Original Paper

A technocreativity learning model based on environmental volunteers for waste management

Can it support Green Campus and Green Entrepreneurship for students?

Sumarmi, Alfyananda Kurnia Putra, Tuti Mutia, Alfi Sahrina, Sharina Osman, Adellia Wardatus Sholeha, Novika Adi Wibowo, Tasya Khairunisa.

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Abstract. *The present condition of waste management in Indonesia has a negative impact on the environment. This study aimed to: (1) develop a technocreativity learning model based on environmental volunteers for waste management to support Green Campus and Green Entrepreneurship for students; and (2) evaluate the effectiveness of the technocreativity learning model. The research method used is the Research and Development (R&D) method with the ADDIE model (Analysis, Design, Development, Implementation, and Evaluation). Data collection techniques is used questionnaires, observation, documentation from the implementation of environmental volunteers. Data analysis was carried out by analyzing quantitative data utilizing tabulation analysis, percentages, and graphical representation. According to the findings of the study, the development of the technocreativity learning model based on environmental volunteers for waste management to support Green Campus and Green Entrepreneurship for students is still in early stages. These stages consist of an initial briefing for students, collecting trash, waste sorting, waste processing for the manufacture (biomol, eco-enzyme, ecobrick, organic fertilizer, briquettes), waste processing, and waste profits. The technocreativity learning model based on environmental volunteers for waste management is effective for supporting Green Campus and Green Entrepreneurship for students, because the longer an individual has been a member of an environmental volunteer group, the higher they interest in participating in Green Campus activities. Moreover, the longer a person has been a member of the environmental volunteer group, the more likely they are to become a Green Entrepreneur for waste management in university.*

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1. Introduction

Waste is a significant issue in Indonesian regions, particularly during development (Sharba, 2019). The rise in population and socioeconomic development has led to increased pollution and waste problems, impacting public

health and the environment (Karak et al., 2012; Olofinnade et al., 2021; Wilson & Webster, 2018). This includes areas around universities. It is crucial to balance the increase in landfills with public awareness for effective waste management (De S. Pereira & Fernandino, 2019).

According to the Minister of Environment and Forestry, the annual quantity of waste disposed is approximately 67.8 million tons, and this number will continue to rise following with the population. Besides from having a physical effect on the ecosystem, ineffective disposal of waste may affect the number of microplastics in the coast and sea, affecting the quality of the marine ecosystem that eats these microplastics. In the end, it impacts the general level of human health. Each year, between 4 and 12 million tons of plastic reach the oceans. Less than 20% comes from marine resources such as fisheries and fishing vessels, while the remaining 80% comes from sources on land that migrate into the sea through rivers (Anugrah, 2020; GESAMP, 2015). The growing amount of microplastics will have an influence on marine life (Jambeck et al., 2015).

Population growth, urbanization, and industrialization are causing an increase in waste problems in Indonesia (Olofinnade et al., 2021; Sharma & Jain, 2020; Wilson & Webster, 2018). The waste problem is closely related to environmental awareness and concern (Chang et al., 2020). The challenges to waste management include: (1) the lack of a waste management plan; (2) the lack of waste separation; (3) the low quality of public cleaning services; (4) the limited availability of environmental education; (5) the lack of social control over waste management policies; and (6) the lack of socialization programs for waste recycling cleaners (De S. Pereira & Fernandino, 2019). The waste management studies that based on community have been shown to be helpful in overcoming waste management issues (Mulasari et al., 2016; Wynne et al., 2018).

Students, as future leaders in society, are required to continually work for environmental quality (Debrah et al., 2021; Karak et al., 2012). It is essential to be prepared using the classroom-based learning model and become volunteers in maintaining a clean campus (Aleixo et al., 2021). Through waste care movement activities involving students as volunteers, environmental awareness will develop among them, driving them to demonstrate their values by developing solutions to ecological issues. Moreover, it also engaging in sustainable entrepreneurship through waste management (Barba-Sánchez et al., 2022; Thelken & De Jong, 2020).

Green entrepreneurship is a form of sustainable entrepreneurship that focuses on business development of natural products, conservation, lifesaving

equipment, and environmental community commodities. Universities as educational institutions can facilitate and enhance green entrepreneurship through sustainable value creation and activity strategies (Yasir et al., 2021). Through the right implementation of the technocreativity learning model based on environmental volunteer to support the Green Campus, the university will be clean and clear of waste, and therefore students will develop an entrepreneurship mindset (Barba-Sánchez et al., 2022; Thelken & De Jong, 2020).

