

Ergonomic Partisipatory Approach for Designing the Innovative Trash Bin

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Abstract

Human daily activities cannot be separated from waste. For this, garbage must be thrown away so as not to contaminate the environment which can lead to the health problems. Therefore, it is necessary to provide the trash bins to facilitate people in disposing garbage. Some existing bins, however, have not accommodated users' need that encompasses the attractive design, easy to use, adequate size, robust, and informative design. The objective of this study is to develop the innovative design of trash bins satisfying user criteria. Participatory ergonomic approach based on focus group discussion was used to determine some design parameters by involving several stakeholders those are Leaders of company, Ergonomist, Designer, Supervisor of Cleanliness, and Users. Statistical analysis by using Marginal Homogeneity test and Wilcoxon test was done to test the hypotheses. The result of this study showed that the proposed design of trash bins is valid to meet the users requirements and more innovative at 5% of significant level.

Keywords: Trash bin; Participatory design; Ergonomics; Innovative design; Robust.

INTRODUCTION

According to the previous study [1], the global waste will nearly double to 2.2 billion tonnes in 2025. Despite that almost all the cities in the world are struggling to reduce their waste [2], population of industries and urbanization as well as educational institutions are still contributing substantially of the solid waste especially in developing countries [3] [4].

In fact, the rate of waste production continues to increase in line with the growth of population and the consumption patterns so as this may also affect the environment and public health. The waste should therefore be managed effectively and efficiently by governments to eliminate the negative impact [5]. One of ways is to provide the adequate facilities to people for disposing a garbage such as a trash bin.

Some studies have been conducted related to trash bin design like [6] [7] [8] [9]. However, their design was identified not still fulfilling what the users require. Thus, this study tries to develop an innovative design of trash bin that meet users' requirements anywhere.

RESEARCH METHOD

Survey

Paper based survey was conducted by distributing questionnaires to 63 stakeholders those are 26 company leaders, an ergonomist, a designer, six cleaning servicer, a supervisor of cleanliness, and 30 users. Their ages were in the range of 19 to 55 years old. This survey was aimed to identify the attributes that user require of the trash bin design and to validate the purposed design.

Apparatus

The research instruments used included questionnaires, solidworks application software, and Statistical Package for the Social Sciences (SPSS) software. The developed questionnaires consisted of two types: to identify user requirement and to validate the innovative trash bin design proposed.

A solidwork software was used to the develop a virtual design. While, SPSS was a software package used for logical statistical analysis.

Participatory ergonomic method to design

Reference [10] defined participatory ergonomics as a method involving people in planning, designing and controlling a significant amount of their own work activities, with sufficient knowledge and power to influence both processes and outcomes in order to achieve the desirable goals.

Reference [11] stated three stages to apply a Participatory Ergonomics method. They are as follows:

1. Selecting the participants. At this stage the participants have not fully participate because the selection process is determined by the researchers themselves.
2. Design and development. This stage is a proces to design and to develop of the system or product innovation of researchers after receiving input from participants.
3. Implementation. Systems or products that have been designed to be evaluate by participants.

Development Concept Design of Trash Bin

Focus group discussion (FGD) was done by involving several stakeholders that are Leaders of company, Ergonomist, Designer, Supervisor of Cleanliness, and Users. At this stage, discussion among them was to determine some attributes or design parameter of trash bin that satisfies the customer criteria.

Referring to the result of FGD, a virtual concept design was developed by using the solid works software.



Figure 1: Virtual design of trash bin

Statistical Analysis

Non-parametric statistical analysis was conducted to test the hypothesis. Stuart Maxwell test of marginal homogeneity was used to validate the proposed design parameter of trash bin whether a design meets customer attribute or not. While the Wilcoxon Signed-rank test was to validate a difference between the proposed design and the existing design to authenticate an innovation of trash bin [12].

RESULT AND DISCUSSION

Result of Customer Survey

Table 1 presents some customer attribute identified. They are attractive design, easy to use, adequate size, robust, informative.

