THE FIVE-FACTOR MODEL OF SANDAL DESIGN

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Received: 15.01.2025 Accepted: 24.02.2025 https://doi.org/10.24264/lfj.25.1.2

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ABSTRACT. The growth of the sandal market in Thailand is on the decline, with purchase behavior changing among young consumers. As a result, the factors of sandal design are currently changing as well. The objective of this research was to study the factors of sandal design using a quantitative method. The data were collected from 400 Gen-Z consumers aged between 18-27 years old in Bangkok, Thailand, obtained by multi-stage sampling. A self-administered online survey questionnaire with a structured interview was used. The data were analyzed by exploratory factor analysis (EFA) and confirmatory factor analysis (CFA). The results revealed 5 factors of sandal design that meet the needs of Gen-Z consumers, i.e., aesthetic, functionality, symbolism, ergonomics, and innovation. Innovation was found to be the factor that most affected sandal design. According to the results, these factors can be applied to set a strategic plan for more efficient sandal design, which would be useful for product designers, manufacturers, and marketers of the sandal industry in Thailand.
KEY WORDS: sandal design, innovation, ergonomics, functionality, aesthetic, symbolism

MODELUL CELOR CINCI FACTORI APLICAT ÎN DESIGNUL SANDALELOR

REZUMAT. Dezvoltarea pieței de sandale din Thailanda cunoaște o scădere, comportamentul de cumpărare schimbându-se în rândul consumatorilor tineri. Drept urmare, și factorii care stau la baza designului sandalelor se schimbă în prezent. Obiectivul acestei cercetări a fost de a studia factorii care stau la baza designului sandalelor folosind o metodă cantitativă. S-au colectat date de la 400 de consumatori din generația Z (Gen-Z) cu vârsta cuprinsă între 18-27 de ani din Bangkok, Thailanda, obținute prin eșantionare în mai multe etape. S-a utilizat un chestionar online autoadministrat cu un interviu structurat. Datele au fost analizate prin analiză factorială exploratorie (EFA) și analiză factorială confirmativă (CFA). Rezultatele au evidențiat 5 factori ai designului sandalelor care răspund nevoilor consumatorilor Gen-Z, și anume estetică, funcționalitate, simbolism, ergonomie și inovație. Inovația s-a dovedit a fi factorul care a afectat cel mai mult designul sandalelor. Conform rezultatelor, acești factori pot fi aplicați pentru a stabili un plan strategic pentru un design mai eficient al sandalelor, care ar fi util pentru designerii de produse, producătorii și comercianții din industria de încălțăminte din Thailanda.
CUVINTE CHEIE: design sandale, inovație, ergonomie, funcționalitate, estetică, simbolism

LE MODÈLE À CINQ FACTEURS APPLIQUÉ À LA CONCEPTION DE SANDALES

RÉSUMÉ. Le développement du marché des sandales en Thaïlande connaît un déclin, le comportement d'achat des jeunes consommateurs étant en train de changer. En conséquence, les facteurs sous-jacents à la conception des sandales sont également en train de changer actuellement. L'objectif de cette recherche était d'étudier les facteurs sous-jacents à la conception des sandales en utilisant une méthode quantitative. Les données ont été collectées auprès de 400 consommateurs de la génération Z (Gen-Z) âgés de 18 à 27 ans à Bangkok, en Thaïlande, obtenues grâce à un échantillonnage à plusieurs degrés. Un questionnaire en ligne auto-administré avec un entretien structuré a été utilisé. Les données ont été analysées par analyse factorielle exploratoire (AFE) et analyse factorielle confirmatoire (AFC). Les résultats ont mis en évidence 5 facteurs de conception de sandales qui répondent aux besoins des consommateurs de la génération Z, à savoir l'esthétique, la fonctionnalité, le symbolisme, l'ergonomie et l'innovation. L'innovation s'est avérée être le facteur qui a le plus influencé la conception des sandales. Selon les résultats, ces facteurs peuvent être appliqués pour établir un plan stratégique pour une conception de sandales plus efficace, qui serait utile aux concepteurs de produits, aux fabricants et aux détaillants de l'industrie de la chaussure en Thaïlande.
MOTS CLÉS : conception de sandales, innovation, ergonomie, fonctionnalité, esthétique, symbolisme

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INTRODUCTION

Sandals are a product with high competition in terms of price, quality, and design. Because they are a fashion product, there are a large number of similar products in the same market [1]. In Thailand, the sandal market accounts for approximately 273 million USD, categorized into sandals of core brands at 60%, while sandals of minor/no brand, and multinational companies make up 40%. Despite intense competition, sandals are products with good profits when compared with other types of footwear. Therefore, many new brands are entering the sandal market, both Thai and international brands [2]. The supporting factors for the growth of the sandal industry include accepted product standards, cost advantage for internal acquisition of materials, quality, and experienced labor. Besides, Thailand also gets privileges from the Free Trade Area (FTA) with 16 ASEAN member countries, i.e., China, Japan, South Korea, Hong Kong, Australia, New Zealand, and Chile. These countries offer exemptions from import duties for Thailand in all items, i.e., rubber/plastic sandals, leather sandals, and those made of woven materials. Out of the total exports, 64% of sandals are exported from Thailand to the FTA's trading partners. According to rankings, Thailand is the 8th country in the world for sandal export, behind China, the EU, Vietnam, Turkey, the UK, Indonesia, and Brazil [3]. However, according to the 5-year retrospective data of sandal export from Thailand Textile Institute, it was found that the total export between 2019-2023 was equal to 110.7 (+9.2%), 86.8 (-20.0%), 89.8 (+3.5%), 93.2 (+3.8%), and 81.0 (-13.1%) million USD. More specifically, the export value in 2023 was lower than in 2020 during the COVID-19 outbreak [4]. Apparently, the growth rate of the Thai sandal market is declining continuously, partly due to economic conditions with a slow recovery rate because Thai consumers buy 0.7 pairs of sandals/per year on average [2]. Change in consumer behavior is also another reason for this incidence.

The purchase behavior of sandals has changed from the past. Market competition is higher because there are numerous brands in the sandal market, facilitating more opportunities for consumers to select their preferred sandals based on shapes, styles, brands, and colors; more varied distribution channels is another factor. Because of their characteristics as fragmented markets, small and international brands emerge, causing little or no brand loyalty among consumers [2]. Particularly, this is the era of rapid changes among consumers in terms of behavioral factors, needs, expectations, health concerns, and social aspects. Rapid changes due to several factors affecting purchase decisions involve more details. Consumers themselves also adapt to deal with changes in the world all the time. Therefore, consumers in this era mainly focus on value and new experiences.

