Original Article

Classification of Children's Toy Products in Emotional Design Using an Integration of Kano Model and Kansei Engineering

Thipsukon Boonyaso[1], Thanate Ratanawilai[1*], Kunlapat Thongkaew[1], and Chanokporn Teelakul[2]

[1]Smart Industry Research Center, Department of Industrial and Manufacturing Engineering, Faculty of Engineering, Prince of Songkla University, Hat Yai, Songkhla 90110 Thailand

[2]Department of Early Childhood Education, Faculty of Education, Songkhla Rajabhat University, Mueang, Songkhla 90000, Thailand

[*]**Corresponding author: thanate.r@psu.ac.th**

Abstract

Young children can improve their fine motor abilities by playing with toys. Finding suitable toys for children is therefore a crucial task. Integrated Kano model and Kansei engineering to determine the consumer preferences and emotions that influence toy buying is the main goal of this study. The emotional words, including "Creativity" and "Attractive," having the strongest emotional resonance, with an average rating of 4.46±0.57 and 4.39±0.58, respectively in the category of components' shape, size, color tone, learning, and fine motor play. Regression models, constructed from this finding help designers create toys with a balanced training style by revealing the design components that affect customer emotions with a mean score of 4.49 ±0.58, the level of satisfaction was assessed to be satisfactory. According to this study, the Kano model and Kansei

engineering may support the development of emotional toys. This research methodology aids designers in developing mood-detecting products.

Keywords: Kansei engineering, Kano model, Children's toy, Product emotional design, Quantification theory type I

1. Introduction

The development of fine motor skills in preschoolers, typically ranging from 3 to 5 years old, plays a crucial role in several tasks related to everyday life. Deficiencies in fine motor skills can impede learning, heighten anxiety levels, and undermine confidence in the child (Gaul & Issartel, 2016). Hence, the promotion of fine motor abilities is of considerable importance.

There are many activities that have been proven to improve fine motor skills. But play is a crucial activity, and toys play a critical role in its conception (Deshpande, 2021). Therefore, involving preschoolers in age-appropriate play training can effectively stimulate and improve their fine motor skills, especially when parents and educators are involved and actively encourage the development of fine motor skills (Cheraghi, Shokri, Roshanaei, & Khalili, 2022). Because of this, parents and educators place a high value on choosing toys for kids that are age-appropriate and adhere to their standards for durability, design, and safety (Prakoso & Purnomo, 2019). A well-made toy can aid in the development of children's fine motor skills.

The development needs of kids in each age group should be carefully taken into account when designing "fine motor skills toys" to include. Toys should be created in such a way that children can practice eye-hand coordination and small muscles in order to develop balance and particular skills (Cheraghi et al., 2022). It must also be designed and manufactured to address consumers' emotional needs and desires. Frequently, designers struggle to comprehend the affective conditions of their consumers. The Kano model and Kansei engineering techniques are noteworthy approaches that aid designers in developing goods that effectively cater to customers' emotional demands.

The Kano model, which takes into account the product's quality category and potential product improvements, successfully reduces customer dissatisfaction and raises customer satisfaction. The questions and replying options included within the Kano approach need adaptation to align with the inherent characteristics of experiences (Ma, Chen, & Chang, 2019). This study uses the Kano model to determine customers' emotional demands and priorities to guide design practice.

Kansei engineering integrates human perception analysis into engineering technology using design science, psychology, cognition, and related subjects. Kansei engineering helps designers grasp customers' perceptual needs while improving product design efficiency and lowering costs. Engineering technology is used in Kansei engineering to study the design elements that influence the mood of consumers (Xue, Yi, & Zhang, 2020). Figure 1. illustrates the customer's emotional needs that affect the product, allowing for the dissection and analysis of design elements. Size, shape, color, and improving fine motor skills are some design elements that can be used to design products that meet customers' emotional needs.

It is clear from previous study results that Kansei engineering approach has been successfully applied when designing and developing children's products. The design work involves a variety of toy categories, including rocking horses (Prakoso & Purnomo, 2019), children's sports toys (Ma & Li, 2023), and children's companion robots children's companion robots (Zhu, Ye, Wang, Wang, & Liu, 2021). The development of consumer goods specifically for kids has also been studied. This category encompasses various products, such as foldable chairs designed for children (Prakoso & Purnomo, 2019), baby cradles (Akgül, Özmen, Sinanoğlu, & Kizilkaya Aydoğan, 2020), children's luggage (Wang, Shaari, & Perumal, 2020), and children's clothing (Lokman & Aziz, 2010).

The literature research findings indicate that Kansei engineering techniques are recently used to develop diverse children's goods. However, it has not yet been used to create preschool toys that enhance fine motor skills. It is for this reason that our research aims to investigate these knowledge gaps. These factors emphasize the significance of creating children's toys. Therefore, this study proposed Kansei engineering and the Kano model for creating fine motor skills toys that satisfy consumers' emotional needs while being age-appropriate and encouraging the development of fine motor skills. Because children develop rapidly in a variety of domains between the ages of 3 and 5 and because this age range is crucial for their future development, the study focused on toy development for this age group. Therefore, it's critical to give this age group adequate attention and to stimulate growth. The research results help designers create products that meet consumers' emotional needs. In addition, the toys derived from the study may be developed into appropriate educational tools. It benefits parents and educators to enhance the fine motor skills of children between the ages of 3 and 5 with greater efficacy.

