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Awareness on Carbon Footprints Among Politeknik Sultan Haji Ahmad Shah Students

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Abstract: In this study, we aimed to investigate the awareness and actions related to carbon footprints among Politeknik Sultan Haji Ahmad Shah (Polisas) students. As the world's greenhouse gas emissions continue to rise globally, it is critical to assess people's attitudes and actions in tackling this environmental challenge, especially those of the younger generation. In addition to evaluating the students' views about the impacts of carbon emissions, the study also studied the students' actions to reduce carbon emissions. The study attempted to measure the carbon footprint values of Polisas students based on their daily activities using the Polisas Carbon Footprint Calculator. Using data from their regular monthly activities, students may estimate their carbon footprint with the help of this simple application, which helps them gain a better awareness of their environmental effects. Important information about the attitudes and behaviours of 406 participating students regarding carbon emissions was obtained through the distribution of questionnaires to them. The respondents' data was analysed using the Statistical Package for the Social Sciences (SPSS), and the results showed an average high mean of 3.68 for attitudes towards carbon emissions and 3.60 for actions connected to lowering carbon emissions. It suggests a positive inclination among Polisas students towards environmental consciousness and sustainable practices. The findings further highlight the monthly carbon footprint of Polisas students, calculated at 3287.14 kg of CO2. To contextualize this data, the Polisas Carbon Footprint Calculator recommends planting an average of 104 plants per month, equivalent to four trees per day, to offset their carbon emissions. It gives students a tangible understanding of their carbon footprint and encourages them to actively participate in carbon offsetting initiatives actively, fostering a sense of responsibility for their environmental impact. In conclusion, this study contributes valuable insights into the awareness, attitudes, and practices of Polisas students regarding carbon footprints. The implications of this study extend to the development of targeted environmental education programs and initiatives to enhance student's understanding of their contributions to carbon emissions. Moreover, the findings underscore the potential for instituting campus-wide sustainability measures and encouraging students to actively engage in carbon offsetting activities, thereby fostering a more environmentally conscious and responsible student community at Politeknik Sultan Haji Ahmad Shah.

Keywords: Carbon footprints; Level of awareness; Practices

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1. Introduction

Awareness of carbon footprints among students varies across different studies. Pradhan and Kumar found that over half of the University of Balasore, India's postgraduate students, had low carbon footprint awareness. However, there was no significant difference in awareness between female and male students, but students from different academic courses had varying degrees of awareness (Dash *et al.*, 2023).

Aydın conducted a study with high school students and found that their awareness related to households and transportation was higher than their awareness related to lifestyle. The study concluded that teaching carbon footprint concepts in the high school biology curriculum did not achieve its objective (Öz-Aydın, 2016). Sippel's study on students at the University of Applied Science in Konstanz, Germany, found that the average student's annual carbon footprint was 10.9t CO2eq, similar to the German average. The study also highlighted differences in emissions based on gender and academic discipline.

Carbon footprint is the amount of greenhouse gas emissions caused directly or indirectly by humans, events, organisations, or products, expressed as CO_2. There are various definitions related to carbon footprints. Wiedmann and Minx (2008) provide several definitions related to the carbon footprint:

"Carbon footprint is the exclusive total amount of direct or indirect carbon dioxide gas emissions caused by the activity or accumulation of the entire life stage of a product."

The carbon footprint is calculated by aggregating all emissions from the product or service stage throughout its life. Throughout the product's life, various greenhouse gases will be released, such as methane, carbon dioxide, and nitrous oxide, which have a large and small ability to trap heat in the atmosphere.

Nowadays, there is much talk about carbon emissions worldwide. Carbon dioxide (CO_2) may cause problems in the future, as it is a significant contributor to the greenhouse effect. The greenhouse effect can cause changes in the world's climate. Based on transparent sources and facts from the Berita Harian newspaper, January 24, 2017, there is an article explaining global warming, which is now at a critical level. The article also states that global warming is a gas-trapping phenomenon known as greenhouse gases, involving a group of carbon dioxide ($C0_2$), carbon monoxide (CO), chlorofluorocarbons (CFC), methane, and nitrogen oxides that prevent and trap the earth's heat from being released into space.

