THE PROFILING DESIGN OF SPECTACLES USING KANSEI ENGINEERING (KE) AND KANO MODEL (KM) FOR CUSTOMERS PREFERENCES

This report is submitted in accordance with requirement of the University Teknikal Malaysia Melaka (UTeM) for Bachelor Degree of Manufacturing Engineering (Hons.)

by

PUTERI HAJAR BINTI BAHARUDIN

B052010073

011016-11-0524

FACULTY OF INDUSTRIAL AND MANUFACTURING

TECHNOLOGY AND ENGINEERING

2024

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

Tajuk: **THE PROFILING DESIGN OF SPECTACLES USING KANSEI ENGINEERING (KE) AND KANO MODEL (KM) FOR CUSTOMER PREFERENCE**

Sesi Pengajian: **2023/2024 Semester 2**

Saya **PUTERI HAJAR BINTI BAHARUDIN (011016-110524)**

mengaku membenarkan Laporan Projek Sarjana Muda (PSM) ini disimpan di Perpustakaan Universiti Teknikal Malaysia Melaka (UTeM) dengan syarat-syarat kegunaan seperti berikut:

1. Laporan PSM adalah hak milik Universiti Teknikal Malaysia Melaka dan penulis.
2. Perpustakaan Universiti Teknikal Malaysia Melaka dibenarkan membuat salinan untuk tujuan pengajian sahaja dengan izin penulis.
3. Perpustakaan dibenarkan membuat salinan laporan PSM ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. *Sila tandakan (√)

☐ SULIT (Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysiasebagaimana yang termaktub dalam AKTA RAHSIA RASMI 1972)

☐ TERHAD (Mengandungi maklumat TERHAD yang telah ditentukan oleh organisasi/ badan di mana penyelidikan dijalankan)

☑ TIDAK TERHAD

Disahkan oleh:

Alamat Tetap:
No.69, Batu 13, Kampung Rhu Muda,
21600 Marang,
Terengganu.

Tarikh: 14/7/24

Cop Rasmi:

TS. DR. SAIFUDIN HAFIZ BIN YAHAYA
Ketua Program Sarjana Kerja Kursus / Mod Campuran
Fakulti Teknologi dan Kejuruteraan Industri dan Pembuatan
Universiti Teknikal Malaysia Melaka

Tarikh: 14/7/2024

*Jika Laporan PSM ini SULIT atau TERHAD, sila lampirkan surat daripada pihak berkuasa/organisasi berkenaan dengan menyatakan sekali sebab dan tempoh laporan PSM ini perlu dikelaskan sebagai SULIT atau TERHAD.

DECLARATION

I hereby, declared this report entitled “The Profiling Design of Spectacles Using Kansei Engineering (KE) and Kano Model (KM) for Customer Preference” is the result of my own research except as cited in references.

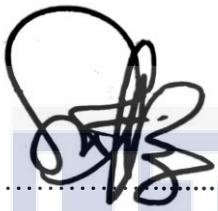
Signature : ……

Author’s Name : PUTERI HAJAR BINTI BAHARUDIN

Date : 14 JULY 2024

APPROVAL

This report is submitted to the Faculty of Industrial and Manufacturing Technology and Engineering of Universiti Teknikal Malaysia Melaka as a partial fulfilment of the requirement for Degree of Manufacturing Engineering (Hons). The members of the supervisory committee are as follow:



……

(TS. DR. SAIFUDIN HAFIZ BIN YAHAYA)

ABSTRAK

Kansei Engineering (KE), yang menangkap respons emosi, digunakan untuk mengenal pasti dan menganalisis aspek emosi dalam reka bentuk cermin mata, mendedahkan pengalaman subjektif pengguna. *Kano Model (KM),* satu rangka kerja untuk kepuasan pelanggan dan pembangunan produk, mengklasifikasikan ciri reka bentuk daripada jangkaan asas kepada penambah kepuasan berdasarkan kesannya terhadap kepuasan pelanggan. Pada masa ini, *Kansei Engineering* untuk menangkap emosi pengguna dan *Kano Model* untuk mengkategorikan dan mengutamakan aspek reka bentuk tidak digunakan dalam perniagaan cermin mata kerana teknik reka bentuk semasa menumpukan pada komponen utilitarian dan mengabaikan faktor reka bentuk emosi yang meningkatkan kepuasan dan penglibatan pengguna. Oleh itu, kajian ini dijalankan untuk menyiasat aplikasi *KE* dan *KM* dalam profil reka bentuk cermin mata untuk keutamaan pelanggan. Melalui tinjauan dan temu bual, maklum balas pelanggan dikumpul berdasarkan lima *Kansei Words* dan lima atribut cermin mata dalam kalangan 50 pelajar UTeM. Dapatan kajian menunjukkan bahawa elemen seperti *Design 4* (*square-shaped*) adalah reka bentuk yang paling digemari dalam kalangan responden yang diwakili oleh *Lightweight* berdasarkan perspektif *KE* yang diperoleh melalui Analisis Purata. Terdapat korelasi antara reka bentuk emosi *(KE)* dan atribut kualiti *(KM)* seperti korelasi sederhana antara elemen *Dysfunctional (Full Frame)* kepada respons emosi *Beautiful* melalui *SPSS.* Hasil pengesahan menunjukkan bahawa *Design 1 (Full Frame)* adalah reka bentuk yang paling digemari sebagai respons kepada reka bentuk emosi Selesa dan ciri produk K4 *(square-shaped)*. Profil reka bentuk komprehensif berdasarkan keutamaan pelanggan dan pengalaman pengguna yang dipertingkatkan telah diwujudkan dengan menggabungkan rangka kerja pengutamaan *KM* dengan pandangan emosi daripada *KE*. Kaedah ini menawarkan garis panduan berharga untuk pereka dan pengeluar dalam membangunkan cermin mata yang memenuhi keperluan fungsional dan membangkitkan respons emosi dalam kalangan pelanggan, menghasilkan peningkatan kepuasan dan kesetiaan.

ABSTRACT

Kansei Engineering (KE), which captures emotional responses, is used to identify and analyse the emotional aspects of spectacle design, revealing users' subjective experiences. Kano Model (KM), a framework for customer satisfaction and product development, classifies design features from basic expectations to delighters by their impact on customer satisfaction. Currently, Kansei Engineering to capture user emotions and the Kano Model to categorise and prioritise design aspects are not used in the spectacles business because current design techniques focus on utilitarian components and ignore emotional design factors that enhance user satisfaction and engagement. Therefore, this research is carried out to investigate the application of Kansei Engineering (KE) and Kano Model (KM) in the profiling design of spectacles for customer preference. Through surveys and interviews, the customer feedback is gathered on five Kansei Words and five spectacle attributes among 50 UTeM students. The findings revealed that elements such as Design 4 (A square-shaped spectacle) is the most preferred design among the respondents represented by Lightweight based on the Kansei Engineering (KE) perspective obtained through the Average Analysis. There is correlation existed between the emotional design (KE) and quality attributes (KM) as such moderate correlation between Dysfunctional element of a spectacle with full frame to the emotional response of Beautiful through SPSS. The validation results shown that Design 1 (A spectacle with full frame) is the most preferred design in response to the emotional design of Comfortable and product characteristics of K4 (square-shaped). A comprehensive design profile based on customer preferences and improved overall user experience is created by combining the prioritisation framework of the Kano Model with the emotional insights from Kansei Engineering. This method offers valuable guidelines for designers and manufacturers to develop spectacles that satisfy functional requirements and evoke emotional responses in customers, resulting in increased satisfaction and loyalty.

DEDICATION

Only

myself

my appreciated mother, Tengku Harliana

my beloved grandparents, Amariah Mamat and Narasudin Ismail

my lovely auntie, Farah Nazihah

my dear friends

for giving me moral support, money, cooperation, encouragement and also understandings

Thank You So Much & Love You All Forever

ACKNOWLEDGEMENT

In the name of Allah, the most gracious, the most merciful, with the highest praise to Allah that I manage to complete this final year project successfully.

I would like to express my heartfelt appreciation to my respected supervisor, Ts. Dr. Saifudin Hafiz Bin Yahaya for his kindness, unwavering patience and mentorship guided me through the process, his easily understood explanation and open mind that allowed me to grow and learn in such a way that I am able to complete the FYP.

I also indebted to the faculty members of Industrial and Manufacturing Technology and Engineering (FTKIP) for their academic mentorship and the enriching learning environment they have provided throughout the Semester 1 of 2023/2024 as well as throughout my degree journey since 2020.

