



# Waste Management Approach Learning at Schools, Indonesia

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**Abstract:** Humans and nature are interdependent, with mutual benefits and coexistence. We humans have a major responsibility to protect nature. This responsibility can be transferred to the younger generation through environmental teaching, especially on prevention, reduction, reuse, recycling, treatment, and disposal-based learning, which adopt from Sixth Environment Action Programmed and Permaculture Design Approach to primary schools. The first author as a teacher had a chance to do socialization on environmental protection studies in 8 governmental primary schools after submitting a proposal to the Ministry of Education in Serdang Bedagai North Sumatera, Indonesia. The short socialization occurred for a week at each primary school. The first author implements *Merdeka Belajar's* curriculum on environmental action research studies. This study helps students to learn environmental ethics and principles to stimulate the students to have a cycle thinking approach toward free waste. The authors put methodology enlightenments on waste management based on Permaculture principles and the teaching implications and suggestions on the way forward.

**Keywords:** Freedom of Learning Independent, Permaculture Design Approach, Science Education, Sixth Environment Action Programme (Prevention, Reduce, Reuse, Recycle, Treatment, And Disposal)

## 1 Introduction

Indonesia, especially in Sumatra island has little action on waste management and little community participation to deal with the management of household waste (Sutomo et al., 2023). People of Indonesia still hold on to the old paradigm of 'collect-transport-disposal' waste management both city and rural frequently (Fariz et al., 2024). Compared to other developing countries, the level of MSW management quality in Indonesia provided by the municipalities is rather low including inadequate waste regulation, low implementation, low budgets, and low private participation. Tun et al., (2020) explain that Indonesia's policy and institutions, market development, cooperation of the private sector, data availability and reliability, and financial resources are medium. Meanwhile, the involvement of stakeholders, knowledge level,

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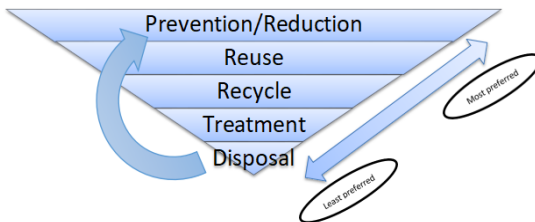
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skilled personnel and training facilities, public awareness, technology, cultural and climate impact, and research development is shallow. The only role of the information sector is high. Therefore, some sectors that are low need attention to improve the quality of waste management for short and long terms.

The level of public awareness, knowledge, and training must be increased. The citizens have to learn how to decline and filter the waste from their homes (Khair at al., 2019). There are many recommended policies that can be implemented for instance the 3R concept involving the community and agencies related to the environment, the local government also evaluates and monitors the local community to heart and gain a sense of interdependence for the environment (Idris et al., 2021). If these concepts are put into practice, the garbage is taken to the landfill drop (Dewilda et al., 2023). In this study, the first author tried to work on the knowledge level and increase awareness for students on waste management approach science education action research at primary school by using an independent learning curriculum and adopting the Sixth Environment Action Programmed and Permaculture Design approach waste management. Through this study, there can be references for learning materials theoretically and practically and insights from teachers and educators to educate students to be civil society who stand with public welfare.

### 1.1 Waste Management Approach

The sixth environmental action program is initiated by European countries, the increasing waste amount in European communities is influenced by economic growth, making the standard of living increase to buy more and creating more waste. The consumption becomes short-term, more single-use and disposable products. These waste phenomena impact the quality of life of society, animals, and the environment. This led the EU toward waste management for the long-term strategy on waste. Landfill is the traditional model of waste management and least recommended. However, landfill/ disposal can be solved by converting biodegradable waste to energy recoveries such as power supply, organic fertilizer, and heaters in municipal waste incinerators treatment. Recycling is a way to make a new one from raw products and this recycling process makes less waste and keeps energy. Reuse means using the product again for example using clothes donations. It brings benefits to society, finance, and nature. Waste prevention is very essential and desirable because there will be no cost, treatment, and disposal stage (EU Publications, 2010) (see Figure 1).



