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Behavior toward energy: An exploration of high school students' perspective in Indonesia

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ABSTRACT

Securing universal access to affordable electricity by 2030 is one of the sustainable development goals. Meanwhile, energy consumption efficiency has a vital role in determining the achievement of this goal. Therefore, exploring behavior toward energy is crucial. Energy behavior is often characterized as individual actions that influence energy consumption and understanding of its production. On the other hand, the perspective of the young Indonesian generation is interesting to explore as their country is well-known as a fossil energy producer. In this study, the participants were 475 junior high school students in the ninth grade from four public schools in Indonesia. The questionnaire has 39 items that explore students' perspectives on their behavior toward energy. The result shows that students' energy behavior is mainly at a moderate level with no significant difference by gender. Students with experience in informal energy education showed higher energy behavior. The result suggests the urgency of a better quality of energy education, both formal and informal, that supports reinforcement in energy behavior.

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1. INTRODUCTION

As the concern of the world's projected growth population and future needs are listed on sustainable development goals (SDGs) [1], [2], the awareness toward pro-environmental behavior has become an international focus [3]. Environmental quality in Indonesia has been reported to decline during the last decade, such as water quality [4], air quality [5], and energy sources. Therefore, raising awareness of these issues and reinforcing pro-environmental behavior [6] among the young generation is urgent. The pro-environmental behavior can be observed in behavior toward energy.

As the fourth most populated country in the world [7], shaping positive behavior toward energy from a young Indonesian perspective is both important and crucial. Indonesia is one of the biggest consumers and energy producers [8]. Despite all the investments in innovations toward renewable energy sources, behavior change is still considered a central strategy for reducing energy consumption [9]. Individual actions will move into family and community action, which is an initial requirement for the national movement. Investments in energy education should be regarded as one of the ways to shape energy in a private household and increase energy efficiency [10]. For example, the awareness of energy will lead to the behavior of choosing an electrical device that consumes less energy. Although this issue is crucial, only a few research studies reported the behavior toward energy in young Indonesians [11].

Behavior toward energy is part of energy literacy. The terminology of energy literacy refers to a broad term encompassing content knowledge as well as a citizenship understanding of energy that includes affective and behavioral aspects [12]. Energy behavior evaluates the personal awareness of the impact of daily actions, the production and consumption of energy, the responsibility as a citizen of the world, and the commitment to actions in saving energy [13]. However, implementing sufficient energy education to shape positive behavior is challenging [14]. Previous research focuses on the cognitive aspect of energy literacy [15], [16] or energy literacy in general [17], but understanding energy issues need to follow with shaping positive behavior toward energy [18]. The importance focuses on linking the cognitive understanding of energy toward positive behavior to the energy.

This research aims at exploring the behavioral aspect of energy in ninth graders in Indonesia. Previous research showed that female students in Japan tend to have more positive behavior toward energy [19]. Within the same grade of students, we argue that experience in informal education brings influences their behavior. Informal education is supplementary to formal education, where students aim to join extra learning without certain curricula [20], such as visiting museums and power plants. Exploration from the perspective of gender and support from informal education experience became our primary focus. The association of the results with aspects of behavior change theory leads to recommendations for behavior development. Insights from the behavior patterns of energy may help support strategic decisions regarding energy learning that build awareness of energy issues and also for policymakers and other environmental stakeholders.

2. RESEARCH METHOD

This study is quantitative in nature, using a survey design, and a questionnaire was our main instrument. The self-reported questionnaire consists of three parts: (part 1) demographic information (school and gender); (part 2) learning experience background; and (part 3) energy-saving behavior consists of 39 items. The questionnaire is part of an energy literacy questionnaire developed by a former researcher and widely used for high school students [12], [19].

2.1. Data collection

Concerning the vast area of Indonesia's archipelagos, we targeted students who are in 9th-grade high school because their behavior will, directly and indirectly, affect future decisions through their energy use, choices, and actions. In 2021, four schools participated in this survey. Those were in Java, Kalimantan, dan Sumatra Islands. The schools were selected in wide areas of Indonesia that could be reached during the pandemic. Valid responses of 452 students from 9th grade (ages 13-15), without missing values, were analyzed. The distribution of the respondents can be seen in Table 1.

Table 1. Distribution of respondents

School	Island	Number of responses		Total
		Male	Female	
A	Kalimantan	48	76	124
B	Kalimantan	41	37	78
C	Java	89	105	192
D	Sumatra	27	29	56
Total				452

2.2. Data analysis

The steps of this exploration research are questionnaire preparation, data collection, and data analysis. Questions related to energy behavior were put in the online form of opinions that must be filled in by the students. Data analysis was descriptive and inferential analysis using software of Microsoft Excel and Statistical Package for the Social Sciences (SPSS). In addition, Origin software was used in visualizing the results into graphs. Then, to deeper the analysis, data was categorized by three levels of behavior toward energy, which are low, moderate, and high, which the range of each category can be seen in Table 2 adapted from the previous study [21]. Moreover, analysis by gender and experience of visiting energy facilities was conducted using Analysis of Variance (ANOVA) after the homogeneity test.