Younger consumers are also paying attention to social and environmental sustainability as one of the principles for decision-making among the new generation [5]. This always results in consumer behavior change. Therefore, sandal design is necessary to meet this rapid change in order to increase more opportunities for access to each group of consumers. Product design is currently more important, with opportunities to connect with success in sandal design for distribution to the market. The product design process is a key part of the sustainable growth of the shoe industry [6] because consumers have changed their focus from price to impression with product shapes. It is no wonder why some companies rely on attractive product design as a key strategy for competitive advantage to create distinctiveness for their products and thus attract consumers [7, 8], as well as to standardize product assessment [9]. According to previous studies, the factors of product design were used to study consumer behavior [10-12], e.g., purchase decision, word of mouth [13], brand preference [9, 14], intention to use, and purchase [15]. Insightful studies on consumer behavior are usually found in research related to electronic equipment and office supplies. So far, however, there have been no studies focused on any factors that affect the purchase behavior of sandals.

The lower growth rate of the sandal market in Thailand and change in purchase behavior among young consumers impact the small entrepreneurs in Thailand who fail to

adapt or understand consumer needs toward sandals at present and in the future. In addition, studies that aim to understand the factors of sandal design in Thailand are still quite limited. Therefore, the objective of this article was to study the factors of sandal design, which will be useful for product designers and entrepreneurs who can apply the factors obtained to design quality sandals for adapting to the trend of current and future consumer change. Other than this, the results of this research will generate advantages and increase opportunities for entrepreneurs of small and medium enterprises (SMEs), who can apply these design factors to create strengths and competitive advantages in the domestic market or to expand the export market to other countries in the future. That is because the sandal market is likely to increase further as sandals are a basic need in the daily lives of consumers of all groups, genders, and ages.

LITERATURE REVIEW

Characteristics of Shoe Design

The literature review of this study started with the application of a systematic review (SR) (Figure 1) to investigate sandal design characteristics. The review revealed that there have been no studies conducted specifically on the design of sandals. Therefore, studies on other types of shoes were used as the criteria instead, with the scope of the SR as follows: 1) the goal and the results of the SR were aimed at the investigation of shoe design characteristics; 2) only research articles were included, with the search conducted using Mendeley with the keywords for searching including " shoe" and "footwear;" 3) the articles were published and publicized in open access international journals with full text; 4) the articles were published in English only and publicized during 2019-2022 and were the most relevant articles, searched for from 4 to 18 January 2023 for the SR. Consequently, 28 articles met the selection criteria for the SR scope. Then, the relationships of these articles were examined in order to categorize the shoe design characteristics. Similar characteristics were used for the primary categorization, which resulted in a total of six categories, i.e., shoe characteristics, usage characteristics, material properties, manufacturing technology, foot proportions, and aesthetics.

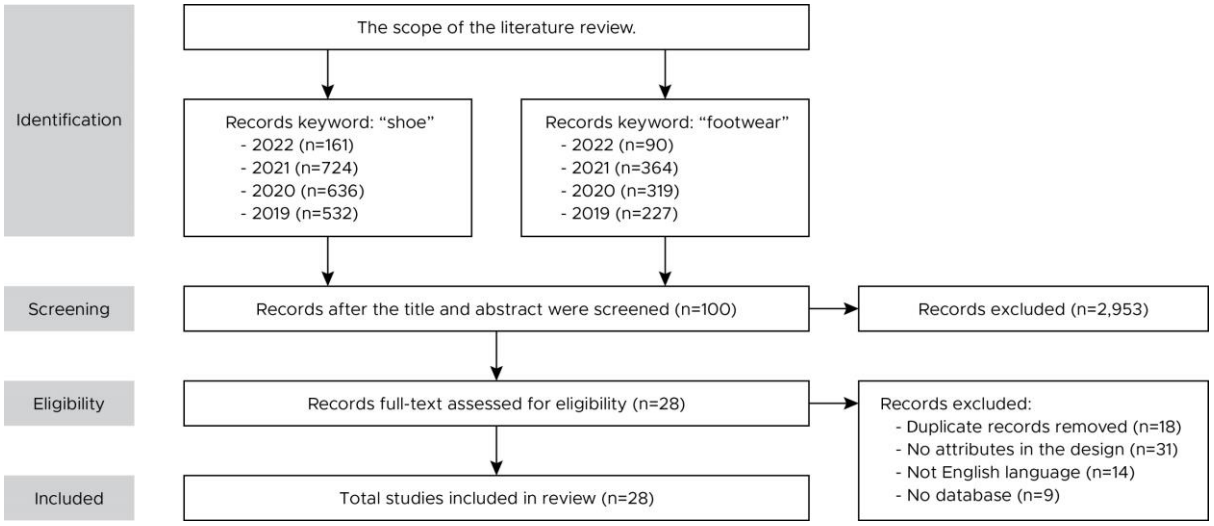

Figure 1. Schematic diagram on literature review process

Shoe Characteristics

Proper fit and comfort are the key characteristics that must be considered as they are significant for shoe design [16-26]. When considering proper fit, it was found that the lengths and widths of the designed shoes did not the fit foot proportions of the sample group [17, 19, 20, 25, 27]. For this reason, a new standard of shoes was set to fit their foot

proportions [28], i.e., heel heights = 14-32 mm, midsoles = 10-15 mm, and the difference of thickness between forefoot and heel-to-toe drop = 4-12 mm. [30]. Regarding comfort, it was found that lightweight shoes with proper fit and soft insoles were generally comfortable. In fact, wearing comfort is not only influenced by shoe design but also the anatomical or physiological differences of each individual and their activities [18]. Foot shapes with suitable proportions will result in the proper fit and comfort of shoes.

Usage Characteristics

Shoes are indispensable to protect feet from injuries. Usage characteristics of shoes vary, depending on the age range of the users, i.e., children [24], middle-aged people, and older adults [17]. Healthy users require comfortable shoes that allow for efficient movements [17, 18, 23]. Patients need suitable shoes to facilitate walking [19, 25, 31]. Older adults need shoes that can enhance their safety while walking and prevent falls [27, 32]. Shoes that are easy to put on and take off and convenient for general users [16], including older adults and patients with gout, are necessary [17, 25]. Wearing durations are a risk factor of athlete's foot [33] and may possibly cause disorders of the muscular system, hip bone, knees, and feet [22]. Therefore, shoe maintenance, durability, and material selection for shoe manufacturing are highly required [16, 33, 34].

Material Properties

Properties of the materials for shoe manufacturing must also be considered. A shoe basically consists of two main parts, i.e., upper and sole. Flexible upper materials generate wearing comfort [18, 24]. However, a long duration of wearing may cause athlete's foot due to the conditions inside shoes, e.g., temperature, moisture, and ventilation. Therefore, the materials used must be capable of absorption or ventilation [18, 30, 33]. A shoe sole is divided into three parts, i.e., insole, midsole, and outsole. Soft and flexible midsoles reinforce wearing comfort [16, 18, 22, 36]. However, they should not be too soft because this can be harmful to body balance and increase the risk of falls. Thus, suitable insole thickness (10 mm) brings better body balance and reduces the risk of falls in older adults [17]. Adding flexible supportive materials for impact absorption of heels [16, 17, 37] helps to reinforce shoe heels, resulting in wearing comfort because high pressures usually occur at the heel while walking or standing [22]. These supportive materials can also relieve foot pain [36]. Midsoles reduce impacts while walking [17, 30, 38]. Impact absorption from shoes is mostly affected by the materials used, which can prevent injuries [26, 34]. Lastly, outsoles must prevent slipping [16, 18]. Therefore, the outsole pattern design must be seriously considered because it directly affects shoe adherence efficiency [17, 35]. Falls in older adults can be caused by inferior outsole materials [26, 27]. Furthermore, shoe material improvement and development should be eco-friendly [6].

