MODESTUM
OPEN ACCESS
EURASIA Journal of Mathematics, Science and Technology Education
ISSN: 1305-8223 (online) 1305-8215 (print)
2018 14(4):1189-1195 DOI: 10.29333/ejmste/81119

A Study on the Correlations among Product Design, Statistics Education, and Purchase Intention – A Case of Toy Industry

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Received 10 September 2017 ▪ Revised 10 November 2017 ▪ Accepted 12 December 2017

ABSTRACT

Being affected by the rapid change in internal and external environments in past years, the fiercer competition has resulted in the declination of toy industry. For the sustained-yield management, toy manufacturers have been searching for strategies. In the consumer-oriented era, an enterprise has to precede statistics education of toy designers so that the market survey could accurately analyze consumer needs to establish differential products for creating product value and meeting consumer needs. The supervisors, employees, and customers of Traxxas are the major research subjects for the questionnaire survey in this study. Total 300 copies of questionnaire are distributed and 236 valid copies are retrieved, with the retrieval rate 79%. The research results reveal significantly positive correlations between 1.product design and purchase intention, 2.statistics education and product design, and 3.statistics education and purchase intention. According to the results, suggestions are proposed, expecting to assist domestic toy manufacturers in the future development of product design for the sustained-yield management.

Keywords: product design, statistics education, purchase intention, toy industry

INTRODUCTION

Being a profound industry in Taiwan, toy industry presented slight basis in the Japanese colonial period and started to boom. Under the government's promotion of export industry, toy industry gradually progressed and replaced Japan to become "Toy Kingdom". The rapid change in internal and external environments impacted toy industry and enhanced the competition that it presented declination in past years. To maintain the survival, toy manufacturers considered cost-oriented orders, where product quality was maintained while the investment in own brand was weak, so that toy industry in Taiwan entered the dark period. To correspond to the environment for sustained-yield management, toy manufacturers stressed on searching for strategies and constantly considered to update. In the consumer-oriented era, the adjustment of organization to cope with changeable customer needs is the goal of business management. In this case, to satisfy customer needs becomes the major consideration for making business strategies as well as the key success factor. To cope with the change of consumer needs, an enterprise has to seek for new product design strategies to establish differential products, create product value, and meet consumer needs. Wang (2015) considered that design could provide the most potential differentiation and positioning for products and services. In the fast-paced market, the advantages of price and technology were inadequate, while design was the key factor in the competitive advantage of a company.

Zhou et al. (2014) indicated that perfect evaluation and clarification could shorten the difference between product image design and consumer cognition and result in win-win for enterprises and consumers. For instance, Target regarded product design as a key competition strategy of an enterprise that the success of product design and business strategy had Target receive the support and identification of Wall Street, designers, and consultants. For this reason, the key of product design was to meet consumer favor and become an important competitive advantage and strategy in product differentiation for enterprises. Product design is therefore closely related to consumer behavior. It is expected to meet consumer needs by discussing consumer concept of product design to further understand consumers' cognition differences in mind and action and then shorten the differences.

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Contribution of this paper to the literature

- The prototype product is operated and adjusted according to the data acquired from statistics education; and, users can be invited to experience the product in order to directly observe the use of the toy product and then make adjustment with such statistical data.
- A toy manufacturer might not have real products, but the shape could be designed or the consistent brand idea could be put in intangible products, e.g. colors to highlight the brand style or service matching the brand idea, to promote product value and enhance consumers' purchase intention.
- In addition to market survey, statistics education aiming at toy designers could have them accurately analyze consumer needs to design relevant toy products.

LITERATURE REVIEW

Product Design

Product refers to anything available for purchase, use, notice, or consumption in the market to satisfy consumer desire or needs. General products are not simply the sets composed of tangible product attributes, but products being sold in the market, including physical products, services, experience, events, characters, locations, belongings, organizations, information, and ideas (Chowdhury et al., 2014). Since industrial revolution, the progress of design has been the transformation between industry and art. Designers work hard to seek for the adaptability between the two in order to pursue new creativity and guide human lifestyles toward design styles and trend. Parameshwaran et al. (2015) regarded design as the overall features of products requested by consumers, which would influence product appearance, features, and problem-solving. Lee (2014) proposed product design as a creative strategy to help an enterprise acquire competitive advantages in the market. In this case, product design was the key success factor in the market that it could not only attract consumer attention, but could also clearly communicate with consumers to promote product value. Go et al. (2015) included human-factors engineering in product design. Napoli et al. (2014) divided the specific functions of design as product properties, human-factors engineering, and appearance aesthetics delivery. Homburg et al. (2015) stated that product design played an important role in the communication of product use and operation procedure with consumers as it was the mutual arrangement and match of product configuration and elements to enhance the functional and economic pleasure of products. Accordingly, the idea of human-factors design is introduced to product design to emphasize the interaction between people and products and is a critical factor in consumers' operation and use.