The technocreativity learning model is a method of learning outside of the classroom that integrates technology and real-world application to increase student creativity (Perumal & Iyer, 2022). Prior studies have indicated that the technocreativity model will lead to an increase in students' creativity (Camacho-Miñano & Del Campo, 2017). Developing students' creativity affects their thought processes, enabling them to evaluate and generate solutions to challenges (Castillo-Vergara et al., 2014). The technocreativity model can be implemented in environmental learning in the form of waste management by actualizing the use of waste management technology and environmental initiatives (Carenzo, 2018). One method is to produce fertilizer from organic waste.

Technocreativity learning prioritizes service and community engagement, enhancing divergent thinking skills, collaboration, project management techniques, empathy, curiosity, and creativity (Lake et al., 2022). The collaboration of transdisciplinary students positively affects the quality of project learning and activity output (Biberhofer & Rammel, 2017). It also encourages critical thinking about waste issues in the community while increasing networking and communication skills (Klein, 2018). This contributes to the sustainability of waste care movement initiatives through environmental volunteering (Nordén, 2018).

The waste management system at the Waste Bank involves short-term, medium-term, and long-term planning. Short-term planning focuses on public education, while medium-term planning generates revenue from exchanging waste for recyclables. Long-term planning ensures uninterrupted waste mobility and conversion of waste into economically valuable products (Istanabi et al., 2022; Kristianto, 2020; Razzaq et al., 2021). The emergence of waste management problems can be linked to a lack of sorting systems and inefficient trash processing and recycling planning. Prior research has identified challenges in waste management including insufficient knowledge about waste separation and inadequate processing and recycling management. In many developing countries, household wastes are directly disposed at final disposal sites without prior sorting

efforts. To address these issues, the technocreativity model is utilized as a problem-solving approach in managing wastes through integrating technology with environmental awareness to enhance students' critical thinking abilities and creativity related to environmental issues.

This research has both theoretical and practical implications for the technocreativity learning model based on environmental volunteer for waste management, particularly in campus surroundings that is easily accessible. Theoretically, this research supports the theory that an individual's experience and active participation can enhance their skills and expertise (Wibowo et al., 2023). The practical benefit of this research aimed to reduce the negative impacts of waste on campus areas, particularly in the faculty canteens. This research also encourages students, particularly environmental volunteers, to care about waste for a clean and healthy campus, as well as fostering an entrepreneurship mindset among students. Based on the background of the identified problems, the objectives of this study are the following: (1) to develop the technocreativity learning model based on environmental volunteers for waste management to support Green Campus and Green entrepreneurship for students; (2) to evaluate the effectiveness of the technocreativity learning model based on environmental volunteers to support Green Campus and Green entrepreneurship for students.

2. Materials and methods

2.1 Research location

The research was conducted on Universitas Negeri Malang area on Jalan Semarang 5, Malang, Indonesia. The learning activities conducted in plant nurseries areas, campus green open spaces, campus parks, and the compost processing facility, all of which are still located on the Universitas Negeri Malang areas.

2.2 Research design

This research is conducted using the Research and Development (R&D) method and the ADDIE model (analysis, design, development, implementation, and evaluation) (Sugiyono, 2010). The ADDIE development model was chosen because it is a systematic model that is consistent with the theoretical foundation of the learning design. The ADDIE development research technique is carried out in a systematic method based on the development stages. The development research procedure is shown in Figure 1.