Manufacturing Technology

This refers to the modern manufacturing technology [39] for manufacturing capabilities in industry and for commercial trade [6]. Shoe design should give consideration to innovation as well. That is because apart from quick prototype designs, it can also shorten the manufacturing process. There are two main types of technology and innovation development, i.e., 3D printing and 3D scanning. To describe, 3D printing is used for shoe prototype design [6, 16]. Supportive heel materials are made of thermoplastic polyurethane (TPU) for greater wearing comfort [37]. Orthopedic inserts can be used for pain relief [36]. Robots can be employed for the gluing process in shoe assembly [39]. As for 3D scanning, it is used to measure foot sizes of different proportions because it can generate the most reliable and precise data [28, 29]. However, technology and innovation development require close cooperation with related experienced agencies [6, 29].

Foot Proportions

Foot shapes generally change with age. Therefore, shoe sizes must be adjusted to suit and fit the foot proportions of users at all ages, i.e., children, adults, and older adults [28]. The differences in foot proportions must also be considered by sex in each particular region [29]; along with foot proportion

measurement at four positions, i.e., foot length, foot width, heel width, [20, 28, 29], and instep height [29]. Simultaneously, foot arch types must not be neglected because this affects wearing comfort, with sensitivity of foot pain while walking or running [17, 18]. Furthermore, working in a standing position for a long duration will cause painful foot soles. The most common painful spots include the foot arch, forefoot, and heel [22].

Aesthetics

Currently, in addition to the shoes sold for foot protection, they can also be designed and developed into fashion products [16, 19, 24, 25]. Design is a crucial element in all businesses because it adds product value. Likewise, fashion design such as for shoes/footwear is a type of communication that requires creativity through the presentation methods for tangibility in the form of the products, i.e., applying inspiration or design concepts, forms, patterns, colors [16, 25, 40], packaging, tailoring [16], material selection, manufacturing processes, marketing, and the tastes/preferences of each gender [17, 33] in order to create unique identities that are distinct from the traditional ones. Creativity also includes the other clothing on the body with styles that perfectly match the fashion trends of a certain time and the stories or reflected emotions behind those shoes. These are all elements that are available to create positive feelings toward the designed shoes [6, 16].

Based on the investigation on the shoe design characteristics of all six categories related to usage characteristics and shoe components for wearing comfort; along with the study of Lamb and Kallal [41], who suggested a consumer model with three needs: Functional, Expressive, and Aesthetic (FEA), this model leads to the various design criteria for consumers and focuses on consumer needs in order to be developed further into a conceptual framework of clothing design. Similarly, Orzada and Kallal [42] suggested that the FEA model is flexible as it can also be applied to clothing products or all types of fashion products. Tian *et al*. [43] applied the concept of the FEA model as a conceptual framework of the design for Chinese older adults based on three factors, i.e., older adults, footwear, and the usage scenario. They mainly considered the needs and the usage situations of the sample as a guideline along with the rules for setting product design, which finally affected the product shapes and forms. Based on the SR and the results of all the research studies as stated, they were implemented for determining the conceptual framework sandal design with three key components, i.e., consumers (functional, aesthetics, and symbolism), feet in terms of the shapes with suitable proportions (ergonomics), and sandals (structure, properties, and manufacturing technology). These three components are fully required for innovation creation. To apply the conceptual framework as aforementioned, the designers must have flexible ideas in order to combine all of the components appropriately at the design step.

Product Design Dimensions

During the past several years, the word “design” has been defined in various ways, starting from a determination to solve problems and to meet consumer needs according to user-based viewpoints [44-46], with the objective to achieve the normative roles of design [47]. Regarding the factors of industrial product design, Homburg *et al*. [13] stated that product design is a source of competitive advantages for companies. They also suggested the conceptual framework as a factor of product design in three aspects, i.e., aesthetics, functionality, and symbolism. Moreover, they examined the effects of these factors in the designed products on purchase intention and word of mouth. The results indicated that these three factors had both direct and indirect positive influences on purchase intention and word of mouth through attitudes toward brands. Later on, Candi *et al*. [10] applied the factors from the study of Homburg *et al*. [13] to investigate consumer behavior. These three factors also had influences on the behavioral responses of consumers. The results imply that product designers should prioritize aesthetic and symbolic elements instead of merely functional ones. In contrast, Moon *et al*. [11] and Jindal *et al*. [12] suggested the related factors of product design (aesthetics/form, features/function, and ergonomics) without

symbolism but with ergonomics because companies compete for user safety as they regard users and the central role of safety as priorities. Gilal *et al*. [14] elucidated that companies view product design as essential for competitiveness and as a standard for performance assessment. They also suggested a model of the factors of product design by combining the results of all of the research studies above into a model with four aspects, i.e., aesthetic, functional, reflective, and ergonomic. The results revealed obsessive passion is influenced by the factors "aesthetic" and "reflective" whereas "functional" and "ergonomics" influenced harmonious passion. Furthermore, Adulyanukosol and Silpcharu [6] pointed out that product design is a vital part of the sustainable growth in the shoe industry. Undoubtedly, they studied the strategies of shoe design for the Thai shoe industry and found that innovation directly influenced shoe design and that design should always consider innovation so that the designed products can remain in the market share over a long period of time. Hence, based on all of these previous studies, this research relied on five components, i.e., aesthetics, functionality, symbolism, ergonomics, and innovation, as the conceptual framework for this research implementation.

Aesthetics

This refers to consumer responses that arise from the perceived physical appearances and beauty of objects [48, 49]. Emotional reactions may be caused by the holistic form of a product, or they may be responses to individual design characteristics [50, 51]. Consumer behavioral responses are related to product design, and the product form of exterior design is the most basic characteristic that motivates consumer responses [48]. Product design aesthetics can also affect emotional responses [52, 53].

Functionality

This component/factor reflects consumer responses arising from product characteristics assessment by usage [54]. They can be assessed with no need to rely on physical appearances [13, 55, 56]. The assessment eventually motivates intellectual responses [54] and includes perceived product characteristics, durability, quality, price, reliability, and technical complication [57]. Primarily, usage value means the utility or rationality of the product. Therefore, product value can be judged by a rational as well as an intellectual appeal to consumers [58-60].

Symbolism

This is perception of the form of products that implies the self-respect and social significance of the consumers [57, 61-63]. Reflective responses occur with consumers who feel attached to products, including their attachment to places or some certain periods of time [54, 64, 65]. Additionally, consumer behavioral responses in terms of motivation are not only caused by product forms or characteristics but also from symbolic connections when compared with the products themselves [51, 66]. Symbolism is thus a key factor of product design because it cannot be inclusive through aesthetic, functionality, and ergonomics only [63, 67]. Moreover, symbolism may be as important as functionality because it usually reveals the consumers' desire to present their personal images to society [13, 61, 68, 69].

