EFFECTS OF TRASH BOX DESIGN ON SOLID WASTE SEGREGATION BEHAVIOR IN UNIVERSITY OF THE PHILIPPINES DILIMAN

J.V. Marcial, N.R. Tibon* and M.A.N. Tanchuling

University of the Philippines Diliman, Quezon City, Philippines
*E-Mail: norizatibon@gmail.com, TP: +63 9065877268

Abstract Despite the presence of segregation bins, the solid wastes collected by maintenance personnel in UP Diliman are still unsorted. Because of this, this study was conducted to determine if the trash box design will greatly affect the decision of the waste generators to segregate. It also aims to assess the condition of solid waste segregation and to propose improvements on the existing solid waste segregation schemes. This is done by selecting four buildings in UP with different trash bin design, namely, the Melchor Hall, Benitez Hall, Palma Hall Annex, and Alonso Hall. Waste characterization and survey were conducted in the selected buildings and findings show that the segregation is not that efficient with waste characterization results of 64.17% and survey results of 53.15%. Majority of the students responded that they are segregating; however, the waste sorting survey results show that they are confused in classifying the wastes. The reasons for not segregating can be classified into four major factors: time, trash bin design and appearance, environment, and behaviour towards segregation. Majority of the students responded that their decision to segregate is affected by the trash bin design. Respondents preferred multi-colored trash bins with waste classification and pictures as label on the face of the bin. The proposed trash bins have four classifications consistent with the guidelines regarding the solid waste management in UP Diliman. An affirmative instruction was also posted to encourage the waste source to segregate. It is further suggested that a specific color should be fixed for each type of waste for easy identification. However, no matter how colorful or detailed the design is, it will only be effective with strict compliance of its implementation and monitoring. The education of students and staff regarding the classification of wastes should also be taken into account.

Keywords: UP Diliman; segregation; solid waste; swm; waste management

1. Introduction

As stated by Republic Act 9003 also known as the "Ecological Solid Waste Management Act of 2000", segregation refers to a solid waste management practice of separating different materials found in solid waste in order to promote recycling and reuse of resources and to reduce the volume of waste for collection and disposal.

To comply with segregation declared by the act, University of the Philippines Diliman (UP Diliman) released a memorandum in 2009 regarding solid waste management in the university. The memorandum encompasses the guidelines in providing waste receptacles for each building in the campus. In line with the memorandum, Melchor Hall (UP College of Engineering Building) provided separate receptacles with labels for paper, recyclables, biodegradables and disposables as shown in Figure 1. However, complaints were raised by the janitorial personnel that even if segregation bins are provided, collected wastes are still unsorted. Up to present, they are spending at least an hour segregating the wastes in a holding area after collection from bins.
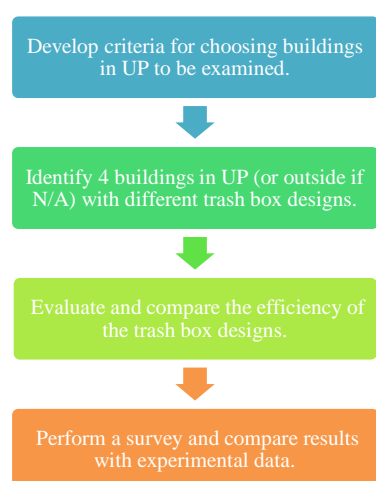
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Fig 1: Melchor Hall's existing trash bin design

2. Objectives

This study targets to determine the effects of trash box design on waste segregation behaviors. In particular, the objectives of this study are: (1) to determine if the trash box design has something to do with the decision of the waste generator to segregate and to identify the most effective trash box design among four different existing designs in the university; (2) to correlate experimental results with survey results; (3) to assess the condition of solid waste segregation in the university; and (4) to propose improvements on the existing solid waste segregation schemes.

3. Methodology

For convenience, existing trash bins in UP Diliman were examined instead of constructing new ones. These trash bins are located at different buildings in the university. The methodology of this study consists of four major steps: (1) the process of choosing buildings (2) solid waste characterization per trash bin, (3) survey, and (4) data processing and analysis.

Develop criteria for choosing buildings in UP to be examined.

Identify 4 buildings in UP (or outside if N/A) with different trash box designs.

Evaluate and compare the efficiency of the trash box designs.

Perform a survey and compare results with experimental data.

Criteria for choosing buildings was first developed to facilitate easier selection and to avoid bias. The criteria are: 1) the number of trash bins per location should be at least three to justify segregation, 2) the trash bins must have appropriate labels, and 3) in case there are two or more buildings with the

same trash box design, the building with the higher population shall be considered.