Green TVET can increase awareness of carbon footprints among students by incorporating sustainable development into the curriculum (Dash *et al.*, 2023). It can be

achieved through teaching strategies that focus on networking and reflection, which have been found to positively impact learning for sustainable development (Ramli *et al.*, 2022). Additionally, online competitions and project-based learning can engage students and spark their interest in environmentally friendly practices (Zelin, 2016).

Students can better understand green practices and their impact on carbon footprints by showcasing their projects online and receiving feedback from peers and non-profit organizations (Pavlova & Chen, 2019). Furthermore, the development of generic green skills should be addressed in the TVET curriculum, as these skills are necessary for all occupations to ensure environmentally friendly workplace practices (Setiawan, 2017). By integrating green skills into TVET institutions, students can acquire the knowledge, abilities, and attitudes needed to reduce carbon footprints and contribute to a greener economy.

Within the dynamic realm of Technical and Vocational Education and Training (TVET), the imperative to align curricula with contemporary global challenges has never been more pronounced. This paper investigates the "Awareness of Carbon Footprints Among Politeknik Sultan Haji Ahmad Shah Students," delving into a critical facet of this alignment. As the world confronts the escalating impacts of climate change, the integration of environmental education into TVET becomes paramount. The study addresses the pressing need for environmental consciousness and positions TVET as a transformative force in shaping a generation of skilled professionals cognizant of their environmental impact (UNESCO, 2021).

The study is being carried out in light of the world's growing globalisation and the need for more awareness and action due to rising greenhouse gas emissions. Observations indicate that student activities at Politeknik Sultan Haji Ahmad Shah (Polisas) contribute to the creation of greenhouse gases. The purpose of this carbon footprint assessment is to gauge student attitudes regarding the effects of carbon emissions, evaluate student behaviours related to reducing carbon emissions, and calculate the value of the student carbon footprint using the Polisas Student Carbon Footprint Calculator, which adds to the greenhouse gas emissions at Politeknik Sultan Haji Ahmad Shah.

2. Literature Review

The carbon footprint is defined as coming from the ecological footprint, a concept that began to be discussed in the early 1990s. An ecological footprint is the area needed to sustain an activity or population. It includes environmental impacts, such as water use and the amount of land used for food production. In contrast, the carbon footprint is usually expressed as a weighted unit of measurement of carbon dioxide production or gas equivalent to CO_2 in a year. In addition, carbon footprint is the burning of fossil fuels in manufacturing, heating, and transportation, as well as generating electricity for producing goods and services.

In addition, other greenhouse gas emissions, such as methane, nitrous oxide, or chlorofluorocarbons (CFCs), are also calculated in this carbon footprint concept. Technically,

a carbon footprint is each individual's contribution to greenhouse gas emissions. It can be calculated by calculating how much carbon dioxide or equivalent gas has been released into the atmosphere due to actions in everyday life. Exact release estimates are difficult to predict, but carbon footprint estimates for each activity performed can provide insight into choosing healthier activities for the environment. Besides carbon dioxide, methane is also the most important greenhouse gas.

According to Dr Fatimah Salim in an article published by Borneo Komrad (Salim, 2019), methane is an organic chemical from the simplest alkane functional group. The chemical molecule of this gas consists of one carbon atom and four hydrogen atoms (CH_4) formed through covalent bonds (sharing electrons). At room temperature, its physical properties are in the form of an odourless and colourless gas. Methane gas is a solid gas that contributes to the greenhouse effect.

This methane gas results from the processing activities of coal and petroleum materials and the decomposition of organic chemicals by bacteria. A lot of free methane gas is produced in waste disposal sites such as 'landfills' or the collection point for the excrement of farm animals such as cows, goats, and pigs. This production is from bacterial activity, which aims to dispose of waste naturally.

Global warming is traced to gases such as carbon monoxide, methane, chlorofluorocarbons, and nitrous oxide in the environment that trap heat from sunlight, resulting in what is known as the greenhouse effect. Therefore, the gas that causes this warming is called a greenhouse gas. Carbon dioxide is a significant contributor to the greenhouse effect, and its concentration in the air is called the carbon footprint.