Ergonomics

This is the perceived usage regarding convenience and safety. This factor is accepted as noteworthy because companies compete for the higher levels of convenience of product usage [11]. Aesthetic and functional product design will be useless unless there are the responses of the user experience, e.g., usage, convenience, and safety [11, 70]. According to the anthropological data, product sizes hugely influence the perceived convenience and suitability for physical products [71]. Product design based on physiological principles can reduce the uncomfortable feelings of users, and thus it will pave a way toward successful product development [72]. More than this, product convenience also has considerable influence on usage intention [73].

Innovation

Innovation development requires knowledge of science and technology, and the innovation creation process requires internal and external knowledge transfer by connecting the factors of marketing and the factors of science and technology [74]. Design-driven innovation can enhance competitiveness and competitive advantages, create product distinctiveness, and prolong useful life [6, 75]. Such innovation is unlike other types of innovation, e.g., technological innovation that mainly focuses on product development or consumer-oriented marketing innovation. On the contrary, design innovation focuses on the reasons for usage rather than what products are or how to use them [76].

Theory of Planned Behavior

Usage Intention

This refers to the willingness of individuals to behave in a certain way. Intention occurs prior to actions, according to the theory of planned behavior (TPB) to explain events that occur before attitudes, subjective norms, and perceived behavioral control. TPB is often used to explain/describe intention directly [77]. Usage intention refers to the willingness or likelihood to use products or services. It is equipped for understanding behavior and for predicting the future actions of consumers, which brings about the success of products in the market [78].

Purchase Intention

This is the act of attempting to purchase products or services. There are several factors affecting purchase intention, e.g., attitudes, perceived behavioral control [79], risk propensity [80], and price [81]. Purchase intention always comes after usage intention [15], although there might be potential intervening factors during purchase intention prior to purchase decision, i.e., attitudes of others and situational considerations [82].

RESEARCH METHODOLOGY

The research was implemented by using a quantitative method (a survey), with the principal subjects as follows.

Sandal Selection Criteria

1) Para rubber sandals or plastic sandals were used because of their highest export proportion (up to 92.4% of total sandal export) [3]. The clog style was selected because of the free design of their physical features, with quite high distinction for users. 2) They were unisex sandals for males, females, and LGBTQ+ so that data collection by the questionnaire would be inclusive among consumers with different needs [83]. 3) The samples were familiar with the product [84]. The selection criteria were used as a guideline for QFD sandal design [85]. Therefore, the newly designed sandals from this guideline were used as the representatives for data collection (Figure 2).

Figure 2. The sandal style is indicative of the process of gathering data

Population and Sample

In this study, the population was selected from Gen Z consumers, born during 1997-2009 [5]. This population group has emerged as the largest generation with supreme financial power in history. According to World Data Lab, it is expected that Gen Z will be the only generational grouping with a population of 2 billion (25% of the world population). It is also expected that the population of Gen Z in 2034 in Asia Pacific will become the supportive group for total household expenses, which amount to over 3 trillion USD. The report of NIQ Spend Z shows that the population of Gen Z in Thailand is the group with the largest strategic spending behavior in Asia. Thus, it is certain that this population has a strong influence on the altered perspectives of retailers in Thailand, resulting in major changes in consumer trends and market dynamics [86]. The sample in this study consisted of 400 consumers between 18-27 years of age in Thailand, with 95% confidence [87]. They were obtained using multi-stage sampling.

Instrument

A self-administered online survey questionnaire with a structured interview was used, under the title "The Factors of Sandal Design." The questionnaire was divided into 2 parts, i.e., 1) 8 checklist questions about general data and consumer behavior, and 2) consumer opinions for evaluation in 5 aspects, i.e., aesthetic, functional, symbolism, ergonomics, and innovation. Each aspect contained 10 questions, a total of 50 questions. All questions were developed from a literature review. A 5-point rating scale was used [88], ranging from 5 (totally agree) to 1 (slightly agree). Content validity was tested by 3 experts, with an index of item objective congruence (IOC) = 0.67-1.00 (> 0.50) [89]. All questions contained content validity. Reliability was tested in the tryout group, consisting of 30 samples. The test revealed Cronbach' s alpha coefficient [90] = 0.932 (>0.70) [91]. Therefore, the questionnaire was reliable. It was also approved by the Human Research Ethics Committee, King Mongkut's Institute of Technology Ladkrabang (KMITL), in Thailand. The project code was EC-KMITL_66_088, approved on 7 August 2023.

Data Collection

The data in this study were collected by a face-to-face survey. To clarify, there were discussions between the researcher and the respondents using Google Forms. The duration for the data collection was between June and August 2024.

Data Analysis

The analysis was divided into 3 parts as follows: 1) general data and consumer behavior were analyzed by a descriptive statistic, i.e., percentage; 2) the factors of sandal design were analyzed by exploratory factor analysis (EFA) using SPSS; 3) confirmatory factor analysis (CFA) was used to analyze the first-order, followed by AMOS to analyze the second-order.

RESULTS

General Data and Consumer Behavior

According to 400 samples between 1 8 - 27 years of age, general data revealed that 201 or most of them were males (50.25%), age 22.005 years on average. 294 (73.50%) graduated with a bachelor's degree. 261 (65.25%) used clog-style sandals. 284 (62.00%) wore sandals for over 2 hours on average. As for consumer behavior, 104 samples (26.00%), or most of them bought a pair of sandals in 1-3 months on average. 203 (50.75%) sometimes studied information and properties of sandals before their purchases. 173 (43.25%) perceived that brand affected usage and purchase.

Exploratory Factor Analysis (EFA)

Adequacy

Adequacy was examined by considering Kaiser-Meyer-Olkin (KMO), equal to 0.958 (KMO > 0.50); (Table 1) or the measure of sampling adequacy (MSA), which was equal to 0.916-0.978 (MSA > 0.50) [92].

Correlation

Correlation was examined by considering Bartlett's test, with the significance value (sig.) = 0.000 (sig. < 0.05) [92]. It can be concluded that this dataset was adequate for the factor analysis technique (Table 1).

Table 1: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.958
	Approx. Chi-Square	15275.828
	df	1225
	Sig.	0.000

Communality

Communality was equal to 0.451-0.776 (Communality > 0.40) [92]. It can be concluded that the observed variables could be assembled as a cluster in the factors.

Factor Analysis

Factor analysis by principal component analysis (PCA) was based on factor extraction criteria; 5 factors were set for their size. Varimax orthogonal factor rotation was used, along with the selection criteria of observed variables, with factor loading > 0.50. Out of the 50 observed variables, 45 passed the criteria (Table 2).