Last but not least, I would like to thank everybody who was important to this FYP especially to my dear best friend, Nur Liyana as well as expressing my apology that I could no mention personally each one of you.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

A		Attractive attributes
BA		Boring-Attractive
HL		Heavy-Lightweight
I		Indifferent attributes
KE	-	Kansei Engineering
KM	-	Kano Model
KW		Kansei Words
M		Must-Be attributes
MC		Miserable-Comfortable
O		One-dimensional
Q		Questionable attribute
R		Reverse attribute
SD		Semantic Differential
SS		Simple-Stylish
SSPS		Statistical Package for Social Science
UB		Ugly-Beautiful

LIST OF SYMBOLS

p	-	significant level of Pearson correlation

CHAPTER 1
INTRODUCTION

1.1 Background

In the ever-evolving environment of product design, the convergence of technology, aesthetics, and user experience plays a key role in defining customer choices. Spectacles, beyond its essential job of eye correction, has become a significant accessory, representing personal style and identity. As customers increasingly seek items that engage emotionally, the eyewear sector has a compelling challenge in meeting not only functional needs but also the nuanced and subjective domain of customer preferences.

The merging of Kansei Engineering (KE) with the Kano Model gives a possible path to bridge the gap between utility and emotional resonance in spectacles design. Kansei Engineering, anchored in recording user emotions, and the Kano Model, known for categorising customer preferences, combined give a holistic approach to spectacles design. However, the synergy between these techniques in the specific context of spectacles design remains a relatively uncharted topic.

1.2 Problem Statement

The eyewear industry is distinguished by an increased emphasis on not only achieving functional requirements but also aligning with the emotional preferences of users. In the goal of generating spectacles that resonate with clients, the merging of Kansei Engineering (KE) and the Kano Model offers a potential method. However, there remains a key challenge in the profiling design of spectacles, as the synergy between KE and the Kano

Model for customer preferences has not been completely studied and used in a systematic manner.

The issues are identified as there is insufficient identification of customer preferences from a Kansei Engineering perspective (Nagamachi, 2019). The author explains that the existing procedures in the eyeglasses sector typically fall short in systematically finding and analysing client preferences through the lens of Kansei Engineering since there is a lack of a structured approach to decode the nuanced emotional responses and subjective experiences of people towards specific design components in spectacles. Desmet and Hekkert (2019) also argued that the integration of Kansei Engineering into the design decision-making process for certain products is not entirely completed. There is a need for a systematic strategy that connects KE concepts with the precise intricacies of product design, ensuring that consumer preferences are accurately collected and transformed into design elements. Thus, since the literature lacks a thorough investigation of the basis of product emotions, notably in the field of spectacles design, future research should dive into the foundations of emotional responses towards spectacles, revealing insights that inform the construction of emotionally resonant designs.

The current state of the spectacles business lacks a comprehensive framework that systematically incorporates Kansei Engineering to capture user emotions and the Kano Model to categorize and prioritize design aspects as the current design techniques in the eyewear business generally concentrate utilitarian components, overlooking the emotional design factors that contribute to user pleasure and engagement (Fevi et al., 2014). Consequently, this constraint hampers the production of spectacles that go beyond mere vision correction, overlooking the potential for emotional interactions with consumers. There is a research gap in the absence of a comprehensive framework that seamlessly blends Kansei Engineering with the Kano Model for spectacles design (Wang et al., 2020). Therefore, developing such a framework will give designers with a systematic strategy to capture and prioritise emotional aspects based on user preferences.

Furthermore, the problem arises when the present paradigms spectacles design sometimes lacks a systematic and thorough validation method to guarantee that the combination of Kansei Engineering and the Kano Model corresponds with and fulfils the increasing preferences of customers (Kim et al., 2020). The absence of a thorough validation

technique leads in a potential mismatch between the intended design features and the actual preferences of the target user population. Hence, research gaps exist in the thorough understanding and application of validation methods in design. Future studies should study and build effective approaches for validating client choices, particularly in the context of incorporating Kansei Engineering and the Kano Model into the design process (Kim et al., 2020).

The problem statement underlines the vital need for a structured and comprehensive strategy to establish client preferences for spectacles based on Kansei Engineering concepts. The observed shortcomings identify potential for research that might contribute to the creation of frameworks enabling the appropriate capture of emotional responses and subjective experiences in the design process. Moreover, the problem statement highlights the need for a systematic, integrated approach to designing spectacles using Kansei Engineering and the Kano Model, suggesting research opportunities to bridge deficiencies and create functional spectacles that establish strong emotional connections with users. Lastly, the study emphasizes the need for a rigorous method to confirm consumer preferences in eyeglasses design, especially when integrating Kansei Engineering and the Kano Model, and suggests research opportunities to enhance validation methodologies' reliability and effectiveness.

1.3 Objectives

The objectives of the study are such as follows:

1. To identify the customer preferences of the spectacles based on Kansei Engineering (KE) perspective.

2. To analyse the customer design preferences based on the product characteristics by integrating Kansei Engineering (KE) and Kano Model (KM).

3. To validate the customer preferences using the pre and post surveys method.

1.4 Scope of Study

To determine and explore consumer preferences, this project uses a method that focuses on the preferences of the target market for the product design of spectacles. The type of spectacles is limited to two sorts of classes such as rectangular and round form. Specifically, the spectacles manufactured or introduced in the market in Malaysia and the current or recent designs of spectacles. The inquiry into the design of the spectacles was carried out by modifying the market-acquired spectacles design and paying attention to the spectacles's design (front view).

Moreover, the statistical method is essential for analysing the data acquired through the survey conducted by constructing the questionnaire. The questionnaire was created through preparatory stages to provide appropriate and pertinent measuring instruments for looking into and analysing the product design, and post-testing was used to validate the results. During the questionnaire development process, the affective identification towards the product design utilising the Kansei Engineering technique is used to determine the semantic difference (SD) towards the words (as the representation of feeling or emotion using Kansei).

This research used the SPSS v.29 for statistical analysis in order to look into and determine the relationship between the parameters (product design versus Kansei Engineering). The questionnaires generated in this study were disseminated in UTeM to students with ages about 18 - 30 years old as the respondents. The questionnaires cover the demography range scales of gender, age, faculty, programme and so on. For evaluation and validation purposes, the post-test survey was applied to justify which specific features identified (based on the finding result) confirmed the customer preferences for spectacles design products.

1.5 Significance of Study

This study aims to investigate spectacles design preferences using Kansei Engineering, integrating with the quality attributes which is Kano Model. This study will also benefit designers and manufacturers in creating spectacles designs that meet customers' desired characteristics.

This study aims to examine the emotional reactions of consumers towards Kansei Engineering and examine its relationship with Kano Model in the development of spectacles designs. The identification of this correlation will facilitate the investigation in generating novel spectacles designs. This objective aligns with the concept of Kansei Engineering, which seeks to integrate the emotional aspect of consumers into the design of spectacles. The results of this study will assist the designer in implementing Kansei Engineering and integrate with Kano Model to analyse the most preferences spectacles designs. This study provides a valuable spectrum to others so they can design more sophisticated products in the future while maintaining customer satisfaction and requirement tracking. In the other product development sector, additional attention should be put into employing this integrated framework for further research in order to assess and access the relationship between customer emotional requirements and product attributes.

CHAPTER 2
LITERATURE REVIEW

This chapter examines the literature on Kansei Engineering (KE), which is related to customer preferences and satisfaction in the eyewear industry. The focus is mostly on Kansei Engineering (KE) to ascertain the specific desires of customers on the current products available in the market today. The purpose of this literature review is to examine the essential component of a published body of information by summarising, categorising, and comparing previous research studies, literature reviews, and theoretical publications that are relevant to the covered subject. In addition, the design team could improve their understanding of client wants by utilising Kansei Engineering (KE) and Kano Model (KM) for data analysis. All measurement instruments pertaining to the assessment of consumer characteristics and background were utilised to alter the data. The goal of the analysis is to examine the correlation and link between the customers' attributes and product design characteristics to the field of eyewear design.

2.1 Manufacturing Process of Spectacles

The manufacturing process of spectacles has undergone substantial changes over time, with to improvements in both materials and manufacturing methods. Originally, spectacle lenses were only composed of glass. However, the use of polymeric or plastic materials has resulted in the production of lenses that are both lighter in weight and more resistant to damage (Pillay et al., 2021). Conventional spectacle lenses are subjected to cutting processes, leading to the production of waste materials that cannot be recycled. However, Pillay et al. (2021) explain that new improvements in 3D printing technology have permitted the fabrication of spectacle lenses with reduced waste, water, and energy consumption.

Besides, Heindel (2022) discusses the incorporation of digitalization into the production process of spectacles is a highly notable advancement. As a result, there has been a development in the business model for producing optical lenses, allowing for the creation of personalised eyeglasses for individuals with facial abnormalities and customised 3D printed spectacles.

Additive manufacturing (AM) techniques, including as 3D printing, have also been examined for the creation of spectacle lenses. According to Xin et al. (2023), these approaches offer the promise for manufacturing spectacles with increased resolution, multi-material capacity, and reduced waste. However, there are still hurdles to solve, such as the requirement for specialized equipment and the potential for laser or heat exposure during the manufacturing process (Lee et al, 2020).

In conclusion, the production process of glasses has seen substantial modifications throughout the years, including breakthroughs in materials and manufacturing procedures. The fusion of digitalization and additive manufacturing has facilitated the creation of personalised and bespoke eyewear. However, there are still obstacles to surmount in order to fully harness the capabilities of these technologies.