Various factors contribute to greenhouse gas emissions, from direct fuel use to indirect effects such as student travel or emissions from other activities. When calculating the carbon footprint, it is essential to try and measure as many emission factors as are sufficient to allow a complete picture of the impact of the activity. Following a structured process and carefully classifying all possible emission factors is essential to produce a reliable carbon footprint. Among the factors taken into account are:

2.1. Electricity Consumption

Burning fossil resources for electricity generation will produce gases such as carbon dioxide, carbon monoxide, nitrogen oxide, and sulphur dioxide, as well as particles and metal oxides that can cause environmental pollution and affect health and comfort if the situation is not controlled. Carbon dioxide is a type of greenhouse gas that causes the effects of global warming. Long-term and excessive exposure to haze can affect health. These gases also dissolve in rainwater and make acid rain.

2.2. Use of Water Resources

Clean water is a limited and renewable resource, which is very important for humans nowadays. However, to get clean water, it is necessary to go through several processes to ensure the water is safe. Various energies must be used to carry out the process, such as machines that mostly use electricity and fuel, such as cooking gas. With this, every energy used will release high levels of greenhouse gases. Therefore, the cleaner water humans use, the more energy is needed to produce new clean water, which can increase the rate of greenhouse gas emissions.

2.3. Use of Paper

The paper significantly impacts the environment, influencing many decisions in the industry and behaviour on a personal and business level. Due to technological advances such as the printing press and wood harvesting, there is a high amount of disposable paper, leading to high consumption and waste due to its affordability. When paper is disposed of in a landfill, it is broken down, and methane is produced as a potent greenhouse gas. In addition, the pulp and paper industry uses fossil fuels for raw material production and transportation, resulting in higher greenhouse gas emissions.

2.4. Food Intake

Every human activity will produce carbon gas emissions, including food consumption. It starts from the food production process, how to get raw materials, taking portions and types of food-to-food waste. It is taken into account to know the value of carbon footprint emissions produced by food consumption and the impact on climate warming and global warming.

2.5. Fuel Consumption

Human use of fossil fuels is a significant source of excess greenhouse gases. By driving a car, using electricity from coal-fired power plants, or heating our homes with oil or natural gas, we release carbon dioxide and other heat-trapping gases into the atmosphere. Scientific researchers have proven that vehicles emit greenhouse gases that result in global warming. Worryingly, the running engine of a stationary vehicle produces double the amount of greenhouse gases. The amount of greenhouse gases produced by vehicles worldwide has surpassed other greenhouse gas sources. The heat produced by a running engine and the smell of burning fuel is dangerous to human health, especially to small children and the elderly.

3. Methodology

3.1. Data Collection

The online survey was used to collect data. An online survey questionnaire was blasted among the students' phones to collect data regarding the attitude of Polisas students

towards the impact of carbon emissions, evaluate the practices of Politeknik Sultan Haji Ahmad Shah students towards carbon emission reduction practices, and determine the carbon footprint value among Politeknik Sultan Haji Ahmad Shah students.

The questionnaire was adapted and modified from The Awareness Level and Carbon Footprint Emission Among University Students in Klang Valley, Malaysia (2017). The questionnaire consists of questions about socio-demographic information, carbon footprint knowledge, attitude, practice, and the level of carbon footprint produced.

3.2. Carbon Footprint Calculator

The carbon calculator is closely related to the carbon footprint. Hunter and Waters (2009) determined that the carbon calculator is used to estimate the carbon footprint. Carbon footprint calculators measure greenhouse gas emissions to determine the amount or quantity of greenhouse gases produced for a specific period.

Each country has a different total emission factor, which can change. The average efficiency for a given power plant (conservative method) is used as the determinant of the formula to calculate CO_2 emissions (Greentech, 2013).

According to Clark (2012), many carbon calculators and evolutionary standards are available to calculate the carbon footprint, but he agrees that there is no precision in calculating the carbon footprint. However, the calculation results using different websites vary depending on their formula.

In this project, the Polisas Student Carbon Footprint Calculator, as shown in Figure 1, was adapted from the Green Campus Initiative (GCI), a project carried out by UCSI University to show their commitment to reducing the risk of climate change (Hooi & Hassan, 2010). This calculator uses online software, www.calconic.com, to facilitate user access online through the link http://bit.ly/KalkulatorJejakKarbonPolisas.