**Figure 1.** Acts on environmental pollution through teaching environmental studies based on The EU's sixth environment action programmed

The characteristic of Permaculture offers three ethics that preserve a healthy environment, a healthy culture, and a healthy people as we can see from the figure below. Mollison (1988) and Holmgren (2011) explained that the first ethic is caring for the land to protect and improve the natural resources, the second is care for the people to prepare a healthy and safe future for everyone, and the third is fair share to promote and create business, livelihood, income, meaningful work, trade, barter, and production. The three ethics of Permaculture guide us to use energy and resources wisely, maintain ecosystem stability, and minimize future impacts. They help us to identify important social and environmental issues, focus on broader goals, and restore the landscape. Without these ethics, we risk going against natural laws, which could lead to system collapse, uncontrollable situations, and higher costs for society, the economy, and the environment (Morrow, 2022). Permaculture also popular with the 12 principles such as observe and interact (Permaculture Principle 1), catch and store energy (Permaculture Principle 2), the principle of harvest (Permaculture Principle 3), self regulate and accept feedback (Permaculture Principle 4), use and value nature's gifts (Permaculture Principle 5), make no waste (Permaculture Principle 6), design from pattern to details (Permaculture Principle 7), integrate don't segregate (Permaculture Principle 8), use small and slow system (Permaculture Principle 9), use and value diversity (Permaculture Principle 10), mind the margins and look to the edges (Permaculture Principle 11), cultivate visions & respond to change (Permaculture Principle 12). These ethics and principles are essential for sustainable harmonious living with nature (see Figure 2).



**Figure 2.** Permaculture ethics

## 2 Methodology

The method of this study is action research to what can be done to develop and implement change (Newby, 2014). normatively, the goal of this action research is to build inquiry and research into the primary curriculum and for students' practices on environment waste management, teachers' practices on teaching environmental education, and educational leaders development in educational institutions. In an attempt to help the primary students with environmental care, the first author as a teacher developed an action plan that is taken from environmental community condition analysis through passive observations and site analysis and transformed into environmental teaching, from knowledge to action.

## 2.1 Teaching sites

The teaching sites are in Dolok Masihul, North Sumatra, Indonesia. There are 8 formal schools where close one and others. The lessons were prepared and all the necessary equipment for each class. Each lesson was different from each class and connected the topic with their own phenomena or particular needs or conditions in their area. Each school starts learning at 7.30 a.m. They have 1-time recess at 9 a.m. The students of grade 1 finish the class at 10 a.m. Grades 2 and 3 finish at 11 am. Meanwhile, grades 4th, 5th, and 6<sup>th</sup> finish 12 pm. The first author started teaching at 7.30 a.m. till the class ended. The first author did the project for about 5 months. Due to various participating classes and schools and environmental themes, this study presents only a teaching approach that encourages students to do most prevention or reduction, reuse, and recycle to do zero waste and least produce disposal waste. Kemendikbudristek (2024) Merdeka Belajar curriculum in Indonesia has been implemented since 2020, it is also called an independent learning curriculum that emphasizes student-centered learning. There are three principles in Merdeka Belajar (1) ensure and support competency and character development, (2) be flexible, and (3) focus on essential content. The curriculum can help students to understand, use, solve, evaluate, and reflect on both social and natural science studies as an active civilization and world citizens. The curriculum has to be flexible based on students' characteristics, interests, and abilities. It should be focused on students' needs and relevant to their reality. The first author used this curriculum to study environmental care in primary schools by arranging different learning methods, themes, and activities based on students' level, cultural context, and their daily life issues on the environment.