2.1.1 The impact of age differences on the dynamic trends of spectacles design

Spectacles, in addition to their ability to correct vision, have a significant impact on facial attractiveness and serve as a means of expressing personal identity. With changing demographics and evolving age preferences, it is becoming more important to comprehend the influence of age disparities on trends in eyewear design. This review examines the present research that combines Kansei Engineering and Kano Model to understand the changing patterns in spectacles design connected to age, analyse the current findings, and identify any gaps in research.

A series of studies have studied the application of Kansei Engineering and the Kano Model in the design of spectacles, with an emphasis on different age groups. Chuan (2013) identified emotionally appealing design features for sunglasses among 18 to 34 years old in Malaysia. The major conclusions of the article are the discovery of emotionally appealing

sunglasses design features for the 18 to 34 age group in Malaysia through Kansei Engineering Type I and the selection of sample sunglasses based on these design aspects. However, the paper's limitations include the study's concentration on a particular age demographic and geographic area, possible drawbacks of the Kansei Engineering Type I approach, the neglect of other relevant variables, the relatively small sample size, and the requirement for additional research to examine emotional appeal across various demographic and cultural contexts.

Sihombing (2013) found that students using spectacles tend to favour bigger frames. Significant correlations were found between sensing-intuitive and visual-verbal learning styles, as well as the prevalence of intuitive and visual learner types, preferences for the design of spectacles, interpretation of frame characteristics, and an overview of learning styles among students studying manufacturing engineering. However, the study's shortcomings include its emphasis on manufacturing engineering students, its need for additional validation, its requirement for a larger respondent involvement from another faculty member, its need to examine lecturer preferences in the classroom, its need to take into account alternative methods of measuring learning styles, and its lack of a clear conceptual framework.

Shi (2019) applied this research to the elderly, producing a Kansei Engineering System for geriatric product design. The study established a Kansei Engineering System for new design patterns in keeping with the elderly's Kansei preference, intending to enhance the experience of products for elderly consumers. The system pays more attention to the Kansei preference of older users while seeking product quality, with the intention that elderly people will sense the Kansei value of the design and lead a creative life.

Shahin (2014) offered an integrated approach of Kansei Engineering and the revised Kano Model, which may be applied to the design of spectacles for different age groups. These studies collectively demonstrate that age variations can greatly affect the design of glasses, and that the integration of Kansei Engineering and the Kano Model can help to identify and address the distinct demands and preferences of different age groups. The author further explained the findings of the study are that the revised Kano model delivers more accurate information than the old Kano model in identifying various Kansei words in respect

of Kano major aspects. This conclusion implies that the improved Kano model can be useful and profitable for firms competing for higher customer satisfaction.

2.2 Kansei Engineering (KE)

Kansei Engineering, derived from the Japanese philosophy of integrating human emotions into the design process, has become a prominent approach in the realms of product design and user experience. The title "Kansei" pertains to the sensory and emotional dimensions, which underscores the methodology's emphasis on capturing and incorporating the deep subtleties of human emotions and experiences into product design (Lokman & Nagamachi, 2019). This method recognises that effective designs go beyond features that are only useful; it also recognises the significant influence that emotional connections may have on user happiness and the success of a product. research methods, and practical uses of Kansei Engineering across many fields.

Through an in-depth analysis of existing research, the objective is to provide significant insights, methodology, and discoveries that enhance our understanding of the influence of Kansei Engineering on product design, user experience, and its larger implications for industries and academics.

2.1.1 The origins and historical development of Kansei Engineering (KE)

Kansei Engineering (KE) has a long history founded in the aim of understanding and incorporating human emotions into the design process. This literature review analyses the origins and historical development of KE, covering major findings and contributions. Kansei Engineering developed in the early 1970s in Japan, with Mitsuo Nagamachi as a pioneering role. The basic principle was to bridge the gap between empirical product attributes and subjective user experiences, focusing on the emotional and aesthetic aspects of design. Nagamachi's early work established the groundwork for what would emerge into the structured methodology known as Kansei Engineering.

Until then, KE has been evolved throughout the years as recent study by Nagamachi (2019) provides insights into the evolution of KE techniques. The study chronicles the

development from early qualitative techniques to more advanced quantitative models, illustrating the adaptability of KE to varied design contexts. Not only by that but, KE has been integrating with advanced technologies as described by Wang and Zhang (2021) since the authors study the integration of KE with advanced technologies. The findings demonstrate how KE has embraced advances like artificial intelligence and virtual reality to better the understanding of consumer emotions and streamline the design process.

KE methodology has been greatly contributed especially to enhance user – centric design which underlined by Chen and Li (2018) underline the significance of KE to user-centric design. The methodology's focus on human emotions has empowered designers to build products that resonate with users on a deeper level, contributing to enhanced user pleasure and loyalty. Besides, KE is adopted into optimisation of aesthetic and functional elements as per highlighted by Kim et al. (2022). The authors illustrate how KE has contributed to the optimization of both aesthetic and practical features in design. By considering user emotions, KE has facilitated a balanced combination of form and function, leading to products that not only work well but also inspire good emotional responses.

The origins and historical evolution of Kansei Engineering have undergone a transformative journey from its early inception to a well-established design approach. Recent discoveries underline the dynamic nature of KE techniques, and its integration with new technologies. Contributions of KE include its role in developing user-centric design and maximising aesthetic and functional features. As KE continues to evolve, its impact on the design landscape remains considerable, establishing a future where emotional resonance is key to product development.

2.2.2 Theoretical foundations of Kansei Engineering (KE)

2.2.2.1 Core principles and concepts

Kansei Engineering (KE) is based on several core concepts and principles that guide its application in design. One of the key concepts in KE is the notion of "Kansei," which refers to the subjective feelings, emotions, and sensibilities that individuals experience when interacting with products or environments. According to Nagamachi (1995), Kansei

represents the affective and emotional aspects of human perception and plays a crucial role in shaping users' preferences and satisfaction. Another important concept in KE is the "Kansei Words," which are descriptive terms used to capture and express users' emotional responses to products or designs. These words serve as a bridge between users' subjective experiences and the design process, enabling designers to understand and incorporate users' emotional needs and desires (Nagamachi, 2002). The principles of KE revolve around the idea of creating emotional value through design. Nagamachi (1995) emphasizes the importance of understanding users' kansei and translating them into design elements that evoke the desired emotional responses. This involves identifying the key kansei words associated with a particular product or design and using them as design criteria to guide the development process.

2.2.2.2 Relationship between emotional design and user satisfaction

Emotional design plays a crucial role in shaping users' satisfaction and overall experience with a product or design. Several studies have explored the relationship between emotional design and user satisfaction, shedding light on the mechanisms through which emotional factors influence users' perceptions and evaluations. For instance, Hassenzahl et al. (2003) conducted a study to investigate the impact of emotional design on users' satisfaction with mobile phones. The findings revealed that emotional factors, such as the aesthetic appeal and the emotional response evoked by the design, significantly influenced users' satisfaction. The study highlighted the importance of considering emotional aspects in the design process to enhance user satisfaction. Similarly, Tractinsky et al. (2000) examined the relationship between emotional design and website usability. The results indicated that emotional factors, such as visual appeal and aesthetics, significantly influenced users' perceptions of usability and overall satisfaction with the website. The study emphasized the need to consider emotional design elements to create engaging and satisfying user experiences. These findings suggest that emotional design plays a crucial role in shaping users' satisfaction and overall experience with a product or design. By incorporating emotional factors into the design process, designers can create products that resonate with users' emotions and enhance their satisfaction.

While the existing research provides valuable insights into the theoretical foundations of Kansei Engineering (KE) and its relationship with emotional design and user satisfaction, there are still some knowledge gaps that warrant further investigation. Firstly, there is a need for more research on the practical implementation of KE principles in different design contexts. While the theoretical foundations of KE are well-established, there is a lack of empirical studies that demonstrate the effectiveness of KE in real-world design projects. Future research could focus on case studies or experimental designs to explore the application of KE principles in various design domains. Secondly, the relationship between specific emotional design elements and user satisfaction needs further exploration. While existing studies have highlighted the importance of emotional design, there is a need to identify the specific design elements or features that evoke desired emotional responses and enhance user satisfaction. Future research could employ qualitative and quantitative methods to investigate the impact of different design elements on users' emotional responses and satisfaction. Lastly, the role of cultural factors in Kansei Engineering and emotional design requires further investigation. The existing research primarily focuses on Western contexts, and there is a need to explore how cultural differences influence users' emotional responses and satisfaction. Future research could adopt a cross-cultural approach to examine the applicability and effectiveness of KE principles in different cultural contexts.

In conclusion, Kansei Engineering (KE) is a user-centered design approach that incorporates users' emotional responses and subjective experiences into the design process. The core concepts and principles of KE revolve around understanding users' kansei and translating them into design elements that evoke the desired emotional responses. Emotional design plays a crucial role in shaping users' satisfaction and overall experience with a product or design. However, there are still knowledge gaps that warrant further research, including the practical implementation of KE principles, the relationship between specific emotional design elements and user satisfaction, and the role of cultural factors in KE and emotional design. Future research in these areas will contribute to a deeper understanding of KE and its implications for design practice.