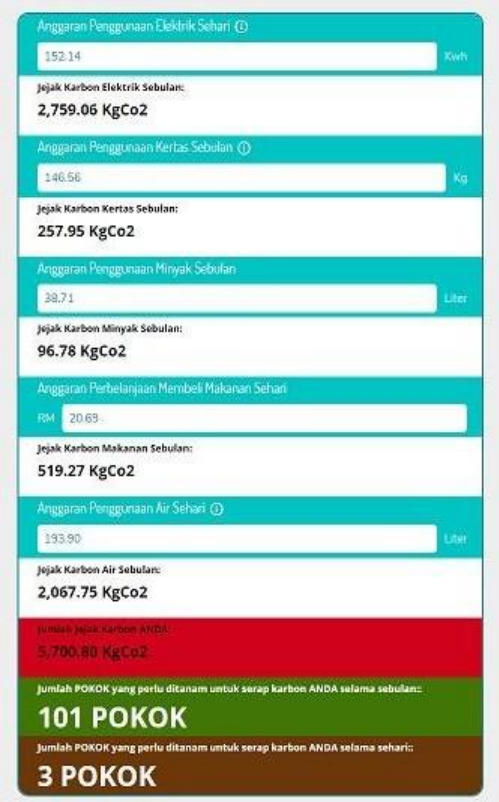

Figure 1. Polisas student carbon footprint calculator

3.3. Statistical Package for the Social Science (SPSS)

Findings from the distributed questionnaire were entered into the Statistical Package for the Social Sciences (SPSS) application version 25. This software is easy to use and quick to give the desired answers. Once the data is entered, it is analysed and presented in the table.

3.4. Carbon Calculation Formula

ISO (2006) does not provide much information on the actual carbon footprint calculation. Standards such as the GHG Protocol (WBCSD & WRI, 2003) and PAS 2050 (BSI, 2008) explain this in more detail. Two basic types of data are needed to calculate the CO_2 emissions of a company or product. First, activity data is needed to provide more detailed information about the activities that lead to emissions. For example, activity data on the amount of petrol used in a certain period of time in litres or the amount of paper used in kilograms. Emission factors can be used to convert activity data into CO_2 emissions.

Emissions can be expressed as CO_2 released per unit of measurement (kg/km/l, etc.). For example, the emission factor can express the amount of CO_2 emitted per kilogramme of paper. Emission factors are resource-specific. For example, the electrical emissions produced by coal will differ from those produced by nuclear power. In general, this is the formula for calculating emissions (WBCSD & WRI, 2003; BSI, 2008):

$$CO_2 \text{ emissions} = \text{Activity data (kg/km/litre)} * \text{Emission factor } (CO_2 \text{ per unit}) \quad (1)$$

Primary and secondary data can be distinguished between activity data and emission factors. Primary data are direct measurements of the life cycle of a particular product. For example, the number of litres of gasoline used per kilometre can be directly measured. Secondary data consists of external average data not specific to the product.

3.5. Carbon Offsetting

One of the counterbalances to the carbon footprint is the number of trees or plants that absorb carbon dioxide and release oxygen into the area. Trees in various stages of maturity can help the carbon dioxide absorption process and help improve the carbon balancing process. Auditors usually check the same tree each time they come to determine the maturity of the tree and survey the surrounding area to count other random trees on the land to calculate carbon offsets.

The Polisas Student Carbon Footprint Calculator, is also included once to provide an overview of the carbon balance required for the carbon footprint produced in the form of the number of trees. According to Idris and Mastura (2017), various types of plants can absorb carbon dioxide. Each type of plant has a different ability to absorb CO_2 (kg/ha/Day), but trees are the type of plant that can absorb the highest CO_2 emissions. So, in this carbon footprint calculator that was developed, an average value of 1742.66 kg/ha/Day is taken to give an idea of the number of trees that students need to plant for the amount of carbon footprint given.

Table 1. Interpretation of CO_2 absorption power according to plant type (Prasetyo *et al*., 2002)

Num	Types of Plants	CO_2 Absorption Capability (Kg/Ha/Day)	CO_2 Absorption Capacity (Ton/Ha/Th)
1	Tree	1,559.10	596.07
2	Bushes	150.68	55.00
3	Grassland	32.88	12.00

The average is nearly 4 tonnes of the world's total carbon footprint emissions. In order to avoid a 2% increase in global temperature, the average global carbon footprint every year needs to drop below 2 tonnes by 2050, according to the website of The Nature Conservancy, which is a non-interested party in the United States that carries out charitable activities to maintain the sustainability of the earth. Lowering an individual's carbon footprint from 16 to 2 tonnes is unlikely overnight. Carbon balancing, one of the methods through which trees are planted, will be able to contribute significantly to reducing the country's carbon footprint. The World Bank website reports Malaysia's CO_2 emission value (metric tonnes per capita) is 7.6 tonnes.

