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Development of customer oriented product design using Kansei engineering and Kano model: Case study of ceramic souvenir

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Abstract

This research was conducted to improve the design of ceramic souvenir to meet the desires of the customers better, using the concept of Kansei Engineering and Kano Model. Kansei Engineering was used to capture and translate consumer perception (Kansei words) to be the elements of design. In addition, this research also classify or categorize Kansei words from consumer perception into attributes in the Kano Model, which then assisted with the calculation and statistical analysis. The influential Kansei words which affect the consumer satisfaction will become priorities for further design development. The results obtained from this research were the factors that influence consumer satisfaction of ceramic products which can be divided into 2 (two) main factors, i.e. factors of appearance and performance. However, based on the results of the mapping on a Kano Model, the appearance factor becomes prioritized more for development of the product design. The conjoint analysis was used to find out the relationship between Kansei words and elements of design that should be included in the appearance factor. As a result, the suggested ceramic souvenir product should have the elements of parabolic-shaped design with artificial 2D decoration, glazed texture and solid/blocked color.

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Keywords: Ceramic souvenir, kansei engineering, kano model

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1. Introduction

During the recent decades the production capacity of consumer products has increased in a never before seen scale. New national and international actors arise and world's markets are globalizing at high speed. Changes therefore play a more important role leading to shorter life cycles of products than before [1]. One of the efforts that can be taken to deal with the increasingly sharp competition is through product design. The attractiveness of a product cannot be separated from the look of the product itself, due to the fact that it is possibly the first impression to be captured by consumers. Display of a product is closely connected with aesthetic value or beauty which used to grab the attention of potential consumers. It is also needs to be consider that the product design can provide a unique value or characteristic of the product / service compared to competitors.

This research took place in one of the handicraft industry center in Dinoyo, Malang, Indonesia, which the product mainly consist of ceramic artwork and souvenirs. Made with basic ingredients of clay, Dinoyo ceramic products have developed, not just in the term of product variety but also the technology used in the making. However, the demand for the product is constantly decreasing compared to the years before. Therefore, it is necessary to analyze what exactly the consumers expect for ceramic products particularly in terms of product design in order to draw the attention of potential customers.

To resolve this problem, researchers used a method of Kansei Engineering to translate customer perception of the product into design elements. Kansei Engineering is a product development methodology, which translates impressions, feelings and demands of the customers on the product or an existing concept to design solutions and design parameters [2, 3]. It was initially proposed by Nagamachi in 1970s and has been successfully used by Mazda Motor Corporation for developing the Miata model which symbolized "human-machine unity". Since then, Kansei Engineering has been successfully used to develop products in a wide range of industry such as automotive, construction machines, home appliance, costume, and cosmetic. The reason behind the use of Kansei Engineering in this research is based on the ability of the method to catch the impression of customers for a certain product which usually hidden, and translating them to a more detailed product specification [4].

It is also hypothesized that affective impact on the user is consequently a result of the composition of the different product properties. Hence, the goal must be to choose the best combination possible in order to maximize the customer satisfaction. When Kano, Seraku and Takahashi carried out investigations on customer needs in the early 1980's, they discovered that customer needs could be grouped into different categories on different levels. This discovery led to the introduction of the basics of the model later called the Kano Model [5, 6]. The application of Kano's model in Kansei Engineering with the object of analyzing the different ways in which consumer perception (emotional attributes or Kansei words) influences the product's purchase decision [7, 8]. An integration framework of the Kano Method and Kansei engineering shows that the perceived attributes or qualities is impacted or influenced against the emotional design or Kansei response [9, 13].

2. Problem Statement

Problem of this research are to capture the customers perspective on ceramic products through Kansei Engineering concept and develop the design elements of ceramic products in accordance with the results obtained from the analysis. This research is focused on the design of ceramics for souvenir products using Kansei Engineering Type I - Category Classification [10, 11, and 12]. This method breaks down a targeted product concept into a more detailed concept, and while expanding it to several levels, it will be interpreted in terms of the physical characteristics of the product design.