Referring to Chien et al. (2015), the following dimensions are used for product design in this study.

(1) Functionality: The functionality of product design lies in presenting the shape and configuration of an object and deciding the use of the object.

(2) Communication: Communication refers to assist people in explaining the function and the operation or use of an object through visualization and imagery in order to enhance the interaction between people and products.

(3) Aesthetics: Design aesthetics refers to consumers' aesthetic response to product appearance. Aesthetic response is defined as the interactive response between the object appearance (features and configuration) and consumers' perception of the object.

Statistics Education

Statistics is the idea and method for collecting and explaining the data of specific research or survey and extracting conclusions from uncertainties and variations (Fuchs et al., 2015). Statistics, as the science to comprehend the real world through the information acquired from classification and measurement, presents the feature to specifically deal with variability and uncertainty (Kuo & Li, 2014). Statistics is to find out information from data for making the conclusion (Altin et al., 2014). Statistics education aims to systematically organize and analyze data to understand the phenomena (Philip, 2013). Lee et al. (2015) contained basic statistics knowledge and basic statistics skills in statistics education, such as being able to organize and classify data, to make statistics tables with classified data, to calculate the mean and the mode, to draw a bar chart or a broken line graph with statistical data, to read statistical charts, and to know that a longer figure in a bar chart stood for more or larger value. Vincent & Blandford (2015) indicated that statistics education covered to know the mean and the mode as the representatives of population as well as the abstract meanings of statistical nouns, to understand the phenomena with the information in statistical charts or statistical figures, to extract meaningful information from statistical charts for analysis,

explanation, and criticism, to understand the change surrounding the life by explaining statistical charts, and to precede reasonable predictions of uncertain situations (Yen et al., 2014).

Referring to Guo et al. (2016), the dimensions of organization, description, presentation, and analysis are used for data processing in this study.

(1) Description: To read data, to display necessary information of diagrams (e.g. title and coordinate axis mark), to be aware of displaying the same data with different charts, and to evaluate such different display of the same data.

(2) Organization: To classify and organize data to understand that some information might be lost after reorganization, to describe data with classical or representative methods, and to describe the distribution of data.

(3) Presentation: To complete parts of constructed data diagram to display the same dataset with different charts.

(4) Analysis: To analyze, compare, or combine data (interpretation among data) to further induce and predict the data (interpretation beyond data).

Purchase Intention

Ghamisi and Benediktsson (2015) defined consumer behavior as human behaviors to directly participate in the acquisition and use of goods, including various decision-making processes to decide such behaviors. Starting from stimulus response model, marketing stimulus and other stimulus enter consumers' consciousness and combine with consumers' features in the psychological process to guide the purchase decision-making process and the actual purchase behavior. Four major psychological operation processes contained motivation, cognition, learning, and memory (Kuo & Li, 2017). Niclas (2015) considered that intention could be used for predicting behaviors; as a result, consumers' purchase intention was used for predicting purchase behavior in practice. Purchase behavior was psychologically a decision-making process (Balta-Ozkan et al., 2013). Halder et al. (2016) regarded purchase intention as to measure the possibility of a consumer purchasing certain products, i.e. the consumer's inclination for a product. Once consumers appeared needs, they, under the drive of need satisfaction, would search for relevant information, according to the experience and external environment. After collecting sufficient information, they would precede evaluation and consideration and decide to purchase certain products after a series of comparisons and judgment. It was the "purchase decision-making process" of consumers (Tylor, 2016). Rashedi et al. (2015) measured purchase intention with the time for a consumer being willing to purchase a product; immediate intention of purchase stood for extremely strong purchase intention, purchase after 1 year represented moderate purchase intention, and purchase after 3 years stood for weak purchase intention. Mysen (2015) measured purchase intention with the time for searching product data, the priority of product trial, and the priority of use.

With literature review, (1) possible purchase, (2) intention of purchase, and (3) consideration for purchase, proposed by Zhang et al. (2017), are applied to measure purchase intention, and the questions are used for the dimensions of consumers' purchase intention in this study.