From this developed criteria, four buildings were selected. These are the (1) College of Engineering (Melchor Hall), (2) Department of Psychology (Palma Hall Annex), (3) College of Education (Benitez Hall), and (4) College of Home Economics (Alonso Hall).

Three elements of the design were inspected: color, type of labels and placement of labels. To determine which set of trash bin color is more effective, the efficiency of the trash bins in Figure 2 with Benitez Hall for color type A and Palma Hall Annex for color type B were compared.
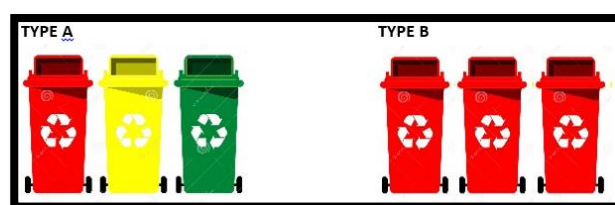
Fig 2: Two Sets of Color Being Compared

To identify which set of labels is more effective, the efficiency of the trash bins in Figure 3 with Melchor Hall for label type A and Alonso Hall for label type B were compared.
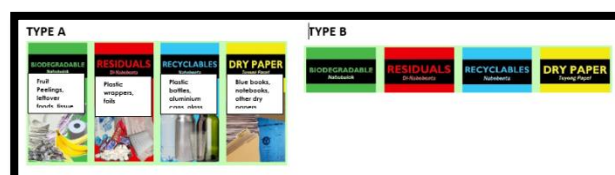
Fig 3: Two Sets of Type of Labels Being Compared

Finally, to determine which placement of design is more effective, the efficiency of the trash bins in Figure 4 with Benitez Hall for placement type A Alonso Hall for placement type B were compared.

Fig 4: Two Sets of Placement of Labels Being Compared

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Survey results regarding the preference for trash bin design were also considered. After the collection of sufficient responses, survey forms were tallied and the data were analyzed.

4. Results and Discussion

4.1 Waste Characterization

Based on solid waste characterization results, the efficiency of segregation was computed. Results show that Benitez Hall has the most efficient solid waste segregation with efficiency of 85.29%. The values for the different buildings play between 50 to 85% with an average of 64.17%. This means that only 64.17% of the solid wastes being thrown to the trash bins are properly segregated in general
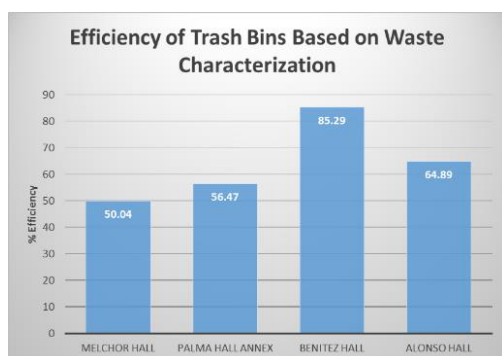

Fig 5: Comparison of Actual Efficiency of Trash Bins Based on Waste Characterization

It is also important to note that Benitez Hall has the least amount of solid wastes collected per set of bins per day as shown in Figure 6. On the contrary, Melchor Hall which has the least efficient trash bins has the heaviest solid wastes per set of bins per day in total.
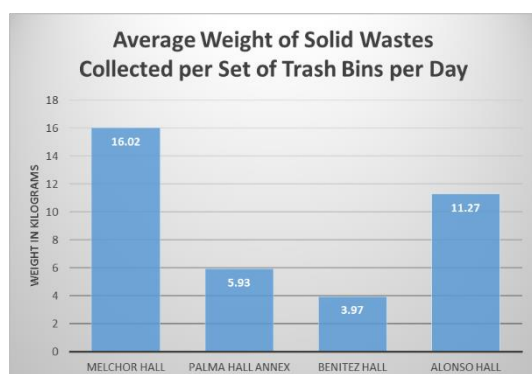

Fig 6: Average Weight of Solid Wastes Collected per Set of Bins per Day

4.1.1 Color

Comparing the efficiency of trash bins, the set of bins with different colors is more effective with a difference of 28.82%. This may be because of the instinct of the waste generator that the variability of colors is an indication that he/she has to segregate wastes

4.1.2 Type of Label

By inspecting the efficiency of the trash bins in Melchor Hall and Alonso Hall, we can see that the trash bins in Alonso Hall with Label Type B has higher value with a difference of 14.85%.

4.1.3 Placement of Labels

The Placement Type B is found out to be more efficient by examining the efficiency of the trash bins in Benitez Hall and Alonso Hall. The difference in the values is 20.4%. This may be attributed to permanence of the label and the closeness of the label to the bin.