2. Methodology

Communicating with consumers to design products that meet their needs is crucial. This study proposes an engagement design system with a sample of consumers using Kansei engineering as the primary design process. There are six major procedures for product design, as shown in Figure 2. First, there is the sample selection for the study. Second, the Kano model was employed to examine and define the emotional demands of the consumers. Third, image samples were gathered and product elements were extracted to define design elements. Fourth, the relationship between emotive language and product design features is examined using statistical analysis. Fifth, the validity of relationship results was performed. Sixthly, utilizing SolidWorks software, design elements were employed to create new goods that satisfy consumer needs. Then, the customer satisfaction and behavioral trends towards the product were obtained in this research.

The primary tool for gathering data is a questionnaire. Both content validity and reliability are assessed for every research tool. The Item-Objective Congruence (IOC) index was used to evaluate the assessment's content validity. The index must be at least 0.5 in value because a score below 0.50 on the IOC indicates that a question or evaluation technique need to be revised or eliminated (Tangviriyapaiboon et al., 2022). The reliability of the evaluation was evaluated using at least 30 trials with comparable samples using the Cronbach's alpha (α) reliability coefficient. A normal distribution with 30 examples is predicted by the Central Limit Theorem (CLT). In order to evaluate an instrument's dependability or internal consistency, the alpha must be at least 0.70 (Taber, 2018). The entire research procedure is as follows:

2.1 Sample selection

Toys for fine motor skills are chosen as educational products. The Multi-Stage Sampling methodology was employed to choose the sample group for questionnaire assessment. The process consists of the subsequent stages.

Selecting three educational institutions at random from the entire Songkhla Province is the first stage in the Cluster Sampling process. The educational forms offered by three academic institutions are as follows: private schools, government schools, and child development centers. Choosing a group of evaluators with a history of purchasing toys and close relationships to the children was the second phase in the Purposive Sampling process. As a result, the assessors who work at all three institutions can be divided into three categories: (i) professional groups that are related, (ii) groups that are associated with children, and (iii) groups that are indirectly involved.

The Taro Yamane equation was used to estimate the sample size (n), which resulted in 275 samples being taken from the 880 participants from the three educational institutions in Songkhla Province. (Sirivongpaisal, Kongyoung, Suthummanon, Penjamras, & Suwatcharachaitiwong, 2023)

2.2 Consumers' emotional needs

Emotional words are compiled to convey how a sample of consumers feels about the product being studied and used to link design elements, as in the following steps. This topic aims to create the emotional limits of the customer when purchasing children's toys.

Firstly, through interviews with toy manufacturers, product design specialists, online news sources, academic journals, early childhood media experts, seasoned users, and relevant research studies, the emotional words database associated with the physical features of fine motor skills toys was compiled. The inclusion of emotional adjectives in the collection process adhered to the research guidelines proposed by many researchers, such as Chiu and Lin (2018); Kittidecha, Marasinghe, and Yamada (2016); and Lee and Han (2022). After consulting with product design experts and early childhood media experts, a total of 8 emotional words can be collected.

Secondly, the Kano questionnaire was created using a combination of 8 emotions connected to the product. Two IOC values below 0.5 were eliminated as a result of validity checks, bringing the total IOC to an acceptable 0.80. Accordingly, the updated questionnaire now contains the six emotional words "beautiful", "attractive", "safe", "creative", "impressive", and "strong and durable" with a Cronbach's alpha (α) reliability coefficient value of 0.818. The results acquired from the questionnaire were afterward used to analyze the replies to find the satisfaction type of emotional words (A, O, M, I, R) which is determined by extracting the responses from the functional and dysfunction questions for each group of participants. Types of satisfaction with emotional words include attractive (A), one-dimensional (O), must-be (M), indifferent (I), reverse (R), and questionable (Q) (Dinulescu & Dobrin, 2022). Consequently, 275 respondents' completed questionnaires were used to calculate the frequency of responses.

Thirdly, the frequency of each level of satisfaction A, O, M, I, R, and Q for all queries were calculated to determine the proportions of Customer Satisfaction (CS) and Customer Dissatisfaction (CD) for each issue, according to Equation 1. and 2. (Dinulescu & Dobrin, 2022)

$$\text{Customer satisfaction (CS)} = \frac{(A+O)}{(M+O+A+I)} \tag{1}$$

$$\text{Customer dissatisfaction (CD)} = \frac{(M+O)}{(M+O+A+I)} \tag{2}$$

Fourth, the emotional words categorized by the Kano model are ranked using the approach of the absolute largest weight, according to Equation 3; where S_i is satisfaction indicator; D_i is dissatisfaction indicator; w_i is significant weight; and m is number of emotional words (Dinulescu & Dobrin, 2022).

$$w_i = \max(S_i\,, D_i)$$

$$w_i = \max\left(\frac{CS_i}{\sum_{i=1}^{m} CS_i}, \frac{CD_i}{\sum_{i=1}^{m} CD_i}\right) \tag{3}$$

2.3 Product images and design elements

To identify and extract design features of the products, the commercial images for fine motor skill toys were collected which is diversity and differences in product composition. The design experts and early childhood media specialists received the gathered images of these products. Through group brainstorming, the most appropriate images for the research questionnaire were chosen. Following the selection of product images, a collaborative brainstorming session with experts in the field was conducted on the images. The goal of this session was to identify and extract design elements that were thought to be essential in toys for fine motor skill development that could successfully meet consumers' emotional needs.