Table 1: Result of Customer Survey

Attribute
Attractive Design
Easy to use
Adequate Size
Robust
Informative

Attractive designs refer to a variety of shapes, images, disposal entrance, attractive colors. Easy to use can be translated into convenient design such as easy-open, trash bin can be easily moved, and the trash collection process easy. Adequate size means the comfortable fits for the user's body posture. Robust design can be translated as durability and Informative refers to clear information.

Concept Design of Trash Bin

Figure 1 shows a final virtual concept design of trash bin satisfying customer attribute.

Attractive Design

A design parameter for shape of bins is used a box (4 sides). It is identified that this shape can increase a capacity of bin so as user can dispose easily. Images for waste classification are symbolized by food scraps, fruit, side dishes for organics and cans, glass, pet, books and newspapers for inorganics. On the other hand, for the dangerous waste, the image is depicted with battery, a former pharmaceutical, lamp, residual hazardous bottles, and floppy disk. The design of image can omit confusion for user in throwing garbage (See Figure 2). By using cartoon picture, it may attract the users to dispose in the right bin. The disposal entrance is made in a box-shape for organics, a round shape for inorganic, and oval for dangerous waste. This different shape is intended in order to the user understand a suitability of the type of garbage. Then, to make the design more interesting, different color on each type of bin is used. They are lime with R: 0 G: 255 B: 0 for organic trash bin, yellow with R: 255 G: 255 B: 0 for inorganic, and a dangerous bin is a red to R: 255 G: 0 B: 0. These colors correspond to [13] suggested. (See Figure 2)



Figure 2: Images for waste classification

Easy to use

The design parameters of the disposal entrance used a push system that it is easy for users to throw garbage without opening first. While for picking up the garbage collected in a bin, a pull system is used and pressing a button for opening. Thus it makes user straightforward employ. The utilization of wheels on the bottom of trash bin is to make it movable easily.

Adequate Size

The holding capacity of trash bin is 40 liters with upper size of 45 cm in height, 36 cm in length, 26 cm in width and lower size of 27 cm in length, 17 cm of width. This capacity will satisfy the user need per day to dispose the household waste. For the handle size it has been developed based on anthropometric potential user. Therefore, it can increase a comfort in use.

Robust

For its robustness, the design of the trash bin used plastic considered to able to prevent any breakage on the bin due to some impacts of hazardous substances. For cantilever a bin is made of stainless steel material. It is because the material may sustain corrosion so as the design will be wear-resistant. Wheels were manufactured from polyurethane material which is a mixture of rubber and nylon. By using this material the trash bin can move and not easy damage.

Informative

The font types used were comic MS and a cooper black type for lettering with 50 pt of size it can produce clearness in reading. Therefore, it will be easy for the user to dispose garbage in a right bin. Black color with C: 0 M: 0 Y: 0 K: 100 for inorganic garbage letter and symbol with yellow background, white color with C: 0 M: 0 Y: 0 K: 100 for organic and dangerous waste letter and symbol with lime background and red background is bright enough to be seen.

Homogeneity Test

Table 3 shows the result of homogeneity test. This test presented that z value was above 0.05 for all attribute. It means that null hypothesis is accepted so that the propose design parameter may meet the users need well. Therefore, the design can improve comfortability for users.

Table 3: Result of Marginal Homogeneity

Attribute	Asymp. Sig. (2-tailed)
Attractive Design	0.411
Easy to use	0.414
Adequate Size	0.248
Robust	0.131
Infomative	0.178

Wilcoxon Test

The result of different test by using Wilcoxon test is presented in Tabel 4.

Table 4: Result of Wilcoxon Signed-Rank Test

Attribute	Asymp. Sig. (2-tailed)
Attractive Design	0.000
Easy to use	0.018
Adequate Size	0.018
Robust	0.026
Infomative	0.004

Table 4 shows that p value of all attributes is <0.05. It means that the proposed design parameter of trash bin is valid to satisfy customer attribute at 5% of significant level. Thus, the design can increase a level of users satisfaction.

CONCLUSION

It can be concluded that the proposed design parameter of trash bin is 128.04 cm in height, 148.89 cm in width colored with green, yellow, and red. Trash bin is made from plastic and fiberglass. This design is valid to meet the consumer feelings that are attractive design, easy to use, of adequate size, robust, and informative as well as more innovative at 5% of significant levels.

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