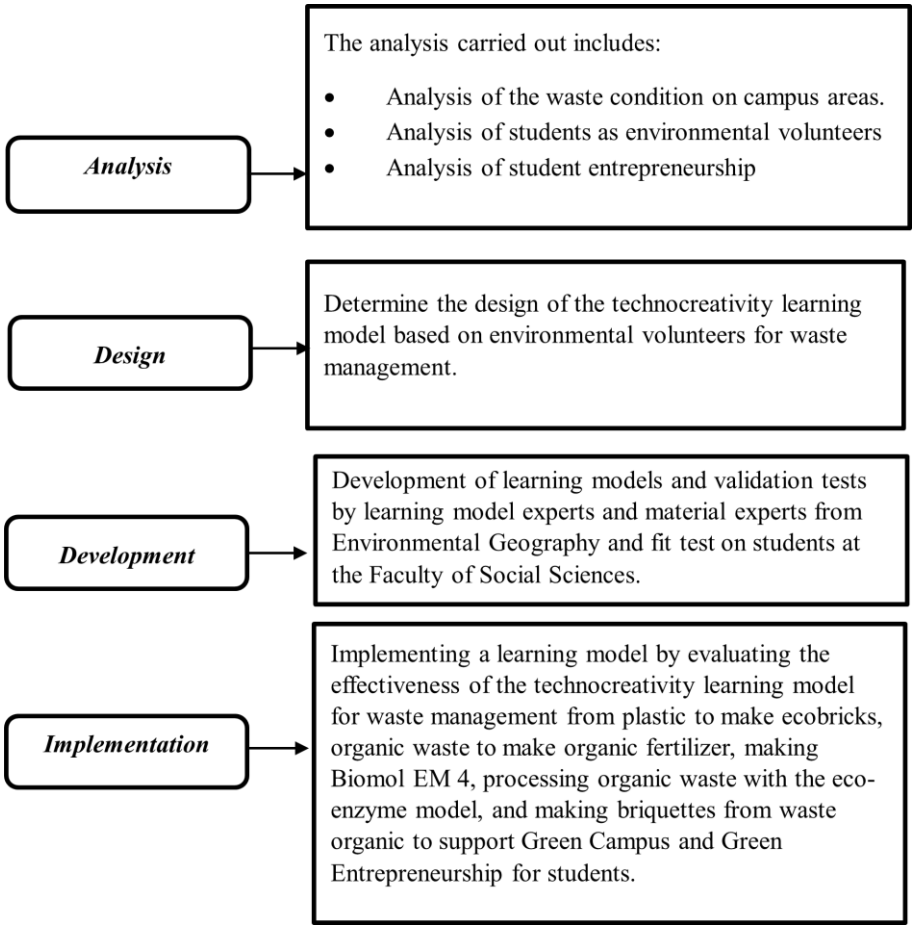

Figure 1. The stages in Research and Development (R&D)

2.3 Data collecting technique

Data collecting methods include questionnaires, observation, and documenting of environmental volunteer implementation. Waste management activities developed with technocreativity are divided into four groups: group 1 processes plastic waste using the ecobricks model; group 2 processes organic waste; group 3 processes organic waste using the eco-enzyme model; and group 4 processes organic waste using the briquette model. Each group is responsible for

processing sorted waste into economical products. The plastic recycling group is responsible for separating and preparing plastic waste as raw materials, which are then processed using ecobricks. The organic waste recycling group is responsible for sorting and preparing processed materials in the form of organic waste that can be converted into fertilizers, eco-enzymes, and briquettes. All groups have the duty and responsibility to educate other students and the general public about technocreativity in waste management by providing training and publication.

The data collected is quantitative and is calculated monthly to see: (1) how many waste volunteers are actively participating, (2) how many kilograms of plastic waste have been collected, (3) how many kilograms of fertilizer can be produced, (4) how many works can be produced from plastic waste, and (5) how many profits can be earned from waste management sales. The validation results of the learning model are carried out by experts and the fit test for the technocreativity learning model based on environmental volunteers are measured using test scores and the results of recycled waste products.

Furthermore, qualitative data were gathered through interviews regarding the level of satisfaction felt by environmental volunteers, the challenges faced in waste management, and the efforts made to ensure that Green Entrepreneurship and waste management by environmental volunteers on campus can be sustained.

2.4 Data Analysis

Data analysis was carried out in two methods, quantitative data analysis with tabulation analysis, percentages, illustrating in graphical form and the results of processing the data were discussed further from the results of observations.

The learning model was validated by experts and tested using Classroom Action Research on Environmental Volunteers to measure its effectiveness. The evaluation was conducted using test scores and surveys. The validation result is shown in the following Table 1.

3. Results and discussion

3.1 Developing the technocreativity learning model based on environmental volunteers for waste management to support Green Campus and Green Entrepreneurship for students

The study discussed the technocreativity learning model, which involves outdoor learning using technology and student participation in waste management

No	Aspects	Validator 1	Validator 2
1	Reasons for developing the Technocreativity Model	4	3
2	The purpose of developing the Technocreativity Model	4	4
3	Description of the Technocreativity Model	4	4
4	Steps of the Technocreativity Model	3	4
5	The suitability of the steps in the Technocreativity Model	3	3
6	The compatibility between the learning objectives and the subject topic	4	4
7	Effectiveness of evaluation	3	4
8	Completion of learning objectives.	3	3
TOTAL		28	29

Table 1. Experts' validation results for the Technocreativity Learning Model based on environmental volunteers

activities around the Universitas Negeri Malang campus areas. The model includes various waste management techniques such as eco-enzymes, ecobricks, briquettes, biomol, and compost production. It has been shown to positively impact students' attitudes towards environmental sustainability (Lestari et al., 2021). The method starts with educating students about waste management's importance and aims to instill a sense of responsibility for waste produced. This approach enhances student behavior identification by building fundamental knowledge onwaste management (Molina & Catan, 2021). The initial activity is shown in Figure 2.