According to the analysis of 5 factors and 45 variables, Factor 1: Aesthetic consisted of 11 observed variables (Aes1, Aes3, Aes8, Aes6, Aes2, Aes4, Aes9, Sym1, Sym2, Sym3, Aes10) with factor loading = 0.505-0.720 and 13.92% variance. Factor 2: Innovation consisted of 9 observed variables (Inn8, Inn5, Inn4, Inn7, Inn10, Inn6, Inn9, Inn3, Inn1), with factor loading = 0.510-0.709 and 12.77% variance. Factor 3: Functional consisted of 9 observed variables (Fun9, Fun5, Fun6, Fun3, Fun4, Fun8, Fun7, Fun10, Fun2) with factor loading = 0.555-0.705 and 12.60% variance. Factor 4: Symbolism consisted of 7 observed variables (Sym7, Sym10, Sym9, Sym8, Erg3, Sym6, Sym4), with factor loading = 0.506-0.827 and 12.30% variance. Factor 5: Ergonomics consisted of 9 observed variables (Erg2, Erg4, Erg1, Erg7, Erg5, Erg9, Erg8, Aes5, Erg6), with factor loading = 0.516-0.630 and 10.57% variance. According to all 5 factors, it can be concluded that the accumulated variance was equal to 62.16%, which was over 60% [92].

Table 2: Rotated component matrix

Code	Variables	Component					Communality
		1	2	3	4	5	
Aes1	The sandal has a visually striking style.	0.720					0.587
Aes3	The sandal is compatible with other clothing accessories.	0.717					0.596
Aes8	The sandal has a beautiful overall shape and proportions.	0.679					0.588
Aes6	The sandal is beautifully colored.	0.675					0.540
Aes2	The sandal is unique.	0.664					0.563
Aes4	The sandal attracts attention.	0.618					0.517
Aes9	The sandals complement one's sense of style.	0.617					0.652
Sym1	The sandals allow you to communicate with others.	0.574					0.582
Sym2	The sandal has the ability to make a strong impression on people.	0.525					0.559
Sym3	The sandals make me proud to own them.	0.519					0.596
Aes10	The sandal has a beautiful texture.	0.505					0.577
Inn8	The sandal can use environmentally friendly materials.		0.709				0.665
Inn5	The sandal uses modern production technologies.		0.676				0.679
Inn4	The sandal can develop materials to make them more comfortable.		0.659				0.653
Inn7	The sandal can develop the bottom sole to provide more traction.		0.658				0.671
Inn10	The sandal can be manufactured using 3D printing technology.		0.646				0.655
Inn6	The sandal uses a material with high elastic properties.		0.638				0.686
Inn9	The sandal can use an environmentally friendly manufacturing.		0.618				0.619
Inn3	The sandal has a strong assembly.		0.606				0.646
Inn1	The sandal has standards in production.		0.510				0.551

Code	Variables	Component					Communality
		1	2	3	4	5	
Fun9	The sandal is waterproof.			0.705			0.661
Fun5	The sandal improves walking efficiency.			0.694			0.665
Fun6	The sandal is simple to put on or take off.			0.687			0.637
Fun3	The sandal is a good fit to wear.			0.682			0.631
Fun4	The sandal is durable.			0.675			0.621
Fun8	The sandal is simple to clean.			0.673			0.633
Fun7	The sandal is lightweight.			0.663			0.641
Fun10	The sandal is breathable and does not get damp.			0.607			0.555
Fun2	The sandal is versatile and suitable for various events.			0.555			0.664
Sym7	The sandal can create stories to share with others.				0.827		0.776
Sym10	The sandal establishes a distinctive image.				0.802		0.693
Sym9	The sandal helps to differentiate yourself from others.				0.792		0.716
Sym8	The sandal can boost your personality and make you look good.				0.791		0.735
Erg3	The sandal has a heel strap to suit a wide range of activities.				0.711		0.616
Sym6	The sandal aligns with the prevailing societal trend.				0.518		0.608
Sym4	The sandals are stylish in accordance with current fashion trends.				0.506		0.553
Erg2	The sandals increase safety while walking.					0.630	0.664
Erg4	The sandal has arch support.					0.595	0.643
Erg1	The sandal seems to be comfortable to wear.					0.584	0.652
Erg7	The sandal has a soft and elastic midsole.					0.572	0.710
Erg5	The sandal upper is soft and elastic.					0.567	0.698
Erg9	The sandal has an outsole for traction.					0.534	0.666
Erg8	The sandal has heel support to help reduce impact.					0.530	0.644
Aes5	The sandal employs a proper design concept.					0.518	0.528
Erg6	The sandal fits snugly and does not discomfort the foot.					0.516	0.664
							Total
	Sum of Squares Loadings (Eigenvalue)	6.961	6.385	6.302	6.149	5.284	31.081
	Percentage of Trace	13.922	12.769	12.604	12.299	10.567	62.161

Confirmatory Factor Analysis (CFA)

Measurement Model

For the examination of 5 measurement models for the observed variables, including aesthetic, innovation, functional, symbolism, and ergonomics, the models were adjusted by removing inadequate observed variables. Modification indices were used to bring the goodness-of-fit index (GFI) between the adjusted model and empirical data. The criteria for GFI consideration = χ^2/df < 3.00 [93], p > 0.05, CFI > 0.96, TLI > 0.96, RMSEA < 0.07 in case of over 250 samples and less than 12 observed variables [92]. According to 45 observed variables that passed EFA analysis criteria, only 20 observed variables remained after all 5 measurement models of the observed variables had been examined and GFI was considered. In detail, the a*esthetic* measurement model was measured by 4 observed variables, i.e., Aes1, Aes8, Aes2, and Aes4 (Standardized factor loading = 0.689-0.754). The innovation measurement model was measured by 4 observed variables, i.e., Inn8, Inn4, Inn5, and Inn7 (Standardized factor loading = 0.707-0.865). The functional measurement model was measured by 4 observed variables, i.e., Fun5, Fun3, Fun4, and Fun10 (Standardized factor loading = 0.603-0.817). The symbolism measurement model was measured by 4 observed variables, i.e., Sym10, Sym9, Sym8, and Sym4 (Standardized factor loading = 0.623-0.902). The ergonomics measurement model was measured by 4 observed variables, i.e., Erg2, Erg4, Erg1, Erg7 (Standardized factor loading = 0.771-0.834) (Figure 3).

