Challenges to anticipate climate change: An environmental awareness survey of High School Students in Indonesia in waste management

Muhammad Aliman[*a], Budijanto[**], Sumarmi[**] and I Komang Astina[**] and Muhammad Arif[***]

[*]*Ph.D Students, Geography Education, Malang State of University, Malang, Indonesia*
[**]*Faculty of Social Science, Malang State of University, Malang, Indonesia*
[***]*Geography Education, STKIP Pesisir Selatan, Indonesia*

ABSTRACT

Waste management is a preventive effort in reducing pollution that impacts on climate change and is an important concern especially in developing countries. The purpose of this study is to determine the environmental awareness of students in waste management based on knowledge, refusal, reuse, reduce and recycle which are seen from gender, school status and majors. This study uses a survey method with a population of high school students in Indonesia. The data were analyzed using non-parametric statistical tests with the SPSS version 23 application for Windows. The results showed that 1) the environmental awareness of high school students in Indonesia was in a sufficient category, 2) there was no difference in the gender of students in managing waste, 3) there were differences in school status and students' majors in managing waste. Real programs are needed to improve students' ability to manage personal waste and the surrounding environment.

Key words: *Environmental awareness, Waste management, Climate change*

Introduction

Climate change is an environmental problem caused by human behavior. Low environmental ethics and human awareness in maintaining the environment are the causes of ecosystem damage (Sumarmi and Amirudin, 2014). In addition, environmental problems occur because of population outbursts, resulting in an increase in the amount of waste (Barnabas *et al.,* 2017). This results in environmental problems such as air pollution and noise (Le Boennec and Salladarré, 2017), water pollution (Shailaja *et al.,* 2016), flooding (Qasim *et al.,* 2016), global warming and climate change (Pachauri *et al.,* 2015). All of these impacts have decreased the quality of the environment and even a wider impact, namely the occurrence of faster climate change (Aliman *et al.,* 2017).

Selfishness and human unconsciousness in protecting the environment can be improved through education, especially environmental education (Anilan, 2014; Estrada-Vidal and Tójar-Hurtado, 2017; Phan Hoang and Kato, 2016). Education that is able to change human thinking is education that contains values about the environment. They are the value of environmental awareness, environmental conservation values and sustainable development (Barth and Rieckmann, 2012; Valderrama-

Hernández *et al.,* 2017). These environmental values are integrated into each existing subject. In high school, environmental education can be integrated into a lesson that uses knowledge and practice as well as geography (Sumarmi, 2016b; Tascý, 2015).

One of the important values in environmental education is how high school students are consciously able to manage their personal waste. Students' awareness will grow because there are role models from teachers and parents (Al Muhdhar, 2016; De Leeuw *et al.,* 2015). Aware students will throw their trash into the garbage dump that has been provided. In fact, students who have high sensitivity to the environment will sort waste based on its types.

Waste management is an important thing to plan and implement well. It is estimated that by 2019, garbage in Indonesia will amount to 68 million tons and plastic waste as much as 9.5 million tons (Purwaningrum, 2016). If the waste is not managed properly, it will cause a lot of pollution and have an impact on the quality of the environment. Waste that is left to accumulate and is not managed adversely affects the soil and surrounding water sources (Shailaja *et al.,* 2016). Solid waste management is a major problem especially in developing countries due to the impact of chaotic transportation, poverty, high urbanization and low education (Ramachandran *et al.,* 2016).

Overcoming the problem of waste generation in high school is not an easy problem. Some studies that implement waste management programs include: programs with the concept of 4R + C (Dhokhikah and Trihadiningrum, 2016; Galea *et al.,* 2014; Huang *et al.,* 2016; Purwaningrum, 2016; Zeng *et al.,* 2010). The concept of 4R + C is a concept of waste management consisting of Refusal, Reduce, Reuse, Recycle, and Composting. The initial solution to waste management is rejecting items that will become garbage. Then the process of reducing waste, reusing items that can be used, recycling goods and making compost. Using this 4R + C concept will reduce the amount of waste and greenhouse gas emissions (Visvanathan, 2009). In-depth research to find out the initial conditions of students' ability to manage personal waste or garbage that is in schools and in their environment is very necessary.

