Research Article

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Case study: Vocational student's knowledge and awareness level toward renewable energy in Indonesia

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Abstract: The facts of increasing use and decreasing fossil energy have made many people think of using renewable energy. Mindset change and dependence on fossil energy can be rectified through education. Renewable energy education is needed to increase student's knowledge and awareness. There are only 12 vocational high schools (VHSs) based on renewable energy in Indonesia. This number is not in line with the government's efforts to revitalize vocational schools toward a sustainable energy state in the future. This article features the knowledge and awareness of vocational students on renewable energy in Indonesia. Data were obtained from 1,250 respondents from 88 VHSs and 27 provinces in Indonesia. Knowledge and awareness level of school students in Indonesia VHSs is discussed in depth based on variables such as gender, parents, island, public school and private school, and areas of expertise at VHS. Respondents filled out questionnaires through a web survey. A descriptive analysis was performed based on the data. National coverage of data related to the vocational student's knowledge and awareness of renewable energy is the novelty of this article. The results show that VHS students already have a knowledge level in the "good" category for renewable energy and have an awareness level in the "fair" category. Detailed analysis on the reasons is performed as well as solution is offered in this article.

Keywords: renewable energy education, knowledge's level, awareness's level, vocational high schools

1 Introduction

Energy is an essential need for all the countries worldwide, and its demand is predicted to increase annually [1]. Energy demand in Indonesia is equivalent to 6–7% of its population growth [2]. This energy demand has increased significantly in the last 4 years, as shown in Figure 1. It predicted an increase in line with the trend of advances in science and technology [3]. Globalization has resulted in increased energy demand throughout the world and is difficult to control, one of the severe consequences of causing various environmental problems [4–6]. Renewable energy is a realistic option to conserve energy without losing the environment. We can save the environment if we can be wise to the environment by reducing and processing the waste into renewable energy [7–11]. Each country has its own natural potential, which is included in renewable energy that can be developed, and several studies related to renewable energy in Indonesia are as follows: wind turbines [12], water turbines [13], and waste materials of the home industry into biofuels [14–17]. The results of these studies can be conveyed to the youth through education. Acikgoz [16] conducted a research on renewable energy education (REE) in Turkey and stated that education is one of the most significant efforts to tackle society's energy problems. This situation is due to the education that will shape knowledge and competencies carried away until students complete an education [17]. Knowledge and concern for the environment need to be emphasized through proper education, as it will become a fundamental character needed to face energy demand responses in the future.

REE plays an essential role in preparing the next generation with knowledge and energy concerns. Through REE, it is hoped that energy resilience will be created in

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Figure 1: Indonesia energy consumption. Source: Handbook of Energy and Economic Statistics of Indonesia (2018) [18].

Figure 2: The comparison of students number in middle schools level in Indonesia during 2015–2020 [26].

a country. Garg and Kandpal [19] stated that organizing and preparing REE for developing countries is not an easy mission. Jennings and Lund [1] started research related to REE since 1999 and found the concept of a new direction of REE. Researchers in several countries, such as Turkey [16], Jordan [20], Palestine [21], Botswana [22], and ASEAN [23], have conducted research related to the application of REE. REE can be applied at all education levels, although it is currently dominated at the graduate level [24]. Bhattacharya [25] argued that developing REE at the middle community level will accelerate the flow of information and society's closeness to its energy.

The education system in Indonesia was organized in a structured and unstructured manner. In a structured manner, education is organized by the Ministry of Education and Culture of the Republic of Indonesia. Education in Indonesia is divided into four levels, i.e., early childhood, elementary, middle, and university/institute/polytechnic. REE's concern is at the middle education level, where there are two groups of middle education, namely, general high schools and vocational high schools (VHSs). The VHS group is currently the group with the most significant number of schools compared to the general secondary school group in Indonesia (Figure 2). Before 2017, in Indonesia, 12 VHSs were selected as pilot projects for developing schools based on renewable energy [27]. This number is still minimal compared to the number of existing VHSs. Responding to these conditions in 2017, the Ministry of Education and Culture increased the number of VHSs to 100 schools based on renewable energy [28].

This research is focused on the level of VHS, where students are prepared to have the competence to work in the industry. This competency will be complete if students at the VHS level understand REE. Implementation

of REE in vocational schools is one of the biggest challenges for Indonesia. The youth must have knowledge and concern for energy problems. The youth also need to understand renewable innovation. Thus, vocational school graduates must be prepared and sharpened regarding REE's sensitivity to face industry challenges in the future [29]. The Indonesian government has designed education related to renewable energy for the youth by including energy education in the curriculum or Adiwiyata school program (environmentally friendly school). The program needs to be guarded and maintained to ensure its achievement. The Indonesian government's programs are an effort to increase knowledge and awareness regarding renewable energy for students. To determine the success of government programs related to REE, it is necessary to measure them. This study aims to determine the level of knowledge and care of VHS students toward renewable energy in Indonesia.

2 Research method

This is a descriptive quantitative research. The study population was all VHS students in Indonesia, with the research sample distribution covering all provinces in Indonesia, as shown in Figure 3. The sample selection was random sampling with a sample calculation approach using Slovin's formula (equation 1). From the sample calculation, a minimum sample size of 400 respondents is obtained. The number of samples in this study was 1,250 respondents, covering 27 of 33 provinces in Indonesia. After testing the normality and homogeneity of the respondents' answers, 1,215 respondents deserved to be used.