2.2.3 Methodologies and approaches in Kansei Engineering (KE)

Kansei Engineering (KE) is a multidisciplinary approach that aims to incorporate user emotions and preferences into product design and development. This literature review explores the methodologies and approaches used in KE, specifically focusing on techniques for capturing and analysing emotional responses and the application of KE in product design and development.

2.2.3.1 Techniques for capturing and analysing emotional responses

Several methodologies and approaches have been employed in KE to capture and analyse emotional responses. One study by Nagamachi (2002) proposed the use of semantic differential scales to measure emotional responses. This technique involves rating various product attributes on bipolar scales, such as "pleasant-unpleasant" and "exciting-boring." The results can be analyzed using statistical methods to identify the emotional dimensions associated with the product. Another approach suggested by Chen and Chen (2011) is the use of physiological measurements to capture emotional responses. They found that physiological signals, such as heart rate and skin conductance, can provide objective indicators of emotional states. These measurements can be combined with subjective self-report measures to gain a comprehensive understanding of emotional responses. Furthermore, a study by Hekkert et al. (2003) proposed the use of visual stimuli to elicit emotional responses. They found that presenting participants with images or videos related to the product can evoke specific emotions. This approach allows researchers to directly observe and analyse emotional reactions in a controlled environment.

2.2.3.2 Application of Kansei Engineering (KE) in product design and development of spectacles

The design and development of spectacles have moved beyond just utilitarian considerations, emphasizing the integration of emotional and artistic factors. In this context, Kansei Engineering (KE) has evolved as a valuable methodology, providing an organised strategy to include user emotions into the product design process. This literature review discusses recent research findings on the application of Kansei Engineering in the product design and development of glasses, shining light on discoveries, trends, and extant research gaps.

Recent research has underlined the significance of emotional design in the context of spectacles. Kansei Engineering, with its roots in understanding human sensibility and emotions, offers a systematic technique to collect and translate consumers' emotional responses into physical design aspects for eyeglasses products (Choi et al., 2019). The application of Kansei Engineering in spectacles design has been particularly beneficial in boosting the aesthetic appeal of eyewear goods. By rigorously examining users' emotional responses to numerous design elements, researchers have identified essential features that contribute to the visual attractiveness and overall appeal of spectacles (Wang & Lee, 2021).

Researchers have studied the application of Kansei Engineering to elicit and incorporate emotional reactions in spectacles design. Studies underline the importance of understanding users' emotional connections with eyeglasses, acknowledging that emotional design features contribute significantly to overall pleasure and brand loyalty (Choi et al., 2021).

2.2.4 Types of Kansei Engineering (KE)

This section aims to explore the different types of Kansei Engineering and their applications that has been evolved throughout the years from KE Type 1 until Type VII to date. Table 2.1 depicts the types of Kansei Engineering (KE) and its definition.

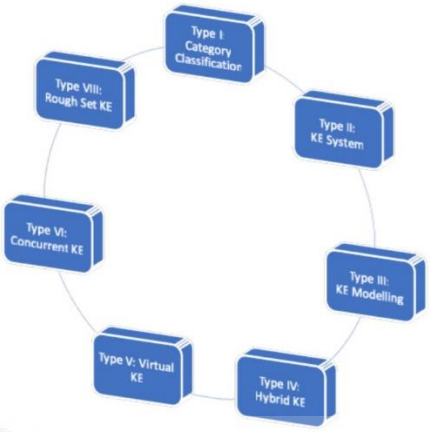


Figure 2.1: Types of Kansei Engineering (KE) (Lopez et al., 2021)

Table 2.1:KE and its definitions.

KE Type	Definition
Type I Category Classification	Created by Mitsuo Nagamachi, is grounded in the systematic categorising of user emotions and sensory experiences. The process entails categorising these emotions into categories, offering a structured framework for designers to comprehend and exploit in product development (Nagamachi, 2010).
Type II KE System	Developed by Mitsuo Nagamachi, is oriented around understanding the psychological and emotional responses of people to products. It entails recording and evaluating qualitative data relating to user experiences, feelings, and perceptions through interviews, surveys, and other qualitative methodologies (Nagamachi, 1995).
Type III KE Modelling	KE Type III, as conceptualized by Mitsuo Nagamachi, involves the construction of mathematical or computational models to represent the links between design characteristics and user emotions. These models aim to provide a quantitative knowledge of how design aspects influence the emotional responses of consumers (Nagamachi, 2012).
Type IV Hybrid KE	KE Type IV comprises the integration of several KE approaches, such as KE Type I, KE Type II, KE Type III, and maybe others, to offer a comprehensive and complex approach to understanding and treating user emotions in product design (Choi et al., 2016).

Type V Virtual KE	KE Type IV focuses on using virtual worlds and digital simulations to record and analyse user emotions. This involves generating immersive and interactive digital experiences that imitate product interactions to evoke authentic emotional responses from users (Chen et al., 2018).
Type VI Concurrent KE	KE Type V comprises the integration of Kansei Engineering principles throughout all stages of the product development lifecycle. Mitsuo Nagamachi (2015) emphasizes the need for designers to address user emotions concurrently with practical and aesthetic factors, ensuring a holistic approach to product design.
Type VII Rough Sets KE	KE Type VII leverages rough sets theory, as proposed by Zdzisław Pawlak (1982), to handle uncertainty and vagueness in the study of user emotions. Rough sets give a mathematical framework for dealing with imperfect information and are employed to describe the links between design aspects and emotional responses (Pawlak, 1982).

Table 2.2: KE type on their findings and research gaps.

KE Type	Findings	Research Gaps
Type I Category Classification	a) Lee & Kim (2021) analyses the integration of KE Type I with user - centred design principles. The study reveals that introducing emotion-based taxonomies into the user-centred design process boosts the potential to build products that resonate with consumers emotionally, leading to better user satisfaction. b) Chen et al. (2022) explored the application of KE Type I in the design of wearable technology. The study discovered several emotion categories that are critical for boosting the user experience with wearable gadgets. The findings underline the versatility of KE Type I in many product categories.	Research gaps exist in understanding how emotion-based taxonomies can dynamically adapt to shifting user preferences and cultural shifts. Jiang et al. (2021) underline the need for research that studies the adaptability of taxonomies throughout time to ensure their relevance in altering market environments.

Type II KE System	a) Kim and Lee (2020) address the integration of KE Type II with user stories in the context of mobile application design. The study concluded that adding user narratives and storytelling helps the knowledge of emotional responses, providing designers with better insights for building emotionally resonant products. b) Chen et al. (2021) explored the applicability of KE Type II in vehicle design. The study found that this methodology was effective in collecting people' emotional responses to numerous design features in autos. The findings underscored the relevance of qualitative data in determining vehicle design strategies.	The validation of emotional insights generated through KE Type II remains a research gap. Liu et al. (2023) underline the necessity for empirical research that demonstrates the efficiency of KE Type II in translating emotional data into practical design strategies and successful product outputs.
Type III KE Modelling	a) Wang et al. (2020) focuses on the application of KE Type III in mobile device design. The study applied computational models to anticipate user emotions based on design elements. The findings suggested that KE Modelling aids to more informed decision-making in creating mobile interfaces that inspire desirable emotional responses. b) Chen et al. (2022) examined the combination of KE Type III with machine learning algorithms to boost modelling accuracy. The study indicated that ML algorithms, when paired with KE Modelling, can enhance the precision of forecasting user emotions, permitting more effective design optimizations.	Research gaps exist in solving interdisciplinary collaboration problems within KE Type III. Jin and Park (2021) underline the need for excellent communication between designers, engineers, and data scientists to ensure the successful integration of KE Modelling into the product design process.
Type IV Hybrid KE	a) Lee et al. (2021) addresses the cross-disciplinary integration of KE techniques in the realm of healthcare product design. The study reveals that combining qualitative insights from KE Type II with computational modeling from KE Type III enhances the design process and adds to more user-centric healthcare solutions. b) Jung and Yoo (2022) investigated the impact of Hybrid KE on design decision-making in consumer electronics. The study found that integrating KE Type I (classification theory) for qualitative insights with KE Type III (modeling) for quantitative analysis leads to more informed and effective design decisions in the development of consumer electronic products.	Research gaps exist in the development of methodological frameworks for the smooth integration of multiple KE approaches within KE Type IV. Kwon and Choi (2020) believe that developing organised frameworks will assist a systematic and efficient integration process

Type V Virtual KE	a) Wang et al. (2019) addresses the applicability of Virtual KE in the gaming business. The study reveals that virtual worlds boost user engagement by delivering a more immersive and emotionally exciting experience. The findings emphasise the potential of Virtual KE in designing goods that resonate with users on an emotional level. b) Zhang et al. (2022) conducted a study confirming the accuracy of emotional reactions produced using virtual prototyping in KE Type IV. The research underlines the need of analysing the reliability and validity of virtual simulations to guarantee that the emotional insights gained coincide with real-world user experiences.	Research gaps exist in understanding the long-term consequences of virtual experiences on user emotions. Wu and Chen (2023) argue that understanding how lengthy exposure to virtual environments changes user preferences and emotional responses is vital for the practical implementation of Virtual KE in long product lifecycles.
Type VI Concurrent KE	a) Lin et al. (2019) addresses the implementation of KE Type V in agile development approaches. The study demonstrates that incorporating user feedback on emotional responses throughout agile cycles leads to more adaptive and user-centric product designs. b) Wang and Zhang (2021) explored the role of cross-functional collaboration in Concurrent KE. The findings indicate that successful communication between design, engineering, and marketing teams throughout the development process optimises the consideration of user emotions and improves the overall product design output.	Research gaps exist in the standardization of Virtual KE techniques. Cheng and Liu (2021) propose that having standardized techniques for building virtual environments and performing virtual simulations will enhance the consistency and dependability of research outputs across diverse investigations.