## 2.2 Teaching Procedures

At the very beginning of the teaching is to show some things that are very familiar in Indonesia such as waste randomly at drains, roads, and landfills. The second habit is using plastic bags while going to markets, the third is having one or single litter bin (no recycle bin) at home, and truck garbage just comes once a day. The information is given that burning waste is not good, especially for our health in the short terms which make us irritated including our eyes, and nose, short breathing, and dizziness, and in the long term that makes us get cancer. The students also showed short videos on the impact on our environment. That is global warming; the earth is burning and hot because the air is toxic. The burning of waste like plastic is very dangerous because the fog spreads in the air and we humans breathe that. Moreover, the ozone of the planet Earth sphere gets thinner. The first author introduced 6<sup>th</sup> environmental action program for example Prevention: choosing longer usage equipment of stainless stuff such as spoons, forks, and straws and using self-bottle from stainless steel stuff which is more endurance Reduce: no plastic bags, Reuse: used cloth for the bag, Recycle: do compost for waste food, etc. After acquiring the environmental contents, the students did various tasks based on the topic they had and then took quick action by making short environmental video campaigns: stop plastic, stop burning, stop plastic bags, yes cloth bags, and videos on making tote (T-shirt) bags. To end our class the students have short powerful words of encouragement to save people, nature, and the future.

### 3 Result and Discussion

Permaculture's ethical task for prevention and reduction is to adopt harmless practices for caring for the earth, and the people and sustaining our natural resources. The stages are cutting down input and importing unwanted materials into our homes and the environment. Permaculture design aims for prevention and reduction to use eco-friendly resources efficiently and make anticipation of future outcomes of the production. If we do not have Permaculture design aims for prevention and reduction, it refers to the pattern of buying and consuming goods and services beyond what is necessary for basic needs, and over-processing of environmental footprint. The messages from the teaching are to make necessary, durable materials last a long time and to not burn the waste the students need to minimize their waste materials and upgrade their waste into more valuable things to continue the life of their products. For example, the students make compost from leftover food and feed the livestock to turn into new food production. Instead of throwing and burning, people can make goods more valuable.

Our ethical task for reuse is to design a clear process for gathering and differentiating materials with care and donating to others, maintaining, prolonging lifespan production, and shrinking for finite resources. Permaculture design aims for reuse are to find and use pre-loved materials by loaning-giving passing on to others, keeping in use instead of new wherever possible, buying secondary stuff, keeping for community, unprecedented disaster, choosing reusable materials that can be regionally biodegradable at the end of their life. From the teaching lesson, if the students choose plastic packages to buy their drinks and non-eco-friendly stuff instead of using their bottles from home, the plastic packs will be wasted and add pollution to their environment. However, if the students use their bottles to buy drinks and endurance equipment such as bringing their bags while shopping, repeatedly use their stainless steel lunch box, bottle, fork, spoon, and straw, and donate good plastic bags to stallers. It prevents waste and pollution to the environment. It means no solid waste, no treatment needed, and no cost. These reuse acts also need to be supported by all parties such as the sellers in the canteen not providing plastic packs, teachers teaching environmental care innovatively, providing students' bottles for their drinks in schools, and designing the classroom with the environmental mind, parents to remind their kids to bring their bottle, and regional government rules on promoting second hands, free stuff, and donations to reduce unnecessary waste production.

Permaculture ethics on recycle stage is to regenerate parts and audit the waste we send to junk-yard and shift towards waste-free. Permaculture design aims for recycling are to produce more renewable resources, use supplies simply and economically, and use biological processes to recycle all waste. If we do not have Permaculture design aims for recycling we disregard futuristic productivity. From the teaching lessons, the students comprehend how important to recycle all waste by sorting waste based on the categories and then re-purpose their materials like unused clothes for handbags, groceries bag and or shopping bags and it is important to have a recycling basement and teaching centre to upgrade the waste into treasure in a community including educational institutions.

