



Energy Literacy Education Characteristics in Gorontalo City, Indonesia: Cognitive Scale

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Abstract

Main objective of this study assess and evaluate energy literacy cognitive in difference system schools in Indonesia, namely are general public school, general private school, islamic public school and islamic private school based on scope of study and gender. A questionnaire was designed to check the cognitive to 64 students from four different senior high school. This study used frequency distribution and independent t-test as analysis and use SPSS software for helping calculating the questionnaires. The overall energy literacy cognitive level is dominant in very poor level (59.4%). One of the reason energy literacy in very poor level cause most of the parents' educational backgrounds are high school graduates (44%), also 41% their parents' educational background are elementary and junior high school and there are only 13% in university. Students in general school study about energy three times in a week than in islamic school is just twice in a week. Therefore, it seems normal when energy literacy in general school is higher (mean value 34) than in islamic school (mean value 32) and it also happened between public school and private school, which public school has 35 and private school has 30. In science class, energy literacy is higher than social class that is caused students in science class study about energy on physics subject and chemistry subject, whereas in social class students study energy on geography, but it is not much as in physics and chemistry subject.

Introduction

The youth generation are an important generation who will build energy sources in Indonesia in the next few years. They will be involved in planning and developing energy. Therefore, the Ministry of National Education (Kemendikbud) has been running a program that is called school literacy movement (Gerakan Literasi Sekolah) (Teguh, 2017). Gerakan literasi sekolah (GLS) is a program with the main goal of increasing students' interest in reading, thus students have creative and innovative characters (Ministry of National Education, 2012). In its implementation, GLS is carried out not only in the school environment, but in the family and community environment (Ministry of National Education, 2012). GLS in schools consists of improve teacher quality through training, make literacy organizations between students, teachers and parents and allocate funds for literacy infrastructures such as reading parks, illustrated books, internet and learning support tools that create a product. Not much different from the school GLS, GLS in family and society consist of parents and students spent time before going to bed to read and exchange ideas and in society there are reading park facilities or mobile libraries or literacy communities that are active in each region (Ministry of National Education, 2012).

Energy literacy is not explicitly mentioned in GLS, but it is part in science literacy. Energy literacy is defined as an individual characteristic of understanding energy use in daily life, the impact of energy over consumption on society and the environment, making appropriate energy choices and decisions and taking actions reflecting one's skills and action for a sustainable society (Barrow & Morrissey, 1989; DeWaters & Powers, 2013; U.S. Department of Energy (2012). Many developing and developed countries have adopted energy literacy. In developed countries, such as Japan and America measured energy literacy in school. Energy literacy in secondary school students in Japan is 67% and energy literacy in secondary school in US is 66% (Barrow & Morrissey, 1989; DeWaters & Powers, 2011; Akitsu et al., 2017). The acquisition of energy literacy values around 60% is also owned by Students in Taiwan on a cognitive subscale (Yeh et al., 2017). Unlike the case in developed countries like Japan, America and Taiwan, in developing countries like Nigeria had lower energy literacy on cognitive subscale that was only 47.3% (Arikunto, 1998). it is not much different from Nigeria, energy literacy level on cognitive subscale in Jember District (region in Indonesia) is lower too (54.15%) (Yuszda, 2018).

Energy literacy cognitive is low that is big challenge for the Indonesian Government in industrial revolution 4.0, moreover the government has been running a science literacy program since 2015 that was effect PISA results that show OECD scores in Indonesia are still low (Ministry of National Education, 2012) Measuring energy literacy in Indonesia is not done yet thoroughly in all provinces in Indonesia. Java Island as the location of the capital city in Indonesia is still very rarely found by researchers conducting research related to energy literacy at the elementary school until university. Most of studies only discussed about energy literacy curriculum assessment without measuring energy literacy curriculum has an impact on students' knowledge (cognitive), attitude (affection) and action (behavior) (Yusup et al., 2017; Rusilowati et al., 2018; Sukendar & Setiawan, 2018; Budiningsih et al., 2015).

Gorontalo Province was a new province in Indonesia since 2000. it has a lot of renewable energies potential (Ahmad & Jaya. 2018; Hasan et al., 2016; Rumbayan et al., 2012; Yuszda 2018). Nevertheless, the electricity supply in this province still depends on North Sulawesi province. Therefore, renewable energy development is needed in this province so that the province can supply electricity to their society. Energy literacy is one way to develop renewable energy. However, this province does not measurement yet related to energy literacy. it can not be known whether energy literacy in this province has been running well and it can create a creative and innovative next generation in the field of renewable energy and energy efficiency. Therefore, we aim to study the energy literacy of students, especially in senior high school in Gorontalo City. We choosed senior high school because we realized that students in senior high school have learned maley lessons related to energy literacy from elementary school until senior high school and they will be ready to create energy efficiency and renewable energy in university. In this paper, an energy literacy scale is developed for a senior understanding of high school students' cognitive regarding energy. Next, we compare it to schools which have the difference in the school system. They are general public school, general private school, islamic public school and islamic private school based on scope of study and gender. Therefore, this study is meaningful from other studies that have ever been done.