Table 3: Model's goodness-of-fit indexes (measurement model)

Model-fit Criterion	Acceptable Level* [92]	Model Level				
		Aesthetic	Innovation	Functional	Symbolism	Ergonomics
χ^2		1.710	5.100	3.302	5.195	4.914
df		2	2	2	2	2
χ^2/df	< 3.00 [93]	0.855	2.550	1.651	2.597	2.457
p-value	> 0.05 [92]	0.425	0.078	0.192	0.074	0.086
CFI	> 0.96 [92]	1.000	0.996	0.998	0.996	0.996
TLI	> 0.96 [92]	1.002	0.988	0.994	0.988	0.989
RMSEA	< 0.07 [92]	0.000	0.062	0.040	0.063	0.060

Note: *The sample size was more than 250 people, and the number of observational variables was less than 12, χ^2 = Chi-square, df = Degrees of Freedom, χ^2/df = Relative Chi-square, CFI = Comparative Fit Index, TLI = Tucker Lewis Index, RMSEA = Root Mean Square Error of Approximation

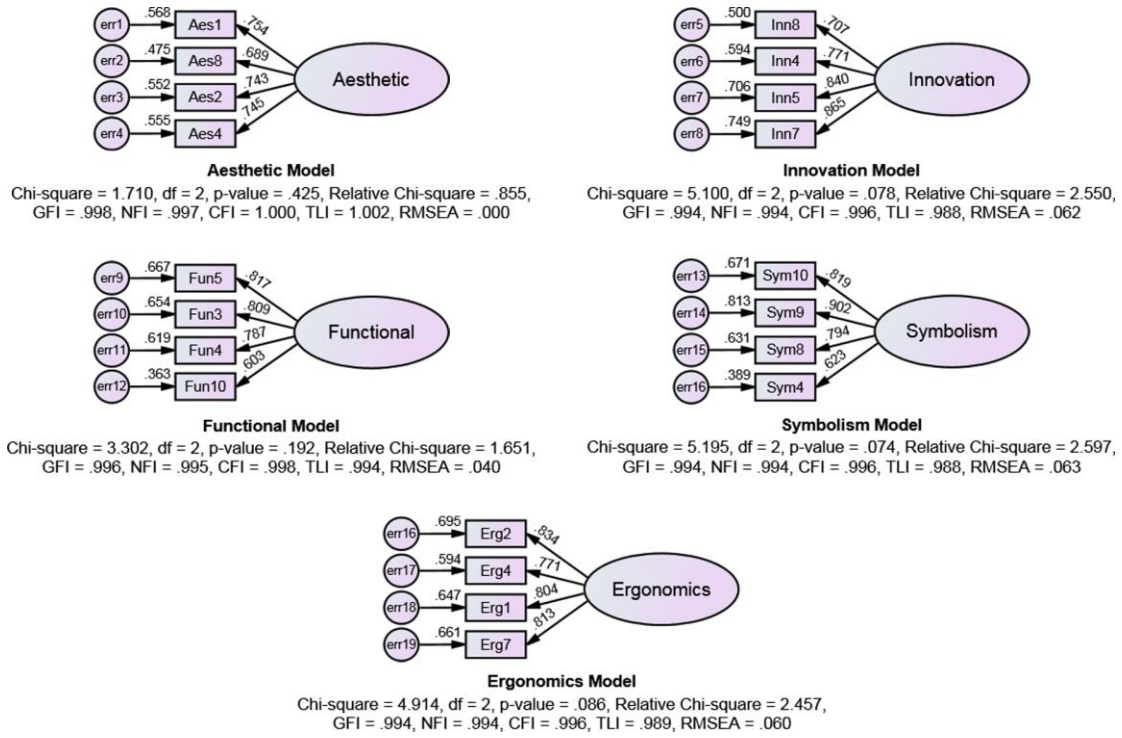

Figure 3. Analyzing the five latent variable measurement models

First-order CFA (F-CFA)

For the CFA of the first-order in all 5 observed variables, GFI was obtained as follows, i.e., χ^2= 340.452, df = 160, p < 0.001, χ^2/df = 2.128, GFI = 0.924, NFI = 0.928, CFI = 0.961, TLI = 0.953, RMSEA = 0.053 (Figure 3). It was found that GFI met the criteria (Table 4). The examination of convergent validity included convergent reliability (CR) examination, i.e., CR $_{Aesthetic}$ = 0.860, CR $_{Innovation}$ = 0.875, CR $_{Functional}$ = 0.844, CR $_{Symbolism}$ = 0.869, CR $_{Ergonomics}$ = 0.881; and analysis of average variance extracted (AVE), i.e., AVE $_{Aesthetic}$ = 0.534, AVE $_{Innovation}$ = 0.638, AVE $_{Functional}$ = 0.577, AVE $_{Symbolism}$ = 0.628, AVE $_{Ergonomics}$ = 0.649. It was found that CRs > 0.70 and AVEs > 0.50, which met the criteria [92]. Thus, it can be concluded that each observed variable contained convergent reliability, which led to further analysis in the next step.

Second-order CFA (S-CFA)

For CFA of the second-order in the factors of sandal design, GFI was obtained as follows, i.e., χ^2= 392.320, df = 162, p < 0.001, χ^2/df = 2.422, GFI = 0.912, NFI = 0.918, CFI = 0.950, TLI = 0.941, RMSEA = 0.060 (Figure 4). It was found that GFI met the criteria (Table 4). Standardized factor loading of all variables

contained a statistical significance of 0.001 ($p < 0.001$). It can be concluded that there were 5 factors for sandal design, arranged respectively as follows. Innovation (Standardized factor loading = 0.894) was measured by 4 observed variables, i.e., Inn7, Inn5, Inn4, Inn8 (Standardized factor loading = 0.723-0.860) Functional (Standardized factor loading = 0.857) was measured by 4 observed variables, i.e., Fun5, Fun3, Fun4, Fun10 (Standardized factor loading = 0.629-0.823). Ergonomics (Standardized factor loading = 0.850) was measured by 4 observed variables, i.e., Erg7, Erg2, Erg1, Erg4 (Standardized factor loading = 0.778-0.827). Aesthetics (Standardized factor loading = 0.568) was measured by 4 observed variables, i.e., Aes4, Aes2, Aes1, and Aes8 (Standardized factor loading = 0.710-0.750). Symbolism (Standardized factor loading = 0.533) was measured by 4 observed variables, i.e., Sym9, Sym10, Sym8, Sym4 (Standardized factor loading = 0.637-0.895) (Table 5).

Table 4: Model's goodness-of-fit indexes

Model-fit Criterion	Acceptable Level	Model Level	
		F-CFA	S-CFA
χ^2		340.452	392.320
df		160	162
p-value	Significant *p*-values expected [92]	< 0.001	< 0.001
χ^2/df	< 3.00 [93]	2.128	2.422
GFI	> 0.90 [94]	0.924	0.912
NFI	> 0.90 [94]	0.928	0.918
CFI	> 0.94 [92]	0.961	0.950
TLI	> 0.94 [92]	0.953	0.941
RMSEA	< 0.07 [92]	0.053	0.060

Note: χ^2 = Chi-square, df = Degrees of Freedom, χ^2/df = Relative Chi-square, GFI = Goodness of Fit Index, NFI = Normed Fit Index, CFI = Comparative Fit Index, TLI = Tucker Lewis Index, RMSEA = Root Mean Square Error of Approximation, F-CFA = First-order Confirmatory Factor Analysis, S-CFA = Second-order Confirmatory Factor Analysis

