

Waste Separation Behavior Among University Students

Fayren Chaerunnissa^{1*}, Sheyrin Putri¹, Lailatul Nursakinah¹, Fikri Arjuna¹,
Ratna Djuwita²

¹Faculty of Psychology, Universitas Indonesia, Depok, Indonesia

²Department of Social Psychology, Faculty of Psychology, Universitas Indonesia, Depok, Indonesia

*Corresponding author, Email: fayren.chaerunnissa71@ui.ac.id

ABSTRACT

This study investigated methods to increase waste separation behavior among undergraduate students at the University of Indonesia. An experiment was conducted to determine whether participants kept their waste materials until being able to dispose the waste into the correct waste bin category or if they littered instead. Participants were divided into two rooms: one with waste bins in the room, and the other with bins outside of room. Participants created artwork by finger painting and were given wet tissue and a snack, which became their waste to dispose. The variables analyzed were waste separation behavior in two conditions: a room with a waste bin and a room without a bin. An independent sample *t* test was used to calculate the results from both groups. Most participants demonstrated waste separation behavior but did not correctly separate their waste into its respective categories. These results suggest that waste separation is not determined by the presence of waste bins, but it is influenced by the waste holder's perceived value of this action.

Keywords: waste facilities, students, perceived value, waste separation behavior.

1. INTRODUCTION

The issue of proper waste management in Indonesia is not just a government concern; rather, it is a shared responsibility that includes all citizens and households, some of whom may lack awareness of public waste management. As a result, an urgent need for community-driven solutions exists, such as an accessible and cost-effective infrastructure to solve Indonesian's waste management problems. In line with the nation's goals, the University of Indonesia published its vision to be a "green campus" and issued the Green Campus Policy in 2010 ("Program pengurangan limbah sampah", n.d.) to contribute towards a sustainable future through education and research, by

being aware of social, economic, and environmental impacts, and by taking sustainability into account for all decision-making.

One of the factors targeted to reach that goal is to reduce littering behavior by increasing the presence of bins for waste, also termed "garbage" herein, that are separated based on respective waste categories. The placement of these bins may increase the possibility of appropriate waste separation behavior versus disposal disregarding the waste category.

Waste separation behavior describes the choice of waste disposal when the waste is separated based on its type and categories, such as paper, plastic, and

general waste (Árnadóttir et al., 2019). Waste separation is very important for the environment because it is proven to reduce the production of greenhouse gases (Árnadóttir et al., 2019).

The increasing presence of waste bins includes those in which a single bin contains different sections separated by waste categories, such as those that were recently installed at the Department of Psychology at the University of Indonesia. The single waste bins exhibit different receptacles classified into 3 categories: *organic waste*, *inorganic waste*, and *other waste*. This installation of 3-section waste bins shows that the increasing presence of bins with proper waste separation categories may lead to the increase of waste separation behavior as well, instead of meeting the minimum threshold of proper waste disposal that disregards the types of waste.

In terms of attitudes towards waste separation behavior among university students, studies found the following student characteristics: they exhibit little knowledge of waste separation behavior; they exhibit a high intention to separate their waste; they are positive about waste separation in general; and they believe that they demonstrate the ability to separate their waste correctly (Árnadóttir et al., 2019). However, these characteristics do not mean that the waste is properly separated, based on the findings that just more than 50% of the waste was correctly separated based on its categories. Therefore, the underlying determinants of waste separation behavior are crucial to study in more depth to discover the relation between underlying psychological factors and external behavior in the form of waste separation.

Environmental psychology research has not often specifically addressed waste separating behavior; instead, these studies placed more emphasis on littering and proper waste disposal without investigation of separating the types of waste. However, waste separation is a crucial step in simplifying the process of recycling waste, and it is important because recycling improves the conditions of the environment. Because of this relationship, interest in the process of recycling became more important for individuals as well as among governments. Despite this interest, compliance with all of the steps of the recycling process, including waste separation behavior, is still low (McCarty & Shrum, 1994).