Figure 2. Giving instruction to students at the beginning of the learning

Furthermore, students will apply waste management theory through practical exercises. This practice allows students to apply knowledge gained from educational activities and gain a deeper understanding of the implementation of accurate waste management, fostering environmental awareness (Shutaleva et al., 2020). In one activity, students create eco-enzymes by collecting organic waste from faculty canteens such as fruit and vegetable scraps. The goal is to reduce campus waste while producing eco-friendly materials. Students then prepare the necessary materials for creating eco-enzymes including scissors, jerry cans, water, and dissolved brown sugar.

Ecoenzym is a fermentation produced from organic waste (Benny et al., 2023). Ecoenzym is an environmentally friendly product composed of a mixture of natural enzymes, bacteria, and other substances that effectively decompose different forms of trash and organic materials (Istanti & Utami, 2022). Research has found that the utilization of ecoenzymes is effective in cleaning a wide range of surfaces, including as houses, bathrooms, kitchens, and even liquid waste (Suwarsono et al., 2023). Eco-enzymes function by decomposing organic waste into simpler substances, such as water and carbon dioxide, through the utilization of enzymes and microbes contained in their composition. This feature enhances its efficacy in eliminating stains, smells, and other contaminants, without needing for chemicals that might be hazardous.

After preparing the necessary tools and materials, the first step is to cut all the organic waste into smaller pieces. Next, all of the waste is placed in a half-full garbage can with water and given a 500-ml solution of brown sugar. Lastly, these cans can be sealed and reopened after three months. The university uses the eco-enzymes produced by the technocreativity model as room cleaners. The Production of eco-enzyme in shown in Figure 3.

The next learning activity in the technocreativity model is biomolecule synthesis (biomol). Similarly, the main components of organic waste are required for the production of eco-enzymes, biomol, or natural EM4, which are used to accelerate waste decomposition. Biomol is a product obtained through the fermentation of organic waste from vegetables and fruit. Biomol is produced by placing crushed or sliced vegetables and fruits into a container for fermentation. Optimizing the process of biomolecular fermentation by utilizing rice bran and inexpensive liquid sugar. The organic liquid fertilizer can be derived from the fermentation process, which typically lasts for about one month. The advantage of utilizing biomol is to enrich the soil with nutrients. Biomol consists of microorganisms that help the decomposition of organic waste and function as a biological controller. Biomol offers advantages as an organic pesticide. Prior

study has revealed that the utilization of biomol positively impacts the growth of sweet potato plants (Shaji et al., 2021). The use of biomol as a liquid organic fertilizer has an impact on the growth of corn plants. In addition, the utilization of Biomol liquid in the production of compost fertilizer might enhance the rate of decomposition of organic waste.

Figure 3. Eco-enzyme production from organic waste.

Furthermore, biomol is also known as natural EM4. Effective Microorganisms (EM4) is a fermented extract of microorganisms and organic waste that promotes plant growth. The use of Effective Microorganisms will accelerate the process of fermenting organic materials, hence enabling the absorption of nutrients for plant growth (Fuadi et al., 2022). These findings align with earlier studies indicating that Effective Microorganisms are utilized as components to accelerate the fermentation process in compost production (Puspitasari et al., 2022). In addition, research has shown that combining organic resources such as compost with Effective Microorganisms (EM4) can effectively enhance agricultural productivity (Siswati et al., 2009).

Therefore, at the beginning of making the biomol, students must search the canteens for organic waste in the form of vegetable and fruit waste. After organic waste has been collected, it is chopped and combined with rice bran and melted brown sugar to accelerate fermentation; the mixture is then sealed within one

month in jerry cans. The results of the biomol fermentation processes will be used as an activator for composting decomposition, allowing for the production of compost much more quickly. The process of producing and packing eco-enzymes can be seen in Figure 4.

Figure 4. a) producing biomol, b) packing eco-enzym, c) presenting in school exhibition.

Figure 3 demonstrated the production of biomol and eco-enzymes that carried out by students in the environmental volunteer group, along with lecturers and administrative staff. The purpose is to raise awareness about environmental responsibility within the academic community on campus. Different sizes of bottles contain eco-enzymes for various purposes such as room fresheners, floor cleansers, bathroom cleaners, and accelerating organic waste fermentation. These are limited to use within the campus area.