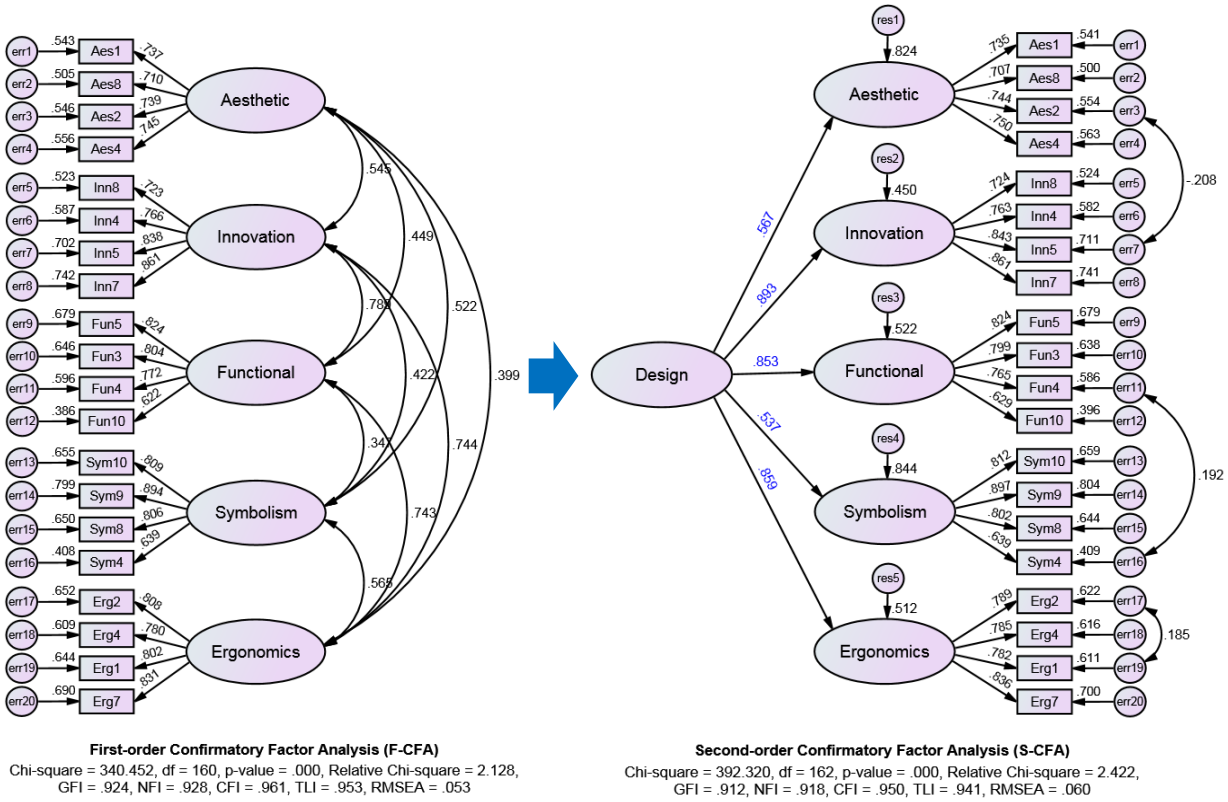

Figure 4. The final model features standardized path coefficients and factor loadings

Table 5: The resulting model's standardized regression weights and squared multiple correlation estimations

Path		Items		β	S.E.	C.R.	R^2	*p*
Design	--->	Innovation		0.893			0.798	
Design	--->	Aesthetic		0.567	0.063	9.012	0.322	***
Design	--->	Functional		0.853	0.069	13.061	0.727	***
Design	--->	Symbolism		0.537	0.072	9.505	0.288	***
Design	--->	Ergonomics		0.859	0.069	14.077	0.738	***
Aesthetic	--->	Aes4	The sandal attracts attention.	0.750			0.563	
Aesthetic	--->	Aes2	The sandal is unique.	0.744	0.072	13.538	0.554	***
Aesthetic	--->	Aes1	The sandal has a visually striking style.	0.735	0.072	13.385	0.541	***
Aesthetic	--->	Aes8	The sandal has a beautiful overall shape and proportions.	0.707	0.076	12.916	0.500	***
Innovation	--->	Inn7	The sandal can develop the bottom sole to provide more traction.	0.861			0.741	
Innovation	--->	Inn4	The sandal can develop materials to make them more comfortable.	0.763	0.050	17.835	0.582	***
Innovation	--->	Inn5	The sandal uses modern production technologies.	0.843	0.046	20.798	0.711	***
Innovation	--->	Inn8	The sandal can use environmentally friendly materials.	0.724	0.053	16.531	0.524	***
Functional	--->	Fun4	The sandal is durable.	0.765			0.586	
Functional	--->	Fun3	The sandal is a good fit to wear.	0.799	0.061	16.044	0.638	***
Functional	--->	Fun5	The sandal improves walking efficiency.	0.824	0.061	16.562	0.679	***
Functional	--->	Fun10	The sandal is breathable and does not get damp.	0.629	0.069	12.356	0.396	***
Symbolism	--->	Sym9	The sandal helps to differentiate yourself from others.	0.897			0.804	
Symbolism	--->	Sym10	The sandal establishes a distinctive image.	0.812	0.045	19.778	0.659	***
Symbolism	--->	Sym8	The sandal can boost your personality and make you look good.	0.802	0.045	19.456	0.644	***
Symbolism	--->	Sym4	The sandals are stylish in accordance with current fashion trends.	0.639	0.047	14.188	0.409	***
Ergonomics	--->	Erg7	The sandal has a soft and elastic midsole.	0.836			0.700	
Ergonomics	--->	Erg4	The sandal has arch support.	0.785	0.051	17.544	0.616	***
Ergonomics	--->	Erg1	The sandal seems to be comfortable to wear.	0.782	0.053	17.091	0.611	***
Ergonomics	--->	Erg2	The sandals increase safety while walking.	0.789	0.052	17.317	0.622	***

Note: β = Standardized Beta Coefficients, S.E. = Standard Error, C.R. = Critical Ratio, R^2 = Squared Multiple Correlation, *** $p < 0.001$

DISCUSSION

According to the CFA of the first-order and the second-order in the model with 5 factors and 20 variables (Figure 5) , GFI was found to meet the criteria. The results revealed that all 5 factors are necessary for sandal design, and can be discussed respectively by the effect size of each factor as follows.