3. Materials and Method

3.1 Subjects

This study was carried out in the city of Malang (Indonesia), a medium-sized city on the East Java Province. Data collection was done by distributing questionnaires to a number of respondents who have been calculated using linear time function. The number of respondents was calculated using the following equation (Eq.1).

$$n = \frac{T - t_o}{t_i} = \frac{144 \text{ hours} - 84 \text{ hours}}{1.5 \text{ hours}} = \frac{60}{1.5} = 40 \text{ sample} \quad (1)$$

with:
T = the time available for research (survey time is 1 month, 3 effective days per week, 4 weeks x 3 days = 12 days)
= 12 hours / day x 12 days = 144 hours
t_o = sampling time = 7 hours / day x 12 days = 84 hours
t_i = the amount of time for respondents to fill the questionnaires = 90 minutes = 1.5 hours

Based on the calculation, the number of samples used in this study is 40 respondents. This survey was conducted among people in public places, covering both gender of male and female, in various economic levels and ages. The questionnaire was filled with personal data of respondents and their responses to each visual samples of ceramic design.

3.2 Stimuli

The set of stimuli used to develop the field study consist of 40 images of ceramics souvenir. Each stimulus was vary in material, shape, color, size, decoration, texture and finishing, which some of them are shown in Fig. 1.

Fig.1. Samples for stimuli

3.3 Questionnaire

Kansei words are adjectives and functions related to the object to be examined and can be obtained through books, journals, magazines and other media. The questionnaire contained 20 Kansei words for describing the emotional response of users for the ceramics souvenir. The first step to obtaining the 20 adjectives was to gather as many words and expressions as possible, mainly adjectives, used by people to express product attributes. These adjectives were collected from different sources such as internet, newspapers, and journals, in order to achieve the most complete semantic description possible. The questionnaire in this study provides an assessment of the Kansei words in Semantic Differential (SD) scale with 5-point scale, which suggested by Nagamachi to facilitate the evaluation. The scale which used to determine the factors that influence consumer preferences is shown in Table 1.

Table 1. Consumer Scale of Preference using 5-point SD scale

Score	Information
5	If the product is closely related with the Kansei word in the right side of scale
4	If the product is loosely related with the Kansei word in the right side of scale
3	If the product is neutral, which related with the Kansei word both in the right and left side of scale
2	If the product is loosely related with the Kansei word in the left side of scale
1	If the product is closely related with the Kansei word in the left side of scale

3.4 Data processing

a. Feasibility Testing Questionnaire
In this process, the data collected were analyzed to determine the feasibility of the questionnaire using the reliability and validity tests.
b. Statistical Analysis
The data collected is processed for factor analysis and conjoint analysis using SPSS 19.0 software. Factor analysis was used to reduce the number of Kansei words, while the conjoint analysis was used to determine the relationship between words and combinations of Kansei words with design elements.
c. Mapping Results Statistics in Modified Kano Model
Having obtained the statistics, the value is entered into modified Kano matrix and mapped into 3 categories of customer satisfaction.

4. Result

Kansei engineering type I is used to determine consumer preferences for product design elements. In the stage of Kansei words collection, there are 21 words that consist of 20 adjectives and functions of the product as the first global Kansei words. Table 2 shows a set of Kansei words that have been collected.

Table 2. Kansei words

Expensive	Modern, Contemporary	Patterned	Attractive
Beautiful, Nice, Artistic	Creative, Innovative	Harmony	Exclusive
Simple	Fascinate	Aesthetics	Aspiring, Inspiring
Neat	Dynamic	Limited Edition	Strong
Cozy	Stable	Safe, Healthy	Variety

From the Kansei words obtained, the related bipolar words were searched to form opposed meanings which shown in Table 3, followed by product sample collection which used to provide a visual picture of the image of ceramic products to be researched. Based on observations of the journals and the internet, there are 40 samples of products with diverse specifications. Collected samples can be divided into 5 items and 22 categories which the classification is shown in Table 4. The calculation of the minimum number of stimuli is as follows (Eq.2):

$$\textit{Minimum number of stimuli } (n) = (\textit{category} - \textit{item}) + 1 = (22 - 5) + 1 = 18 \quad (2)$$

Based on the calculation, the number of samples that should be the stimuli is a total of 18 samples. Therefore, it can be concluded that the samples used in this study had sufficient minimum amount.