Research Hypothesis

Soesanti and Syahputra (2016) mentioned that consumers, when the product design conformed to the need, would be satisfied and memorize the product satisfaction for the reference of future purchase decision. On the contrary, consumers, when being dissatisfied, would appear cognition gap on a product to influence the next purchase behavior. At the evaluation stage, when consumers completed search and acquired enough information, they would evaluate the optimal choices and make decisions. The evaluation standard was the expected result from the viewpoints of consumption and purchase to further present on the preferred product attributes (Yen et al., 2014). In other words, Chien et al. (2015) indicated that the data search and evaluation stage required the match between product designers and consumers; product designers had to perceive consumers' preference and needs for product attributes so as to design consumers' favored products and enhance consumers' purchase intention to be willing to purchase such products (Chowdhury et al., 2014). Accordingly, the following hypothesis is proposed in this study.

H1: Product design shows significantly positive correlations with purchase intention.

Guo et al. (2016) mentioned that an enterprise would make multiple criteria of decisions when determining a design case. The decision-making indicators were set by supervisors of the company and related designers, according to individual aesthetic or subjective awareness. Such a non-objective reference was lack of systematic analyses for the judgment that the enterprise could easily make wrong judgment and lose profits. For this reason, statistics education was necessary for the analysis with objective data in order to understand consumers' purchase intention and precede product design aiming at professional statistical analysis results (Philip, 2013). Wang (2015)

made a complete objective product evaluation model as the key factor in designing new products. Vincent & Blandford (2015) stated that a product designer had to pay attention to the product function being able to satisfy consumer needs; professional statistics education was therefore required for definite analyses. Moreover, the adverse influence of product design on consumers' use should be analyzed; it specifically explained the close relationship between product design and statistics education (Lee et al., 2015). Apparently, the features of a product design are greatly related to statistics education. The following hypothesis is therefore proposed in this study.

H2: Statistics education reveals remarkably positive correlations with product design.

Yim et al. (2014) indicated that the changing industry resulted in various products being promoted in short period; besides, the import of foreign products also rapidly had the market competition become fierce that manufacturers encountered larger challenges. Halder et al. (2016) mentioned that, in addition to new products, consumer preference and needs should be understood; understanding market structure was also a consideration. To understand market structure, market survey and the analysis were necessary that statistics education was required for definitely interpreting the market survey results and realizing consumers' purchase intention, preference and needs. Zhou et al. (2014) indicated that reducing R&D costs for products, promoting products easily accepted and favored by consumers, and extending the life cycle of products became the major considerations of an enterprise surviving among various competitors. To understand the products easily accepted and favored by consumers, statistics education was required for definitely analyzing consumers' purchase intention (Kuo & Li, 2017). Consequently, the following hypothesis is proposed in this study.

H3: Statistics education presents notably positive correlations with purchase intention.

SAMPLE AND INDICATOR

Research Sample and Object

Toy industry in Taiwan is the major research object in this study, and the supervisors, employees, and customers of Traxxas are proceeded the questionnaire survey. Total 300 copies of questionnaire are distributed, and 236 valid copies are retrieved, with the retrieval rate 79%. Traxxas has professionally designed and produced high-quality electric radio controlled and engine model cars, boats, engines, and radio controllers for 35 years and the sales in the USA is ranked on the top. The major products contain radio controlled cars, electric boats, engine cars, engine boats, engines, 1/10th engine cars, 1/5th engine cars, 1/6th engine cars, 1/10th electric cars, and engines.

Reliability and Validity Test

The questions used for the questionnaire survey are referred to domestic and international researchers, and a pretest is preceded before the formal questionnaire that the questionnaire presents certain content validity. The overall structure causal relationship among product design, statistics education, and purchase intention is tested in this study. The linear structure relations model analysis shows that the overall model fit achieves the reasonable range that it presents good convergent validity and predictive validity. Item-to-total correlation coefficients are used for testing the construct validity of the questionnaire, i.e. reliability analysis, in this study. The acquired item-to-total correlation coefficients are used for judging the questionnaire content. The item-to-total correlation coefficients of the dimensions in this study are higher than 0.7, revealing certain degree of construct validity.

Reliability analysis is further proceeded to understand the reliability of the questionnaire. According to the standards to develop the formal questionnaire, the measured Cronbach's α reliability appears in 0.80~0.92, obviously conforming to the reliability range.

EMPIRICAL ANALYSIS

LISREL Model Indicator

LISREL (linear structural relation) model combines factor analysis and path analysis in traditional statistics and is added simultaneous equations in econometrics that it could calculate multi-factors and multi-causal paths. In regard to the evaluation of model fit, it could be evaluated from preliminary fit criteria, overall model fit, and fit of internal structure of model.

