



The relationship between students' science process skills and awareness in environmental issues using outdoor learning

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ABSTRACT

Outdoor Learning has been recognized as a learning strategy to be learned and applied in enhancing students' science process skills and awareness. However, the problem of waste management is the biggest challenge because it has not been realized in vocational high schools. Students' science process skills and awareness are needed to develop the student's potential insight, attitude, and employability skills. This study aimed to analyze the relationship between science process skills and awareness using the outdoor learning process. The research type is a quasi-experiment. Samples were obtained from students and used purposive sampling. The essay instrument consists of 10 items developed of science process skills. Awareness is measured using a test questionnaire consisting of 19 items. The collected data were analyzed through prerequisite, Independent Sample test T-Test, Gain Score, multivariate analysis of Variance (MANOVA), and Pearson correlation tests. The result showed that the outdoor leaning application enables to increase between science process skills and awareness aspects. The test results of each class Showed that the difference significantly. It means there was a positive relation, showed by a significant score of 0.042 with 0.05 standard. The results of the analysis show the Pearson correlation value of the two variables is 0.291, it can be interpreted that the relationship between the two variables has a low relationship, but the average response value of awareness after learning increased compared before learning in the two treatment groups.



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Introduction

Vocational High School is a secondary education that prepares students to become workers and entrepreneurs according to their expertise. Technical and Vocational Education and Training (TVET) is designed to develop students' potential

(Hadam et al., 2017). In fact, Outdoor learning using school environment media is still rarely implemented. The problem is due to the difficulty of managing learning and requires time management for teachers. The impact on student achievement is decreasing. Outdoor learning can develop characters such as

independence, skills, mutual cooperation, and learning students to control emotions, increase awareness of the environment and create a scientific attitude because the learning process is presented with learning strategies while trying or practicing, so that students are directly involved in the learning process and are closer to the environment (Dhanapal & Lim, 2013; Vera, 2012; Widiasworo, 2017). Utilization of land around the school allows students to learn directly related to natural phenomena based on observations making the learning process meaningful (Ramadhani et al., 2016).

Therefore, in learning science at vocational schools, process skills are an important part of learning activities (Astuti, 2015). Science process skills consist of several abilities including, observing is the initial position in carrying out a scientific process. Then, continuing to higher abilities such as measuring, classifying, and the highest skills are called experimental skills (Subali, 2009).

Besides that, process skills are involved in cognitive, manual, and social skills. Cognitive or mental skills are involved because by doing the skills process students use their minds. Manual skills are involved in the skills of using tools and materials, measuring, building, or assembling tools. Meanwhile social skills arise when students interact and communicate with each other, for example when discussing observations (Rustaman, 2007). Process skills are an important step in building an understanding of scientific concepts, theories, and understanding scientific procedures to solve environmental issues (Nunaki et al., 2020).

In addition to students' science process skills, an attitude of awareness for students is needed. Knowledge and awareness about the existence and scope of environmental issues is important because it can generate awareness and concern for the environment (Widyaningrum & Prihastari, 2018). The emphasis should be on knowledge of causes, knowledge of effects, and knowledge of strategies for change when dealing with environmental problems. Schools can help students understand the impact of human behavior on this earth, and become a means for sustainable life (Desfandi, 2015). However, various environmental problems that are getting out of control show that Environmental

Education has not succeeded in shaping the character of humans who care about the environment. The failures of environmental learning in schools include (i) environmental education facilities and infrastructure have received less attention. (ii) The materials and methods of implementing environmental education are deemed inadequate and cannot be applied so that the target group's understanding of environmental conservation is incomplete. (iii) In the formal education pathway there is an assumption that environmental education is insufficient.

Increasing awareness through learning outside (outdoor learning) aims at 1) personal through daily problems, 2) people through group problems and decision making, 3) environment through direct observation (Waite, 2011). Science process skills and awareness for students can be realized in outdoor learning, teachers can increase environmental literacy. The aspects that are considered in the use of environmental learning include encouraging creativity, providing opportunities for students to experiment and explore, the media created must pay attention to safety factors, can be used individually or in groups, and must be easily used by both teachers and students (Husamah, 2013).