2.4 Statistical analysis

The link between design features and emotional demands is determined in this stage using statistical concepts. The emotional information, design elements, and images of children's toy items gathered in the preceding stage should be used as the foundation for creating a design questionnaire using the Kansei engineering method. Emotional words are assessed in image samples. Images were evaluated for emotional expressions.

In order to evaluate images at the same level of response, a sample of 275 people gives each image 55 evaluation responses.

Since the Kansei engineering questionnaire data includes quantitative and qualitative variables, the information from the questionnaire must be translated before regression models can be created. The qualitative factors are converted into dummy variables, with a value of 1 indicating a purchasing decision influence and a value of 0 signifying an uninfluence, D_{ij}^{b} as shown in Equation 4. (Chiu & Lin, 2018)

$$D_{ij}^{b} = \begin{cases} 1 \\ 0 \end{cases} \tag{4}$$

Next, the regression models were constructed to study the design elements influencing consumers' emotional needs. Quantification theory type I is a categorical multiple regression analysis that aims to ascertain the extent of the effect of numerous categorical independent variables on a quantitative dependent variable. The research focuses on the design components of children's toys as the independent variable which is the achieving consumers' emotional needs that influence the acquisition of children's toy products. Dummy variables are used to define these categorical parameters, called design elements. The multiple regression equation is presented, as shown in Equation 5. (Chiu & Lin, 2018)

$$y^{b} = x_0 + \sum_{i=1}^{d} \sum_{j=1}^{e_i} x_{ij} D_{ij}^{b} \tag{5}$$

Where b is the number of the design sample, i = 1, 2, …, d (d is the total number of design elements) and j = 1, 2, …, e_i (e_i is the total number of categories for design element i). In the above Equation, y^b represents the emotion score of samples, x_0 represents the intercept of the regression model and x_{ij} is the category score, (Chiu & Lin, 2018)

2.5 Test of validity

In this stage, the outcomes of the preceding statistical analysis are used to assess the precision of the regression models, constructed to study the design elements influencing consumers' emotional needs. During this examination, the examiner assesses the following values:

(i) The independence of each independent variable is assessed using Variance Inflation Factor (VIF) and tolerance statistics.

Multicollinearity occurs when a number of independent variables in a multiple linear regression model have a high degree of correlation. High correlation among the explanatory variables diminishes the validity of the analysis. To eliminate multicollinearity from regression models, selecting a subset of significant variables was studied by using VIF (Tamura et al., 2019). The same concept is applied in the current study to achieve a VIF value lower than 10 (García, Gómez, & García, 2019). The value of tolerance consistently exhibits an inverse relationship with the value of VIF. The tolerance value is between 0 and 1. The variables are independent if the tolerance number is close to 1. However, as the value gets closer to zero, multicollinearity is indicated.

(ii) The F-test, R-Square, and Significant values of the model were derived using the analysis of variance (ANOVA) to assess the sufficiency and appropriateness of the model. The next step is to assign the Unstandardized Regression Coefficient (B) values from the coefficients analysis table as the coefficients of the regression model in order to anticipate the design elements that affect client emotions.

2.6 Fine Motor Skills Toys

In this phase, a suitable regression model is employed to determine the product design specifications required for toys that effectively address the emotional needs of customers and help them develop fine motor skills. These toys were designed using the SolidWorks software.

Once the toy product design has been received, customer satisfaction with the product design is collected. This section discusses three aspects of satisfaction including the impact of satisfaction on emotions, product design, and loyalty. The customer satisfaction and product designs that aid in developing fine motor skills and purchasing trends for children's toys could be obtained.

3. Results and Discussion

3.1 Emotional Words for fine motor skills children's toys

Finding the different types of satisfaction with words that express emotion was made possible by gathering questionnaire data from the target group of 275 people, as shown in Table 1. It could see that the satisfaction of emotional words is classified as the most common type (highest frequency) into two categories: Attractive type (A), which includes Attractive and Creative. One-dimensional type (O) includes the words Beautiful, Safe, Impressive, Strong, and Durable.

This section enables to create a list of the most emotive word for fine motor skills toys, which were classified based on their absolute weight as defined by Equation 3, as shown in Table 2. The table comprehensively examines several crucial factors, such as customer satisfaction, customer dissatisfaction, the significant weight of satisfaction and dissatisfaction, the absolute maximum weight value, and the ranking of emotional words.

Based on the largest absolute weight method in Table 2, it was found that emotional words can be ranked with similar weight values. As a result, this section takes the classification of the items into account when determining the ranking. This analysis concentrates on the factor of attractive (A) more than one-dimensional (O). The attractive (delighter needs) is the quality attribute that the consumers do not expect trait leads to increased pleasure. Nevertheless, lacking these characteristics does not result in a higher level of customer discontentment (Dinulescu & Dobrin, 2022). Therefore, the findings on the impact of emotional words of fine motor skills toys are demonstrated. The essence of this concept may be succinctly encapsulated by the terms “attractive”, consistent with research by Prakoso and Purnomo (2019), indicating that interesting and pleasant can show children’s emotions in choosing and playing toys. This could be applied to the stage of design innovation. “Creative” is consistent with research by Ma and Li (2023). They found that creative is a key cognitive term that influences the design of children’s toys. This means that these two powerful terms provide useful information for creating toys that successfully satisfy consumers’ emotional needs.

3.2 Design Elements for fine motor skills children’s toys

The results of gathering images of commercially available motor skills and choosing appropriate images for the research questionnaire by design experts and early childhood media specialists showed that 23 out of 30 images of toys were appropriate. The composition of each of the 23 photos was then assessed.