Methods

Survey Questionnaire

This study uses quantitative descriptive method that describes the differences cognitive, in general public school, general private school, islamic public school and islamic private school based on scope of study and gender. The data is collected using the questionnaire. The

questionnaire based on the Energy Literacy Survey for Middle School, Clarkson University[8] and the Energy Literacy Survey for lower secondary schools in Japan Akitsu et al. (2017) is developed, modified and consisted of 15 which consists of 4 parts, namely knowledge of basic scientific (KBS), knowledge of issues related to energy sources (KES), knowledge of general trends in Indonesia (KGT) and cognitive skills (CS).

Table 1. Energy Literacy Cognitive Component

Subscale	Outcome	Total in Questionare
Cognitive	knowledge of basic scientific (KBS)	5
	Knowledge of issues related to energy sources (KES)	4
	Knowledge of general trends in Indonesia (KGT)	4
	Cognitive skill (CS)	2

Sample

In April 2018, four senior high school in Gorontalo City participated in this survey. The questionnaire is carried out in the classroom by each teacher and researchers. SMAN 1 is general public senior high school and SMA Prasetya is general private senior high school. MAN 1 is islamic public senior high school and MAS Muhammadiyah is islamic private senior high school. in order to balance cognitive computation proportionally, samples were taken in each school that are the same comparison, either based on gender or scope of study. Samples in this study are 64 students which consists of 8 students in SMAN 1, 8 students in SMA Prasetya, 8 students in MAN 1 and 8 students in MAS Muhammadiyah. Every school consists of 4 male and 4 female in each scope of study. These schools are chosen because they have A accreditation . it means that these schools have the best national education standard competence, both in terms of facilities (infrastructure) and teachers' certification.

Data Analysis

The cognitive subscale employed five-option multiple- choice questions. The cognitive items were allocated one point for each correct response and zero points for each incorrect response. Next, knowledge level measurement used the percentages level formula 6 and class classification, namely (1) 76% - 100% = good; (2)

56% - 75% = fair; (3) 40% - 55% = poor; (4)0% - 39% =

very poor (Arikunto, 1998).

Percentage level uses formula (Ali, 2013):

$$\text{Percentage} = \frac{\text{score obtained}}{\text{question total}} \times 100$$

Indepent t-test analysis is used to determine mean difference between two data. This analysis provides an overview of mean difference between data on public school and private school; general school and islamic school; science class and social class; and male and female

Results and Discussion

These section present results obtained from the data collected when 64 students in senior high school were interviewed. The choice of school samples is based on the type of senior high

school system in Indonesia, namely senior high schools have maleaged by government and senior high schools have maleaged by the private sector. Both of them are divided into two types, namely general school and islamic school. General schools have a smaller number of subjects that are taught than islamic schools, namely mathematics religion. Islamic school are also taught mathematics, science, social, Indonesian language, sports, but for religion subjects, it is divided into 3 or 4 subjects, namely, Qur'an and Hadisth and Cultural History Islam and especifically in the Muhammadiyah Islamic school there is subject about Muhammadiyah.

Energy Literacy Cognitive

Some of the important questions asked to test the students cognitive about energy were chosen and discussed in this section. The resulting for cognitive level mean from 64 students is 33. Overall most students are in very poor level that are 38 students (59,4%) dan there are only 6 students (9,4%) who answered the questions in fair level. This indicated that the students did not perform well in “cognitive”. Not much different from studied in Jember District that students had only 54,15% cognitive level were low (Yuda, 2017), whereas in Nigeria was better for cognitive level, where students answered wrong questions only 47,3% (Arikunto, 1998). Although it is in low level too.

Students in science class have mean value who are 34,57, whereas students in social class have mean value who are 31,6 (lower than science). it is impact to score cognitive level, which there are 16 students in science class in very poor level, whereas there are 22 students in social class in very poor level. Although, there are 4 students in social class in fair level, whereas there are only 2 students in fair level. Mean value in science class is higher than social class that is caused students in science class are taught more about energy (physics and chemistry) than in social class (geography).