Table 2. Energy behavior level

Level	Range	Score
Low	$X < M - 1\ SD$	$X < 3.41$
Moderate	$M - 1\ SD \leq X < M + 1\ SD$	$3.41 < X < 4.08$
High	$X < M + 1\ SD$	$X > 4.08$

3. RESULTS AND DISCUSSION

Positive behavior toward energy is essential to educate high school students because they will make their own decision on energy as an adult. When energy behaviors are repeatedly performed, they will become a habit for their individual [9]. Our participants showed an energy behavior score of 74.95 on average, with a deviation standard of 6.70 as shown in Table 3. More profound exploration results in the energy literacy level, gender, formal learning experience, and informal learning experience are discussed in this section.

Table 3. Student's energy behavior

Descriptive statistics	Value
Number of students	452
Average score	74.95
Standard deviation	6.70
Highest score	93.33
Lowest score	49.74

3.1. Energy literacy level

Literate citizen is needed to adapt to the changing world [22], for example in the change of global energy issue. The level of energy literacy can be observed in Figure 1, where most of our participants are at a moderate level. The most common energy behavior accomplished by the children (n=293; 64.82%) was item B10 (even if there are new technologies that can solve energy problems for future generations, we must still conserve energy), followed by item B27 (everyone has a responsibility to save energy to protect the global environment) which is n=292 (64.60%). Even though these statements are in the highest score of the items, the percentage is still on the moderate level.

Interestingly, the least common energy behavior was B9 (energy saving is up to me) and B36 (I'm not worried about global environmental and energy-saving issues) with the same score (n=49; 10.84%). From this result, students cannot find the relation that what they do as an individual will bring affect global issues such as global warming. The connection among concepts in energy is missing [16]. The need for energy education to be more focused on shaping energy behavior is crucial [23].

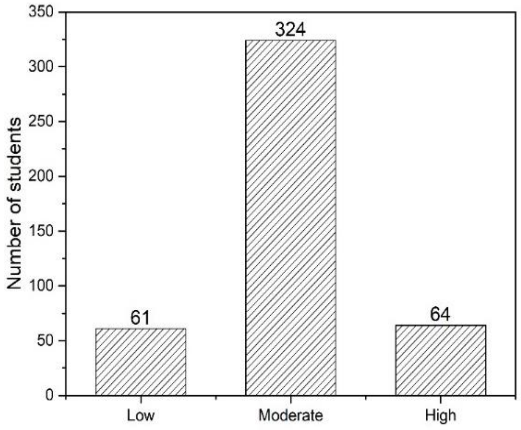

Figure 1. Energy behavior level

3.2. Energy behavior by gender

Although in the same age, the factor of gender is commonly influenced children's behavior [24]. From the educational perspective, of course, equal opportunity for both gender is favorable. Our participants showed that the average energy behavior score for the female is slightly higher than male students as presented in Figure 2. In detail, Figure 3 shows the energy behavior level of each gender. The result clarifies the consistency of both genders, resulting in the low, moderate, and high levels being consistent with slightly different scores.

Gender is one of the personal variables that have been related to differences found in motivational functioning and self-regulated learning [25]. Although other research has demonstrated the existence of different attribution patterns in male and female students, our result in Figure 3 showed there is almost no

difference between male and female responses toward energy behavior questions. Female students were slightly higher than males in low and moderate levels. This result is different from the result of energy behavior in Japan, where gender is one of the influential factors [19]. Our result supports the previous result that in terms of attitude and behavior aspects, gender does not affect high school students environmental awareness [26].