The data are organized as below. The preliminary fit criteria, fit of internal structure of model, and overall model fit are explained as followings.

From **Table 1**, three dimensions of product design (functionality, communication, and aesthetics) could significantly explain product design ($t>1.96$, $p<0.05$), the four dimensions of statistics education (description, organization, presentation, and analysis) could remarkably explain statistics education ($t>1.96$, $p<0.05$), and three

Table 1. LISREL model analysis

Evaluation item	Parameter/evaluation criteria		Result	t
preliminary fit criteria	product design	functionality	0.733	10.68**
		communication	0.691	8.21**
		aesthetics	0.683	7.66**
	statistics education	description	0.722	9.94**
		organization	0.716	9.25**
		presentation	0.704	8.73**
		analysis	0.736	11.42**
	purchase intention	possible purchase	0.747	12.37**
		intention of purchase	0.751	12.65**
		consideration for purchase	0.739	11.96**

Note: * stands for p<0.05, ** for p<0.01, *** for p<0.001

Table 2. LISREL model analysis

Evaluation item	Parameter/evaluation criteria	Result	t
fit of internal structure of model	product design → purchase intention	0.864	23.58**
	statistics education → product design	0.896	29.66**
	statistics education → purchase intention	0.824	18.75**

Note: * stands for p<0.05, ** for p<0.01, *** for p<0.001

Table 3. LISREL model analysis

overall model fit	X2/Df	1.872
	GFI	0.974
	AGFI	0.927
	RMR	0.004

Note: * stands for p<0.05, ** for p<0.01, *** for p<0.001

dimensions of purchase intention (possible purchase, intention of purchase, and consideration for purchase) could notably explain purchase intention (t>1.96, p<0.05). Apparently, the model presents favorable preliminary fit criteria.

From **Table 2**, product design shows positive and significant correlations with purchase intention (0.864, p <0.01), statistics education reveals positive and remarkable correlations with product design (0.896, p <0.01), and statistics education appears positive and notable correlations with purchase intention (0.824, p <0.01) that H1, H2, and H33 are supported.

From **Table 3**, the overall model fit standards $\chi 2/Df=1.872$, smaller than the standard 3, and RMR=0.004, showing the proper results of $\chi 2/DF$ and RMR. Furthermore, chi-square value is sensitive to sample size that it is not suitable for directly judging the fit. However, the overall model fit standards GFI=0.974 and AGFI=0.927 achieve the standard 0.9 (the closer GFI and AGFI to 1 reveals the better model fit). This model therefore presents better goodness-of-fit indicators.

CONCLUSION

In order to cope with rapidly changing consumer needs in the globally changeable environment, toy manufacturers have to establish and create product value with differential product design to satisfy consumer needs. The research results show that the product design features of functionality, communication, and aesthetics present positive relations with consumers' purchase intention. In this case, consumers, when purchasing daily necessities, agree with the positive relations between such three product design features and purchase intention. The product design features of functionality, communication, and aesthetics should be taken into account of the product design process when product designers or product developers developing product design. First, toy designers should receive statistics education to discuss the functionality, which would mostly influence consumers' purchase intention, as the design consideration. Second, toy designers should have statistics education to discuss the product design with communication. Finally, aesthetics is added in the product design. It would enhance consumers' purchase intention to further promote the new product design performance of a toy manufacturer.

SUGGESTION

From the important research results and findings, practical suggestions are proposed as below.

1. The design tactic of a toy manufacturer would directly affect the corporate style. When a toy manufacturer intends to establish product identification in complicated products, the extension of design tactic and classification could systematically design the same products favored by consumers and add different design tactics to different products for the discrimination. A toy manufacturer might not have real products, but the shape could be designed or the consistent brand idea could be put in intangible products, e.g. colors to highlight the brand style or service matching the brand idea, to promote product value and enhance consumers' purchase intention.
2. When designing toy products, a toy manufacturer has to apply statistics education to understand the proportion, user sense, and use importance. In addition to consider the aesthetic design, a designer has to pay attention to the usability of operation, the comfortable grasp, the convenient use, and the proportion of the toy product appearance. Moreover, the prototype product is operated and adjusted according to the data acquired from statistics education; and, users can be invited to experience the product in order to directly observe the use of the toy product and then make adjustment with such statistical data.
3. From the practical design of toy products, it is realized that distinct appeal would result in different production processes and crafted products are largely different from mass-production goods. In this case, toy designers, when not being aware of consumer needs during the product design, might easily design the product different from consumer needs. As a result, in addition to market survey, statistics education aiming at toy designers could have them accurately analyze consumer needs to design relevant toy products.

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