Learning with science process skills and awareness related to waste management issues. Garbage is the biggest challenge for small and large city authorities in developing countries (Abdel-Shafy & Mansour, 2018). Solid waste management systems include all measures that seek to reduce negative impacts on health, the environment and the economy (Ejaz et al., 2010). Organic waste processing in schools is realized by vermicompost. Vermicompost is defined as making compost from biodegradable waste into high-quality compost using earthworms (Wahyono, 2001).

Vermicompost is compost obtained from the decomposition of organic matter carried out by earthworms at mesophilic temperatures (21-30°C) (Nasution et al., 2013; Yulipriyanto, 2010). Meanwhile, plastic waste is processed by making paving blocks or Eco bricks. The Eco brick method comes from the word "ecology" which refers to ecology and bricks which means bricks from plastic waste to support the environment. The advantage is that paving blocks can be formed into beautiful

patterns. This is one of the solutions for using plastic for a long time (Sebayang, S. et al., 2012). Fatmawati's research (2013) shows student learning outcomes through direct observation learning methods increase the value of process skills and environmental awareness. The existence of knowledge, the attitude of students who are consciously practiced through environmental behavior which is the goal of learning sustainable development in environmental preservation (Purnomo, 2015). Knowledge of material content is also an important outcome because it has relevance to science process skills and awareness (Chiappetta & Adams, 2004). For further research, it is suggested to improve students' process skills which are integrated with environmental awareness with learning methods including daily activities.

One of the efforts to support environmental education, schools must provide effective learning practices to develop environmentally responsible behavior. The learning environment provides students with opportunities to observe nature, practice and develop scientific processing skills. Therefore, this study uses worksheets as an effort to develop students' skills and awareness of the science process in outdoor learning. Worksheets can be used simultaneously with other learning resources or learning media (Widjajanti, 2008). Worksheets can improve students' scientific process skills and attitudes with modifications (Nugraheny, 2018). The use of worksheets also increases student interest in learning through discussion and implementation of experimental work steps (Toharudin et al., 2011). In the next part of this paper, the author tries to realize learning with science process skills and environmental literacy towards outdoor learning with worksheets related to organic waste management into vermicompost and plastic waste management into Eco bricks and paving blocks. This study aims to determine the relationship between students' science process skills and awareness, using an outdoor learning process.

Method

This research had a quasi-experimental design and one-group with a

pre-test and a post-test model. Non-equivalent control group design was used. There were two groups in this study, namely the experimental group and the control group. A total of 85 students in automotive class XI of a vocational high school in SMK Muhammadiyah 1 Sleman, Yogyakarta. They were the population in this study. They were divided into 3 classes.

The purposive sampling technique was used to take research samples. A total of two classes were drawn based on the sampling technique used. The two classes that were sampled were 25 students' automotive class XI 1, and 25 students' automotive class XI 2. XI 1 was a group control, and XI 2 was an experimental group (Table 1).

Table 1. Design of non-equivalent control group

Group	Pretest	Treatment	Posttest
Control	O1	X-control	O2
Experiment	O1	X-olp	O2

Note:

X-control: Conventional learning use class lecture

X-olp : Learning with the outdoor learning in science process skills and awareness

O1 : The pretest is used to test the preliminary ability

O2 : Posttest is used to test the final ability

Students in the experimental group were taught to use outdoor learning related to the context of environmental issues around them, and applied the science process skills and awareness (Table 2). Besides, the students in the control group used conventional learning with class lectures. The teacher explains face to face in the classroom. The process skills test, awareness questionnaire, lesson plan, student worksheet was the instrument used. The instrument was arranged based on inquiry science learning. The instrument was validated by three validators. The following were presented by the validator (Table 3).

The first data analyzed was descriptive. The analyzed aimed to describe the differences in the achievement of each science process skill and awareness indicator in the experimental and control groups. The second analyzed was quantitative. Quantitative analyzed was used the independent sample t-test.

Table 2. Steps of science process skill

Steps	Activity
Basic science process skill	
observing	Paying attention to the properties of object
Measuring	Expressing and provide the number of objects
Classifying	Connecting object and events
Predicting	Forecasting future events based on past observations
Communicating	Using words, symbols, or graphics to describe an object, action, or event
Integrated science process skill	
Controlling variables	Manipulating and controlling properties related to the situation
Making a hypothesis	Stating tentative generalization from observation or conclusions to explain a relatively large number
Conducting experiments	Testing hypothesis through the manipulation and control of independent variables and observing the influence on dependent variable
Interpreting data	Result of explanations and conclusions from data

(Inayah et al., 2020)

The research data were analyzed through multivariate analysis of variance (MANOVA) test, and Pearson correlation test. Analysis prerequisite test using Kolmogorov Smirnov Z and Levene's test. The significant level was 0.05.