4. Findings and Discussions

4.1. Analysis of Student Attitudes Towards the Impact of Carbon Emissions

Several factors influence student attitudes towards the impact of carbon emissions. Firstly, education plays a significant role in shaping these attitudes. Students who know about climate change and its effects are likelier to have positive attitudes towards reducing carbon emissions (Kapuka *et al.*, 2017; Oliver & Adkins, 2020).

Based on Table 2, the analysis of student's attitudes towards the impact of carbon emissions was made through the online distribution of questionnaires by obtaining the mean, which is the average calculated value of the respondents, the standard deviation, which is the probability distribution of the respondents, and also the level of the respondents' attitudes. The overall mean score value for the student's analysis of the impact of carbon emissions shows a mean reading of 3.68, and the overall average level of student's attitudes towards the impact of carbon emissions based on the questionnaire that has been analysed is moderately high. It shows that students understand that carbon emissions occur and that many factors around them can cause the cause.

This is proven through the global climate change question item related to the carbon footprint, which has the highest average score value of the respondents, 4.01, with a standard deviation of 0.699, which is at a high level. Students are generally aware of the specific impacts of certain activities on carbon emissions, such as the fast and unnecessary acceleration of cars and using paper. However, there is room for improvement in their understanding of the environmental impact of meat consumption. Overall, the survey results suggest that students are willing to take action to reduce their carbon footprint.

Table 2. Analysis of student attitudes towards the impact of carbon emissions

Items	Mean	Standard Deviation	Level
Meat can lower carbon footprint levels.	3.30	0.831	Medium High
Global climate change is related to the carbon footprint.	4.01	0.699	High
The fast and unnecessary acceleration of the car can increase its carbon footprint	3.53	0.901	Medium High
The use of paper can contribute to the carbon footprint.	3.66	0.901	Medium High
Turn off all electrical appliances when not in use to reduce your carbon footprint.	3.88	0.868	Medium High
The overall mean score value for the student's analysis of the impact of carbon emissions.		3.68	Medium High

4.2. Analysis of Student Practices on Carbon Emission Reduction

The analysis of students' practices on carbon emissions found that turning off electrical appliances after using them has a mean value of 4.20, which is at a high level according to the set Likert scale. Though there is always room for improvement, students are trying to reduce their carbon footprint. Most students switch off electrical appliances when unused, although some might be better about using less meat and more recyclable paper.

Additionally, lecturers' mode of delivery of course materials can influence students to develop responsible environmental behaviours, such as reading electronic course documents and reusing paper (Ghanbari *et al.*, 2023). Although they could use them more frequently, students occasionally use sustainable transportation.

Finding places where they can make improvements to lessen their environmental impact is something that many students have never done before checking their carbon footprint. Based on the analysis of student practice items on carbon emission reduction, it was found that the level of student practice on carbon emission reduction was at a medium-high level with a mean score of 3.60.

Table 3. Analysis of student practices on reducing carbon emissions

Items	Mean	Standard Deviation	Level
I turn off electrical appliances every time I use them.	4.20	1.020	High
I prefer to use virgin paper rather than recycled paper.	3.41	1.033	Medium High
I include meat in my diet.	3.62	0.951	Medium High
I usually ride a bike or walk.	3.65	1.009	Medium High
I have checked the level of my carbon footprint before.	3.10	0.896	Medium High
The overall mean score value for students' practices towards reducing carbon emissions.	3.60		Medium High

4.3. Carbon Footprint Value Determination Analysis Using the Polisas Student Carbon Footprint Calculator

The average carbon footprint of Polisas students is considered for a month. This value is obtained through a questionnaire and analysed by the students using the Polisas Student Carbon Footprint Calculator. Carbon emission sources are electricity, paper, vehicle fuel or oil, daily food, and water use.

