH METHOD

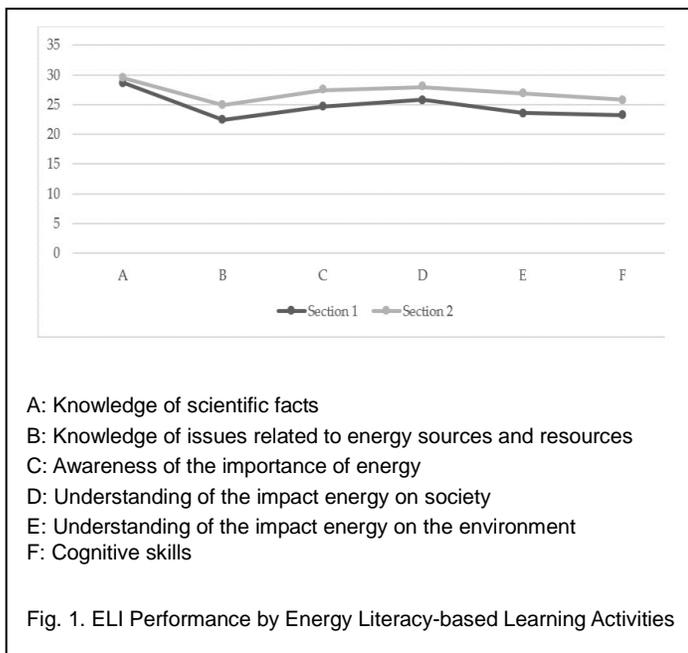
This Study expect to expose and improve student' energy literacy by using energy literacy-based learning. The participant in this study was 47 vocational school female students (26 tenth grade; 21 eleventh grade; mean age = 17.2; range age = 16.3 - 17.8). The activities in this study had been held on 10 weeks (90 minutes each week). This study was conducted by using Energy Literacy Instrument (ELI). ELI is an instrument to measure student's energy literacy by using test and questionnaire based on energy literacy problem in Indonesia. The ELI administered two weeks before the activities to expose initial student' energy literacy (section 1) and one week after activities to expose final student' energy literacy (section 2). The ELI test was analyze statistically using compare mean test. Furthermore, ELI was analyze descriptively viewing by indicator activities in energy literacy-based learning.

3 RESULTS AND DISCUSSION

The data from ELI test of student' energy literacy used to perform compare mean test. Means and standard deviations present on Table 1.

Compare mean test perform to compare student' energy literacy before and after activities. In addition of *p*-values

(0.01), the effect size reported. The result between ELI test section 1 and ELI test section 2 in overall view, there was significant different between initial and final student' energy literacy ($df = 45$; $sig < 0.01$). In the other hand, student' energy literacy was improved as an effect of energy literacy-based learning activities (viewing by the biggest mean score). Furthermore, we also comparing mean between 10th grade student and 11th grade student on section 2. In the section 2, there no significant different between 10th grade and 11th grade students ($df = 45$; $sig = 0.14$). Thus, there's no different effect of energy literacy-based learning activities on 10th grade and 11th grade students. Energy literacy-based learning give the same benefit for both 10th grade and 11th grade students. Figure 2 shows mean of each activity in energy literacy-based learning.



The result of this study related to knowledge of scientific facts shown indicate that student can learn about definition and forms of energy. Definition and forms of energy is basic concept of energy literacy. Student performance shown by make an observation to search example of energy resources and the relationship between energy and power. Student knows about the transfer of energy through living systems or nonliving systems. Furthermore, student can analyze the relationship between energy and power arrived at mentioning units of energy and power. Thus, the knowledge about the actual facts stimulating student' awareness about energy in everyday life. In addition, the knowledge about facts shows the awareness issues related to energy sources and resources. The energy literacy-based learning activities discuss about factual issues of Indonesian energy resources nowadays. Using mass media, news videos and internet resources, student can research more effectively about the national issues of energy such as primary energy source and other sources of energy used by Indonesian people. Student sorts by two category i.e. renewable resources or non-renewable resources. On each category student analyzes about advantages and disadvantages of developing and using energy resources viewing by technical, environmental, economic, and societal. By working in small group, the result of this learning activities