Table 3. Validity result

Teaching device	average	Validity criteria
Lesson plan	59	Very good
Worksheet	63	Very good
Instrument test and questionnaire	42	Very good

Decision making was H0 (there was no difference in student science process skill and awareness in both experimental and control groups) if sig. > 0.05. In other cases, H1 (there was a difference in the science process skill and awareness of the students in both experimental and control groups), was accepted.

Independent Sample T-test Test

Independent t-test aims to find out whether there is a relationship between Science process skills and awareness using Outdoor Learning Process (OLP) related to environmental issues.

N-gain test

The N-Gain Test was conducted to analyze the increase in scores of science process skills and awareness obtained before and after treatment. argues that n-gain is an increase in the results of the pretest and posttest which is calculated using the analysis of the average normalized gain (Formula I) (Bao, 2006).

$$\langle g \rangle = \frac{\%(S_f) - \%(S_i)}{\%(S_{max}) - \%(S_i)} \dots\dots\dots (I)$$

Note:

- Sf : final score (posttest)
- Si : preliminary score (pretest)
- Smax : maximum score achieved

The results of this calculation are then interpreted based on the criteria for obtaining an N-Gain score (Table 4).

Table 4. Range of criteria for qualitative N-Gain scores

Interval	Category
0.7 ≤ (g)	High
0.3 ≤ (g) < 0.7	Medium
(g) < 0.3	Low

(Hake, 1999)

Manova test

The manova test is performed with the condition that the data meets the test prescriptions, which are normally distributed and in a homogeneous population.

Correlation test of science process skills and awareness

Pearson correlation test is used to determine the relationship between students' science process skills and awareness (Table 5).

Table 5. Interpretation of correlation values

Correlation value range	Decision
0.000 - 0.190	Very low
0.200 - 0.399	Low
0.400 - 0.599	Intermediate
0.600 - 0.799	Strong
0.800 - 1.0	Very strong

(Priyatno, 2012)

The percentage of the implementation of learning is determined by the following Formula II.

$$score (\%) = \frac{value\ obtained}{total\ number\ of\ students} \times 100\% \dots (II)$$

Results and Discussion

This research presents data in the form of average and percentage of each achieved of science process skill, N-gain

from each of the measured process skill indicators, the correlation test of science process skills and awareness using outdoor learning and conventional learning. The results obtained the pretest of the experimental class and the control class is in the range of equivalents, although the average value of the experimental group is higher than the control class with a difference of 2.25 (Figure 1).

In the experimental and control groups, there was an increase in scores at the post-test. The average value obtained by the experimental group was higher than the control group. Meanwhile, the following data on students' environmental awareness used a questionnaire. Recapitulation of questionnaire data for each indicator of environmental awareness and their percentage.

Statement of Measurement of the value of awareness amounting to 19 items that will be filled by students using a Likert scale. The non-test instrument of awareness value is given to students before learning to find out the preliminary response of students, and after learning is done to see the final response awareness values students have. In brief, the values of students' awareness are presented in the following Table 6.

Based on each treatment group there is an increase in the awareness of environment. All values are then converted to qualitative assessment criteria and are

in a good category. The following are awareness that have been analyzed based on the Ideal Standard Deviation (SBI) and converted to a qualitative assessment. The average value of environmental care attitudes obtained before and after learning (see Figure 2) is in the range of $36.4 < X \leq 44.2$ so that all are included in the good category.

Table 6. Criteria for qualitative values of environmental awareness of students

Range of average rating scores (i)	Category
$X > 44.2$	Very good
$36.4 < X \leq 44.2$	Good
$28.6 < X \leq 36.4$	Enough
$20.8 < X \leq 28.6$	Less
$X < 20.8$	Very less

The research shows that students' environmental awareness is still rare at first, but after the application of the outdoor learning model to treat waste, students began to show an increase in their concern for the environment. Similar to Tamara's research (2016), that awareness in learning is an action to reduce environmental problems. Environmental awareness is a general attitude towards environmental quality, by participating in protecting the environment related to student behavior. Besides, students are also able to provide solutions to solve environmental problems around them (Widyaningrum & Prihastari, 2018).