Figure 3: Sample distribution.

$$n = \frac{N}{(1 + (Ne^2))} \quad (1)$$

$$n = \frac{5,036,748}{1 + (5,036,748(0.5)^2)}$$

$$n = 400 \text{ respondents,}$$

where n is the minimum number of respondents, N is the number of population, and e is the margin of error. The instrument is distributed using the web survey method via the Google form within view time. The research instrument was distributed through teachers. The teacher will select students who can be trusted as research respondents. Therefore, the data collection was conducted under teacher supervision. This method was chosen to guarantee the quality of the online survey. The two instruments used in this study are as follows:

(1) Knowledge instrument is an instrument used to measure VHS students' knowledge of renewable energy. The question model uses true and false questions. This instrument has ten detailed questions, as shown in Table 1.

(2) Awareness instrument is an instrument used to measure VHS students' awareness of renewable energy. This level of awareness includes concern, prevention, and priority. This instrument is structured using the 5 Likert scales. Details of the awareness instrument are given in Table 2.

The instruments were developed based on Kacan [29] and adjusted by the Indonesian student's characteristics, as shown in Tables 1 and 2. Table 1 shows the results of knowledge level questions after the validity test. The number of questions used to determine the level of knowledge of VHS students previously had 12 questions. However, after the validity test was conducted, there were two invalid questions and ten valid questions, as shown in Table 3. The initial awareness indicator consisted of 30 questions, as shown in Table 4, but after testing the instrument (validity test), there were 25 valid questions and 5 invalid questions. Table 2 shows valid questions for indicators of awareness, which include nine questions for concern, eight questions for preventive, and eight questions for priority.

Table 1: Knowledge's indicators

No.	Knowledge's questions
1	The sun's heat cannot be converted directly into electrical energy to drive a dynamo but can be converted into electrical energy directly using solar panels
2	Wind energy can drive a dynamo motor directly. Its rotation can be converted into electrical energy
3	Geothermal energy can produce hot steam and high pressure, both of which trigger a generator to generate an electric current
4	Various organisms or living things, both plants and animals, contain chemical compounds that can be converted into energy known as biomass energy
5	Jatropha and other plants can be processed into liquid fuel to drive vehicles, such as cars and motorcycle, as bioenergy fuel
6	Biodiesel is one kind of fuel derived from fossil energy, which is currently still widely used in society
7	Ocean waves can generate tidal waves and can be used to move propellers attached to a generator to generate electric current
8	Various kinds of rubbish and organic waste, such as leaves, coconut shell waste, sawdust, and fruit peels, can be processed in a special furnace (reactor) to be converted into synthetic gases and liquid oil as an environmentally friendly fuel
9	Rubbish and organic waste from both plants and animals that go through fermentation cannot be fuel. Therefore, it is not considered renewable energy
10	Water irrigation, rivers, and waterfalls have the amount of water discharge and the height as the driving force of the dynamo motor to produce electric power

Table 2: Awareness indicators

No.	Questions
Questions for concern	
1	The increasing energy demand requires the promotion of renewable energy
2	The lack of renewable energy technology in public facilities affect the low public awareness of renewable energy
3	I always dispose off rubbish in its place based on whether it is organic or inorganic
4	I understand and comply with the rules regarding the cleanliness of the school environment
5	Sometimes, I am sad. Global warming makes the weather unpredictable due to the excessive use of fossil fuels
6	I use water for hand washing and other purposes only as and when necessary
7	Vocational schools are the most potential and appropriate middle schools to discuss renewable energy because they are practice-based, have specific competencies, and make use of technology
8	I support the government's program to develop and strengthen VET through renewable energy-based initiatives to reduce the world's energy scarcity
9	I am happy with the learning that fosters ideas, insights, and concerns for the environment, such as REE
Questions for preventive	
1	Excessive dependence on fossil energy harms the environment throughout the world, demanding prevention, control, and substitution (replacement) of environmentally friendly energy, namely, renewable energy
2	I support the school's efforts to use solar panels to power electronic facilities, such as lamps and projectors, in classrooms
3	If I work and have a sufficient salary, I will set aside some of my money to buy solar panels to save my home's electricity needs
4	I would reprimand a friend for not turning off the classroom lights after not being used
5	I often bring my water bottle to school to reduce the use of plastic materials
6	I use a water reservoir so that it is more controlled and saves electricity
7	Vocational schools need to build, implement, and develop renewable energy technology independently
8	I support school programs, such as prohibiting the use of vehicles to enter the school, to maintain a clean environment
Questions for priority	
1	The increasing use of fossil energy will have negative impact on the environment in the long term, demanding that renewable energy technology be prioritized
2	When traveling in public, I choose to walk or use public transportation
3	I like to use LED lamps, instead of fluorescent lamps, to light up my home because they save electricity
4	I choose to drive a diesel car over a gasoline car
5	I choose to use a fan rather than air conditioner because it contains freon substances that can damage the ozone layer
6	I choose to use a bicycle instead of a vehicle to go to school because it is more environmentally friendly
7	I agree that VETs that apply renewable concepts will survive in the long term
8	I prefer a safe environment, rather than technology is developing but out of control

Table 3: The results of the validity test of knowledge's questions

Questions	Scale mean if item deleted	Scale variance if item deleted	Corrected item-total correlation	Cronbach's alpha if item deleted	r_{Table}	Category
X1	50.6667	36.042	0.458	0.707	0.344	Valid
X2	50.8485	35.758	0.473	0.705	0.344	Valid
X3	51.5455	33.131	0.757	0.671	0.344	Valid
X4	51.7576	34.252	0.536	0.692	0.344	Valid
X5	51.6667	34.667	0.642	0.689	0.344	Valid
X6	50.5152	39.820	0.509	0.701	0.344	Valid
X7	51.7576	35.189	0.531	0.698	0.344	Valid
X8	51.8182	37.028	0.423	0.715	0.344	Valid
X9	50.2121	39.485	0.943	0.747	0.344	Valid
X10	55.1818	40.153	0.244	0.726	0.344	Invalid
X11	58.3421	40.860	0.281	0.739	0.344	Invalid
X12	50.1724	38.064	0.450	0.734	0.344	Valid

3 Results and discussion

3.1 The knowledge of VHS students toward renewable energy

In this study, VHS students' knowledge level on renewable energy was measured using a test instrument. Students were asked to answer ten questions, correct answers are scored as 1, and incorrect answers are scored as 0. Thus, the range of VHS students' level of knowledge on renewable energy is 0–10. The distribution of students' knowledge levels from 0 to 10 has the following meanings: (1) <5: very poor, (2) 5–6: poor, (3) 6–7: fair, (4) 7–8.5: good, and (5) ≥8.5: excellent.