Type VII Rough Sets KE	a) Li and Chen (2019) address the applicability of Rough Sets KE in sustainable product design. The study analyses how rough sets theory can be used to analyse customer preferences and emotions related to sustainability characteristics in products, contributing to eco-friendly and emotionally appealing designs. b) Rough Sets KE are used in a study by Zhang et al. (2021) on the creation of decision support systems for product design. The research reveals that adding rough sets theory boosts the accuracy and reliability of decision support systems, supporting designers in making educated choices based on user emotional concerns.	Research gaps exist in the research of merging Rough Sets KE with modern machine learning approaches. Wu and Li (2020) believe that merging rough sets theory with machine learning techniques could further strengthen the predictive powers of KE models, delivering more accurate insights into user emotions.

2.3 Kano Model (KM)

The Kano Model is a framework for measuring customer happiness that was created by Noriaki Kano. It classifies product attributes according to how they affect customers' levels of contentment and discontent. It categorizes features into five distinct groups, enabling product developers to prioritize innovations that will have the most significant influence on consumer perception and eventually, success. Therefore, this literature review aims to study on the origins and historical developments, theoretical foundations, methodologies, attributes, and the application of Kano Model.

2.3.1 The origins and historical development of Kano Model (KM)

In the 1980s, Professor Noriaki Kano created the Kano Model, a framework for measuring consumer happiness (Shahin *et al.,* 2013). The model operates on the assumption that customer happiness is not exclusively influenced by the mere existence or nonexistence of product characteristics, but also by the degree of significance customers assign to those characteristics (Mikulic & Sc, 2007). The Kano Model is extensively employed in marketing research and product development to ascertain customer needs and preferences (Mikulic & Sc, 2007; Cudney & Antony, 2019).

The Kano Model's history and development have been examined in a number of studies that have evaluated the literature on the subject. For instance, Hartmann and Lebherz (2017) carried out a review of the literature on the Kano Model from 1984 to 2016, emphasising the various applications of the Kano methodology, the ways in which various scientists interpreted the theory, the ways in which they contributed to the theory and the ways in which they connected the Kano model to a particular school of thought. The authors observed that the number of publications containing Kano's theory and model was stable, and it even increased in 2016.

Another study by Tontini *et al.* (2013) analysed the literature on the Kano Model and its use in the context of performance and customer satisfaction. The authors observed that the Kano Model has been used to discover the most significant product attributes that drive consumer happiness and to build effective product development strategies.

Overall, the literature study reveals that the Kano Model has been widely employed in marketing research and product development to uncover client needs and preferences. The model has evolved throughout time, with academics adapting it to new business situations and merging it with other approaches such as QFD to provide effective method direction for product development.

2.3.2 Theoretical foundations of Kano Model (KM)

In this section, the theoretical foundations of Kano Model (KM) are further explained into the core concepts and principles as well as the relationship between customer satisfaction and quality attributes.

2.3.2.1 Core concepts and principles of Kano Model (KM)

The Kano Model is a theoretical framework used to enhance services and enhance customer happiness. Professor Noriaki Kano developed it during the 1980s. The approach separates value into two key component which are subjective (end-user fulfilment) and objective (real satisfaction or conformity with specifications). The model categorizes value elements into five major classifications: Attractive Quality Elements, One-Dimensional

Quality Elements, Must-Be Quality Elements, Indifferent Quality Elements, and Reverse Quality Elements. Attractive Quality Elements refer to aspects that, when met, bring satisfaction to the client, although they are not always anticipated or demanded. When one-dimensional quality elements are met, there is satisfaction; when they are not, there is discontent. Must-Be Quality Elements are anticipated and result in unhappiness when not satisfied. Indifferent Quality Elements do not affect satisfaction or discontent. Reverse Quality Elements result in unhappiness when satisfied and fulfilment when not satisfied.

Besides, in terms of product design, Kano Model is a framework used in product design to analyse and categorize client demands and preferences. It assists designers in making their goods more competitive by optimising them based on actual consumer needs. The model enables the creation of products that support the spread of culture by examining the design preferences and perceptual demand factors of consumers of cultural creative products. Customer to Engineering (C2E) systems are developed by integrating the Kano Model with other techniques like QFD and S-Curve to close the communication gap between engineers and consumers throughout the design phase. Not only does the model take into account the desired and unwanted functions of each feature, but it also works in tandem with the ideal ratio to pick and prioritise the design of new items. Additionally, the Kano Model is used to examine and categorize numerous product attributes, helping designers uncover requirements that can boost customer happiness without increasing environmental burden, thereby enhancing product sustainability.

2.3.2.2 Relationship between customer satisfaction and quality attributes

The relationship between customer satisfaction and quality attributes in the Kano Model of product design is explored in several papers. Tröster *et al.* (2023) found that identifying optimum values of product specifications and avoiding over-specification is significant in decoupling customer satisfaction from environmental burden increase as the paper discusses the relationship between customer satisfaction and product specifications based on the Kano model where it identifies specifications that can effectively increase customer satisfaction and suggests that identifying optimum values and avoiding over-specification is important for enhancing product sustainability.

Akmal *et al.* (2023) used the Kano Model to prioritize aesthetic quality attributes of women's office outfits and found that certain attributes, such as free size, are one-

dimensional requirements that must be fulfilled to avoid customer dissatisfaction as the paper discusses the relationship between customer satisfaction and quality attributes in the context of Malay women's office outfits. It states that functional and aesthetic attributes influence customer satisfaction.

Santhoshkumar *et al.* (2022) described the different categories of quality elements in the Kano Model, including attractive, one-dimensional, must-be, indifferent, and reverse elements as they discuss the relationship between customer satisfaction and quality attributes in the Kano Model, which categorizes attributes into different types based on their impact on satisfaction in a hospital setting and found out that the most common scenarios are attractive, one – dimensional, and must – be quality elements.

2.3.3 Methodologies and approaches in Kano Model (KM)

The Kano Model is a methodology used to assess and prioritize product attributes based on customer satisfaction. Several approaches and methodologies have been used in the application of the Kano Model. One approach integrates the Kano Model with the ideal ratio to select and prioritize new product designs based on qualitative analysis of desired and undesired functions which enable product designers to determine designs suitable for customer's expectations and provide a desirable prioritization of product design based on customer's viewpoints (Shahin, 2022).

Another study focuses on analysing the results of the Kano Model survey and suggests the need to refine the evaluation criteria for the model described by Paul (2023) through case study methodology and qualitative research approach as he discusses the analysis of Kano Model survey results using a spreadsheet with formulas and proved to be effective. However, the Kano Model evaluation criteria may need further refinement to address situations where there are tied responses, attributes desired by many are still rated as indifferent, and respondents do not properly answer the questions as well as neglecting of spreadsheet processing aspect in literature.

Pereira et. al. (2022) used a questionnaire-based approach to identify customer requirements and categorize them into mandatory, one-dimensional, and attractive attributes in a footwear company and applied to non – probabilistic sampling to collect information

and ensure its reliability by applying Cronbach's α as a parameter. The research contributes to helping management to prioritize actions that contribute to customer satisfaction and allows for better strategic alignment of company actions. But, one limitation of methodologies and approaches in the Kano Model is the time-consuming and expensive nature of conducting interviews or surveys to collect data on customer preferences and expectations for product attributes.

Additionally, Reichenbach (2021) explores the possibility of extracting Kano model factors from user feedback, specifically app reviews, using machine learning classifiers. These different approaches and methodologies contribute to understanding customer satisfaction and prioritizing product attributes in various industries as the methods applied by the author are regression approaches and empirical analysis which greatly contribute to help organization's identity and prioritise customer needs in product development and provide insights into regression approaches for Kano classification.

In conclusion, the Kano Model is a widely used approach for identifying and prioritizing attributes into different types, including must-be attributes, one-dimensional attributes, attractive attributes, reverse attributes, and questionable attributes for products and services. Besides, the Kano Model survey is commonly used to collect data on customer preferences and expectations for these attributes and evaluating product designs, has been refined to improve attribute ratings accuracy. It has been integrated with other methodologies like value engineering and regression to enhance product design selection and prioritization. It is used in industries like app stores and footwear to identify customer satisfaction attributes and guide strategic decision-making.