Table 2. Energy Literacy Cognitive Level

Variable	Good	Cognitive Frequency Level			Mean	Max	Min
		Fair	Poor	Very Poor			
Cognitive level total	-	6 (9,4%)	20 (31,3%)	38 (59,4%)	33	60	6,7
Cognitive level of general school	-	5 (7,8%)	10 (15,6%)	17 (26,6%)	34	40	20
Cognitive level of islamic school	-	1 (1,6%)	10 (15,6%)	21 (32,8%)	32	40	20
Cognitive level of private school	-	1 (1,6%)	10 (15,6%)	21 (32,8%)		40	20
Cognitive level of public school	-	5 (7,8%)	10 (15,6%)	17 (26,6%)	35	40	20
Cognitive level of social class	-	4 (6,3%)	6 (9,4)	22 (34,4%)	31,6	60	6,7
Cognitive level of science class	-	2 (3,1%)	14 (21,9%)	16 (25%)	34,57	46,6	13,1
Cognitive level of male	-	-	13 (20,3%)	10 (29,7%)	30,4	53,3	6,7

Cognitive level of female	-	6 (9,4%)	7 (10,9%)	19 (29,7%)	35,8	60	6,7
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In table 3, it shows chemistry subject, a student must achieve competence that a student can calculate changes in energy and understand fossil fuels (uses and energy energy and energy sources: (1) Counting conservation laws of energy; (2) Explain the process of effects). Students can understand too about a form of energy change, example energy kinetic and potential energy in daily life. They should know how energy changes in the light bulb, charging mobile, TV, etc. In physics subject, a student must achieve competence that a student can understand energy definition, energy sources and calculate energy conservation. Competence in physics subject is not much different from chemical subject, only in physics subject students know about renewable energy, definition energy and energy conversion. Energy literacy competence is taught in social class that is not as much as in science class. Geography subject is only one subject that there is a energy competence. In geographic competence, students are only required to know conventional energy without involving renewable energy sources or energy changes.

Table 3. Energy Literacy Competency

Subject	Chapter	Competency
Chemistry	Conservation laws of energy	<ul style="list-style-type: none"> • Counting kinetic energy • Counting potential energy • Counting heat reaction • Understanding fuel energy concept • Analyzing burning reaction
	Fuel energy	Understanding definition
Physics	Effort and Energy	<ul style="list-style-type: none"> • energy and energy sources • Counting conservation laws of energy • Explain the process of forming a mine
Geography	Mining distribution in Indonesia	<ul style="list-style-type: none"> • Mention the potential and mining distribution mining in Indonesia

^aafrom books in SMAN 1, SMA Prasetya, MAN 1 and MAS Muhammadiyah

An individual cognitive level is depended on several factors, such as parents' education. A study in OECD countries on the role of deviations in students' characteristics to their performan showed that students whose parents (especially mothers) have high school certificates or higher qualifications perform better than their peers[44] . In figure 1, it shows students' parents education background that are dominant in senior high school, namely it is 44%, whereas parents's education background in undergraduate and master is lower (9%- 4%). Parents educational background are low that can influence to their kids academic achievement (Alves et al., 2017; Rindermann et al., 2010).

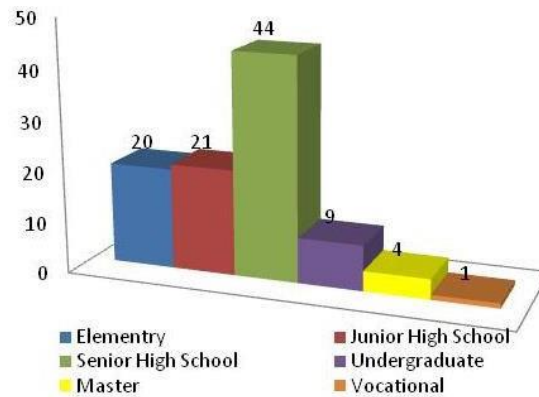


Figure 1. Parents Education Background Percentage

B. Difference in Energy Literacy Cognitive

Independent T-test analysis was used to find out difference in Energy Literacy Cognitive significantly on public senior high school (SMAN 1), private senior high school (SMA Prasetya), public islamic senior high school (MAN 1) and private islamic senior high school (MAS Muhammadiyah). In table IV, there is difference between public school and private school (35 and 30), but it is not significant ($0,179 > 0,05$). However, cognitive level in public school is more than in private school. In recent years, several researchers have attempted to assess the relative quality of public versus private schools in Indonesia. the results of which tell a mixed story of the public/private education quality gap. Public schools have higher quality inputs (often driven by more funding) than do private schools (Newhouse & Beegle, 2006; Strauss et al., 2004; World Bank; 1998). Finally, the OECD's most recent report on PISA examined the differences in achievement for public and private schools across all tested countries. While they found that nearly all countries showed higher PISA scores for private school students, Indonesia was one of several countries where public schools outperformed private schools (U.S. Department of Energy, 2012). .Public school students on the PISA reading exam outperformed private school students in Indonesia. Additionally, OECD found that Indonesia was one of only a few countries in which private school students were not more socioeconomically advantaged than their public school counterparts.