3.1.1 Student's knowledge level by gender

In this study, the number of respondents disaggregated by gender was 722 (59%) male respondents and 493 (41%) female respondents. Although the number of males is more than the number of females, the average level of male students' knowledge of renewable energy is lower than that of females. The knowledge levels of male students are 7.6 and that of female students are 7.7, as shown in Table 5 and Figure 4. These results are similar to those of Zyadin *et al.* [30] in Jordan and Varho *et al.* [31] in Finland, where females are more knowledgeable regarding renewable energy than males. This condition is because females are more interactive and can easily absorb information related to renewable energy.

Table 4: The results of the validity test of awareness's questions

Questions	Scale mean if item deleted	Scale variance if item deleted	Corrected item- total correlation	Cronbach's alpha if item deleted	r_{Table}	Category
Questions for concern						
X1	287.39	1350.121	0.761	0.732	0.344	Valid
X2	287.82	1356.653	0.450	0.734	0.344	Valid
X3	288.12	1360.922	0.291	0.735	0.344	Invalid
X4	286.94	1359.496	0.417	0.735	0.344	Valid
X5	288.55	1354.693	0.344	0.734	0.344	Valid
X6	287.27	1354.830	0.515	0.734	0.344	Valid
X7	287.76	1354.064	0.371	0.734	0.344	Valid
X8	287.82	1323.466	0.619	0.728	0.344	Valid
X9	287.79	1335.047	0.566	0.730	0.344	Valid
X10	287.42	1347.689	0.515	0.732	0.344	Valid
Questions for preventive						
X11	288.21	1376.860	0.081	0.739	0.344	Invalid
X12	287.24	1358.064	0.450	0.734	0.344	Valid
X13	288.52	1370.820	0.167	0.737	0.344	Invalid
X14	287.64	1350.176	0.333	0.734	0.344	Invalid
X15	288.00	1346.250	0.356	0.733	0.344	Valid
X16	287.58	1339.752	0.624	0.731	0.344	Valid
X17	288.33	1344.042	0.437	0.732	0.344	Valid
X18	287.48	1352.633	0.479	0.733	0.344	Valid
X19	287.33	1350.604	0.505	0.733	0.344	Valid
X20	287.48	1339.945	0.708	0.730	0.344	Valid
X21	288.27	1348.392	−0.580	0.747	0.344	Valid
Questions for priority						
X22	287.52	1336.258	0.695	0.730	0.344	Valid
X23	287.55	1325.881	0.759	0.728	0.344	Valid
X24	287.94	1350.934	0.493	0.733	0.344	Valid
X25	287.48	1337.258	0.667	0.730	0.344	Valid
X26	287.88	1331.235	0.655	0.729	0.344	Valid
X27	287.55	1356.881	0.481	0.734	0.344	Valid
X28	287.97	1355.030	0.325	0.734	0.344	Invalid
X29	287.55	1339.631	0.659	0.730	0.344	Valid
X30	287.27	1347.767	0.556	0.732	0.344	Valid

Table 5: Group statistics of knowledge level by gender

Gender		<i>N</i>	Mean	Std. deviation	Std. error mean
Knowledge level	Male	722	7.6080	1.58883	0.05913
	Female	493	7.6734	1.48462	0.06686

Figure 4: Student's knowledge level by gender.

However, both (male and female) with knowledge levels of 7.6 and 7.7 showed that vocational school students in Indonesia already had a good knowledge of renewable energy. Furthermore, to prove whether the difference is significant or not, a statistical test is carried out with the following hypotheses:

H0 There is no difference in the mean knowledge level between male and female students.

H1 There is a difference in the average knowledge level between male and female students.

Based on Table 6, the independent samples test of knowledge level by gender, it is known that the value of Sig. (2-tailed) is $0.470 > 0.05$. These results indicate that H_0 is accepted and H_1 is rejected. This result means that although there is a statistical difference, the difference is not statistically significant.

3.1.2 Student's knowledge level by parents' job

In this study, to explore the influence of the family environment on the level of knowledge of renewable energy, observations were made on the relationship between the students' parents' work types. Why is it necessary

Table 6: Independent samples test of knowledge level by gender

Levene's test for equality of variances			t-test for equality of means							
<i>F</i>	Sig.	<i>t</i>	df	Sig. (2-tailed)	Mean difference	Std. error difference	95% confidence interval of the difference			
							Lower	Upper		
Knowledge level	Equal variances assumed	2.829	0.093	-0.723	1,213	0.470	-0.06539	0.09041	-0.24277	0.11198
	Equal variances not assumed			-0.733	11020.4	0.464	-0.06539	0.08926	-0.24053	0.10974

Table 7: Descriptive of knowledge level by parents' job

	N	Mean	Std. deviation	Std. error	95% confidence interval for mean		Minimum	Maximum
					Lower bound	Upper bound		
Private	348	7.5862	1.58561	0.08500	7.4190	7.7534	3.00	10.00
Labor	646	7.6347	1.54005	0.06059	7.5157	7.7537	3.00	10.00
Civil servants	44	7.9318	1.33639	0.20147	7.5255	8.3381	5.00	10.00
Entrepreneurs	107	7.6262	1.62250	0.15685	7.3152	7.9371	3.00	10.00
Others	70	7.7000	1.43809	0.17189	7.3571	8.0429	5.00	10.00
Total	1,215	7.6346	1.54710	0.04438	7.5475	7.7216	3.00	10.00