Following is a summary of the outcomes of the design elements. As shown in Table 3, there are 5 main design elements and 27 sub design elements. Each element of the design has its own set of variables which will be substituted to each design element in the following phase.

3.3 Regression models for fine motor skills children's toys

The study used the Kansei engineering questionnaire to assess the design components that impact customers' emotional demands. The questionnaire's validity was evaluated by the IOC analysis. A sufficient level of congruence is shown by the IOC value of 0.72, which is in agreement with Tangviriyapaiboon et al. (2022), finding that the used IOC exceeds 0.5.

Furthermore, it is worth noting that Cronbach's alpha (α) reliability coefficient of 0.809 shows a high level of consistency, aligning with Lee and Han (2022) and Taber (2018), having Cronbach's alpha (α) exceeds 0.7. This shows that using this questionnaire to collect data is appropriate. The outcomes derived from the questionnaire may be delineated as the dependent variable, which pertains to consumers' purchase behavior concerning children's toys, specifically concerning fulfilling emotional requirements. The variable is quantified by the average score values. The independent variable used in this research is a dummy variable representing the presence or absence of certain design components in children's toys. These two variables are employed in the construction of a regression model.

Quantification theory type I is a categorical multiple regression analysis that aims to ascertain the extent of the effect of numerous categorical independent variables on a quantitative dependent variable. Hence, a regression model was developed to search for children's toy design elements (independent variable) that influences the emotional needs of customers (dependent variable) by using multiple regression with the enter method for analyzing the regression model.

Table 4 shows the statistical results of the design elements of children's toys impact consumers' emotional requirements regarding attractiveness. Furthermore, it was discovered that the design aspects of children's toys impacted consumers' emotional requirements regarding creativity as shown in Table 5.

Both emotional words were examined for multicollinearity from the regression model using a VIF of less than 10 which is in good agreement with the research of García, Gómez, and García (2019). In order to demonstrate that the variables are independent, they chose a VIF value of less than 10 and tolerance levels with tolerance values close to 1.

According to the findings shown in Table 4, it can be seen that there is a significant effect of at least one sub-design feature on consumers' emotional demands in terms of attractiveness. This influence is supported by a statistically significant F-value of 178.018, at a significant level of 0.05. Furthermore, the observed data has a high multiple correlation coefficient was 1.000 (R = 1.000), indicating a strong linear relationship among the variables. This coefficient possesses a predictive power of 99.9% ($R^2 = 0.999$), suggesting that it may accurately forecast future outcomes. The associated prediction error is minimal, with a value of 0.01417 ($S.E._{est} = 0.01417$).

Upon examination of the individual components of each independent variable, it was determined that the following variables were: Cylindrical parts ($X_{1.5}$), Cubic piece ($X_{1.6}$), Free-form parts ($X_{1.7}$), Promote numbers learning ($X_{2.3}$), Playing according to the specified format ($X_{3.1}$), Play where materials around you can be played together ($X_{3.3}$), Balance training ($X_{3.4}$), Playing with tongs/spoon as a play element ($X_{3.6}$), Large piece ($X_{4.3}$), Warm color parts ($X_{5.2}$), and Pastel color parts ($X_{5.4}$) gave a significant impact on the dependent variables at a statistical significance level of 0.5, excepting Rectangular shaped parts ($X_{1.4}$). The sub-design element that has the most significant impact on customers' emotional demands related to attractiveness is Balance training ($X_{3.4}$), as shown by a standardized coefficient value of 0.952. As a results, a regression model which provides the most suitable approach for developing toys that cater to consumers' attractiveness-related emotions could obtained as shown in Equation 6.

$$\begin{aligned} \text{Attractive} = \; & 4.845 - 0.365 X_{1.5} - 0.676X_{1.6} + 0.168X_{1.7} + 0.292X_{2.3} \\ & - 0.166X_{3.1} - 0.319X_{3.3} + 0.330X_{3.4} - 0.082X_{3.6} + 0.307X_{4.3} \\ & - 0.320X_{5.2} + 0.056X_{5.4} \end{aligned} \tag{6}$$

Hence, this study has included design components of children's toy items that only cater to the positive effect on the emotional needs of customers by emphasizing their "Attractive" qualities. Therefore, the information can be condensed into five design requirements, which are outlined below:

1. Balance training ($X_{3.4}$)
2. Promote numbers learning ($X_{2.3}$)
3. Large piece (about 4.5 - 7 centimeters) ($X_{4.3}$)
4. Free-form parts ($X_{1.7}$)
5. Pastel color parts ($X_{5.4}$)

According to the findings shown in Table 5, it can be seen that there is a significant effect of at least one sub-design feature on consumers' emotional demands in terms of creativity. This influence is supported by a statistically significant F-value of 28.406, at a significance level 0.05. Furthermore, the observed data has a high multiple correlation coefficient was 0.997 (R = 1.000), indicating a strong linear relationship among the variables. This coefficient possesses a predictive power of 99.4% ($R^2 = 0.994$), suggesting that it may accurately forecast future outcomes. The associated prediction error is minimal, with a value of 0.04009 ($S.E._{est} = 0.04009$).