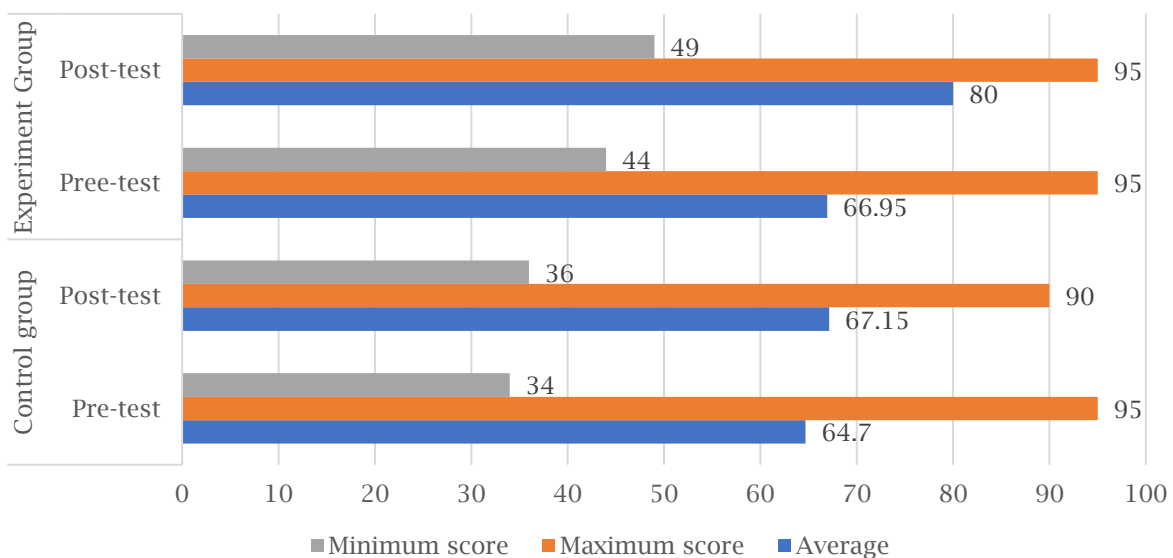


Figure 1. The average science process skills score

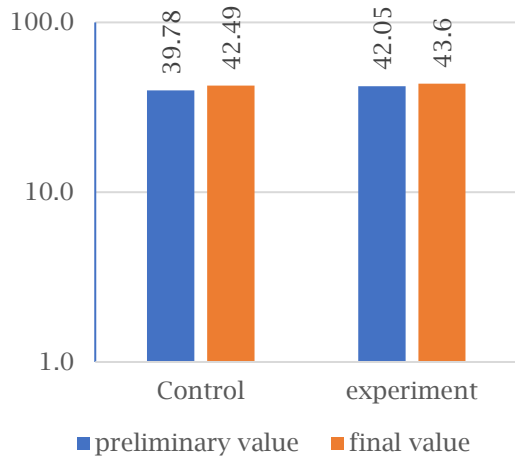


Figure 2. Students' awareness

The homogeneity test (Table 7) conducted the value of science process skills and awareness for the two treatment groups had significant results > 0.05 . So that all data collected has the same variant or in a homogeneous population.

Table 7. Homogeneity test result of research

Test of homogeneity of variances				
	Levene's statistic	df1	df2	Sig.
Science process skill	0.877	1	47	0.354
Awareness	3.492	1	47	0.068

Different tests of the ability of science process skills and awareness are used to determine the presence or absence of the influence of the experimental group's post-test scores and the post-test scores of the control group. Testing is done by using the independent sample t-test (Table 8).