Figure 5: Student's knowledge level by parent's job.

to observe this relationship? The reason is based on the study by Ntona *et al.* [32], which revealed that parents' job status influences students' learning motivation. The students' parents' job was grouped into five groups, i.e., private, labor, civil servants, entrepreneurs, and others. As presented in Table 7 and Figure 5, the study results show that students whose parents work as civil servants have a better knowledge of renewable energy than others. This condition can be influenced by the average civil servants who have good work environment and education level to provide self-education to impart the knowledge of renewable energy to their students. However, the five occupational groups of students' parents contributed to students' knowledge level on a good level. This study indicates that VHS students in Indonesia have the support of

their parents, and some parents have also provided self-education to their students. Indeed, this is an excellent starting capital for REE in Indonesia. Furthermore, to prove whether the difference is significant or not, a statistical test is carried out with the following hypotheses:

H0 There is no difference in VHS students' mean knowledge level concerning parents' jobs.

H1 There is a difference in VHS students' mean knowledge level concerning parents' jobs.

Based on Table 8, the analysis of variance of knowledge level by parents' job shows that the value of Sig. (2-tailed) is $0.719 > 0.05$. These results indicate that H0 is accepted and H1 is rejected. Although there is a statistical difference, this result has meant that the parents' job differences in knowledge level are not significant.

3.1.3 Student's knowledge level by island

Figure 6 illustrates the relationship between geographic islands in Indonesia on VHS students' level of knowledge on renewable energy. In this study, the geographic grouping is based on five major islands in Indonesia, i.e., Sumatra, Java, Kalimantan, Sulawesi, and Papua. Research respondents have a distribution as shown in Table 9. The results showed that VHS students in Papua Island have a better knowledge of renewable energy than other islands in Indonesia. The factors that influence this result are because Papua Island is currently in full swing with electrification programs and the construction of large-scale power plants.

Table 8: Analysis of variance of knowledge level by parents' job

	Sum of squares	df	Mean square	F	Sig.
Between groups	5.009	4	1.252	0.522	0.719
Within groups	2900.739	1,210	2.397		
Total	2905.748	1,214

Figure 6: Student's knowledge level by island.

Most of the power plants built on Papua's island use renewable energy sources, such as pico hydro, biomass, and solar power. The electrification process currently taking place on Papua's island has benefited the student's knowledge level.

On the other hand, VHS students in Java, Sumatra, Kalimantan, and Sulawesi have almost the same knowledge level, between 7.47 and 7.65. This condition occurs because on these islands, the power plants that operate mostly come from nonrenewable energy. It can be observed from the results of this study that the level of students' knowledge of renewable energy is closely related to the existence of energy generators in the area around students. Furthermore, to prove whether the difference in the knowledge level of students related to geography/island

is significant or not, a statistical test is carried out with the following hypothesis:

H0 There is no difference in mean knowledge level among VHS students concerning geography/island.

H1 There is a difference in VHS students' mean knowledge level concerning geography/island.

Based on Table 10, the analysis of variance of knowledge level by parents' job, it is known that the value of Sig. (2-tailed) is $0.417 > 0.05$. These results indicate that H0 is accepted and H1 is rejected. This result means that although there is a statistical difference, the knowledge level by island difference is not statistically significant.

3.1.4 Student's knowledge level by public school and private school

This study distributes respondents based on the type of school as follows: 956 respondents from public schools and 259 respondents from private schools. The results showed that students' level of knowledge from the public and private schools did not differ significantly as shown in Table 11 and Figure 7 (7.6 for public school and 7.7 for private school). This result means that the knowledge level in private schools is slightly higher than in public schools. This result indirectly impacts the policy to open access for the establishment of private schools in Indonesia. For the last 5 years, Indonesia has been productive in building vocational schools. This opportunity was captured and used to establish private schools. It is proven

Table 9: Descriptive of knowledge level by island

	N	Mean	Std. deviation	Std. error	95% confidence interval for mean		Minimum	Maximum
					Lower bound	Upper bound		
Sumatra	363	7.6584	1.66674	0.08748	7.4864	7.8304	3.00	10.00
Jawa	681	7.6358	1.47214	0.05641	7.5251	7.7466	3.00	10.00
Kalimantan	128	7.4688	1.58207	0.13984	7.1920	7.7455	4.00	10.00
Sulawesi	20	7.6500	1.26803	0.28354	7.0565	8.2435	5.00	10.00
Papua	23	8.1304	1.76595	0.36823	7.3668	8.8941	5.00	10.00
Total	1,215	7.6346	1.54710	0.04438	7.5475	7.7216	3.00	10.00

Table 10: Analysis of variance of knowledge level by island

	Sum of squares	df	Mean square	F	Sig.
Between groups	9.387	4	2.347	0.980	0.417
Within groups	2896.361	1,210	2.394		
Total	2905.748	1,214			

Table 11: Group statistics of knowledge level by public school and private school

Public school and private school		N	Mean	Std. deviation	Std. error mean
Knowledge level	Public	956	7.6297	1.55220	0.05020
	Private	259	7.6525	1.53098	0.09513

that by early 2020, the number of VHSs has exceeded Public Middle Schools (60:40). Therefore, students' input and quality in private and public schools in Indonesia are not significantly different. Many private schools currently offer vocational education with a better quality of service, curriculum, and practical equipment than public schools. Furthermore, to prove whether the difference is significant or not, a statistical test is carried out with the following hypotheses:

H0 There is no difference in the average knowledge level between public and private schools.

H1 There is a difference in the average knowledge level between public and private schools.