After the production of biomol, there was a learning activity focused on composting leaf waste. Compost made from leaf litter around the campus area can be used to fertilize plants and reduce waste. Composting is a simple process that does not require much effort. Students collected leaf debris for about a month before starting composting activities, which included two types of examinations. Compost management has environmental benefits by reducing the need for toxic fertilizers and decreasing waste production by adding organic liquids such as EM4 and biomol.

Composting leaf waste also helps raise public awareness about waste management and fosters environmental consciousness. Similar innovations are expected to continue in other universities, especially in Indonesia. The conversion of campus-area leaf waste into useful compost serves as an example of how organic materials can be processed effectively for plant fertilization without relying on expensive commercial products. The processing of organic waste materials can be seen in the following Figure 5.

Figure 5. a) decomposition of leaf waste with a grinding machine, b) refined organic waste, and c) compost fermentation boxes to accelerate decomposition

Organic fertilizer is a nutrient source for plants derived from organic substances, including plant wastes, animal feces and other organic components (Shaji et al., 2021). Organic fertilizer is created via a process of natural decomposition facilitated by microorganisms like bacteria and earthworms. These microorganisms turn the fertilizer into nutrients that can be readily absorbed up by plants (Roidah, 2013; Sayara et al., 2020). Prior study has revealed that organic fertilizer plays a significant role in environmental conservation by utilizing organic waste as a fundamental component for its production (Bahri et al., 2022). An important benefit of organic fertilizer is its ability to enhance soil structure and promote soil microbial activity, leading to improved soil fertility (Zhou et al., 2022). In addition, organic fertilizer has the capability to reduce soil erosion, enhance water retention, and minimize use on chemical fertilizers that can have negative impacts on the environment (Assefa, 2019). Further, the processing of organic waste into ready-to-use compost can be seen in Figure 6.

Figure 6. a) sorting organic waste materials, b) separating organic waste materials, c) Harvesting compost, d) Packing compost.

Figure 5 showed the first stage in processing basic organic waste materials, which involves the separation of organic and non-organic materials to enhance the effectiveness of the fermentation process. Then, the materials that have been stored in the trash container are regularly rotated on a set schedule of every 3 days. Afterwards, the compost is collected and put in plastic containers weighing either 5 kg or 10 kg, to be distributed to the academic community.

Leaf litter was quickly incorporated into a soil excavation, resulting in coarse compost after one month. In the second experiment, the collected leaf waste was ground with a machine and treated with a solution of EM4 or biomol from previous fermentation. The modified storage box accelerated decomposition, producing quicker and more uniform compost used as organic fertilizer for campus plants. This approach also supports recycling efforts and reduces the need to purchase additional compost for campus surroundings.

Figure 7. a) Applying fertilizer to sweet potatoes (Ipomoea batatas L), b) fertilizing herbal plants.

Figure 7 demonstrated the use of compost for food and herbal plants on campus, aiming to reduce operational expenses. The selection is limited to prolific plants that can be immediately used by the academic community, aligning with the objective of managing the campus as a green environment with zero waste indicators. Waste management strategies should be implemented for effective utilization and recycling of campus waste.

The next learning activity is ecobrick construction. Created from plastic trash, ecobricks are a creative way to recycle waste materials (Widiyasari et al., 2021). To minimize plastic waste, one can utilize ecobricks as a means of recycling plastic trash (Antico et al., 2017; Mihai et al., 2021). The process of creating

ecobricks is recognized as an environmentally friendly practice and serves as an effective way for reducing the accumulation of plastic trash (Siregar & Fitri, 2021). Prior studies have discovered that ecobricks have the potential to serve as construction materials, specifically for furniture in gardens and rooms (Akbar et al., 2023; Antico et al., 2017). Ecobricks, which are produced from recyclable plastic waste, are considered durable due to their resistance to decomposition (Cai et al., 2023). In addition, the making of artwork using ecobricks is also attractive to both local and international tourists (Adyantari, 2022). Similar with research findings, the utilization of ecobricks has been shown to enhance revenues in the tourism industry (Ariyani et al., 2021; Kiswantono et al., 2019).

Students collect plastic waste from canteens, cut it into pieces, and arrange it in a specific pattern to create ecobricks. This process shows that student involvement as environmental volunteers can reduce waste and enhance the campus environment (Sunassee et al., 2021). The production of ecobricks is shown in Figure 8.