The purpose of this current study is to determine whether the presence of waste facilities demonstrate an impact on the prevalence of littering behavior within a university setting. The hypothesis is that university students exhibit a positive attitude towards waste separation behavior, based on the conclusions from previous research. The second hypothesis is that waste separation behavior is more prevalent in conditions in which the waste bins are present in the room of the individual who has waste to dispose compared with conditions in which the waste bins are absent from the room or placed at a location that is more difficult to reach.

1.1. Waste Separation Behavior

In line with the efforts to decrease the amount of waste produced through recycling, waste separation behavior became increasingly important to address as a waste management problem today. Different regions present different regulations regarding waste management

and recycling waste, including waste separation; however, much of the waste ultimately dumped in the landfills provided could actually have been recycled.

In Indonesia, the 3 main types of waste are already widely known: *organic*, *inorganic*, and *hazardous and poisonous waste*, also called “B3” for the Indonesian term, *Bahan Berbahaya dan Beracun* (Jakarta Smart City, 2019). These 3 categories may be considered insufficient because other countries use many additional categories to discriminate the waste. For example, the population in Kakimatsu, Shikoku, Japan, is already familiar with up to 44 waste categories (Lane, 2014). Their waste is sorted as burnable (red bags), non-burnable (blue bags), paper, plastic, PET (polyethylene terephthalate) bottles, and many other categories. Another example is from Germany, where the waste also is required to be separated into several categories (Margarita, 2018). Thus, different countries present different regulations about waste management depending on the conditions of the country.

1.1.1. Facilities

Waste facilities are one of the possible factors that can predict littering behavior. Several studies reported that the availability of waste bins can affect the behavior of the “litterbug”—a term for an individual who litters (Asmui, Wahid, Zaki, Mokhtar, & Harith, 2019; Ong & Sovacool, 2012). This finding suggests that predicting waste separation behavior is possible because the rate of waste separation depends on the availability of waste facilities. Next, the condition of the waste facilities can also predict littering

behavior. Recent studies show that the lowest rate of littering occurs when a waste receptacle is available and close to the location of the waste holder, fewer than 20 feet away (Schultz, Bator, Large, Bruni, & Tabanico, 2013).

A country that is known to exhibit excellent waste bin facilities is Singapore, where many waste bins are located in public places across the country and are in view for pedestrians to be able to spot them easily and appropriately dispose of their waste. In Singapore, the Ministry of the Environment and Water Resources (MEWR) is charged with carrying out the task of keeping the country clean. They maintain the cleanliness of the environment of public spaces and work with many agencies, such as the National Environment Agency (NEA), to clean public roads and sidewalks, as well as open areas and other public spaces (Ong & Sovacool, 2012). Next, they also empty the waste bins along the streets and bus stops daily to enable pedestrians to dispose of their waste without spilling over. This focus shows that Singapore’s waste management facilities are very effective to maintain cleanliness overall.

1.1.2. Perceived Value

The term *environmental cue* describes a stimulus that can trigger the normative behavior expected from the environment (Steg, van Den Berg, & de Groot, 2013). Several case studies proved about the effect of environmental cues on littering behavior and can be used to gain a basic understanding of waste separation behavior (Schultz, Bator, Large, Bruni, & Tabanico, 2013; Cialdini, Reno, & Kallgren, 1990; Ong & Sovacool, 2012). Other studies focused on perceived value

as the result of an individual's perception regarding these environmental cues. For waste separation behavior to occur, the individual undergoes the process of perception about the benefits and costs in order to initiate waste separation behavior (Lee, Choi, & Koo, 2017). If the benefit of waste separation can be experienced, it must be perceived as an easy task. If the cost of waste separation is too much, then it may be perceived as a difficult task, and thus the behavior will not occur (Andrew et al., 2017). This perception also influences the intent of waste separation behavior that would be expressed (Chen et al., 2019)