Table 3. 5-Point SD Scale of Kansei words

NEGATIVE	1	2	3	4	5	POSITIVE
Affordable, inexpensive						Expensive
Antique, classic						Modern, contemporary
Plain						Patterned
Dull						Attractive
Ugly						Beautiful
Uncreative						Creative, innovative
Not harmonious						Harmonious
Inclusive						Exclusive
Complex						Simple
Not appealing						Appealing, dazzling
Not Aesthetics						Aesthetics
Not inspiring						Inspiring
Untidy						Tidy
Rigid						Dynamic
Common						Limited edition

NEGATIVE	1	2	3	4	5	POSITIVE
Fragile						Strong
Uncomfortable						Comfortable
Not stable						Stable
Dangerous						Safe, healthy
Common, normal						Variety, unique
Will not buy						Will buy

Table 4. Classification of items and category

	Item		Categories	Notation
1	Shape	1	Straight line	X11
		2	Curved round	X12
		3	Parabolic	X13
		4	Ellipse	X14
		5	Catenary	X15
		6	Spiral	X16
		7	S Curve	X17
2	Decoration	1	Plain (Coloured, Glazed)	X21
		2	2D (Pattern, Drawing)	X22
		3	3D (Relief)	X23
3	Colour	1	1 Colour	X31
		2	Many colours	X32
		3	Blocked / solid colours	X33
		4	Colour gradation	X34
4	Texture	1	Glaze	X41
		2	Matt	X42
		3	Porous	X43
5	Shape exploration	1	Landscape	X51
		2	Flora	X52
		3	Fauna	X53
		4	Geometric	X54
		5	Artificial	X55

Based on the factor analysis, it can be concluded that:

1. Factor 1 (appearance of ceramic) consist of : Kansei 3 (patterned), Kansei 4 (interesting), Kansei 5 (beautiful), Kansei 6 (creative and innovative), Kansei 7 (harmonious), Kansei 8 (exclusive), Kansei 10 (dazzling), Kansei 11 (aesthetic) and Kansei 12 (aspirational and inspirational).
2. Factor 2 (performance of ceramics) consist of : Kansei 13 (tidy), Kansei 14 (dynamic), Kansei 16 (strong), Kansei 17 (comfortable), Kansei 18 (stable), Kansei 19 (safe and healthy) and Kansei 20 (variety, unique).

Table 5 is an output component transformation matrix, which can be seen that both Factor 1 (component) and Factor 2 have a strong correlation of 0.795. Thus Factor 1 and Factor 2 are capable to summarize the 16 independent variables. Fig. 2 shows the plot of a variable component.

Table 5. Output component transformation matrix

Component	1	2
1	.795	.606
2	-.606	.795

Component	1	2
1	.795	.606
2	-.606	.795

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

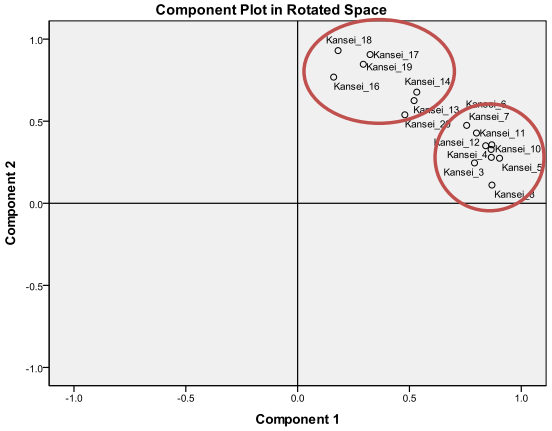

Fig.2. Plotting of variables

Llinares and Page [7] have modified the Kano model to evaluate the impact of consumer preferences on real estate purchase decisions. In this case they modify it by using the value factors to identify when consumers consider an attribute to be raised (positive value) or excluded (negative). This study is using the same model to identify the attributes. Kansei words in a new factor that is developed from the previous analysis were performance and appearance factors.