Upon examination of the individual components of each independent variable, it was determined that the following variables; Cylindrical parts ($X_{1.5}$), Cubic piece ($X_{1.6}$), Playing with tongs/spoon as a play element ($X_{3.6}$), and Large piece ($X_{4.3}$) had a significant impact on the dependent variables at a statistical significance level of 0.5. The sub-design element that significantly impacts customers' emotional demands related to creativity is the Large piece (about 4.5 - 7 centimeters) ($X_{4.3}$), as shown by a standardized coefficient value of 0.400. As a result, a regression model which provides the most suitable approach for developing toys that cater to consumers' creativity-related emotions could achieved as shown in Equation 7.

$$\text{Creative} = 4.788 - 0.292X_{1.5} - 0.510X_{1.6} + 0.156X_{3.6} + 0.189X_{4.3} \quad (7)$$

Hence, this study has included design components of children's toy items that only cater to the positive effect on the emotional needs of customers by emphasizing their "Creative" qualities. So, the information can be condensed into two design requirements, which are outlined below:

1. Large piece (about 4.5 - 7 centimeters) ($X_{4.3}$)
2. Playing with tongs/spoon as a play element ($X_{3.6}$)

3.4 Design fine motor skills children's toys

In this result, the regression model that gave the best suited for analyzing emotional words is used to develop the fine motor skills of children's toy products. This design aims to address the emotional requirements of customers by creating children's play items that are both visually attractive and encourage creativity. The design parameters that were previously determined have been consolidated into a unified specification for the children's play product that focuses on fine motor abilities. Consequently, the outcomes of designing children's toys was discovered that there was design and development in terms of five essential design elements, including the Parts shape, Promoting learning, Play that development of fine motor skills, Parts size, and Parts color tone, as shown in Table 6 and Figure 3.

The data shown in Table 6 and Figure 3 indicate that the developed product has undergone design and development in five distinct areas. The present study draws inspiration from the Songkhla Zoo with an entitle "Songkhla Zoo Children's Toy Product Set", a prominent recreational destination for youngsters residing in the Songkhla Province - frequent visitation opportunities. The gameplay is that the child can play freely according to the child's imagination by using tongs to manipulate trees, leaves, and other animals for balance training by putting pieces together. Additionally, acquiring numerical knowledge is a crucial aspect of education by quantifying or aggregating the numerical values of animal populations.

These activities have the potential to facilitate the enhancement of fine motor skills, meditation, and visual acuity. Furthermore, it can enhance cognitive abilities such as analytical reasoning and problem-solving aptitude.

3.5 Customer satisfaction for fine motor skills children's toys

The validity of the questionnaire was assessed using IOC to evaluate customer satisfaction with children's toy products. The questionnaire measured satisfaction in three areas: emotional needs, design elements, and behavioral tendencies in deciding to purchase the toys of customers. The obtained IOC value of 0.80 suggests an acceptable degree of consistency, aligning with the findings of Tangviriyapaiboon et al. (2022), who also reported an IOC surpassing 0.5. Furthermore, the reliability of the questionnaire was evaluated by calculating Cronbach's alpha reliability coefficient (α). The obtained value of satisfaction for the emotional needs was 0.776. The satisfaction rating for design elements is 0.891. The behavioral patterns in buying children's toy items were 0.872. Each of the three questionnaire's components that has a value greater than 0.7 demonstrates a high level of consistency. The results of this study, which have Cronbach's alpha (α) values of 0.7, are in agreement with those of Lee and Han (2022) and Taber (2018). Consequently, the survey's validity and dependability implies that this survey is appropriate for gathering data. Table 7 illustrates the findings of emotional needs satisfaction, design features, and behavior patterns in purchasing children's toys.

According to the data presented in Table 7, it is found that the average level of satisfaction among customers with children's toy product formats comes from the Creative feeling. The degree of pleasure was good, with an average rating of 4.46±0.57. This finding aligns with Ma and Li (2023), reporting that "creative" and "fun" are the two perceptual adjectives most strongly associated with sports toys. In emotional gratification, the attractiveness attribute was positioned as the second highest. The degree of satisfaction was good with the mean value of 4.39±0.58.

Furthermore, the delight of consumers is derived from many design features included in the development of this particular children's toy product. The study results indicated that the customer group was most satisfied with balancing training as their first preference. The degree of satisfaction was good, with a mean value of 4.49±0.58.

The inclusion of balance training design components in the design of toys has been shown to increase satisfaction within the target demographic. Children who engage with these toys can also develop muscular strength, enhance their meditative abilities, and improve their vision addition. This finding was consistent with the results of Cheraghi, Shokri, Roshanaei, and Khalili (2022) reported that assisting youngsters in developing fine motor skills allows them to engage in eye-hand coordination exercises.

The customer group is inclined to purchase this toy product for their children. The mean value of this tendency is reported as 4.36±0.68. Additionally, it has been observed that the customer demographic exhibits a behavioral inclination to endorse and disseminate information on children's toy goods, hence recommending the items above to others. This tendency was favorable, as shown by a mean value of 4.34±0.65. The results showed that the regression model generated from Quantification theory type I is a categorical multiple regression analysis that could satisfactorily account for the relationship between consumers' emotional impressions and the design of children's toys. In both the "Creativity" and "Attractive" directions, they found that consumers' emotional satisfaction had a favorable impact on newly designed and developed toys. This study thus supports the Kano model and Kansei engineering's potential for promoting the development of toy designs that can meet customers' emotional needs. The results of this study could be advantageous to designers who wish to produce goods that take into account customer moods.