2.3.4 Attributes of Kano Model (KM)

Kano categorizes product attributes into three main types: Basic Needs, Performance Needs, and Excitement Needs. Performance Needs represent features that exhibit a linear relationship with customer satisfaction. As the level of performance increases, so does customer satisfaction (Kano *et al.,* 1984).

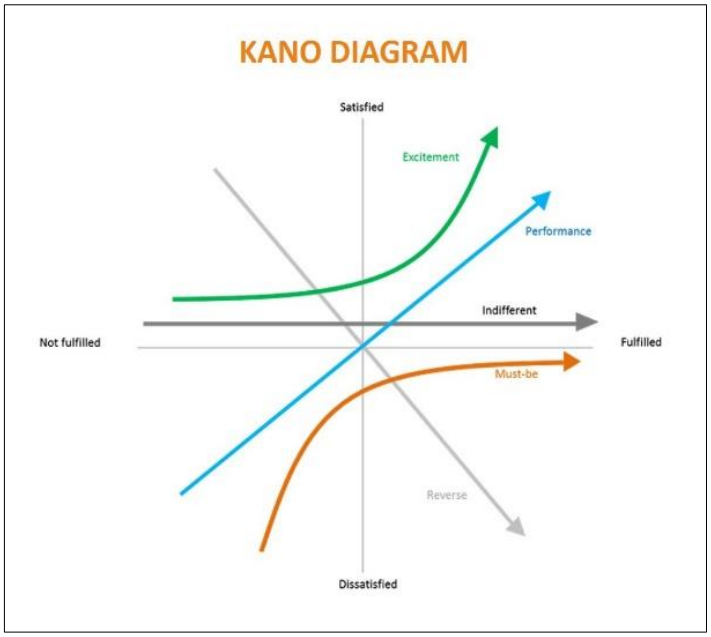


Figure 2.2: Kano Model (KM) graph (Schellenberg, 2023).

2.3.4.1 Basic-Needs (Must-Have)

These are the most fundamental requirements that customers expect from a product or service. They are the minimum requirements that customers expect to be met, and their absence can lead to dissatisfaction. Basic Needs are often related to the functionality and reliability of a product or service. For example, in the context of spectacles, customers would expect the glasses to be comfortable, provide clear vision, and not fall apart easily (Quan *et. al.,* 2021). In the Kano Model, the Basic Needs attributes are classified as "M" quality attributes, which means they must be present in the product design to avoid customer dissatisfaction.

The Kano Model identifies four types of attributes in product design, one of which is the Basic Needs or Must-Have attributes. These attributes are considered essential by customers and their absence leads to dissatisfaction. In the context of the papers provided, the attributes that fall under the Basic Needs category include the design points of cultural creative products in Fang Zhimin Memorial Hall by Wang *et al.* (2023), attributes that customers look for when deciding to buy a summer house by Paul (2023), and attributes that have a significant effect on customer satisfaction in Malay women's office outfits as stated

studied by Jagusiak-Kocik (2022). These attributes are crucial for meeting customers' minimum expectations and ensuring their satisfaction with the product.

However, the Kano Model has limitations such as the need for a clear understanding of customer preferences and the potential confusion caused by the questionnaire used in the survey (Akmal, 2023). Not only by that but, the sample size and the ranking of quality attributes can also affect the accuracy of the results obtained from the Kano Model analysis (Wang, 2023). To overcome these limitations, future research can focus on improving the sampling method and using other decision-making tools like the Analytical Hierarchy Process (AHP) for ranking the quality attributes.

2.3.4.2 Performance-Needs (Linear Relationship)

These requirements are related to the performance of a product or service. They are the expectations that customers have for a product or service to perform well in specific areas. For example, in the context of spectacles, customers might expect the glasses to have a wide field of vision, be lightweight, and have good UV protection (Quan *et al.,* 2021). Performance Needs in the Kano Model of product design refer to attributes that have a linear relationship with customer satisfaction. These attributes are directly related to the performance of the product and their presence or absence has a direct impact on customer satisfaction through customer feedback and data from various sources, such as customer surveys, online reviews, and product maintenance records, to determine the performance needs of a product (Wang, 2023).

Recent studies have continued to explore and validate the concept of Performance Needs in the Kano Model. For example, Berg (2019) explores the automotive sector and highlights the linear relationship between customer happiness and technology developments in safety features. Improved safety innovations like collision avoidance systems have a direct impact on higher satisfaction rates. In addition to the recent studies, Enhancements in user interface responsiveness and efficiency result in a linear rise in user satisfaction, according to a study on digital interface design conducted by Chen *et al.* (2021). This conclusion underscores the continuous significance of Performance Needs in current digital product design.

Despite recent developments, there are noticeable gaps in the present literature. Kim and Singh (2022) claim that there is a limited grasp of how cultural variations alter the linear relationship of Performance Needs. Cross-cultural validation is necessary to generalize findings and accommodate for various worldwide preferences in product design. Besides, according to Huang et al. (2023), longitudinal research is essential for capturing changing market trends. Rapid technology improvements may disrupt the linear relationship of certain features over time, needing continual research to stay aware of growing consumer expectations.

Even so, future research should address these gaps to advance the understanding of Performance Needs in the Kano Model by incorporating cultural perspectives as research conducted across cultural boundaries is essential to guarantee the applicability of conclusions and take into consideration cultural differences in consumer preferences. Furthermore, It will be possible to identify developing patterns and dynamic shifts in the linear relationship between Performance Needs over time by carrying out longitudinal research.

Recent findings continue to demonstrate the presence of Performance Needs with a linear relationship in the Kano Model. However, research gaps continue, underlining especially the need for cross-cultural validation, and continual monitoring of dynamic market trends to keep product design strategies aligned with increasing client expectations.

2.3.4.3 Excitement Needs (Delighters/Killers)

Delighters, also known as Excitement Needs, are attributes that greatly increase customer satisfaction without significantly enhancing product specifications. Recent studies have continued to explore and validate the concept of Excitement Needs in the Kano Model through the innovations in smart devices by Smith et al. (2020) as they highlight the significance of innovations as Excitement Needs. Features that go beyond user expectations such as augmented reality interfaces and personalised AI assistants were identified as key contributors to customer delight.

Besides, in their investigation of the function of personalisation and customisation in product design, Wang and Lee (2019) emphasised how meeting consumer preferences might serve as an Excitement Need. The study indicated that personalized experiences, such as adjustable product interfaces and adaptable functionalities, contribute significantly to customer delight (Wang & Lee, 2019). This is also emphasised by Li *et al.* (2019) in the context-dependent nature of Excitement Needs since they study that factors like user demographics, cultural background, and product category influence what features are perceived as delightful which requires tailoring product design strategies to specific target audiences and market environments.

In defiance of the findings, there are there are noticeable gaps in the present literature especially in cultural variations in delighters highlighted by Li and Kim (2021) as Limited study has addressed cultural variances in the perception of Excitement Needs. Li and Kim (2021) claim that cultural nuances play a vital part in determining what delights customers, and a cross-cultural analysis is important to find these variations. There are also gaps in context of quantitative measurement of delight which argued by Chen *et al.* (2023) as they claim that creating methods for assessing consumer delight will permit a more rigorous investigation of Excitement Needs.

Nevertheless, future research should address these gaps to advance the understanding of Excitement Needs in the Kano Model from cross – cultural examination where a deeper understanding of cultural variations in Excitement Needs is essential for global product design. Future research should explore how cultural nuances influence the perception of delighters. Besides, developing standardized quantitative metrics for measuring customer delight will enhance the precision and comparability of research findings. Future studies should focus on establishing reliable and valid measures for the quantitative assessment of Excitement Needs.

Recent studies on Excitement Needs in the Kano Model underline the relevance of innovation, customization, and personalization in satisfying customers. However, research gaps persist, including the need for examination of cultural variances, and the development of quantitative criteria for assessing delight. Closely examining these gaps will lead to a deeper comprehension of Excitement Needs in modern product design.

2.3.4.4 Indifferent Needs

Understanding Indifferent Needs in the Kano Model can be explained into its definition and dynamic nature. Kano *et al.* (1984) originally defined Indifferent Needs as traits that, when present, neither significantly boost nor decrease consumer satisfaction. These are often aspects that customers don't feel passionately about, and their presence or absence has little impact on overall satisfaction. While Indifferent Needs are recognised for their dynamic nature which client tastes might fluctuate, causing traits labelled as Indifferent to shift in value over time due to shifting market conditions or technology improvements (Matzler et al., 2007).

From the recent studies, Wu *et al.* (2019) evaluated consumer perceptions of technological characteristics in smartphones, primarily focused on attributes labelled as Indifferent in the Kano Model. The study indicated that qualities like wireless charging, once labelled Indifferent, became increasingly relevant as technology improved, questioning the static nature of Indifferent attributes. This is also explored by Geng et al. (2019) on the dynamic nature of indifference where technological advancements and market evolution can change the perception of Indifferent Needs as what appears irrelevant today might become a Performance or even Excitement Need in the future.