Figure 8. The production of ecobricks from plastic waste.

The final step in the technocreativity learning model involves producing biobriquettes, which are natural charcoal made from organic byproducts like sawdust, coconut shell powder, and leaf waste compost. Briquettes are formed by compressing powdered or small fragments of organic or inorganic substances

to create a solid fuel (Kumar et al., 2021). They can be used as an alternative to wood or coal for industry and household use (MS et al., 2020), serving as an eco-friendly energy source with benefits including efficient combustion, practical transportation and storage, and the ability to be recycled from organic waste or biomass. The process includes crushing the collected waste into smaller pieces for processing with other materials before being combined with a binding agent (Haryanti et al., 2021; Marreiro et al., 2021), consisting of ash powder left over from burning, sawdust and coconut shells (Handayani et al., 2023). This mixture is then compressed using a press machine and dried using methods such as sunlight or dryers before they can be used as an alternative fuel for cooking or heating. The process of producing briquette is shown in Figure 9.

Figure 9. A) Processing organic waste, B) printing briquette, C) making sun-dried briquettes, D) packing briquette.

Figure 9 showed the method of producing briquettes from organic waste. The process begins with the collection and processing of organic waste, followed by

turning it into certain shapes and sizes through printing. Following the printing process, the briquettes get sun drying to decrease their moisture content. The briquettes are dried for around 5-7 days before being packaged in plastic and labeled with the brand.

The technocreativity model involves students as environmental volunteers to manage waste within the campus environment, inspiring creative and critical student thinking (Alm et al., 2022; Chusni et al., 2021). This can also lead to increased entrepreneurship skills for commercializing the results of waste management on campus (Owojori et al., 2022). Cooperation and commitment between students, professors, and the campus are essential for sustainable waste management with a broader impact.

3.2 Evaluating the technocreativity learning model based on environmental volunteers for waste management to support Green Campus and Green Entrepreneurship for students

The evaluation demonstrated that the technocreative learning model based on environmental volunteers, effectively enhances students' understanding and experience in waste management. This learning model fosters the development of students' critical and creative thinking skills to address waste problems by generating innovative solutions. This is evident from the activities in which students participate, including the production of compost, waste banks, and creative waste products. The results of student activities implementing the technocreativity learning model for one month are presented in Table 2.

No.	Activities	Unit	Total
1	Total quantity of active environmental volunteers	Person	35
2	Quantity of plastic waste collected	Kg	225
3	The quantity of fertilizer that can be produced	Kg	350
4	Plastic waste can be transformed into a material called Ecobrick	Pieces	24
5	Profit generated from the sale of organic waste management products	Rupiah	750
6	Quantity of Biomol that can be produced	Liter	30
7	The quantity of Eco-enzyme that can be produced	Liter	20
8	Quantity of briquettes that can be made from waste	Kg	50

Table 2. Student activities in implementing the Technocreativity Learning Model for one month

The number of students that participate in environmental volunteer organizations is an essential indicator for assessing their level of awareness and involvement in environmental conservation. This also demonstrates the

effectiveness programs aimed at fostering environmental awareness among students. The results of student participation in volunteer groups in shown in Table 3.

N.	Name of environmental volunteer group	Students	Percentage
1	The Ministry of Environment from Student Executive Board of Universitas Negeri Malang	2	4%
2	The Environmental Conservation Division from Faculty of Social Sciences Student Executive Board	10	20%
3	The Student Activity Unit "Bhumi"	9	18%
4	The Student Activity Unit "MPA Jonggring Salaka"	4	8%
5	The Environmental Division of Geography Department Student Association	8	16%
6	Graduate student environmental volunteers from the Faculty of Social Sciences	7	14%
7	Don't join the group	10	20%
TOTAL		50	100%

Table 3. Percentage of students in environmental volunteer groups

According to the table above, 80% of the 50 respondents analyzed were members of the environmental volunteers at Universitas Negeri Malang, while just 20% were not.

N.	Name of environmental volunteer group	Join period (in months)	Percentage
1	The Ministry of Environment from Student Executive Board of Universitas Negeri Malang	12	17%
2	The Environmental Conservation Division from Faculty of Social Sciences Student Executive Board	4	6%
3	The Student Activity Unit "Bhumi"	10	14%
4	The Student Activity Unit "MPA Jonggring Salaka"	24	34%
5	The Environmental Division of Geography Department Student Association	18	26%
6	Graduate student environmental volunteers from the Faculty of Social Sciences	2	3%
TOTAL		70	100%

Table 4. Join time of students in environmental volunteer groups

Based on the average duration of environmental volunteers have been a part of the group, the MPA Jonggring Salaka unit has the longest, at 24 months, while the Postgraduate Environmental Volunteer Group has the shortest, at 2 months. The following Table 5 showed the average comparison of the duration volunteers joined the environmental volunteer group.