Students use 152.14 kilowatt-hours (kwh) of electricity daily, releasing an average carbon gas of 514.98 kilograms of CO_2 ($kgCO_2$) monthly. Next, for paper use, an average of 146.56 kilograms (kg) of paper is used in a day, equating to a carbon gas emission of 100.1 kilograms of CO_2 ($kgCO_2$) for a month. In addition, for oil or vehicle fuel, an average of 38.71 litres (ℓ) is used daily, equating to carbon gas emissions of 85.04 kilogrammes of CO_2

($kgCO_2$) for a month. At the same time, the average food consumption is RM 20.69 per day spent buying food, equating to carbon gas emissions of 519.27 kilogrammes of CO_2 ($kgCO_2$) per month. Next, for water consumption, an average of 193.90 litres (ℓ) is used daily, equating to carbon gas emissions of 2067.75 kilogrammes of CO_2 ($kgCO_2$) for a month.

The carbon dioxide emissions are totalled, resulting in 3287.14 kilograms of CO_2 ($kgCO_2$) for a month. Using the Polisas Student Carbon Footprint Calculator, the average number of trees that need to be planted within a month is as many as 104, equivalent to 4 trees per day. It aims to reabsorb the carbon gas released by the amount of carbon footprint produced through the activities carried out by Polisas students. The primary role of the photosynthesis process is to allow the carbon gas released in the air to be absorbed and converted into oxygen gas.

5. Conclusion

In Malaysia, efforts to overcome this problem are on the right track, with a report issued in Berita Harian showing that a study in 2014 found that Malaysia succeeded in reducing greenhouse gas emissions by 33 per cent of the Gross Domestic Product (GDP). The government will undoubtedly strive to introduce effective policies to control the production of greenhouse gases at every level and of all ages while encouraging sustainable lifestyle practices (Susskind *et al.*, 2020). Some practices can be done, especially by Polisas students, to help reduce the carbon footprint that contributes to the production of greenhouse gases in their daily lives. Among those practices are:

5.1. Take Care of Your Electronic Equipment

Buy electronic equipment with a good energy rating, and make sure to unplug electronic equipment when not in use. Removing unused electric plates is found to save the cost of paying electric bills and indirectly contributes to reducing individuals' carbon footprints. Using equipment with a SIRIM label can also help reduce the carbon footprint because the equipment is certified by the Malaysian government as an energy-efficient tool.

5.2. Reduce Red Meat Intake

Methane is a big problem in the livestock industry. There is no need to stop eating beef altogether, but consider including it on the menu for special occasions, as some occasions will use large quantities of red meat. It can help reduce carbon dioxide emissions.

5.3. Use Greener Transportation.

Consider using public vehicles such as buses or sharing vehicles with friends to reduce carbon emissions. If you are close to your destination, you can practice cycling. It also benefits the body's intelligence and makes the physical body healthier.

Carbon footprint reductions can also be made while driving a car. Driving habits impact the amount of carbon dioxide emissions from the vehicle. Maintaining a steady and moderate speed while driving and anticipating the stops and starts of driving saves a tonne of carbon gas a year.

5.4. Reduce Daily Water Consumption

Use a shorter shower because it saves more water, and choose a shower head that saves water. According to National Geographic, if you use a low-flow shower, you can save 15 gallons (56.8 L) of water if you shower for ten minutes.

Also, use the washing machine only when it is complete. About 22% of daily water consumption comes from the use of washing machines. Always make sure that the appropriate washing system is selected. Activate the small or medium load setting if the laundry load is small. Some washing machines, especially front-loading machines, automatically adjust the water level.

5.5. Proper Waste Management

Proper waste management at home is the most significant contributor to efforts to reduce greenhouse gas emissions from waste disposal. Scientifically, garbage will produce methane gas when it goes through the decomposition process. Methane gas is a greenhouse gas with a more substantial impact than carbon dioxide gas. However, the life span of methane gas is found to be shorter when compared to other greenhouse gases, which are only 12 years, compared to carbon dioxide gas, which can last for 100 to 300 years. Therefore, reducing the production of methane gas produced in waste disposal centres is an effort that is worth making to help overcome the problem of global warming.

3R is an activity to reduce waste (reduce), reuse (reuse), and recycle (recycle). This practice is an important step that every student should take to reduce their carbon footprint in their daily lives. The three steps will only happen if each individual is highly aware of the 3R practices.

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