Furthermore, Kim and Wong (2021) studied the impact of cultural preferences on the classification of qualities as Indifferent. The study indicated that certain qualities, once regarded as Indifferent, gained value in various cultural situations, offering light on the impact of cultural nuances in affecting client opinions while Sun et al. (2020) suggested that attributes considered unnecessary in one culture might be important in another as Indifferent Needs can vary significantly across cultures and demographic groups in which the authors highlighted the need for culturally sensitive product design and tailored marketing strategies.

However, research gaps exist in creating standardized quantitative metrics for assessing customer apathy as current methods for identifying Indifferent Needs rely heavily on self-reported surveys, which can be subjective and susceptible to bias. Therefore, Zhang et al. (2023) propose that providing accurate metrics for evaluating indifference will lead to a more sophisticated understanding of the role of Indifferent Needs in the Kano Model since it would enable more precise and comparable assessments of the role of Indifferent Needs in shaping overall customer satisfaction.

Recent discoveries show the dynamic nature of Indifferent Needs in the Kano Model, contradicting the traditional concept of these qualities as static and unchanging. Research gaps in the literature include the need for the creation of quantitative metrics for assessing indifference. Closing these gaps will help organizations to comprehend the complex role of Indifferent Needs in modern product design on a more thorough level.

CHAPTER 3
METHODOLOGY

This chapter provides a concise explanation of the research methodology employed to conduct the analysis of the research. This study involves conducting causal research to determine the causal relationship between variables, with the aim of identifying concrete evidence to enhance comprehension and predict the relationship. Additionally, the document explores the research methodology employed. The research will employ the KE method with an SD methodology to measure emotional expression using Kansei Words. An analysis will be conducted on the methodology employed and the data gathered to determine the customer's emotional response in selecting the most desirable attributes of the product through Kano Model. This analysis will categorise the findings into perception and expectation, in accordance with decision-making theory. The SPSS, also known as the Software Package for Statistical Analysis, is utilised to process and analyse collected data, producing statistical outcomes. The methodology provides a comprehensive description of all the objectives, including project planning, and serves as a guide for conducting the research.

3.1 Research Methodological

The approach employed in this thesis is described in Figure 3.1. Through the framework shown, the demand and the expectations are analysed. The research is organised into three primary elements. To conduct out the inquiry in Part 1, the questionnaire is designed for surveys by utilising the framework measurement of KE and Kano Model. Part 1 consisted with the combined of KE and spectacles design to produce the final surveys. The process in Part 1 is established from the respondent's information during the preliminary test by utilising the approach of product design analysis and emotional 30-word analysis. The Kansei Engineering (KE) approach is utilised as a guidance to interpret the design features

connected to customer emotional feeling. Due to all questionnaires are very necessary to represent the customers' preferences and demands, the validation toward the questions is carried out through the preliminary or pilot test. If successful, the framework measurement is able to apply to the product domain.

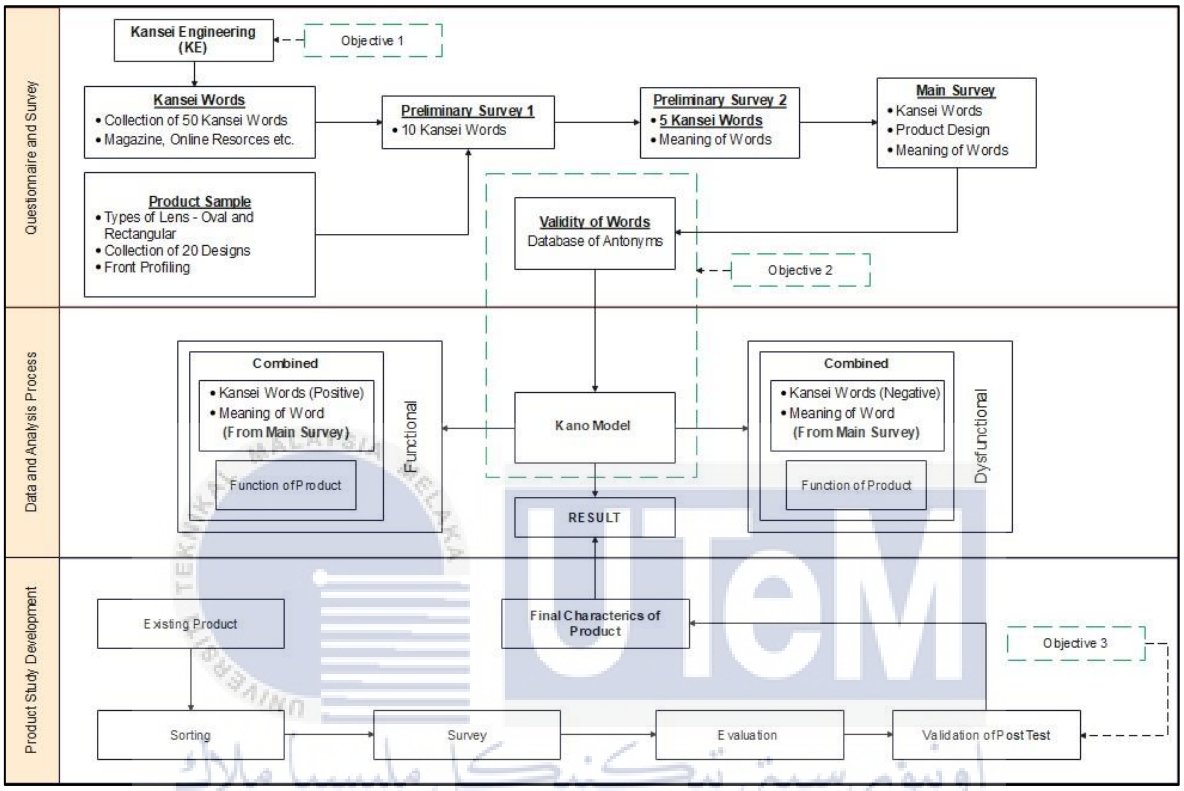


Figure 3.1: The framework of product study

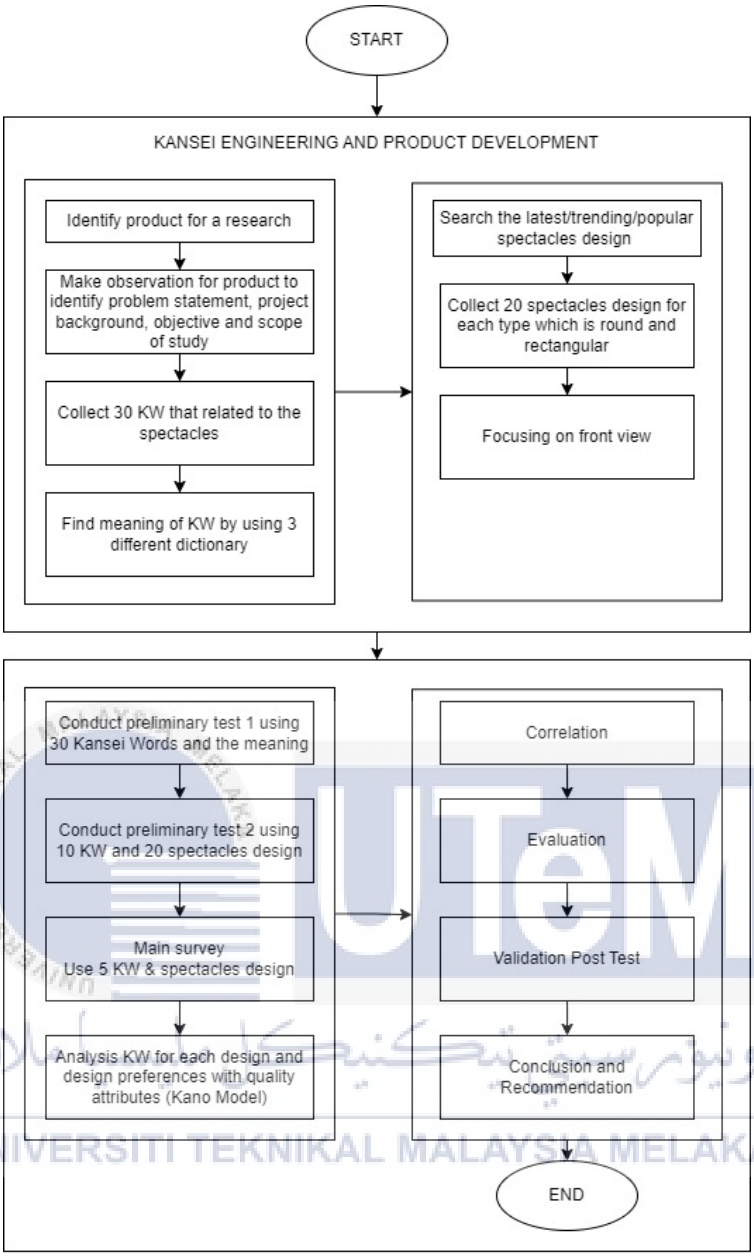


Figure 3.2: The flow chart of framework.