Table 8. Differentiation Test with Independent Samples Test Science process skills and awareness

Variable	Sig. (2-tailed)
Science process skill	0.014
Awareness	0.411

Based on Table 8, Analysis of the results for the independent sample t-test, it was described that if the Sig-2 tailed value $0.014 < 0.05$ then there were

Table 9. Average n-gain test results of science process skills

Class	pretest	post-test	N-gain	criteria
experiment	66.92	82	0.55	intermediate
control	64.7	67.15	0.1	low

significant differences value of the science process skill between the two groups. The results of the independent t-test show that the Sig-2 Tailed value is $0.411 > 0.05$, so the Sig-2 tailed value is greater than 0.05 and it is assumed that there is no significant difference in the value of environmental awareness from the experimental class and the control class. Because the Sig-2 Tailed value is $0.411 > 0.05$, it can be stated that H_0 is accepted. To find out the increase in the score for each test group, the data will be tested with N-Gain.

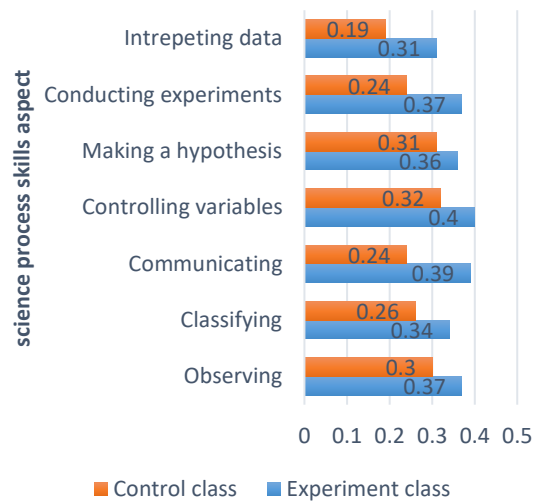


Figure 3. Differences in the achievement of N-Gain test science process skills between the experimental and control

The criteria revealed that students in outdoor learning of the science learning better their process skills (Figure 3). Students who are in the classroom with conventional learning gain lower process skills (Table 9). That is, the opportunity to learn with outdoor learning enhanced students' science process skills. The obtained results were similar with the previous findings (Fatmawati, 2013; Khairi et al., 2016; Lathifah & Wilujeng, 2016; Sari et al., 2017), the understanding of science process skills in the experimental class experienced a higher improvement process, compared to the control class.

This is based on the acquisition of individual completeness scores in the experimental class, after following the learning process using outdoor learning devices. Learners who master skills well, they will be able to solve problems in their real life (Aydoğdu et al., 2014). There are several possible explanations for the beneficial effects of outdoor learning. Learning through outdoor school ground lessons may help students to build more complex cognitive structures with concrete activities in regards to ordinary activities inside the classroom (Archie, 2003; Buntod et al., 2010; Keil et al., 2009; Rickinson et al., 2004).

The effect of learning environmental awareness with outdoor learning is measured through the acquisition of values obtained from student response questionnaires before and after learning. Statistically, the results of different tests on the value of students' awareness did not show significant results, but the average response value of awareness after learning increased compared before learning in the two treatment groups. Furthermore, an N-Gain analysis was performed on the responses of students' environmental care attitudes to see the percentage increase in value (Figure 4).

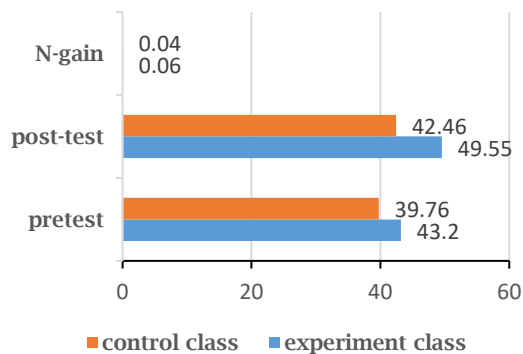


Figure 4. Average of N-Gain test awareness between the experimental and control

The differences in the acquisition of character scores are caused by various factors that influence students in filling out the questionnaire. Character building in students does not occur in seconds, but requires a long process and a certain effort (Hidayah, 2015). These results can be seen that student motivation is very influential in shaping awareness, so that it is the students' factors that play the most role in the formation of environmental awareness (Kresnawati, 2014; Taufiq et al., 2014). If growing environmental awareness is equivalent to helping students become aware of the various interrelationships between issues/problems and human life (Dolan et al., 2009; Sadler & Zeidler, 2005; Zeidler & Nichols, 2009). For example, the garbage around the school yard can be used as a learning medium that produces products and benefits students' process skills in vocational high school.