Based on FAO's data (2019), Indonesia is second largest food waste is annually disposed of approximately more than ten million tons. Food waste-to-energy technologies are highly recommended to be improved in Indonesia. Permaculture ethics and principles in the treatment stage are to fix, reform, and redevelop waste into valuable sources. If we do not have Permaculture design aims for treatment, we misplace energy capability and distinctiveness, overcharge to create a design, work, restore, and maintain which results often causing ecosystem damage and health risks, and use the Earth's resources at an unsustainable rate. The message from the lessons is students know how to deal with their leftover food. For example, making dry and liquid compost, it will bring benefits to other cycles such as livestock, plants, insects, soil fertility, and plant productivity.

Landfill is still part of the same form of municipal waste disposal in a lot of places. However, biodegradable waste can be turned into energy production like methane gas. If methane does not break down fully, it may free heavy metals. That can contaminate local groundwater, surface water, and soil which could bear public health and environmental issues (Lan et al., 2024). Our ethical task for disposal is to encourage convert bio-waste to produce energy and turn it into annual marketplace value. Permaculture design aims for disposal are to work on recovery energy like advanced waste combustion plants for renewable energy. If we do not have Permaculture design aims for disposal, we put force on non-renewable resources, excessively occupied and complex lives may manifest very up-scale from now on, keep using and collecting vague which creates unnecessary waste that threatens water, air, soil, and food supplies, degrading levels of waste of all resources, and fail to see opportunities for new recycling industries. The lesson from the teaching is we try to identify what most solid waste exists near their schools, keep be inconvenient surrounded by waste, and how to avoid such waste thrown randomly in their community.

## 4 Implications

The action research study brings three implications for green students, community, and schools on waste management issues. School where a platform to educate students and the local community about environmental science and a cycle-thinking approach toward free waste. Students who are now and future actors to study at school and be civil society in a community to create prosperity and a sustainable environment.

The implications are not limited to primary school students only, but also to all school student levels and grades. They need to learn how to do prevention, reuse, recycle, treatment, and upgrade the disposal of waste. To do waste management ethically and appropriately, each student can learn some values and skills. For instance, the students can observe green and nongreen materials and durable products/ recycled or recyclable products to use sustainably and discourage any use of a single product. They commit to using greener materials for long-term benefits to avoid hazardous substances into the environment and by using green and endurance materials can save money and store natural resources. They can identify their needs, wants, addictions, abilities, liabilities, and responsibilities to prevent and reduce material consumption. They know about a balanced diet to serve better balanced meals. They

acknowledge that slow food makes slow food waste, bears slow energy consumption, and slow environmental impacts. The students are encouraged to audit what waste they must have and find alternative ways to avoid the waste by learning how to do better prevention acts through self-education (books, social media, AI learning, etc). The students provide a space for reuse/recycling storage material at home such as e-waste components such as hand-phones, refrigerators, cars, computers, etc. They are willing to donate reused products to needy people. The students cultivate and evaluate how good and bad recycling activities at home and local community recycling strategies to maximize the value of renewable recycle products. The students know the causes and consequences of traditional disposal in environmental impacts. They understand how the service of living nature works (animals, plants, soil, and self-purifying water system) and also support community service to share knowledge and service on waste management. When green students have these environmental skills, it will help them to cope waste management in their local community confidently with the support from their community and school as well.