2. METHODS

2.1. Data Collection and Sampling Characterization

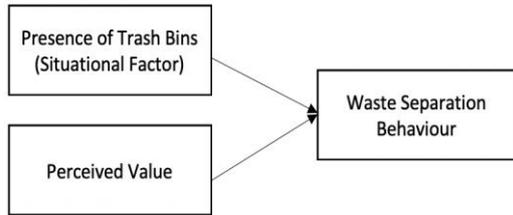
Data were collected using a survey administered at the University of Indonesia in 2019. Samples were taken during 14 consecutive days (excluding Sundays). Through random sampling, the 91 study participants were male and female university students recruited from various departments across the university; they were age 18 years and older and were residing in the Greater Jakarta Area. On the first 2 days, trial sampling for 5 students was performed by administering a preparatory online questionnaire regarding daily views, attitudes, and behaviors related to the environment and its connection with nature. After collecting feedback from these 5 samples, gaps in the questionnaire were identified, and the questionnaire was revised. Additionally, other adjustments regarding research procedures were also made by increasing monitoring of the study participants and

repositioning the placement of waste bins in the experiment rooms.

An observational form was used to measure the variables of the observed behavior of the participants. The process was counting the number of participants who either disposed of their waste in the waste bin or choose to litter in the experiment room. The research team also observed wasting-separation behavior by administering a questionnaire to participants derived from a study by Wulandari (2019) that consisted of 21 questions related to waste separation behavior.

2.2. Analytical Framework

An independent sample t test was performed in which the dependent variable (behavior of waste separation) was measured as self-efficacy and the availability of the waste facilities. The self-efficacy variable was manipulated by the conditions of providing a clean room but not providing a waste bin, whereas the variable of waste facilities availability was manipulated by adding a waste bin to the clean room. This study investigated the effect of self-efficacy and whether the presence of waste bins resulted in littering behavior. Specifically, the study explored and analyzed the variables in which participants would dispose of waste in two different conditions: a room with a waste bin and a room without waste bin, for which the waste bin was instead placed outside of the room.



2.3. Research Procedure

To avoid bias of the participant and bias toward manipulation, this research was promoted to the participants as an activity of knowing their personality by creating art. Participants were asked if they were willing to gain insight to their personality, meaning that they were willing to take part in the research by undertaking art activities that would directly pollute their hands with paint. Then, if so, participants were directed to the experimental room that was manipulated. In the experimental room, participants were given a tissue to clean their hands after the art activity and also given snacks to eat. Next, participants were asked to eat their snacks before proceeding to the next room. After the

participants ate their snacks provided, they were asked to move to the next room and complete questionnaires while the researchers conducted debriefing. To facilitate the study, the researchers used three rooms that were connected and covered with insulation to facilitate the flow of mobilizing the participants. In addition, participants were randomized by dividing them into rooms with odd and even numbered snacks. The distribution is adjusted by the absence number of the subject's presence. Odd and even numbered snacks were applied to the experiment room alternately. After participants completed the steps in the study, the researcher examined the experiment room and waste bins provided to determine the waste disposal and separation behavior of the participants. After this checking was completed, the researcher cleaned the room and recorded the observations on the observation sheet.

3. RESULTS

3.1. Waste Separation

Table 1. Descriptive Statistics and Frequencies of Waste Separation Behavior

Variable	N	M	SD	Frequency	%	Valid Percent	Cumulative Percent
No Bin Room	45	0.98	0.149				
Don't Separated				1	2.2	2.2	2.2
Separated				44	95.7	97.8	100
Total				45	100		
Bin Room	46	0.91	0.285				
Don't Separated				4	8.7	8.7	8.7
Separated				42	91.3	91.3	100
Total				46	100		
Valid N (listwise)	45						
N = Population, M = Mean, SD = Standard Deviation							

Data analysis showed that more students separated their waste in the “No-Bin

room” condition, with 97.8% of participants separating their waste based on types compared with 91.3% of participants in the “Bin room.” These results are contrary to the study hypotheses and previous findings. Fewer students separated their waste despite the existence of a waste bin very close to them in the

room. However, students tended to separate waste when they were placed in a condition that required them to expend more effort by disposing of the waste in a more distant location (**Table 1**).