The Multivariate Analysis of Variance (MANOVA) Hypothesis Test was conducted to examine the effect of the Outdoor Learning Process (OLP) related to environmental issues on the relationship of Students' Science process skills and awareness (Table 10).

There are four test results, namely Pillai Trace, Wilk Lambda, Hotteling Trace, and Roy's Hotteling Trace. All significance values in this test indicate the value of sig $0.00 < 0.05$. If the significance value < 0.05 , it can be concluded that there is an influence of the Outdoor Learning Process (OLP) related to environmental issues on the relationship of Students' Science process skills and awareness. similar to Martiningsih et al. research (2018), there is a difference in the average generic skills of science, environmental awareness that is taught based on outdoor learning (experiment class) and lectures (control class) in class that are taught using learning tools from the teacher. Besides that, here are the results of calculations using the Pearson correlation.

Table 10. Multivariate analysis of variance (MANOVA) test results

	Effect	Value	F	Hypothesis	Error df	Sig
class	Pillai's Trace	0.123	3.228 ^a	2.000	46.000	0.000
	Wilks' Lambda	0.877	3.228 ^a	2.000	46.000	0.000
	Hottelling's Trace	0.140	3.228 ^a	2.000	46.000	0.000
	Roy's Largest Root	0.140	3.228 ^a	2.000	46.000	0.000

Table 11. Correlation Test of Students' Science process skills and awareness

Correlation test results		Science process skills	awareness score
Science process skills score	Pearson Correlation Sig. (2-tailed) N	1 49	0.291* 0.042 49
Awareness score	Pearson Correlation	0.291*	1

Pearson correlation test showed there is a relationship between science process skills and environmental awareness using outdoor learning, marked by a significance value of 0.042 or smaller than 0.05. The results of the analysis show the Pearson correlation value of the two variables is 0.291, it can be interpreted that the relationship between the two variables has a low relationship. Students who have a high level of science process skills, do not necessarily have high awareness or are inversely proportional, because some students do not understand, in carrying out experimental activities. At least science process skills and awareness in science learning are very important, because through practice students have the opportunity to develop and apply science process skills and scientific awareness to gain knowledge (Subiantoro, 2010; Yilmaz, 2019).

Conclusion

Science processing skills and environmental awareness using outdoor learning strategies have a positive effect on the development of environmental problems. This is based on the reason that outdoor learning can support the development of aspects of science process skills from observation to data interpretation. The use of outdoor learning also has a positive but not significant effect on students' environmental care attitude scores. This is because the measurement of character values is limited to filling out questionnaires by students. The Outdoor Learning Process (OLP) approach has a positive effect on science process skills and the value of students' environmental awareness in the multivariate analysis of variance (MANOVA) test with a 2-tailed Sig value. $0.000 < 0.05$. To obtain optimal measurement results for the student's environment, a caring attitude must be developed in a sustainable manner and requires a long process and certain efforts.

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Supplementary material

Indicator	Statement
Having awareness and gratitude for the role and existence of food and drink and air as God's creation	I am grateful, god has created food and drink and air I don't care about the existence of food and drink and air as God's creation I will protect the earth according to my ability as a form of gratitude
Have a curiosity, critical, and care for the environment identify the impact of global warming due to waste disposal	It is important for me to know the impact of global warning on waste disposal I will try to find out from books, the internet or other sources on the effects of global warming and how to reduce it I do not care about the environmental conditions affected by global warming because it is not in the environment where I live I have a desire to know the causes and ways of tackling global warming After learning about the effects of global warming then my concern for the environment increases I will reprimand those who commit defamation to the surrounding environment as a cause of heating global I used to throw garbage everywhere I don't care if someone throws trash out of place I will keep the trash from my snacks under the tree because I don't see any trash cans If there are cleaning activities at school or at home, I'm more likely to stay quiet The information class about the impact global warming is very important in my opinion
Use the ingredients wisely greenhouse gases and maintaining the balance of the ecosystem in the surrounding environment	I will bike/walk to school to reduce greenhouse gases even though I have a car/motorcycle I will use a motorized vehicle wherever I go because it is faster I will use wisely, things which produces greenhouse gases I don't care if the stuff I use generates greenhouses gases or not because I don't think it is the important thing I will turn off the lights if I see any lights that are still on during the day