shows by mapping concept in accordance with their findings. The purpose of implementation energy literacy-based learning activities grow student' awareness about society' need for energy. This is very important because early students must be given an understanding of energy-saving culture, cultivating energy and using energy effectively. Students can also campaign for energy literacy to give an intervention for other people to do the same culture about energy. Thus, the importance of energy not only use for individual functioning but also societal functioning. Furthermore, the activities on energy literacy-based learning give student some basic knowledge about the impact energy resource development and use from various renewable and nonrenewable resources on all spheres of the environment. Teacher collaborate with us to give guided for student to access information about energy resources by showing video concept of developing energy and their relationship to all environment around students. Activities on energy literacy-based learning educate student to reason about influence of energy resource supply and demand on relationships between states, regions, and nations. Societal and economic problems related to shortages in nonrenewable energy resources. Societal impacts related to energy resource development and use. Then, personal and community health and safety factors associated with energy resource development and use. In addition, the activities not used for remembering content but to train students' sensitivity about energy.

The main content of energy literacy in this study related to cognitive skills. Learning activities by using energy literacy-based learning improve ability related to energy literacy in cognitive domain. The ability to assimilate and resolve current problems relevant to energy problems by the result of student research in activities. This ability improved by collecting data from mass media, news video, internet resources and the content provided by the teacher. The second ability, analyze and assess information relevant to energy issues. This ability make student to discover problem related to the use of energy in Indonesia. In addition, this ability also has relationship to student' awareness about energy need and how to use correctly and effectively. The third ability, to evaluate energy costs and benefits related consumer purchases. Related to factual issues about energy need, student make a plan about energy costs to reduce energy and financial waste. The quality about their plan some were rational value but some did not create rational planning. However, students' thinking of being able to prevent waste denote a positive thing. The end of activities purpose reached. Energy literacy-based learning activities give students benefit about energy literacy.

The previous studies educate people about energy education and training program [3,30,34], meanwhile this study design instructional activities by using energy literacy-based learning. Energy literacy-based learning activities administered to achieve a good student' energy literacy. The activities show different view about energy literacy learning. Energy literacy usually learned by directed learning [1,5]. On the other hand, energy literacy-based learning executed by research activities. Thus, students can use all resources to achieve knowledge of scientific fact and have awareness about the importance of energy to everyday life. Viewing by affective aspect, most previous studies was very attentive

about awareness of the importance of energy [21,22,33,34]. This study also achieve improvement about energy awareness as affective aspect. Therefore, this learning activities show significant effect to student' energy literacy.

The importance of energy literacy at education field make teacher integrated energy education to their class [20,27]. Meanwhile, the present study design energy literacy-based learning as an extracurricular to get deeper achievement. Energy literacy ability divided into six categories. Knowledge of scientific facts, knowledge of issues related to energy sources and resources, awareness of the importance of energy, understanding of the impact energy on society, understanding of the impact energy on the environment and cognitive skills. Viewing by each category, energy literacy-based learning activities has a change to integrate in school learning activity. The reason, energy literacy-based learning can develop ability to assess the use of energy resources around students and aware to the issues of energy resources. Therefore, implementation of energy literacy-based learning is very important to improve energy literacy to give education about saving and managing energy resources.

Female students are more concerned toward energy conservation than male students [35]. Female students showed more positive of attitudes than male students toward energy [4]. Female students also have more knowledge, positive attitudes, and responsible behavioral than male students in educational level (Alp, Ertepinar, Tekkaya, & Yilmaz, 2008; Tikka, Kuitunen, & Tynys, 2000; Tuncer, Ertepinar, Tekkaya, & Sungur, 2005). Teaching and learning who connected the students experience about energy may usefull, for example the information stimulated students to observed the using of energy in daily life and school, understand about how the make an electricity and what the source using [6].

4 CONCLUSION

The result of this study shows that energy literacy-based learning activities improve student' energy literacy. The student' energy literacy viewing by knowledge of scientific facts, knowledge of issues related to energy sources and resources, awareness of the importance of energy, understanding of the impact energy on society, understanding of the impact energy on the environment, and cognitive skills. Based on the activities, the important point was student' awareness about energy to instill the importance of energy for individually and society. Basic knowledge about the various energy resources around student and ability to manage energy effectively.

The implementation of energy literacy-based learning was not included to school' curricula. Then, the activities done outside regular learning activities. Therefore, its important to use energy literacy-based learning inside the regular learning (school' curricula) to teach students the importance of energy. Thus, the future research can make learning model viewing by energy literacy as an addition purpose. Furthermore, energy literacy-based learning used to improve not only student but also other people especially in Indonesia.

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