N.	Name of environmental volunteer group	Amount
1	The Ministry of Environment from Student Executive Board of Universitas Negeri Malang	60
2	The Environmental Conservation Division from Faculty of Social Sciences Student Executive Board	62
3	The Student Activity Unit "Bhumi"	89
4	The Student Activity Unit "MPA Jonggring Salaka"	58
5	The Environmental Division of Geography Department Student Association	66
6	Graduate student environmental volunteers from the Faculty of Social Sciences	80
7	Don't join the group	56
TOTAL		67

Table 5. Average score of student awareness for campus environmental conditions

According to the results of the data analysis presented in the table above, the average score of student awareness for the condition of the campus environment is highest among UKM Bhumi members, with an average score of 89, and lowest in students who did not join to any environmental volunteer group. The following Table 6 demonstrated the average level of student awareness for the condition of the campus environment.

N.	Name of environmental volunteer group	Amount	Percentage
1	The Ministry of Environment from Student Executive Board of Universitas Negeri Malang	Rp 100.000	12%
2	The Environmental Conservation Division from Faculty of Social Sciences Student Executive Board	Rp 150.000	18%
3	The Student Activity Unit "Bhumi"	Rp 350.000	41%
4	The Student Activity Unit "MPA Jonggring Salaka"	Rp 150.000	18%
5	The Environmental Division of Geography Department Student Association	Rp 100.000	12%
6	Graduate student environmental volunteers from the Faculty of Social Sciences	Rp 0	0%
7	Don't join the group	Rp 0	0%
Total		Rp850.000	100%

Table 6. Sales value of waste management results on the campus

The Bhumi UKM group had the highest sales value for the results of waste management on the Universitas Negeri Malang performed by environmental volunteer students, followed by the Postgraduate environmental volunteer group and students who did not join.

Table 7 presented the results of evaluating students' attitudes towards waste management in implementing the Technocreativity Learning Model, based on environmental volunteers. The table provided a detailed illustration of the shifts in students' attitudes about the issue of waste throughout two implementation cycles of the learning model. This table served as a crucial tool for assessing the effectiveness and effect of the learning model used to enhance environmental awareness among students. It included attitude categorized into specific score ranges and measures the percentage changes in attitudes between the first and second cycles.

N.	Score	Qualification	Cycle I	Percentage	Cycle II	Percentage
1	91-100	Very High	0	0 %	9	25,7 %
2	81-90	High	0	0 %	16	45,7 %
3	71-80	Moderate	9	25,7 %	10	28,6 %
4	61-70	Low	8	22,9 %	0	0
5	< 60	Very Low	18	51,4 %	0	0
Total			**35**	**100 %**	**35**	**100 %**

Table 7. Evaluation results of students' environmental awareness towards waste in implementing the Technocreativity Learning Model based on environmental volunteers.

The results of evaluating student entrepreneurship in implementing the Technocreativity Learning Model based on environmental volunteers are presented in Table8. The table provided a detailed overview of the development of students' entrepreneurial characteristics during the two cycles of implementing the learning model. This table is a crucial tool for assessing the effectiveness of the Technocreativity Learning Model in fostering entrepreneurial skills among students. It included qualifying scores that measure the level of entrepreneurship and percentage changes between the first and second cycles.

Based on the description and assessment of the data in the table above, it can be concluded that student's awareness and participation in Green Campus activities increase the longer they are a member of the Environmental Volunteer group. And the longer a student has been a member of the Environmental Volunteers, the more likely it is to become a Green Entrepreneur in waste management.

N.	Score	Qualification	Cycle I	Percentage	Cycle II	Percentage
1	91-100	Very High	0	0 %	7	20 %
2	81-90	High	0	0 %	14	40 %
3	71-80	Moderate	10	28,6 %	11	31,4 %
4	61-70	Low	13	37,1 %	3	8,6 %
5	< 60	Very Low	12	34,3 %	0	0 %
Total			**35**	**100 %**	**35**	**100 %**

Table 8. Evaluation results of students' entrepreneurship in implementing the Technocreativity Learning Model based on environmental volunteers.