Waste management using the 4R + C concept has a good impact if high school students understand and are aware of the stages and benefits of the concept. Understanding the concept begins with the ability of students to recognize and distinguish 4R + C using their five senses (Al Muhdhar, 2016). The concept of 4R + C can be implemented by students in schools because it does not impose students' assignments as students. Increasing the awareness of high school students towards waste management is an effort to preserve the environment (Sumarmi, 2016a). Knowing the understanding and awareness of the environment can be seen from the initial perception and knowledge of high school students on waste management.

Study area and data source

This study uses a survey method with the technique of distributing questionnaires through the google form application during the period of 7 February - 20 June 2018. Questionnaires contain questions relating to waste management by high school students in terms of demographic indicators, school status, students' majors, knowledge, refusal, reuse, reduce and recycle at school. Each answer has a point between 1 and 3 according to the tendency of the student's answer. The questionnaire was designed by the author as many as 29 questions and tested twice namely stage 1 in 28 students with 4 invalid questions and stage 2 in 56 students as many as 25 valid questions. Then the questionnaire was tested for reliability with cronbach alpha results> r table (0.665> 0.266) which means that this questionnaire has been consistent to use.

During the distribution of questionnaires through social media (Whats App, Facebook and Email), there were 508 respondents from high school students from various schools in Indonesia. Obtaining initial data is then summed based on indicators and searched for the average value which is then grouped according to the category of environmental awareness level in managing waste, namely: 0 - 1.0 (low), 1.1 - 2.0 (sufficient) and 2.1 - 3.0 (high). Quantitative data obtained were then analyzed descriptively and tested the normality of the data. Data analysis using non parametric statistical tests because the data is not normal (p 0.000 <p 0.05). Furthermore, the data were analyzed using the Mann-Whitney test on the gender and school status variables while the students' majors variables were analyzed using the Kruskal-Wallis test. All quantitative data analysis uses the SPSS version 21 application for Windows.

Results and Discussion

Knowing the ability of students to manage the generation of personal waste and garbage in their environment can be used as an initial model in creating a waste control program in the future. Measurement of survey indicators based on independent variables including gender, school status, and students' majors. Students' ability as dependent variable is measured based on indicators such as knowledge, refusal, reuse, reduce and recycle. The details are in in Table 1.

Based on Table 1, it can be seen that the average value of students' environmental awareness in managing waste in terms of knowledge, refusal, reuse, reduce and recycle is in an adequate category which is 1.91 on a scale of 1-3. In general, the average indicator of waste management is below the value of 2, but the average value of the indicator of knowledge is higher than other indicators with a value of 2.47. The lowest average value of waste management by students is in the reuse indicator with a value of 1.22.

In depth, the results of Table 1 can be explained that the ability of students in terms of knowledge is higher than other abilities. This is consistent with several studies that state that knowledge skills are higher than participation in the environment (Abbas & Singh, 2014). The low average value of the refusal,

reuse, reduce and recycle indicators is suspected because students are less emotionally involved in managing waste (Singh *et al.,* 2014).

Waste Management Based on Gender Indicators

Gender differences are always an interesting study to discuss. Gender equality is the reason for researchers to investigate. The following are the results of a study that examines the gender differences in high school students based on waste management.

Based on Table 2, it can be seen that from the five indicators of waste management the asymp-sig (2-tailed) value> 0.05. Therefore, this data analysis concluded that there were no gender differences between men and women in terms of waste management in terms of knowledge, refusal, reuse, reduce and recycle. However, the average value of male students is slightly higher compared to female students only in terms of the ability of waste management as reviewed from knowledge. The difference in average values occurs in the ability of waste management in terms of refusal, reuse, reduce and recycle on female students who have a slightly higher average score than male students. Further explanation can be seen in Fig. 1.