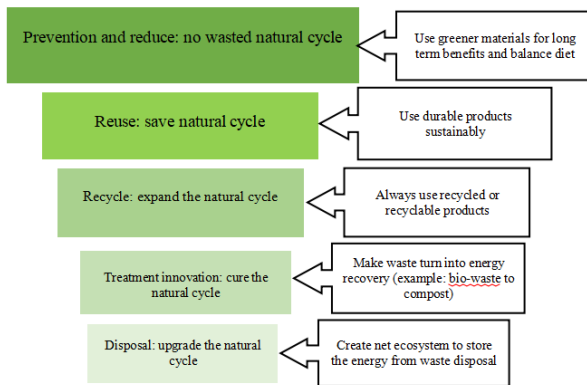
A green community is people who agree to pursue a sustainable environment. They set on green collective agreements that support life and have a low risk to the environment which is represented by sustainable plans and buildings, a lot of conservative areas, Permaculture design (permanent agriculture) adoption, using renewable resources, providing community building (Ristianita, 2016). One can be found in Java Island established prevention program on green products and services to boost the economy and save the environment like the 'Kang PisMan' mobility to manage waste management and cultivate positive participation from the local community to take responsibility (Sekarningrum, et al., 2024). The citizen demands greener products and less packaging in their community. They cut off their bad habits by burning waste around their houses. They also raise campaigns to educate the public and encourage consumers to demand goods that produce less waste and drive the creation of more resources goods that produce less waste and drive the creation of a more resource-efficient market. The community acknowledges that reuse products have social, economic, and environmental benefits, creating jobs and making products available to their neighbors. Such an empowering community example can be taken from a Green community CSR PT Pertamina EP Prabumulih Field in South Sumatra consists of two main programs, namely: 1) women empowered together to manage waste, 2) home of inorganic residue waste recycling innovation. The programs bear optimistic results including profits, civics, and ecological views in the community (Rosadi et al., 2024). Besides, the green community also can build charity areas like a food bank, garden club, a repair cafe for clothes, furniture, kitchen equipment, etc. They encourage waste management acts for all ages, at all types of workplaces, at all interests, and in all cultural contexts. Last but not least, the community creatively transfers treatment/ landfill to an accumulation of public infrastructure, education, business areas, cultural areas, social health care, and so forth.

Green school is one of the productive platforms to educate students to care about their environment be green citizens in their community, and learn to manage natural wealth fairly. School is essential to put waste management education programs in the curriculum both for students and the local community like recycling, gardening,

and green workshop. School initiates to start passive education movement with tool library about waste management care. Schools design recycling programs to ensure the students and community can separate their waste into different material types (paper, glass, plastics, metal, garden, kitchen, food waste, and so on). One example is green audit action in school facilities (Filippi & Sirombo, 2015). The school equips students to be sustainable gardeners to build soil from waste, particularly organic matter can be useful for soil improvement, animal feed, fuel crop rotation, pasture, and shrubs that encourage more green spaces both in the school and community environment. Green spaces can be a ‘social bridge’ and may have effects on the welfare of personal and community levels (Vazonienė & Vazonis, 2017). In the same vein, Green schoolyard improvement can lessen health issues, academic results (score, students’ presence, enhanced integrated learning, and school atmosphere), local district results (school impact on society and more collaborative bonding with community) (Barenie et al., 2023). The green school also facilitates inter-ship, field trips, and volunteers at the landfill areas to learn the energy recovery process.

### 5 Conclusion and Suggestion

From the environmental learning approaches, the students could see, touch, smell, feel, hear, and think through activities based on student grade, environmental issues, and interests as set in the *Merdeka Curriculum*. Sixth Environment Action Programmed and Permaculture Design Approach is necessary for primary grades may help them to be more preventive and conscience on cycle thinking and close loop approach (prevention and reduce: no waste cycle, reuse: save the natural cycle, recycle: expand the natural cycle, treatment innovation: cure the natural cycle, disposal: upgrade the natural cycle) (see Figure 3).



**Figure 3.** Cycle thinking and close loop of waste management approach

The practical teaching for primary school students were done in comprehensive and practical ways such as recognize type of waste, do recycle, reduce disposal solid waste, use friendly environmental stuff to create zero waste, change waste to more valuable,



picking up waste, making a drama of environmental awareness, elevate their knowledge on environmental issues through listening, watching, drawing, playing and singing environmental cares. Besides, this study provides ethical reasoning and tips for students to do environmental waste management based on Permaculture ethics and the 12 principles. Facing clear challenges ahead, the authors suggest teachers in educational schools need to update and upgrade the development of the science, technology, society, and environment (STSE) education, which aims to widen the science education significance to connect with relevant culture and social of students for the sake of 'science for all' (Pedretti & Nazir, 2011).

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