The sale of organic fertilizers can be considered an example of eco-friendly entrepreneurship because they can be used to solve environmental issues. This is in line with the positive impact of waste processing, which waste utilization and management has a positive impact on environmental resilience and economic health. The application of green entrepreneurship in the campus environment requires university support, as this will increase the intentions and role of students in green entrepreneurship implementation (Qazi et al., 2021).

Thus, waste management activities based on intensive environmental volunteers can be a suitable method of creative economy for enhancing student creativity and increasing their economic income (Istanabi et al., 2022). Student understanding of environmental issues contributes to ecological problems, particularly in waste management. The majority of students have a positive attitude and are aware of environmental issues in their environment, but due to a lack of practical education from educational activities that assist students in waste management, they also contribute to environmental problems. Therefore, a policy is required to incorporate environmental education into both academic and extracurricular activities (Debrah et al., 2021).

Environmental education is the involvement of students as environmental volunteers through the waste care movement (Boca & Saraçlı, 2019). In environmental education, universities should encourage their students to create actions and maintain their own internal environment, as this environment is a location of learning and students spend the majority of their time on campus (Aleixo et al., 2021). Environmental education can educate students to become future activists and prepare them for a sustainable environment. This is in line with the fact that environmental education can positively affect the perceptions, behavior, and commitment of pro-environmental students, thereby supporting the Sustainability Development Goals (SDGs) on campus (Yu et al., 2019).

Making strategic plans for the waste care movement on campus with the whole participation of the university community is essential for saving energy through recycle, reuse, and composting operations. Thus, these environmentally responsible activities can reduce waste production, thereby accelerating the implementation of sustainable environmental strategies (Ugwu et al., 2020).

4. Conclusion

The results of developing the technocreativity learning model for waste management based on environmental volunteers to support Green Campus and Green entrepreneurship for students are in the beginning of the learning stages. These stages consist of an initial briefing for students, waste collection, waste sorting, waste processing according to the purpose of manufacture (biomol, eco-enzyme, ecobric, organic fertilizer, briquettes), waste gathering, and waste profits.

The longer a student has been a member of the environmental volunteer group, the greater their awareness and involvement in Green Campus activities. In addition, the longer a student has been a member of the environmental volunteer organization, the more qualified they are to become a Green Entrepreneur in campus waste management.

This study offers suggestions in promoting environmental volunteer groups' participation in order to promote and invite students to care about the green campus movement. Conducting education and training to develop students' green entrepreneurship abilities. Collaboration with external parties to construct infrastructure as part of green campus activities. Further research will involve monitoring and evaluating the development and implementation of the technocreativity learning model based on environmental volunteer.

5. Limitation

The limitations of this study include its early stage of the development of the technocreativity learning model, which might hinder the comprehensive assessment of its long-term effectiveness. Although it shows a positive correlation between longer membership in environmental volunteer groups and increased interest in Green Campus activities and Green Entrepreneurship, its contextual focus on Indonesia may limit generalizability to other regions with different dynamics. Furthermore, it does not provide an extensive review of the fundamental processes. Moreover, there can be a lack of funding for the suggested partnership with outside parties to build the infrastructure needed for

green campus activities. These limitations provide important information for future research and projects in the fields of waste management and environmental education.

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Authors

Sumarmi (*corresponding author*) sumarmi.fis@um.ac.id 0000-0002-3102-0376
Department of Geography, Universitas Negeri Malang, Indonesia.

Alfyananda Kurnia Putra alfyananda.fis@um.ac.id 0000-0003-2016-4144
Department of Geography, Universitas Negeri Malang, Indonesia.

Tuti Mutia tuti.mutia.fis@um.ac.id 0000-0001-6589-914X
Department of Geography, Universitas Negeri Malang, Indonesia.

Alfi Sahrina alfi.sahrina.fis@um.ac.id 0000-0001-9204-4956
Department of Geography, Universitas Negeri Malang, Indonesia.

Sharina Osman sharina@unikl.edu.my 0000-0001-8220-2439
Universiti Kuala Lumpur Malaysia, Malaysia.

Adellia Wardatus Sholeha adellia.wardatus.2107218@students.um.ac.id 0000-0001-9545-4600
Department of Geography, Universitas Negeri Malang, Indonesia.

Novika Adi Wibowo novika.adi.2107219@students.um.ac.id 0009-0007-8238-8473
Department of Geography, Universitas Negeri Malang, Indonesia.

Tasya Khairunisa tasya.khairunisa.1907216@students.um.ac.id 0009-0001-1452-5591
Department of Geography, Universitas Negeri Malang, Indonesia.

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