The results of the study illustrated in graph 1 are supported by research that states that environmental practice in female students is higher than male

Table 1. Average Variable Value Based on Assessment Indicator

Variable	Waste Management Assesment Indicator					Σ
	Knowledge	Refusal	Reuse	Reduce	Recycle	
Male	2.49	1.99	1.18	1.96	1.85	1.90
Female	2.48	2.01	1.24	1.98	1.93	1.93
Adiwiyata	2.53	2.02	1.19	1.99	2.01	1.95
Non Adiwiyata	2.35	1.95	1.30	1.89	1.51	1.80
Social Science	2.52	1.97	1.24	1.97	1.89	1.92
Science	2.47	2.05	1.21	1.94	1.75	1.89
Language Science	2.45	1.97	1.16	2.06	2.37	2.00
Σ	2.47	2.00	1.22	1.97	1.90	1.91

Table 2. Results of Gender Statistics on Waste Management

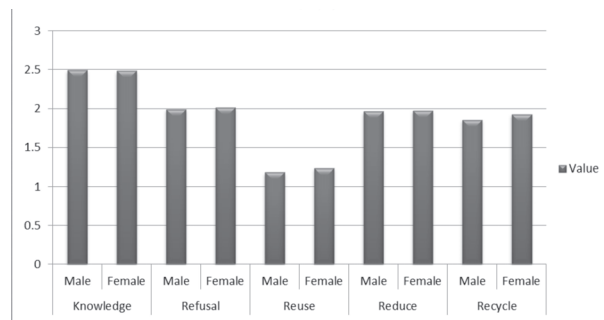|	Knowledge	Refusal	Reuse	Reduce	Recycle
Mann-Whitney U	28934.000	28477.000	29008.500	28323.500	27861.500
Wilcoxon W	82562.000	44948.000	45479.500	44794.500	44332.500
Z	-.426	-.716	-.665	-.810	-1.118
Asymp. Sig. (2-tailed)	.670	.474	.506	.418	.264

a. Grouping Variable: Gender

Fig. 1. Average Value of Waste Management by Gender

students in three colleges in Tamil Nadu, India (Singh *et al.,* 2014; Sivamoorthy *et al.*, 2013) . Therefore, a waste management development program involving male students is needed to improve their abilities.

Waste Management Based on School Status Indicators

The ability of waste management based on students' school status is seen based on the type of *Adiwiyata* school and *Non Adiwiyata* school. *Adiwiyata* School is a school that runs programs from the government as an environmentally friendly school. Environmentally friendly schools adapt to sustainable development programs, while *Non Adiwiyata* schools are schools that have not implemented environmentally friendly school programs. The following table explain the difference ability of waste management of *Adiwiyata* students and *Non Adiwiyata* Schools.

In table 3, the results of the Mann-Whitney statistical analysis explain that there are differences in knowledge, reduce and recycle between *Adiwiyata* schools and *Non Adiwiyata* schools. This is proven by the value of Asymp-Sig (2-tailed), which is a knowledge indicator of 0.000 <0,05, a reduce indicator of 0.002 <0,05 and a recycle of 0.000 <0,05. In addition, the Mann Whitney Test results also prove that there are no significant differences between the *Adiwiyata* and *Non Adiwiyata* schools on refusal and

reuse. It is proven by the Asymp-Sig (2-tailed) refusal indicator 0.126> 0.05 and the Asymp-Sig (2-tailed) reuse value of 0.102> 0.05.

Based on Table 3 and the explanation it can be concluded that the differences in the status of *Adiwiyata* schools and *Non Adiwiyata* schools can affect the ability of waste management in students to be viewed from knowledge, reduce and recycle. From table 3, it can be explained that students in *Adiwiyata* schools have higher average values of knowledge, refusal, reduce and recycle than students in *Non Adiwiyata* schools. The Fig. 2 shows the details.

Based on Fig. 2, it can be seen that the ability of students in *Non Adiwiyata* schools is higher than students in *Adiwiyata* school on the reuse indicator. It is suspected that students in *Non Adiwiyata* schools more often use objects that have been used. In addition, students' creativity also plays a role in making new objects from unused materials.
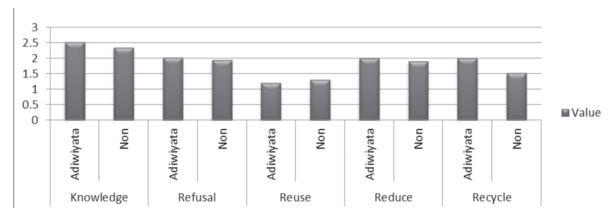

Fig. 2. Average Value of Waste Management Based on School Status

Waste Management Based on the Indicator of the Student' Majors

In Indonesia, high school students are divided based on specialization towards certain majors such as Social Sciences, Science and Language. This grouping is thought to have a role in influencing the ability of waste management because students have focused their minds on studying the material in accordance with their majors. The results of the study can be seen in Table 4.