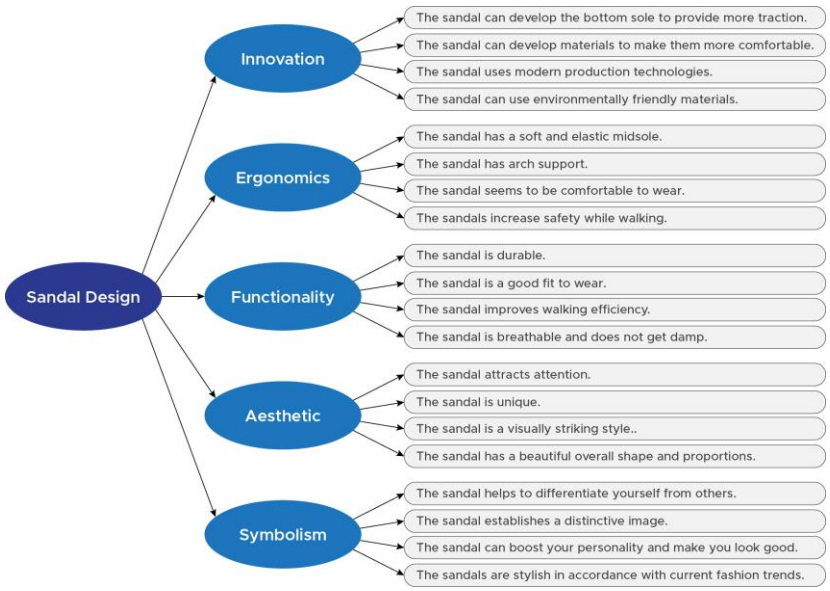

Figure 5. The five-factor model of sandal design

Innovation

Designers must pay attention to the development of materials, manufacturing technology, and knowledge of science, as well as technology as they are all indispensable for innovation development [74]. Sandal design requires updated materials and technology to create prototypes of fashion innovative products, which are necessary for value-added and prolonging product life cycles [95, 96]. Therefore, manufacturing technology should be developed regularly, e.g., material development for more comfortable wear or outsole development for durability and more efficient adherence to the ground [16, 17, 35]. Nonetheless, the development of materials and manufacturing technology for modern shoes still requires environmental concern for sustainability in future sandal industry [97, 98].

Ergonomics

Designers must care about the convenience and safety of users [11]. Ergonomics is a factor affecting the usage and purchase decision of sandals [15]. Wearing shoes that fail to meet ergonomics principles can affect consumer health, particularly foot pain and foot disorders [99]. These problems definitely affect users' feelings negatively. Therefore, caring about ergonomics for users directly affects consumers because they connect directly with their shoes. The midsole is also a key component that designers must consider as a major part affecting the user body. Soft and elastic materials should be used, with wide space for the forefeet to facilitate the natural movement of toes. What is more, shoe soles should be thick enough to reduce impacts around foot soles and heels while walking. Arch support is also required in order to spread body pressure throughout the soles [17, 30, 38].

Functionality

Designers must pay attention to perceived usefulness, perceived comfort, and perceived ease of use. Furthermore, functionality also includes perceived product characteristics, e.g., durability, quality, reliability, technical complexity [14], good ventilation, and lack of moisture [30, 33]. This factor refers to the basic needs of users that designers must keep in mind. It is also a user-centered concept [100]. Users need fit and comfort from wearing shoes because fit is a key factor in perceived comfort [17, 18, 101, 102]. Also, these two feelings affect the ability to wear, body balance, and movement efficiency [103].

Aesthetics

Designers must pay attention to the visual perception of the beauty of sandals. The beauty of clothing mainly arises from applied design principles and compositions to create aesthetics as intrinsic beauty according to user perception. Product beauty design is related to the intrinsic creativity and artistic abilities of designers. Aesthetics emerges from appropriate features for new products [96], usually represented through shapes and forms of eye-catching, distinctive, and attractive products [41]. Aesthetics, perceived by user satisfaction, originates from contact with physical features of products, i.e., the eyes or skin, which motivate feelings inside users [13, 52, 104]. These features must represent beauty and distinction, affecting consumer motivation in terms of their purchase decisions [7, 102, 105-107].

Symbolism

Designers must communicate the meanings of products through their styles and symbolism in order to create a proper understanding of those meanings through the shapes and forms of sandals. Symbols/symbolic meanings will be created into identity or be used to enhance images so that users will understand and take interpreted meanings from product forms for their purchase decisions [13, 14]. Sandals are regarded as a fashion product that helps improve personalities and represent the "self" of users. Anyway, the marketing strategies and styles of fashion products are usually adjusted with time. Therefore, sandal design requires studies on the tendency of future fashion [108, 109] so as to design sandals with modern styles that follow fashion trends and enhance user-distinctive images [6].

CONCLUSIONS

The objective of this research was to study the factors of sandal design in Thailand's market. The 5 factors affecting sandal design can meet consumer needs as users. To illustrate, "Factor 1: Innovation" requires the study and development of materials and manufacturing technology to be up-to-date. These innovations can increase the comfort and safety of users. "Factor 2: Ergonomics" must give precedence to the appropriate body sizes of users. It should give the feeling of more comfort when wearing and support positive effects on their health. "Factor 3: Functionality" must focus on comfort wear, related to quality material selection. "Factor 4: Aesthetics" must be concerned about intrinsic values through visual and physical contact. "Factor 5: Symbolism" must consider communication through the shapes and forms of sandals. Designers must interpret the meanings they want to communicate to users through sandal features.

These 5 factors will pave the way to sustainable development in the sandal fashion industry of Thailand's market. Kotler *et al*. [5] stated that young generations are usually interested in social responsibility and environmental sustainability, which are key aspects of their decision-making, particularly Gen Z and Gen Y consumers. These factors also bring innovative ideas for sandal design that gives priority to feedback from consumers so that designers can understand and set efficient guidelines for new product design [110-113]. Creativity is a key part of the future success of the sandal industry [114]. Therefore, design is the beginning of innovation from efficiency improvement to meet user needs and to expand market share by prolonging product life cycle for opportunities to make worthy profits for entrepreneurs and manufacturers [115].

Comfortable and modern sandal design requires the skills and experiences of designers. They must embrace comprehension of design principles and the tendency of fashion trends to be able to transfer inspirations and ideas/concepts into desirably designed sandals. Cooperation with external agencies is also required, e.g., shoe factories (for marketing data, technology, and innovations) and hospitals (for data on foot ergonomics). By doing so, designers can extend the scope of their knowledge for broader perspectives, using the capabilities of data analysis for a better understanding of consumer needs, e.g., foot shapes, foot structures, materials, accessories, manufacturing equipment, and QC to follow design outlines. These goals should be implemented under the common goals, i.e., to be worn with appropriateness and beauty, to enhance personalities, and to meet the needs of consumers in the new era.

LIMITATIONS AND FUTURE RESEARCH

This study is necessary to create value for sandals through design that relies on feedback from consumers in order to apply sandal design to Thailand's market as a significant product for the national economy. Even so, two limitations in this study should be addressed, which could be used to guide related studies and research in the future. For the first limitation, the samples consisted of Gen-Z consumers only, a group of consumers having grown up in the era where the Internet is a major trend. Undoubtedly, they can quickly adapt to new technology, and thus they are viewed as a key market for sandal brands. Future research should focus on other consumer groups, such as older adults, because the size of this group of people keeps increasing. As for the last limitation, the study results of consumer behavior revealed that brands affected the usage and purchase of sandals, according to opinions from most consumers. This implied that they still viewed sandal brands as essential. Therefore, future research should study and examine how these 5 factors of sandal design can affect consumer usage and purchase through their attitudes toward brands.

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