4. Conclusions

Fine motor skills deficiencies might hinder learning, increase anxiety, and lower kid confidence. Thus, fine motor skills development is crucial, which can be aided by play toys. Children's play items should be age-appropriate, emotive, and fine motor skills-focused. According to the research findings, the relationship between consumers' emotional demands and children's toy design is accurately reflected by the quantification theory type I regression model, multiple regression analysis. The emotional research revealed that "Creativity" and "Attractive" had the most emotional resonance with customers. The study also showed that shape, size, color tone, learning, and fine motor play are important design elements. Balance training involves fine motor skills, a key design component influencing the "attractive" sense which is the customers' favorite design. Therefore, it might be useful for developing hand muscles and focus of the children. Another important design element influencing the emotion of "creativity" is the larger size of the children's toy. When the toys are designed with their emotional needs in mind, consumers will be creative and attracted to the products. This research suggests that the Kansei engineering and the Kano model can promote for creation of fine motor skills toys that meet consumers' emotional needs. Additionally, it may serve as a framework to assist designers in creating many other products or toys that fulfill customers' emotional requirements. Parents, educators, or other interested individuals may use the toys acquired from this study to create educational materials to help promote and increase the effectiveness of preschoolers' future development.

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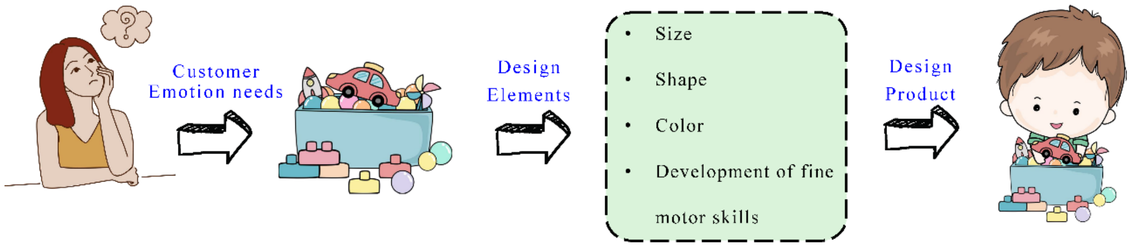