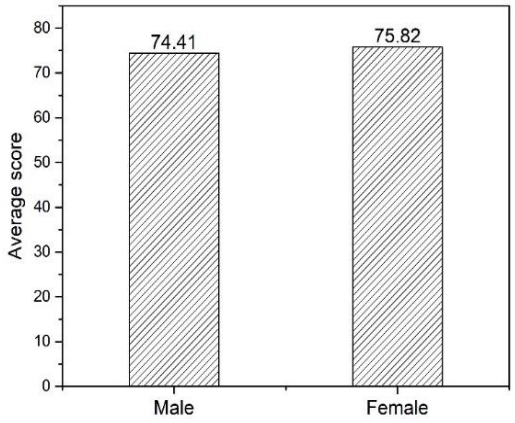

Figure 2. Energy literacy by gender

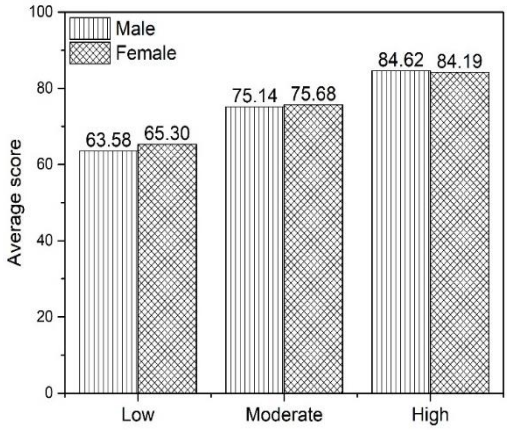

Figure 3. Energy literacy by level and gender

3.3. Energy literacy by an informal learning experience

With relatively similar formal learning experience, informal learning experience toward energy was explored by the participants. Informal education support limited interaction between student and teacher at school [27]. Figure 4 shows that student with more informal experienced has a higher energy behavior score of 76.45 points. The informal learning experience means the experience of visiting energy facilities such as water, thermal, solar, and wind power generators. The waterpower generator is the most visited facility, accounting for 62.1% of students. On the statement of B19 (I turn off the computer when I am not using it), most experienced and inexperienced students answered that they almost always practice that with a percentage of 73.4% and 67.88%, respectively. However, experienced students (72.34%) tend to have an answer "strongly agree" on the item related to government and society responsibility, which is B31 (the government and society are responsible for saving energy and protecting the environment). This signifies that informal energy education can raise awareness of responsibility for energy sustainability. Moreover, the proportion of students who strongly agreed that everyone must care about global environmental and energy-saving issues is higher for experienced students (18.08%) than inexperienced students (8.94%).

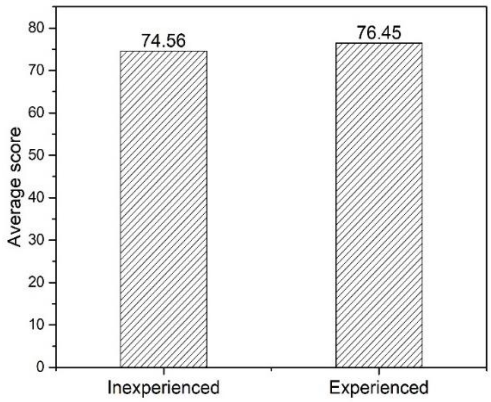

Figure 4. Energy literacy by an informal learning experience

Figure 5 shows the result by gender and informal learning experience. If the categorization of gender was used, the result in Figure 5 showed the tendency for female students achieved higher scores than males. Inferential statistics with ANOVA clarify the factor that brings significant difference to the energy behavior. The result indicates that the difference between experienced and inexperienced students in informal learning is significant ($p<0.05$). As shown by the ANOVA result in Table 4, the result by gender is not significantly different ($p>0.05$).

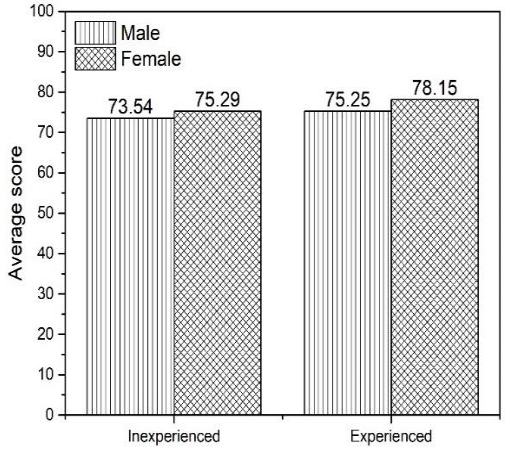

Figure 5. Energy literacy by gender and informal learning experience

Since all of our participants in this study were ninth-grade junior high school students, they all had a similar experience of energy learning at school. Based on Indonesia's national science curriculum that should be followed by all schools [28], energy topics are facilitated in grades VII and VIII [29]. An example of a competence standard in grade VII is understanding energy concepts, various sources of energy, and energy transformation without focusing on renewable energy sources[30]. This topic could be observed in science textbooks [31], [32]. Although having a similar formal learning experience, the important role of informal education in shaping energy behavior is highlighted in our result.

Table 4. Two-way analysis of variance (ANOVA) of energy behavior

Source	Type III sum of squares	df	Mean square	F	Sig.
Corrected model	761.546[a]	3	253.849	4.743	.003
Intercept	1681164.211	1	1681164.211	31408.409	.000
Gender	197.613	1	197.613	3.692	.055
Experienced	620.640	1	620.640	11.595	.001
Gender * Experienced	9.623	1	9.623	.180	.672
Error	23979.615	448	53.526		
Total	2595550.296	452			
Corrected total	24741.161	451			

a. R Squared = .031 (Adjusted R Squared = .024)

This study reveals that informal energy education positively shapes energy behavior [33]. It is consistent with postmodernist research that shows the future of informal education aims to make living conditions better [20]. It is also in line with previous research that reported that students' energy-saving behaviors are strongly influenced by encouragement from their environment [34]. Even though informal education related to energy is found to improve the students' awareness of energy saving, the involvement rate of students in such programs is regarded as relatively low. Therefore, the conduct of extra-curricular activities about energy to expose students more to the energy-related phenomenon and the encouragement to students for visiting energy exhibition facilities are essential to creating energy-saving attitudes among students [35].

4. CONCLUSION

The result shows that students' energy behavior is mainly at a moderate level with no significant difference by gender. Students with experience in informal energy education showed higher energy behavior. This study contributes to clarifying energy behavior levels in Indonesian high school students and their significant influence on the informal learning experience. The result suggests the urgency of a better quality of energy education, both formal and informal, that supports reinforcement in energy behavior.

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