4.1.4 Survey Results

Survey results show that majority of the respondents said that they are segregating their wastes. The results are the same for all the four buildings under study with a weighted average of 78%.
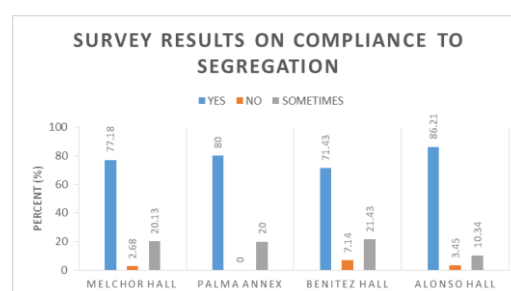

Fig 7: Survey Results on Compliance to Segregation

It is noticeable from the graph in Figure 7 that approximately one of five students said that they are not sorting their wastes all the time. About 3% said that they are not segregating their wastes at all. The responses can be classified into four factors: time, trash box design and appearance,

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environment, and behavior towards segregation.

Majority of the respondents, approximately seven out of ten in this case as shown in Figure 8, are still aware that there is an existing waste segregation scheme being implemented in the university. From this finding, we can say that unawareness is not the major factor for the inefficiency of waste segregation in four of the buildings studied.
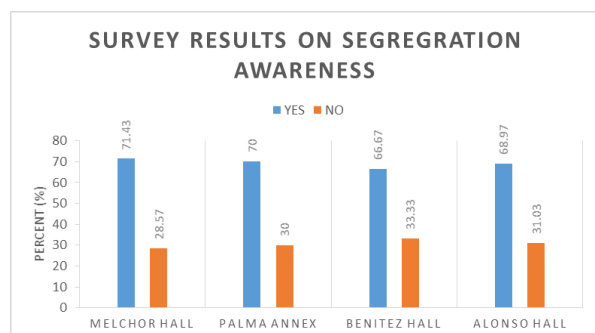

Fig 8: Survey Results on Segregation Awareness

From Figure 9, we can see that approximately three out of four said that trash bin design can influence their decision. Thus, providing trash bins with appropriate designs (color, labels) can be a good investment to start an effective solid waste management in the university.
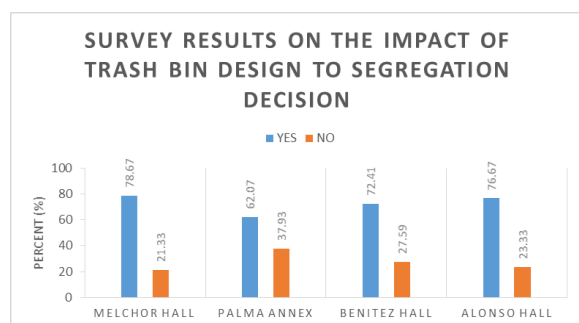

Fig 9: Survey Results on the Impact of Trash Bin Design to Segregation Decision

Aside from the results of the solid waste characterization, survey results will also be used to arrive at a proposed trash bin design. From the survey, respondents prefer the multi-colored trash bins, i.e. each type of waste is designated to a specific trash bin color.
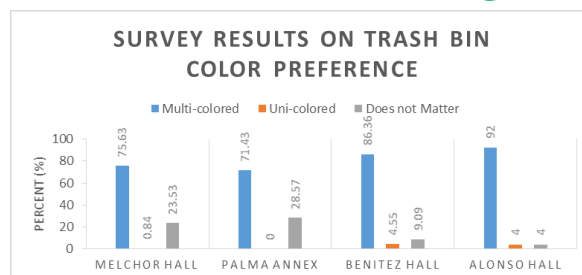

Fig 10. Survey Results on Trash Bin Color Preference

The result for type of label preference shows close values for Classification + Picture (e.g. "Biodegradable" + Picture of biodegradable wastes) and Specific + Picture (e.g. "food wastes, fruit peelings, etc." + picture of biodegradable wastes). It seems that the picture serves as an aid to select the right trash bin to put their trash into.
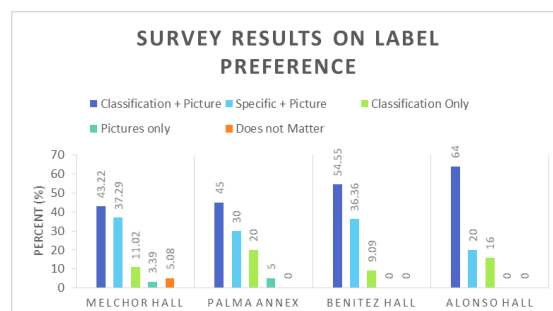