Based on Table 12, the independent samples test of knowledge level by gender, it is known that the value of Sig. (2-tailed) is $0.833 > 0.05$. These results indicate that H0 is accepted and H1 is rejected. This result means that although there is a statistical difference, the difference is not statistically significant.

Figure 7: Student's knowledge level by public school and private school.**Table 12:** Independent Samples Test of knowledge level by public School and private school

		Levene's test for equality of variances					t-test for equality of means				
		F	Sig.	t	df	Sig. (2-tailed)	Mean difference	Std. error difference	95% confidence interval of the difference		
									Lower	Upper	
Knowledge level	Equal variances assumed	0.001	0.978	-0.210	1,213	0.833	-0.02280	0.10842	-0.23551	0.18990	
	Equal variances not assumed			-0.212	413.052	0.832	-0.02280	0.10756	-0.23424	0.18864	

Table 13: Descriptive of knowledge level by areas of expertise of VHS

	N	Mean	Std. deviation	Std. error	95% confidence interval for mean		Minimum	Maximum
					Lower bound	Upper bound		
Technology and Engineering	581	7.5611	1.57627	0.06539	7.4327	7.6895	3.00	10.00
Information technology	188	7.7819	1.58208	0.11539	7.5543	8.0095	3.00	10.00
Energy mining	78	7.6538	1.49307	0.16906	7.3172	7.9905	5.00	10.00
Health and social workers	55	7.8000	1.33888	0.18053	7.4381	8.1619	4.00	10.00
Tourism	49	7.3878	1.61782	0.23112	6.9231	7.8524	4.00	10.00
Business and management	19	7.7895	1.61861	0.37133	7.0093	8.5696	6.00	10.00
Maritime	240	7.7167	1.46469	0.09455	7.5304	7.9029	3.00	10.00
Agribusiness and agrotechnology	5	7.0000	2.82843	10.26491	3.4880	10.510	4.00	10.00
Total	1,215	7.6370	1.54848	0.04442	7.5499	7.7242	3.00	10.00

Figure 8: Student's knowledge level by areas of expertise at VHS.

3.1.5 Student's knowledge level by areas of expertise at VHS

VHSs in Indonesia are divided into eight areas of expertise, i.e., (1) technology and engineering, (2) information technology, (3) energy mining, (4) health and social workers, (5) tourism, (6) business and management, (7) maritime, and (8) agribusiness and agrotechnology. Table 13 and Figure 8 show that students in the seven areas of expertise had an average level of knowledge of renewable energy at a “good” level. However, for the agribusiness and agrotechnology expertise, the student's level of knowledge was at 6.25. These results occur because the number of students who want to study in these fields are gradually reducing. Therefore, the input and quality of students who enter the agribusiness and agrotechnology expertise still need to be improved.

Figure 9: Student's awareness level by gender.

Furthermore, to prove whether the differences in students' knowledge levels related to areas of expertise are significant or not, a statistical test is carried out with the following hypothesis:

H0 There is no difference in the average knowledge level between VHS students in terms of areas of expertise of VHS.

H1 There is a difference in the average knowledge level between VHS students in terms of areas of expertise of VHS.

Based on Table 14, analysis of knowledge level variance by areas of expertise shows that the value of Sig. (2-tailed) is $0.473 > 0.05$. These results indicate that H0 is accepted and H1 is rejected. This result means that

Table 14: Analysis of variance of knowledge level by areas of expertise of VHS

	Sum of squares	df	Mean square	F	Sig.
Between groups	15.816	7	2.259	0.942	0.473
Within groups	2895.117	1,207	2.399		
Total	2910.933	1,214			

Table 15: Group statistic of awareness level by gender

Gender		N	Mean	Std. deviation	Std. error mean
Awareness level	Male (Concern)	722	3.8570	0.78480	0.02921
	Female (Concern)	493	3.9588	0.76593	0.03450
Awareness level	Male (Preventive)	722	3.6690	0.81671	0.03039
	Female (Preventive)	493	3.8103	0.80315	0.03617
Awareness level	Male (Priority)	722	3.5608	0.78626	0.02926
	Female (Priority)	493	3.5517	0.76109	0.03428

although there is a statistical difference, the difference is not statistically significant.

3.2 The awareness of VHS students toward renewable energy

In this study, VHS students' awareness level on renewable energy was grouped into three indicators: (1) concern, (2) prevention, and (3) priority. The level of awareness was measured using a Likert scale 1–5. Data were analyzed based on the group average of all respondents and compared. The distribution of student awareness levels 1–5 has the following meanings: (1) very poor, (2) poor, (3) fair, (4) good, and (5) excellent.

3.2.1 Student's awareness level by gender

Figure 9 shows that the awareness level of male and female VHS students in Indonesia is classified at the "fair" level. These results indicate that male and female students' awareness still needs to be further increased by inserting REE into the curriculum. Through REE, it is hoped that it can prepare students who are responsive and care about renewable energy for all genders in the future. The results also showed that female students had a higher awareness level than male students. This condition can be seen from two indicators of awareness level; female students have a better concern and preventive

attitude toward renewable energy than male students. Furthermore, to prove whether the difference is significant or not, a statistical test is carried out with the following hypotheses (Table 15):

H0 There is no difference in the average awareness level for concern indicators between male and female students.

H1 There is a difference in the average awareness level for concern indicators between male and female students.

and
H0 There is no difference in the average awareness level for preventive indicators between male and female students.
H1 There is a difference in the average awareness level for preventive indicators between male and female students.

Based on Table 16, independent samples test of awareness level by gender for concern indicator, it is known that the value of Sig. (2-tailed) is $0.025 < 0.05$. These results indicate that H0 is rejected and H1 is accepted. This result means that there is a significant difference in awareness level by gender for concern indicators. Meanwhile, at the awareness level by gender for preventive indicators, the Sig. (2-tailed) value is $0.03 < 0.05$. These results indicate that there is a significant difference in awareness level by gender for preventive indicators.