3.2. Types of Waste Separation

Table 2. Descriptive Statistics and Frequencies of Type of Waste Separation Behavior

Variable	N	M	SD	Frequency	%	Valid Percent	Cumulative Percent
No Bin Room							
Organic	45	0.02	0.149				
Don't Separated				44	97.8	97.8	97.8
Separated				1	2.2	2.2	100
Total				45	100		
Inorganic	45	0.98	0.149				
Don't Separated				1	2.2	2.2	2.2
Separated				44	97.8	97.8	100
Total				45	100		
Valid (N) listwise	45						
Bin Room							
Organic	46	0.71	0.383				
Don't Separated				38	82.6	82.6	82.6
Separated				8	17.4	17.4	100
Total				46	100		
Inorganic	46	0.78	0.417				
Don't Separated				10	21.7	21.7	21.7
Separated				36	78.3	78.3	100
Total				46	100		
Valid (N) listwise	46						
N = Population, M = Mean, SD = Standard Deviation							

Data for the types of waste separation behavior are shown in **Table 2**. In the Bin room, differences were observed in the correct disposal of organic and inorganic waste as follows: for organic waste, 17.4% of was separated according to its corresponding bins, whereas 82.6% was

not disposed in the proper bin; for inorganic waste, 78.3% was separated according to its corresponding bins, whereas 21.7% was not disposed in the proper bin.

In the No-Bin room, for organic waste, only 2.2% of was separated accordingly into its corresponding bins, whereas 97.8%

was not disposed in the proper bin. For inorganic waste, 97.8% was separated accordingly into its corresponding bins, whereas 2.2% was not disposed in the proper bin.

Most students from both rooms dispose of inorganic waste appropriately, but students from the No-Bin room more often disposed of inorganic waste properly than students from Bin room. Students from the

Bin room more often disposed of organic waste properly than students from No-Bin room, though most students in No-Bin room separated their waste. Data related to how the intervention can answer the hypothesis are discussed next.

3.3. Post-Experiment Questionnaire for Bin Room Participants

Table 3. Descriptive Statistics on the Post-Experiment Questionnaire for Bin Room Participants

Items	M	SD
Sorting garbage is good	5,68	0,513
Sorting garbage is just a waste of my time	1,74	1,046
Sorting garbage is not my responsibility	1,58	0,859
Sorting garbage is a beneficial activity	5,58	0,609
Most of the people I consider important think that I should sort out garbage	4,54	1,328
Most of the people I consider important will support me in sorting garbage	4,84	1,095
My friends expect me to sort garbage	4,10	1,418
My family expects me to sort garbage	3,94	1,346
If there are many people sorting out garbage, I will sort out the garbage more often	5,42	0,859
Sorting garbage is easy	5,14	1,088
I know how to sort garbage by its category	5,14	0,926
I know how to dispose of garbage in the bin according to its category	5,16	0,817
I have time to separate my garbage (for example food scraps, plastic, paper and other garbage) by category	4,80	1,030
I have the opportunity to separate garbage by category	4,92	0,986
I know what categories of garbage should be separated from other garbage	4,92	0,778
I usually separate recyclables	4,26	1,275
I am used to sorting out garbage according to its category when disposing it	4,46	1,110
I rarely sort garbage according to its category	2,60	1,178
I intend to sort out my garbage starting next month	4,82	1,101
Every time I throw out garbage, I will sort the garbage correctly according to the category	4,72	0,927
I am really willing to sort out my garbage properly in the next three months	4,72	1,213
M = Mean, SD = Standard Deviation		

Data from the questionnaire administered to Bin room participants after the experiment are shown in **Table 3**. Participants in the Bin room exhibited an awareness of the good behavior of separating waste (mean 5.68). Participants were also aware that separating waste was easy (mean 5.15), and they demonstrated no problem with the time they spent to sort waste (mean [M] = 1.74). Participants were also aware of the benefits of separating waste (5.58) and aware that sorting the waste is part of their responsibility (M = 1.58). Next, participants also separated waste when

disposing it (4.72). Participants knew how to sort waste by category (M = 5.16). However, when the experiment was conducted, their attitude towards separating waste behavior was slightly different from their behavior in the room. Although 91.8% separated their waste, they still did not sort it properly, and even combined 82.6% of the organic waste in the other waste categories.