Figure 1 Kansei engineering product design process

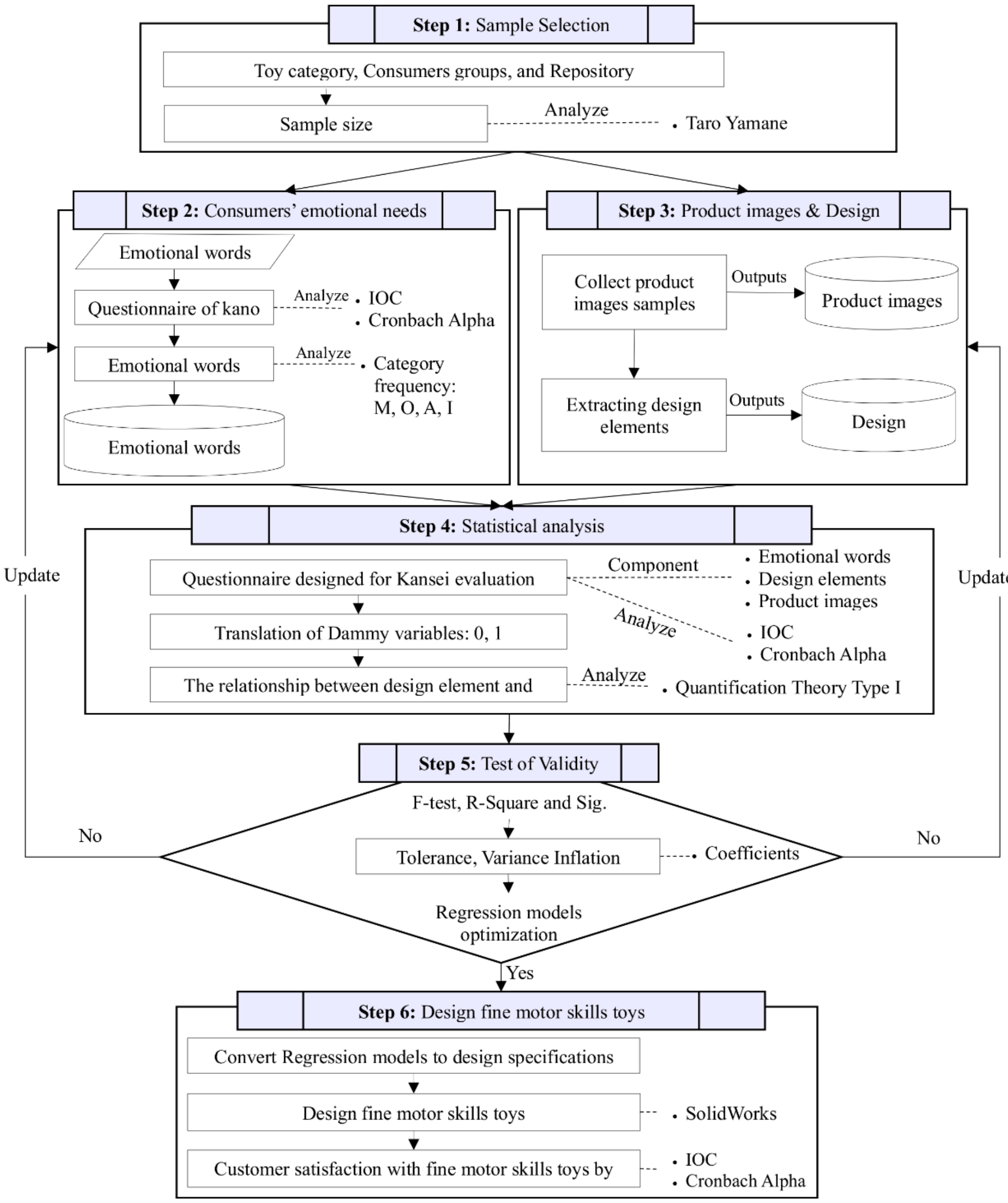

Figure 2 Research framework of design system on Kansei engineering

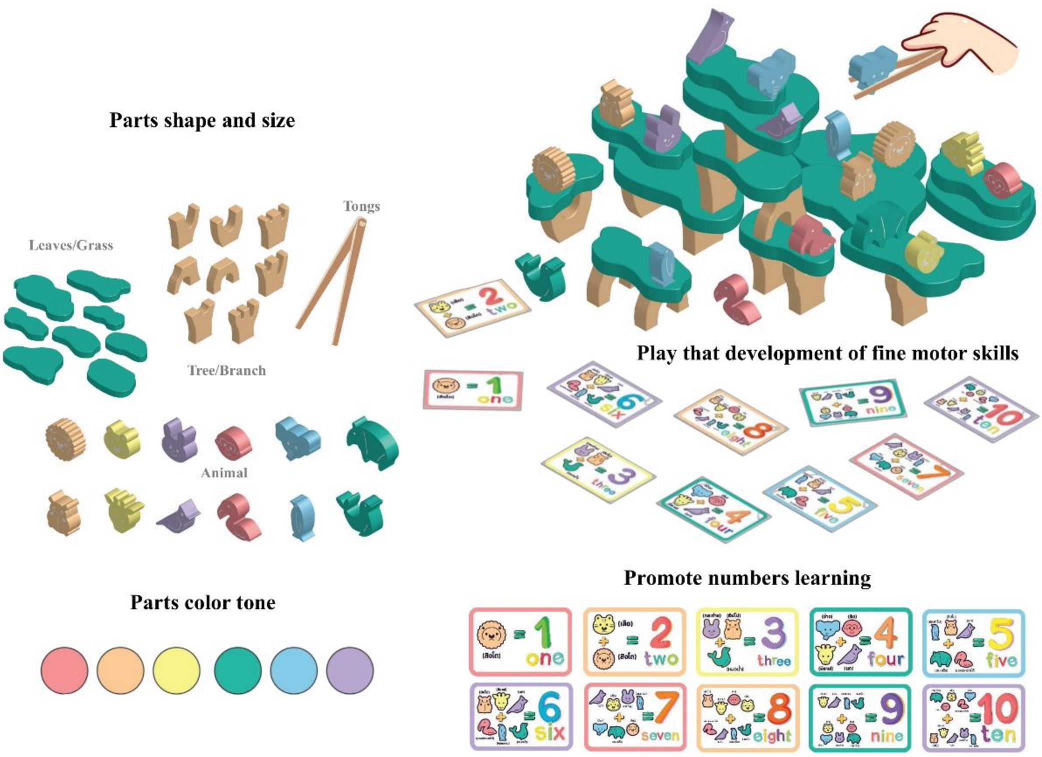

Figure 3 Children's fine motor skills toy set with the name of the toy "Songkhla Zoo Children's Toy Product Set"

No.	Emotional Words	A	O	M	I	R	Q	Total	Final category
1	Beautiful	90	**106**[*]	41	38	0	0	275	O
2	Attractive	**152**[*]	103	15	2	0	3	275	A
3	Safe	121	**126**[*]	19	7	0	2	275	O
4	Creative	**138**[*]	115	8	12	0	2	275	A
5	Impressive	75	**112**[*]	25	62	0	1	275	O
6	Strong and Durable	113	**127**[*]	13	19	0	3	275	O

* The most common type. (highest frequency)

Table 1. The categorization of emotional words

No.	Emotional Words	CS	CD	Si	Di	Maximum weight	Rank
1	Beautiful	0.713	0.535	0.141	0.180	0.180	3
2	Attractive	0.938	0.434	0.186	0.146	0.186	1*
3	Safe	0.905	0.531	0.179	0.179	0.179	4
4	Creative	0.927	0.451	0.184	0.152	0.184	2*
5	Impressive	0.682	0.500	0.135	0.169	0.169	6
6	Strong and Durable	0.882	0.515	0.175	0.174	0.175	5

* Emotional words to select fine motor skill toys

Abbreviations: CS = Customer satisfaction, CD = Customer Dissatisfaction, Si = the significant weight of satisfaction, Di = the significant weight of dissatisfaction

Table 2. Ranking emotional terms by pleasure and dissatisfaction coefficients and weights

Main design elements	Sub design elements	Variables
Parts shape	Trapezoid shaped parts	$X_{1.1}$
	Triangular shaped piece	$X_{1.2}$
	Square shaped parts	$X_{1.3}$
	Rectangular shaped parts	$X_{1.4}$
	Cylindrical parts	$X_{1.5}$
	Cubic piece	$X_{1.6}$
	Free-form parts	$X_{1.7}$
Promoting learning	Promote English language learning	$X_{2.1}$
	Promote vehicles learning	$X_{2.2}$
	Promote numbers learning	$X_{2.3}$
	Promote animals learning	$X_{2.4}$
	Promote Thai language learning	$X_{2.5}$
	Promote color learning	$X_{2.6}$
Play that development of fine motor skills	Playing according to the specified format	$X_{3.1}$
	Playing freely according to your imagination	$X_{3.2}$
	Play where materials around you can be played together	$X_{3.3}$
	Balance training	$X_{3.4}$
	Playing with rope as a play element	$X_{3.5}$
	Playing with tongs/spoon as a play element	$X_{3.6}$
	Playing with cloth/paper as a play element	$X_{3.7}$
Parts size	Small parts (about 1 - 2 centimeters)	$X_{4.1}$
	Medium-sized piece (approximately 2.5 - 4 centimeters)	$X_{4.2}$
	Large piece (about 4.5 - 7 centimeters)	$X_{4.3}$
Parts color tone	Natural color parts from rubber wood	$X_{5.1}$
	Warm parts	$X_{5.2}$
	Cool color parts	$X_{5.3}$
	Pastel color parts	$X_{5.4}$