In the indicator of priority attitude toward renewable energy, male students are slightly superior to female students, but the value is not too significant due to the Sig. (2-tailed) value $0.842 > 0.05$ (Table 16). Results analysis into indicators of concern for renewable energy shows that female students are better than male students. Almost

Table 16: Independent samples test of awareness level (concern, preventive, and priority indicator) by gender

Levene's test for equality of variances			t-test for equality of means							
<i>F</i>	<i>Sig.</i>	<i>t</i>	<i>df</i>	<i>Sig.</i> (2-tailed)	Mean difference	Std. error difference	95% confidence interval of the difference			
							Lower	Upper		
Awareness level concern	Equal variances assumed	2.294	0.130	-2.240	1,213	0.025	-0.10172	0.04541	-0.19081	-0.01264
	Equal variances not assumed			-2.251	1073.718	0.025	-0.10172	0.04520	-0.19041	-0.01303
Awareness level preventive	Equal variances assumed	0.953	0.329	-2.983	1,213	0.003	-0.14137	0.04740	-0.23436	-0.0484
	Equal variances not assumed			-2.992	1068.548	0.003	-0.14137	0.04725	-0.23408	-0.0487
Awareness level priority	Equal variances assumed	0.508	0.476	0.199	1,213	0.842	0.00904	0.04535	-0.07992	0.09801
	Equal variances not assumed			0.201	1079.252	0.841	0.00904	0.04507	-0.07939	0.09748

all female student respondents are concerned about the increased use of nonrenewable energy, such as fossil fuels and environmental impacts, and global warming issues. Female students also have a good preventive attitude toward renewable energy through energy-efficient behaviors in everyday activities. Female students also support technological innovations in using renewable energy sources, such as solar energy and waste as energy. The findings in this study indicate that the female students have a better level of knowledge than the male students. The awareness level of female students is also better than male students. The results of this study are similar to those of Kacan, 2015 [29].

3.2.2 Student's awareness level by parents' job

The assumption that parents' job has a relationship with students' awareness level of renewable energy is answered in this study. In the previous section, we discussed the relationship between parents' jobs and students' knowledge of renewable energy. Students whose parents work as civil servants have a better level of renewable energy knowledge than others. Figure 10 shows the measurement of the awareness level, where the relationship between the types of parents' jobs and the student's awareness level has the same results as the knowledge level. Students whose parents work as civil servants have a higher level of awareness than other occupations.

Based on Table 17, it is statistically descriptive, and there is a difference in VHS students' average awareness level on the indicators of concern, preventive, and priority to parents' type of work. The awareness level indicator for concern, preventive, and priority indicators shows the level "fair" based on the mean calculation. Furthermore, to prove whether the difference is significant or not, a statistical test is carried out with the following hypotheses:

H0 There is no difference in the average awareness level of VHS students on indicators of concern, preventive, and priority to the type of parents' job.

H1 There is a difference in the average awareness level of VHS students on indicators of concern, preventive, and priority to the type of parents' job.

Based on Table 18, analysis of awareness level variance by parents' job, it is known that the value of *Sig.* (2-tailed) is $0.000 < 0.05$. These results indicate that H0 is rejected and H1 is accepted. This result means a significant difference in VHS students' awareness level on the indicators of concern, preventive, and priority to parents' job.

Figure 10: Student's awareness level by parent's job.

Meanwhile, VHS students whose parents work in other occupations such as private, labor, entrepreneur, and others (nonformal jobs) show almost the same level of awareness. These results are also related to government programs, namely, renewable energy base industry development (REBID) and renewable energy based on economic development (REBED), applied to all fields of work and industry in Indonesia. In this program, the students' parents have understood how to use energy efficiently and prioritize energy that leads to renewable energy. This result also strengthens the previous finding that students whose parents work as civil servants have a high level of knowledge on renewable energy and also have a good level of awareness.

3.2.3 Student's awareness level by island

The measurement results related to the awareness level based on the island showed that VHS students' average awareness level in five major islands in Indonesia is

“fair,” as shown in Figure 11. Table 19 shows that it is statistically descriptive, and there is a difference in the average awareness level based on the student's location or the island for indicators of concern, preventive, and priority. Furthermore, to prove whether the difference is significant or not, a statistical test is carried out with the following hypotheses:

H0 There is no difference in the average awareness level of VHS students on indicators of concern, preventive, and priority related to the location of the island.

H1 There is a difference in the average awareness level of VHS students on indicators of concern, preventive, and priority related to the location of the island.

Based on Table 20, analysis of awareness level variance by island of VHS students, it is known that the value of Sig. (2-tailed) is $0.000 < 0.05$. These results indicate that H0 is rejected and H1 is accepted. This result means a significant difference in VHS students' awareness level based on island indicators for concern, preventive, and priority.