3.4. Post-Experiment Questionnaire for No-Bin Room Participants

Table 4. Descriptive Statistics on the Post-Experiment Questionnaire for No-Bin Room Participants

Items	M	SD
Sorting garbage is good	5,74	0,492
Sorting garbage is just a waste of my time	1,79	0,742
Sorting garbage is not my responsibility	1,60	0,929
Sorting garbage is a beneficial activity	5,44	0,666
Most of the people I consider important think that I should sort out garbage	4,07	1,438
Most of the people I consider important will support me in sorting garbage	4,70	1,013
My friends expect me to sort garbage	3,72	1,453
My family expects me to sort garbage	3,42	1,516
If there are many people sorting out garbage, I will sort out the garbage more often	5,12	0,851
Sorting garbage is easy	4,67	1,210
I know how to sort garbage by its category	4,81	1,220
I know how to dispose of garbage in the bin according to its category	5,14	0,966
I have time to separate my garbage (for example food scraps, plastic, paper and other garbage) by category	4,67	1,107
I have the opportunity to separate garbage by category	4,74	1,136
I know what categories of garbage should be separated from other garbage	4,88	0,981
I usually separate recyclables	4,19	1,435
I am used to sorting out garbage according to its category when disposing it	4,35	1,412
I rarely sort garbage according to its category	2,98	1,456
I intend to sort out my garbage starting next month	4,40	1,383
Every time I throw out garbage, I will sort the garbage correctly	4,81	1,118

according to the category		
I am really willing to sort out my garbage properly in the next three months	4,77	1,192
M = Mean, SD = Standard Deviation		

Data from the questionnaire administered to No-Bin room participants after the experiment are shown in **Table 4**. The same phenomenon occurred in No-Bin room as in the Bin room. Participants in the No-Bin room demonstrated an awareness of the good behavior of separating waste (M = 5.74). Participants were also aware that separating waste was easy (M= 4.67), and they demonstrated no problem with the time they spent to sort waste (M = 1.79). These results indicate that participants in the No-Bin room found disposing of waste more difficult compared with participants in the Bin room. Participants in the No-Bin room were also aware of the benefits of separating waste (M = 5.44) and aware that sorting out waste is part of their responsibility (M = 1.60). Participants also reported that they separated waste correctly when disposing it (M = 4.72) and that they knew how to sort by category (M = 4.88). However, when the experiment was conducted, their attitude towards separating waste behavior was slightly different from their behavior in the No-Bin room. Even though 91.8% of them

separated their waste, they still do not sort it properly, and they even combined 82.6% of organic waste in other categories.

Based on the differences in response on the questionnaire, participants in the No-Bin room tended to exhibit an average score lower than the Bin room participants. In addition, the same as the Bin room participants, the No-Bin room participants exhibited behavior contrary to their attitudes toward waste disposal behavior. This finding was indicated by 97.8% of organic waste disposed of in the wrong category.

3.5. Independent Sample t Test Results

A t test calculation was performed to determine any differences in waste disposal behavior based on the 2 types of room conditions. Then, to determine the relationship between their behavior for separating waste in the presence of waste separation facilities, the t test score was calculated for the Bin room participants' waste separation behavior. In addition, the t test scores were calculated to determine the tendency to dispose certain of the categories of waste (**Tables 5–7**).

Table 5. Results of the t Test for Waste Separation Behavior

Waste Separation Behavior	Facility	
	t	Sig. (2-tailed)
	20.482	0.044

Note. *p≤.05. **p≤.01. ***p≤.001

The difference in the amount of littering for both groups (Non-Bin vs. Bin) were not significant (t[89] = .044, p > .05).

Frequencies of waste separation was slightly lower for the No-Bin room (M = .98, SD = .149) versus Bin room (M = .91, SD = .285) participants. The eta squared

statistic ($\eta^2 = 0.307$) indicated a large effect size. This finding shows that neither

the presence or absence of waste bins affected the frequency of waste separation.

Table 6. Results of the t Test for Waste Separation Behavior in the Bin Room

Types of Waste Separation	Bin Room	
	t	Sig. (2-tailed)
	-7.289	0.000

Note. * $p \leq .05$. ** $p \leq .01$. *** $p \leq .001$

A significant difference was noted in the frequency of waste separation between organic waste and inorganic waste ($t[90] = .00, p < .05$). More inorganic waste was separated properly ($M = .78, SD =$

.417) compared with the small amount of organic waste that was separated properly ($M = .17, SD = .383$). The eta squared statistic ($\eta^2 = 1.523$) indicated a large effect size.