Public and private schools are subject to the same regulations (i.e., registration and accreditation procedures, following the national curriculum, provision of textbooks to all students, educational calendar, teaching load, teaching quality standards, etc.) and are even supported by maley of the same government programs (Stern et al., 2016). However, there are differences in the funding section. In the public school, teachers salary are paid directly by the government, infrastructure development and infrastructure maleagement are funded by the government. This is contrast in private school, where teachers salary are paid by the school, infrastructure development and infrastructure maleagement are funded mostly by the school. Mostly, private school funding source come from alumni donation, parents and student school fees. Low funds in private school will be impact student achievement quality who can be low. Because, student development equipments are limited or some of them

are already broken, low teacher salaries and rare teacher participation in self-development training (teacher quality) (Canales & Maldonado, 2018; Kingdon & Teal, 2007; Akiba et al., 2012).

Table 4. Characteristics Difference In Energy Literacy Cognitive

Data	Mean	Sig. (2-tailed)
Public	35	0,179
Private	30	
General	34	0,315
Islamic	32	
Social	31	0,436
Science	34	
Male	30	0,144
Female	35	

There is difference between general school and islamic school (34 and 32), but it is not significant($0,315 > 0,05$). However, cognitive level in general school is more than in islamic school. it is caused students in islamic school who are taught physics subject and chemistry subject only twice in a week, whereas in general school, it is three times in a week. Comparison of getting information on physics and chemistry subjects in general and islamic school does not produce a significant difference. it means, energy literacy cognitive level is not too influenced by the number of hours they study every week. students' cognitive are not only influenced by how many hours students study energy in school (formal education), but there is another factors that is non-formal education such as parental support (Weltevreden et al., 2018; Zhu et al., 2011) outside information source (internet, tv, magazines) and students motivation/interesting (Chang et al., 2008). Another important and generally consistent finding is that girls usually perform better than boys. This happened in this study. In table 4, it shows that mean value of female students is higher (35) than male students (30), although there is no significant difference ($0.144 > 0.05$). Measuring the level of knowledge of energy literacy carried out in students in secondary school that also showed that female students scored higher than males on the cognitive (Akitsu et al., 2017)

Conclusion

GLS is one of the programs that has been running in an effort to increase interesting of reading and writing to students, so that it can shape students character who are creative and innovative. Energy literacy is one part of GLS that focuses on the energy sector. Energy literacy can impact on energy efficiency and renewable energy development. After the findings and discussions based on data collected from 64 students in various high schools in Gorontalo City showed that energy literacy cognitive level is dominant in very poor level (59.4%), which means this is not much different from energy literacy in Jember District that is low energy literacy. Comparison mean value in public schools and private schools; public schools and Islamic schools; female and male; science and social classes do not show differences significantly. However, mean value is still in very poor level. The interesting thing happened in social class. There are 4 students who are in fair level, whereas there are only 2 students in science class who are in fair level. Another interesting thing is that there are 6 female students in fair level, whereas none male students is in fair level. Many factors affect a person's cognitive level. Students cognitive level do not only influence by formal learning, but non-formal learning (family and society) can also influence it. based on study, most of the parents' educational backgrounds are high school graduates (44%) and also 41% their parents' educational background are elementary and junior high school. There are only 13% in university.

Energy literacy is low in Gorontalo City and Jember Regency that it can be interpreted that GLS cannot be implemented properly, so that OECD score in Indonesia will be lower in the

future again. Students need to be equipped with adequate energy knowledge and for the future of energy in Indonesia. Therefore, the role of schools, families, communities and government is very much needed in increasing energy literacy in industry revolution 4.0. There are some ways that government and all elements can do together, namely: Students study tour in location that renewable energy is running. Example, inviting students to a corn cobs steam power plant in Pulubala District, Gorontalo. Establishment of energy clubs in schools or society. School is involved with parents in GLS, whether in energy club or reading and discussing energy before going to bed. There are some reading parks and mobile libraries.

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