These results indicate that REE in each island in Indonesia needs to be increased so that the awareness level can increase at least to the “good” level. In-depth analysis related to the awareness level indicator obtained interesting results to discuss as follows: (1) VHS students in Java Island showed the highest results on the indicator of concern, followed by Papua, Kalimantan, Sumatra, and Sulawesi islands. As the center of government and economy, Java Island has problems related to sustainable energy and environmental pollution due to fossil energy use. According to VHS students on the island of Java, this problem's condition is a concern that must be immediately sought for a solution. (2) VHS students on Kalimantan Island on the preventive and priority indicators show the highest achievement level than other islands. The high value of the two indicators is due to the massive mining activity on Kalimantan's island related to fossil energy exploitation. Therefore, students of VHSs on the island of Kalimantan want preventive action and priority for

Table 17: Descriptive of awareness level by parents' job

	N	Mean	Std. deviation	Std. error	95% confidence interval for mean		Minimum	Maximum
					Lower bound	Upper bound		
Concern	1,215	3.8985	0.77865	0.02234	3.8547	3.9423	1.00	5.00
Preventive	1,215	3.7470	0.81805	0.02347	3.7010	3.7930	1.00	5.00
Priority	1,215	3.5593	0.77565	0.02225	3.5157	3.6030	1.00	5.00
Total	3,645	3.7349	0.80288	0.01330	3.7089	3.7610	1.00	5.00

Table 18: Analysis of variance of awareness level by parents' job

	Sum of squares	df	Mean square	F	Sig.
Between groups	70.156	2	35.078	56.061	0.000
Within groups	2278.824	3,642	0.626		
Total	2348.979	3,644

Figure 11: Student's awareness level by island.

renewable energy so that environmental sustainability can be appropriately maintained. (3) Papua Island, which in the previous discussion showed the highest level of knowledge of renewable energy among other major islands in Indonesia, was ranked third at the awareness level. Even though at the third rank on the awareness level, VHS students on the Papua Island are not inferior to students on Java and Kalimantan islands who are at ranks 1 and 2, respectively. This condition can be seen from the questionnaire score on the awareness level indicator; VHS students on the Papua Island have an average score closer to students from Java and Kalimantan islands. This study's results reinforce the research findings that if students

have a good level of knowledge, they will have a good awareness level.

3.2.4 Student's awareness level by public school and private school

Figure 12 shows the student's awareness level based on VHS, i.e., public and private schools. This achievement still needs to be improved to increase students' awareness in both public and private schools. Table 21 shows the statistical description. There is a difference in VHS students' average awareness level based on school type for the indicators of concern, preventive, and priority. The awareness level indicator for concern, preventive, and priority indicators at public school and private school shows the level "fair." Furthermore, to prove whether the difference is significant or not, a statistical test is carried out with the following hypotheses:

H0 There is no difference in VHS students' average awareness level on indicators of concern, preventive, and priority toward the type of VHS (public school and private school).

H1 There is a difference in VHS students' average awareness level on indicators of concern, preventive, and priority toward the type of VHS (public school and private school).

Based on Table 22, analysis of variance of awareness level by public school and private school, it is known that the value of Sig. (2-tailed) is $0.000 < 0.05$. These results indicate that H0 is rejected and H1 is accepted. This result

Table 19: Descriptive of awareness level by island

	N	Mean	Std. deviation	Std. error	95% confidence interval for mean		Minimum	Maximum
					Lower bound	Upper bound		
Concern	1,215	3.8985	0.77865	0.02234	3.8547	3.9423	1.00	5.00
Preventive	1,215	3.7285	0.81362	0.02334	3.6827	3.7743	1.00	5.00
Priority	1,215	3.5689	0.77754	0.02231	3.5251	3.6127	1.00	5.00
Total	3,645	3.7320	0.80128	0.01327	3.7059	3.7580	1.00	5.00

Table 20: Analysis of variance of awareness level by island

	Sum of squares	df	Mean square	F	Sig.
Between groups	66.027	2	33.013	52.882	0.000
Within groups	2273.627	3,642	0.624		
Total	2339.653	3,644

Figure 12: Student's awareness level by public school and private school.

means a significant difference in VHS students' awareness level on indicators of concern, preventive, and priority to the type of VHS (public school and private school). Details of achievements of awareness level of both schools are as follows: The concern and preventive indicators of VHS students in public schools are slightly higher than private schools. However, the priority indicator for students in private schools is slightly higher than in public schools. These findings show that when linked to the measurement of knowledge levels, they show contradictory results. However, if we examine the students' scores on each indicator of awareness between

public and private schools, they are almost close together, as seen in Figure 12. Therefore, this finding also strengthens the previous finding that if students have a good level of knowledge, they will have a good awareness level.

3.2.5 Student's awareness level by areas of expertise at VHS

Table 23 shows a statistically descriptive difference in VHS students' average awareness level on indicators of concern, preventive, and priority toward VHS areas. The awareness level indicator for concern, preventive, and priority indicators shows the level "fair" based on the mean calculation. Furthermore, to prove whether the difference is significant or not, a statistical test is carried out with the following hypotheses:

H0 There is no difference in the average awareness level of VHS students based on areas of expertise on indicators of concern, preventive, and priority.

H1 There is a difference in the average awareness level of VHS students based on areas of expertise on indicators of concern, preventive, and priority.

Based on Table 24, analysis of awareness level variance by areas of expertise at VHS, it is known that the value of Sig. (2-tailed) is $0.000 < 0.05$. These results indicate that H0 is rejected and H1 is accepted. This result means a significant difference in VHS students' awareness level on indicators of concern, preventive, and priority toward areas of expertise at VHS. Figure 13 shows

Table 21: Descriptive of awareness level by public school and private school

	N	Mean	Std. deviation	Std. error	95% confidence interval for mean		Minimum	Maximum
					Lower bound	Upper bound		
Concern	1,215	3.8983	0.77849	0.02233	3.8545	3.9421	1.00	5.00
Preventive	1,215	3.7263	0.81387	0.02335	3.6805	3.7721	1.00	5.00
Priority	1,215	3.5571	0.77584	0.02226	3.5134	3.6008	1.00	5.00
Total	3,645	3.7272	0.80157	0.01328	3.7012	3.7533	1.00	5.00

Table 22: Analysis of variance of awareness level by public school and private school

	Sum of squares	df	Mean square	F	Sig.
Between groups	70.729	2	35.365	56.724	0.000
Within groups	2270.606	3,642	0.623		
Total	2341.335	3,644			