Table 7. Results of the t Test for Waste Separation Behavior in the No-Bin Room

Types of Waste Separation	Bin Room	
	t	Sig. (2-tailed)
	-30.408	0.000

Note. * $p \leq .05$. ** $p \leq .01$. *** $p \leq .001$

Similar results were also obtained from the participants in the No-Bin room regarding waste separation. A significant difference was observed in the frequency of waste separation between organic and inorganic waste ($t[88] = .00, p < .05$). More inorganic waste was separated properly ($M = .98, SD = .149$) compared with the small amount of organic waste that was separated properly ($M = .02, SD = .149$). The eta squared statistic ($\eta^2 = 5.23$) indicated a medium effect size.

4. DISCUSSION

The purpose of this study was to analyze factors that encourage waste separation behavior among university students at the University of Indonesia, whether the norms or waste disposal facilities that affected students more to

waste their waste. The data shows that 97.8% and 91.3% of participants separate their waste in the No-Bin room and the Bin room, respectively. Both groups show the same high rate of waste separation behavior, so no significant differences of waste separation behavior shown in both groups existed. Therefore, the conclusion exists that the presence or absence of waste separation facilities demonstrate no significant effect differences on waste separation behavior.

This study's result is aligned with several previous studies regarding waste separation behavior in several contexts. Infrastructure exhibits a positive direct impact on waste separation behavior (Ma, et al., 2020). Therefore, the waste disposal facilities provided in Bin room exhibited a positive impact on waste separation behavior. It also could be implied that for

waste separation behaviors to occur, there first must be waste facilities provided.

Subsequently, the questionnaire given to participants shows the participant's positive attitude regarding waste separation behavior. The items that test their perceived value regarding waste separation behavior (e.g., "sorting garbage is good" and "sorting garbage is easy") exhibits a relatively high score from both groups. Thus, these findings show a negative effect that perceived value exhibits on waste separation behavior. These observations are also aligned with results of several studies in several contexts (Ma, et al., 2020), which suggest that the next step to be taken in order for waste separation behavior to occurs is to make sure individuals exhibit a good perceived value regarding waste separation behavior.

Participants in both rooms did separate their waste but did not separate their waste properly into its category. In the Bin room, participants scored an average of 4.92 of 6 for the "I know what categories of garbage should be separated from other garbage" item, and the No-Bin room participants scored 4.88 of 6. Despite claiming that they know how to separate their waste properly, the data show that participants were unable to separate most of the organic waste properly for both groups. Only 2.2% and 17.4% of organic waste was sorted properly in No-Bin room and Bin room, respectively, but 97.8% and 78.3% of inorganic waste was sorted properly in No-Bin room and Bin room, respectively.

These results align with a study conducted by Árnadóttir et al. (2019), which found that students exhibit limited knowledge about waste separation,

demonstrate a high intention to separate waste, are positive about waste separation in general, and believe that they can separate waste correctly. Despite demonstrating a positive attitude towards proper waste separation, most participants were still unaware of the proper way to dispose of the different types of waste.

5. CONCLUSIONS

This study shows that waste disposal facilities and perceived value of waste separation behavior can exhibit an effect on the waste separation behavior among university students. Despite great control to ensure the internal validity of the study results, this study exhibited several limitations. First, only a small proportion of the University of Indonesia student population participated in the study. Thus, the study results are not applicable to the whole population. For future studies, the results would be more applicable if the investigation were performed in various settings across in the university with the appropriate sample size based on the student population.

Second, the study was not performed in a natural setting. The study was performed in a classroom during the breaks between semester and under guise of personality test. In the real-world setting, many factors may influence waste separation behavior. So, the possibility exists that the study results would be different if it is performed in a natural setting such as a cafeteria. For future research, determining the mediating factors that influence waste separation behavior in a broader environment and more complex situation would be of great interest.

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