Calculation of factors correlation was then performed by using the value from questionnaires which divided into two categories, namely positive and negative answers. With SPSS 19, the summary of generated output can be seen in Table 6. Table 6 shows that Factor 1 (appearances) has a positive value which means that the factors are correlated to the purchase / design, although the correlation is low. Significance (p-value) is less than 0.05 which indicates that the results are significant or have a small error rate, so that the results can be used. While on the contrary, Factor 2 (performance) has a very low correlation to positive answer and not correlated to negative answer. Judging from the value sig (p-value) indicates that the results are not significant, so that the data cannot be used. By using the positive data and negative answer as the axis, it can be used to describe and map the customer satisfaction by using the Kano diagram. Table 7 is the coordinate matrix for Factor 1 and Factor 2.

Table 6. Summary of correlation between factor 1 and factor 2

Factor	Positive Answer			Negative Answer		
	Coefficient	p-value	N	Coefficient	p-value	N
1	0,279	0,000	261	0,264	0,008	99
2	0,124	0,079	201	-0,010	0,931	79

Table 7. Matrix coordinate for factor 1 and factor 2

Factor	PA	NA
1	0.279	0.264

2	0.124	-0.010
Total	0.403	0.254
Average	0,202	0,127

By using the data in Table 7, we can develop Modified Kano Model diagram in Fig. 3.

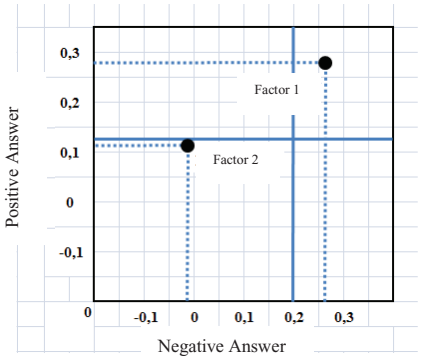

Fig. 3. Modified Kano model diagram

The average value of each Kansei word on each sample was then processed using SPSS 19.0 software for conjoint analysis. Conjoint analysis is used to determine the relationship between the design elements with Kansei words. Based on the analysis in the previous section, a summary of the relationship of each design element and Kansei words is shown in Table 8. The ceramic design is preferred to be parabolic-shaped base with artificial exploration, with 2D and textured glaze decoration, as well as blocks of color. Based on the recapitulation of the results from the questionnaire, the preferred type of ceramic souvenir is drinking mug with 19% of respondents choose it as a wedding gift.

Table 8. Summary of Ceramic Design

Code	Kansei Word	Shape	Decoration	Colour	Texture	Exploration
103	Pattern	Parabolic	2D	Block	Glaze	Geometric
104	Attractive	Parabolic	2D	Gradation	Glaze	Fauna
105	Nice, beautiful	Parabolic	3D	n-Coloured	Glaze	Fauna
106	Creative, innovative	Straight line	3D	Block	Glaze	Geometric
107	Harmony	Parabolic	3D	Block	Glaze	Artificial
108	Exclusive	Catenary	Plain	Block	Glaze	Artificial
110	Appealing	Parabolic	3D	Block	Matte	Artificial
111	Aesthetics	Catenary	2D	Block	Glaze	Fauna, Artificial
112	Aspiring, inspiring	Parabolic	2D	Block	Glaze	Geometric

5. Conclusions

Some conclusions were obtained from the study:

1. From 20 Kansei word obtained, 16 valid Kansei word were used for the evaluation of reduced form factor analysis for two main factors, namely performance and appearance factors.

2. Of the two main factors, only the appearance factors was used for further design development, because this factor is in the area of linear attributes in the modified Kano model diagram. The performance factors were not analyzed further because it is in the area of not significant in the modified Kano model diagram.
3. The Kansei words for appearance factors were evaluated for its relationship with design elements that are divided into 5 categories and 22 items. The result shows that preferred souvenir is a drinking mug / cup with basic parabolic-shaped design, artificial exploration with 2D and textured glaze decoration, as well as colored blocks.

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