Fig 11. Survey Results on Label Preference

Survey results regarding the preferred placement of trash bin label show close values for label on the face of the bin and label on the wall with a difference of about 5-12%. Thus, utilizing either of the placement can be effective.
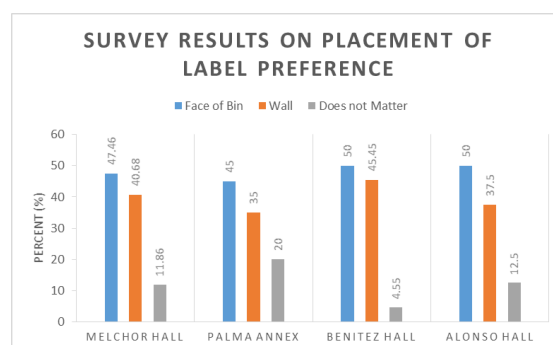

Fig 12. Survey Results on Placement of Label Preference

It was mentioned earlier that unawareness is not the major factor for segregation inefficiency in the university. Since majority of the respondents said that they are

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segregating, their knowledge in segregating or classifying solid wastes were tested through the waste sorting test included in the survey. Waste sorting survey results show that not only because respondents said that they are segregating means that they are segregating correctly.

4.1.5 Comparison of Waste Characterization and Survey Results

The efficiency of the trash bins for the survey results are computed and graphed in Figure 12. The efficiencies of the trash bins fall between 40 to 65 % with the highest efficiency for trash bins in Melchor Hall. Trash bins in Benitez and Alonso hall which differs only in the placement of the labels have almost the same efficiency. The simplest trash bins which are in Palma Hall Annex yields the lowest efficiency.
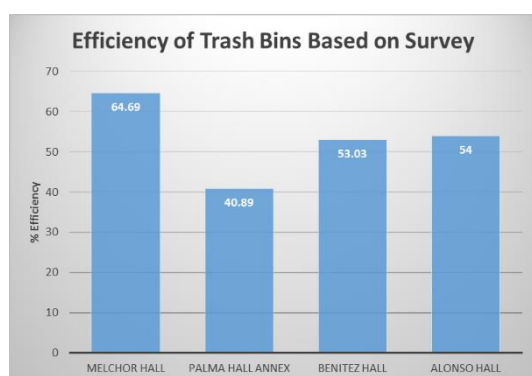

Fig 12: Efficiency of Trash Bins Based on Survey

Utilizing paired t-test, it was computed that for an average difference of -11.02 between waste characterization and survey data with N = 4 and dof = 3, t-value is 1.135 with a corresponding P-value of 0.339. With this P-value, we fail to reject the null hypothesis that the difference between the mean of the two sets of data is zero. Thus, there is insufficient evidence to suggest a difference between characterization data and survey data on average.

4.1.6 Trash Bin Design

Finally, a trash bin design is proposed based on the data gathered from survey results on trash bin design preference. Considering all the desirable types for the three parameters considered, the trash bin in Figure 13 is suggested. The design used bilingual classifications as an aid to understanding waste classification. An affirmative instruction to segregate is placed on the wall to encourage students and staff to segregate wastes.

Calculating the efficiency of the design for Melchor Hall gives us a value of 69%. This is 5% higher than the average efficiency from waste characterization results and can still be improved through hands-on implementation of rules and monitoring.

Fig 13: Proposed Trash Bin Design and Arrangement

The proposed trash bins have four classifications consistent with the guidelines regarding the solid waste management in UP Diliman. Recyclables and Dry paper are placed beside each other because of relevance. It is suggested that the colors of the trash bins be fixed for a specific type of waste so that color itself can be a distinction. In this case, green is for biodegradable, red is for residuals, blue is for recyclables and yellow is for dry papers.

5. Conclusions

Findings in this study show that the segregation of wastes in the university is not that efficient with waste characterization results of 64.17% and survey results of 53.15%. This is despite the fact that majority of the students are aware that there is an existing solid waste segregation scheme in UP Diliman campus. The highest segregation efficiency is recorded from Benitez Hall, which also produces the least amount of wastes among the four. Trash bins in Benitez Hall are multi-colored with its labels on the face of the wall indicating classifications only in texts.

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Majority of the students said that they are segregating but waste sorting survey results display that they can be confused in classifying the wastes. For the students who are not segregating at all and for those who segregate some of the time, reasons for not segregating can be classified to four major factors: time, trash bin design and appearance, environment, and behavior towards segregation.

Majority of the students said that their decision to segregate will be affected by the trash bin design, thus, providing properly designed trash bins that may aid in more efficient solid waste management in the university can be a good investment. The design that respondents chose are summarized in the proposed trash bin design in Figure 13. However, this design, no matter how colorful or detailed it is, will only be effective with proper implementation and monitoring and with the compliance of students and staff who have care to contribute to attaining a cleaner and greener UP.

Acknowledgement

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