Table 23: Descriptive of awareness level by areas of expertise at VHS

	N	Mean	Std. deviation	Std. error	95% confidence interval for mean		Minimum	Maximum
					Lower bound	Upper bound		
Concern	1,215	3.8985	0.77865	0.02234	3.8547	3.9423	1.00	5.00
Preventive	1,215	3.7285	0.81362	0.02334	3.6827	3.7743	1.00	5.00
Priority	1,215	3.5593	0.77565	0.02225	3.5157	3.6030	1.00	5.00
Total	3,645	3.7288	0.80133	0.01327	3.7028	3.7548	1.00	5.00

the relationship between areas of expertise in VHSs to awareness levels. The analysis of eight areas of expertise in VHSs has reached awareness levels in the “good” category, namely, concern indicators. Several indicators show performance at the “fair” level, although some indicators score close to the “good” level, such as the prevention and quality indicators. This finding is interesting because a good level of awareness is not achieved by areas of expertise close to renewable energy, such as (1) mining and energy and (2) technology and engineering. However, the expertise areas, such as (1) healthy and social workers, (2) management and business, and (3) agribusiness and agrotechnology, have good awareness levels. In deepening the research findings, the following results were obtained: students in healthy and social workers’ expertise see the impact of environmental pollution on health as their concern to overcome this problem. Therefore, the concern indicator of students’ awareness level in the healthy and social worker level of expertise was higher than in others. Students in management and business expertise state that preventive action for energy conservation needs to be done using renewable energy that is friendly to the environment. Meanwhile, agribusiness and agrotechnology students stated that the needs of

fossil energy must be reduced and the use of renewable energy must be encouraged.

The relationship between areas of expertise in VHSs and awareness levels is shown in Figure 13. Based on the analysis of eight areas of expertise in VHSs, there are areas of expertise that have reached awareness levels in the “good” category, namely, on indicators of concern. Several indicators show performance at the “fair” level, although some indicators score close to the “good” level, such as the prevention and quality indicators. This finding is interesting because the best level of awareness is not achieved by areas of expertise close to renewable energy, such as mining and energy or technology and engineering, but is achieved by areas of expertise in healthy and social workers, management and business, and agribusiness and agrotechnology. In deepening the research findings, the following results were obtained: (1) students in the expertise areas of health and social workers see the impact of environmental pollution on health as their concern to overcome this problem. Therefore, students’ concern in healthy and social worker expertise is greater than in others. Students in the field of management and business expertise state that preventive action for energy conservation needs to be done

Table 24: Analysis of variance of awareness level by areas of expertise at VHS

	Sum of squares	df	Mean Square	F	Sig.
Between groups	69.891	2	34.945	56.065	0.000
Within groups	2270.057	3,642	0.623		
Total	2339.948	3,644

Figure 13: Student's awareness level by areas of expertise at VHS.

using renewable energy that is friendly to the environment. Meanwhile, students in agribusiness and agrotechnology fields stated that the increasing use of fossil energy needs to be reduced by using renewable energy substitutes.

4 Conclusion

This study has carried out measurements related to VHS students' knowledge and awareness level in Indonesia using 1,215 respondents from 27 provinces in Indonesia. Knowledge and awareness level of school students in Indonesia VHS is discussed in depth based on variables such as gender, parents, island, public school and private school, and areas of expertise at VHS. The results of the study can be concluded as follows.

- The results showed that VHS students in Indonesia had a "good" level of knowledge on renewable energy. These results were obtained from an analysis of the level of knowledge based on variables such as gender, parents, island, public school and private school, and VHS areas.
- Knowledge level by gender shows that females are more knowledgeable regarding renewable energy than males. This condition is because females are more interactive and easily absorb information related to renewable energy.
- Knowledge level by parents' job shows that VHS students in Indonesia have the support of their parents. Some parents have also provided self-education to

their students. Indeed, this is an excellent starting capital for REE in Indonesia.

- Knowledge level by island shows that the level of students' knowledge of renewable energy is closely related to energy generators in the area around the student's environment or island.
- Knowledge level by school type shows that the knowledge level in private schools is slightly higher than in public schools. This result indirectly impacts the policy to open access for the establishment of private schools in Indonesia. For the last 5 years, Indonesia has been productive in building vocational schools.
- Knowledge level by areas of expertise at VHS shows that the seven areas of expertise have an average level of knowledge of renewable energy at a "good" level. However, in the agribusiness and agrotechnology expertise, the student's level of knowledge was at a "fair" level.

The results showed that VHS students' awareness level on renewable energy was grouped into "fair" levels. These results were obtained from an analysis of the awareness level based on variables such as gender, parents, island, public school and private school, and VHS expertise areas.

- Awareness level by gender shows that female students had a higher awareness level than male students. This condition can be seen from two indicators of awareness level; female students have a better concern and preventive attitude toward renewable energy than male students.
- Awareness level by parent's job shows that students whose parents work as civil servants have a better level of renewable energy knowledge than others. These results are also related to government programs, namely, REBID and REBED, applied to all fields of work and industry in Indonesia. In this program, the students' parents have understood how to use energy efficiently and prioritize energy that leads to renewable energy.
- Awareness level by island shows that the average awareness level in the five major islands in Indonesia is "fair." These results inform that REE in each island in Indonesia needs to be increased.
- Awareness level by public schools and private schools shows that VHS students' concern and preventive indicators in public schools are slightly more significant than in private schools. However, the priority indicator for students in private schools is slightly higher than in public schools.

- (e) Awareness by areas of expertise at VHS shows that the awareness level is based on expertise area of VHS for concern indicators, preventive and priority indicators show the “fair” level. This finding is interesting because a good level of awareness is not achieved by areas of expertise close to renewable energy, such as (1) mining and energy and (2) technology and engineering. However, it is achieved by areas of expertise such as (1) health and social workers, (2) management and business, and (3) agribusiness and agrotechnology.

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