Table 3. School Status Statistics Results for Waste Management

	Knowledge	Refusal	Reuse	Reduce	Recycle
Mann-Whitney U	16430.000	20244.500	21066.000	18134.500	13225.000
Wilcoxon W	22871.000	26685.500	99276.000	24575.500	19666.000
Z	-4.378	-1.531	-1.638	-3.074	-6.758
Asymp. Sig. (2-tailed)	.000	.126	.102	.002	.000

a. Grouping Variable: School Status

Table 4. Statistical Results of Students' Majors on Waste Management

	Knowledge	Refusal	Reuse	Reduce	Recycle
Chi-Square	3.096	4.500	.862	11.390	47.397
df	2	2	2	2	2
Asymp. Sig.	.213	.105	.650	.003	.000

a. Kruskal Wallis Test.   b. Grouping Variable: Majors

Based on Table 4, it is known that the Kruskal Wallis statistical test results show that there are differences between students in Social Sciences, Science and Language majors in terms of reduce and recycle. Based on the Asymp-Sig indicator the reduce value is 0.003 <0.05 and the Asymp-Sig recycle value is 0,000 <0.05. The Kruskal Wallis statistic test also proves that there is no difference between social studies, science and language majors in terms of knowledge, refusal and reuse. It is proven by the Asymp-Sig knowledge value of 0.213> 0.05, the Asymp-Sig refusal value is 0.105> 0.05 and the Asymp-Sig reuse value is 0.650> 0.05.

It can be concluded that the differences in students' majors in high school can affect the ability of waste management seen from the indicator reduce and recycle. In Table 4, it can be explained that students of Language major have a higher ability to reduce and recycle than students in Social Sciences and Science. On the knowledge and reuse ability, students majoring in Social Sciences have higher average scores than students majoring in Science and Language, while the average value of the ability of refusal of Science students is higher than Social Science and Language students. The Fig. 3 shows the details.

The higher ability of Science students compared to Social Science and Language students in the refusal indicator supports research that states that biology students have a positive attitude in various e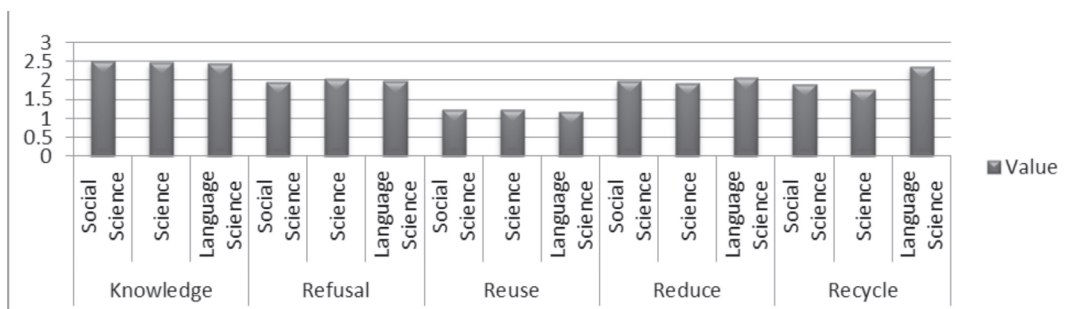nvironmental activities (Tikka *et al.*, 2000). The differences that occur between the three students' majors contribute to the latest research in assessing the ability of waste management among high school students.

Conclusion

Based on the research and discussion above, the challenges in preventing climate change are related to students' ability to manage waste based on knowledge, refusal, reuse, reduce and recycle. This capability needs to be improved because it is still in the sufficient category. The gender differences in school students do not have a significant effect on waste management in schools. The role of *Adiwiyata* school is proven to be able to influence students' success in managing waste in schools. Differences in students' majors affect differences in students' ability to manage waste at school.

Scope for further studies

Good waste management is needed to reduce the impact of climate change. Therefore, a reinforcement program (behavioral habit) is needed for students at *Adiwiyata* because reuse ability is considered unsatisfactory. In addition, the status of *Non Adiwiyata* schools needs to be increased to *Adiwiyata* School by adjusting the ability of the school to implement the program. Collaboration between school elements is needed to not differentiate empowerment of students with different majors.

Fig. 3. Average Value of Waste Management Based on Students' Majors

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