Table 3. Design elements for fine motor skills toys

Model of Attractive	Unstandardized Coefficients		Standardized Coefficients			Multicollinearity	
	B	Std. Error	Bata	t	Sig.	Tolerance	VIF
(Constant)	4.845	0.041		118.165	0.000*		
$X_{1.4}$	0.069	0.030	0.113	2.299	0.105	0.122	8.168
$X_{1.5}$	-0.365	0.018	-1.037	-20.790	0.000*	0.119	8.429
$X_{1.6}$	-0.676	0.027	-1.323	-25.038	0.000*	0.106	9.454
$X_{1.7}$	0.168	0.017	0.465	9.636	0.002*	0.127	7.870
$X_{2.3}$	0.292	0.015	0.842	19.599	0.000*	0.160	6.243
$X_{3.1}$	-0.166	0.019	-0.445	-8.617	0.003*	0.111	9.025
$X_{3.3}$	-0.319	0.018	-0.919	-17.266	0.000*	0.104	9.588
$X_{3.4}$	.0330	0.014	0.952	23.531	0.000*	0.181	5.540
$X_{3.6}$	-0.082	0.013	-0.232	-6.179	0.009*	0.210	4.766
$X_{4.3}$	0.307	0.014	0.737	21.925	0.000*	0.261	3.827
$X_{5.2}$	-0.320	0.026	-0.628	-12.424	0.001*	0.116	8.642
$X_{5.4}$	0.056	0.013	0.109	4.137	0.026*	0.425	2.353
R = 1.000, R^2 = 0.999, $S.E._{est}$ = 0.01417, F = 178.018*							

*Statistically significant at the 0.05 level

Abbreviations: B = Unstandardized Regression Coefficient, VIF = Variation Inflation Factor

Table 4. Multiple linear regression models for "Attractive."

Model of Creative	Unstandardized Coefficients		Standardized Coefficients			Multicollinearity	
	B	Std. Error	Bata	t	Sig.	Tolerance	VIF
(Constant)	4.788	0.116		41.270	0.000		
$X_{1.4}$	-0.184	0.085	-0.266	-2.169	0.119	0.122	8.168
$X_{1.5}$	-0.292	0.050	-0.732	-5.871	0.010*	0.119	8.429
$X_{1.6}$	-0.510	0.076	-0.882	-6.679	0.007*	0.106	9.454
$X_{1.7}$	0.060	0.049	0.146	1.215	0.311	0.127	7.870
$X_{2.3}$	0.004	0.042	0.009	0.084	0.939	0.160	6.243
$X_{3.1}$	0.047	0.055	0.111	0.864	0.451	0.111	9.025
$X_{3.3}$	-0.017	0.052	-0.044	-0.333	0.761	0.104	9.588
$X_{3.4}$	0.100	0.040	0.254	2.516	0.087	0.181	5.540
$X_{3.6}$	0.156	0.037	0.390	4.161	0.025*	0.210	4.766
$X_{4.3}$	0.189	0.040	0.400	4.763	0.018*	0.261	3.827

Model of Creative	Unstandardized Coefficients		Standardized Coefficients			Multicollinearity	
	B	Std. Error	Bata	t	Sig.	Tolerance	VIF
$X_{5.2}$	0.002	0.073	0.003	0.026	0.981	0.116	8.642
$X_{5.4}$	-0.029	0.038	-0.050	-0.767	0.499	0.425	2.353
$R = 0.997$, $R^2 = 0.994$, $S.E._{est} = 0.04009$, $F = 28.406^*$							

*Statistically significant at the 0.05 level

Abbreviations: B = Unstandardized Regression Coefficient, VIF = Variation Inflation Factor

Table 5. Multiple linear regression models for "Creative"

Main design elements	Sub design elements
1. Parts shape	Free-form parts
2. Promoting learning	Promote numbers learning
3. Play that development of fine motor skills	Balance training
	Playing with tongs/spoon as a play element
4. Parts size	Large piece (about 4.5 - 7 centimeters)
5. Parts color tone	Pastel color parts

Table 6. Product design requirements fine motor skills children's toys

Customer satisfaction		Average	Standard deviation
Emotional words	Attractive	4.39	0.58
	Creative	4.46	0.57
Design elements	Free-form parts	4.40	0.60
	Promote numbers learning	4.43	0.58
	Balance training	4.49	0.58
	Playing with tongs/spoon as a play element	4.41	0.58
	Large piece (about 4.5 - 7 centimeters)	4.32	0.59
	Pastel color parts	4.44	0.60
Behavior trends	When you see children's toy products and study the details of such products, you have	4.36	0.68

Customer satisfaction	Average	Standard deviation
decided to purchase this toy product for your child.		
After you have seen or purchased this children’s toy product, You would like to recommend and tell others about this children’s toy product.	4.34	0.65

Table 7. Customer satisfaction with emotional needs, design elements, and behavior trends in buying toys