3.1.1 Kansei Words (KW)

In discovering what the consumer needs through their emotions, a procedure must be established and tied to every phrase divulged. Figure 3.1 illustrates the process of gathering Kansei Words (KW) to analyse customer preferences for feelings and emotions expressed in Kansei Words concerning design profiles. The synthesis of Kansei Words is derived from user-articulated words to the product design based on the items that are already on the market, as well as external collections (such as magazines and papers). First, collecting the 30 relevant Kansei Words that logically symbolise a spectacle.

Table 3.1: 30 Relevant Kansei Words (KW)

Kansei Words					
1	Attractive	11	Flashy	21	Safety
2	Beautiful	12	Lightweight	22	Sensual
3	Bold	13	Glamorous	23	Sporty
4	Casual	14	Gorgeous	24	Stylish
5	Classic	15	Hot	25	Sleek
6	Cool	16	Intellectual	26	Sophisticated
7	Comfortable	17	Modern	27	Practical
8	Designer	18	Mysterious	28	Trendy
9	Edgy	19	Lovely	29	Youthful
10	Feminine	20	Premium	30	Robust

Every term has its meaning explained using Kansei words, which are derived from three dictionaries: the Collins, Cambridge, and Merriam-Webster dictionaries. These dictionaries are used to express people's understanding and sentiments through their use of language. The initial questionnaire is then created and sent to the respondents, asking them to describe their thoughts and feelings about the spectacles design they would like to use and select the appropriate translations for the Kansei Words. Next, the respondents with the highest score are sorted using 10 Kansei words and one dictionary to find the meaning of each word for the first preliminary survey. As for the second preliminary survey, five final Kansei words is sorted, and the respondent's major score is used in the main survey.

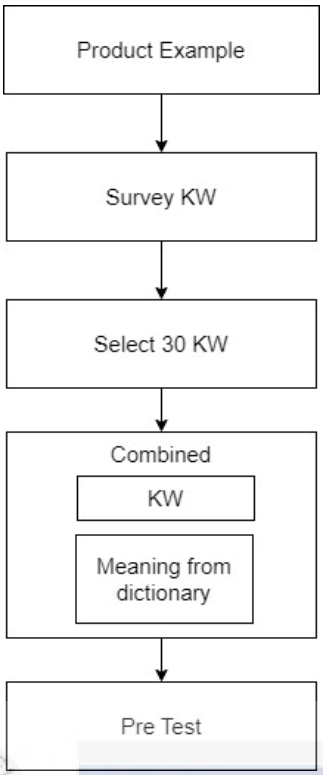


Figure 3.3: The flow chart of Kansei Words (KW)

3.1.2 Product Design

Finding the element needed by using the present items on the market is the first step towards determining the precise requirements in the design process (Figure 3.4). The primary prerequisite is that the spectacles must be the recent trends among the students and sold in Malaysia. According to shaped design, the spectacles design in this study includes one design profiles. There are two categories of spectacle types which are round and rectangular shape. These were chosen from the market while keeping the primary criteria in mind. Every type of spectacles has 20 designs of spectacles based on shape design which are round and rectangular that related to the front view. There is one preliminary survey that must be completed to achieve a final design, using the methods shown in Figure 3.1. It is then sorting with the highest score by respondent with five types of design for each type of spectacles.

A spectacles' appearance can impact a consumer's decision in a variety of ways, thus it's critical to conceal certain aspects of the spectacles' identity (such as the name and logo) to prevent brand bias. The spectacles are chosen as the product study as the selection of the spectacle stems from its significance as a teaching tool in the classroom, its frequent usage

as a product in students' daily lives, and the assumption that 90% of students had worn glasses or spectacles at some point in their lives (Fevi, 2014).

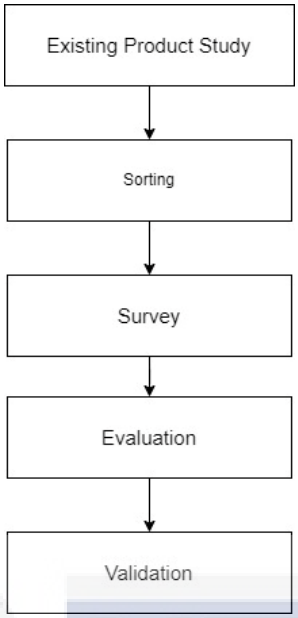


Figure 3.4: The flow chart of product design.

3.1.3 Main Survey

After this, the designs are examined using the main survey's SD scale and Kansei Words. As a prerequisite for selection in the product domain, a product (spectacles) is chosen as the focal point of a survey that is administered to Melaka residents and students at one higher education institution which in this case, UTeM. Following a preliminary survey spanning gender (male, female), and current status of education, a final sample size of 50 participants is obtained. To achieve customer preferences through product design, the Kansei Engineering technique is utilising to determine the effectiveness and qualities needed in the product design characteristics to fulfil consumer satisfaction. Next, constructing Kano Model questionnaire, the study examined each spectacles design individually and correlate with the Kansei Words to retrieve the most preference spectacles designs and validate through the post-test.

Miserable	1	2	3	4	5	6	7	Comfortable
Boring	1	2	3	4	5	6	7	Attractive
Simple	1	2	3	4	5	6	7	Stylish
Ugly	1	2	3	4	5	6	7	Beautiful
Heavy	1	2	3	4	5	6	7	Lightweight
How much do you like this design?								
Strongly Dislike	1	2	3	4	5	6	7	Strongly Like

Figure 3.5: Kansei Words (KW) in Semantic Differential (SD) scale

3.1.4 Data Process

The procedure of gathering data for analysis is the last phase of the technique. In this section, the collected data and information is examined utilising the Kansei and physiognomic methods that are suggested in this thesis. Based on how comprehensive they are, the total data gathered from the observation and survey which used questionnaires as data sources is supported in the study of customer satisfaction with product design. All the information gathered is entered into Microsoft Excel under the sections determined by the survey questions. Data analysis with Microsoft Excel is the next step (after data collection). Three distinct sorts of data, such as those based on Kansei Word and product design preferences, design values, and Kano Model, are referred to as the three types of analysis that are required. Additionally, utilising SPSS statistical software, ascertain the link between the Kansei Words, Kano Model and the design profile.

3.1.5 Validation

Justification of the findings in the synthesis and evaluation phases requires a new survey or post-test. Therefore, the post-test survey is completed and circulated in order to validate whether the decision reached regarding the design preferences (based on Kansei Words and Kano Model) is legitimate or not. This method is eventually crucial since the decision of the customer's preferences towards the design of the product could be diverse.

As a result, the comparison between the evaluation and post-test findings is used to draw the conclusion.

3.2 Types and Data Sources

This section provides a general discussion of types and data sources to be used in this project which are observation, data collection, and population and sample.

3.2.1 Observation

The qualities of the product more especially, the one that was chosen were determined by observation based on actual circumstances. Typically, the product serves the customer's internal needs, but the outward design which is chosen as the shape is the only thing that draws attention. Every spectacle design and style were examined through market observation. Before performing the analysis and evaluation, this stage establishes the plan on which the outputs must be gathered. This study is restricted to the design of round and rectangular eyeglasses. These are not the only criteria that are included in the questionnaires created for product design. As a result, the purpose of the literature study is to increase understanding of product development by utilising Kansei Words and product design, which are the same concepts that would be covered in questionnaires.

3.2.2 Data Collection

The objective of data collecting is to get information and to preserve it on record. In this data component, the data obtained is from observations and surveys that have been carried out. The goal of data collecting is to ascertain respondents' expectations and perceptions on customer satisfaction, which will subsequently be examined using KE. Therefore, gathering data is crucial to the study because it may be used as proof to support the findings.

3.3 Population and Sample

A group or collection of people or study objects with predetermined standards of characteristics is referred to as the population or sample. It can be characterised as a collection of people or things with at least one observation of the characteristic equation, depending on the quality and characteristics of the population (Cooper and Birman, 1995). According to Hair *et al.* (1998), the sample size is (n) x 5 observations for each estimated parameter; hence, if (n) = 20, the sample size is made up of 100 respondents. This amount is merely an initial sample determination because the number of samples above no longer fits if the data do not appear regularly.

CHAPTER 4
RESULT AND DISCUSSION

This chapter presents the findings of the collected data regarding customer satisfaction with the product. The survey questionnaire was distributed to identify, investigate, and analyse customer satisfaction based on their expectations and requirements for the product design (emotional requirements). Two types of questionnaires were used which are the Kano Method (KM) with a pair of Functional-Dysfunctional questions and the Semantic Differential (SD) Scale for the Kansei Engineering (KE) approach. The Likert Scale was used to assess preferences for product design. The final questionnaire will be analysed using the Statistical Package for Social Science (SPSS v. 29) to obtain statistical information such as reliability and correlation.

4.1 The Customer Satisfaction and Requirement on KE and KM

Based on the data collected for product design against what of the customer's wants the development of the questionnaire is constructed refers to Kansei Words (KW) in KE approach. On this, the KW is considered on the customer emotional feeling that is gained in the initial process as mentioned in the methodology, while the KW is built and manipulated towards the SD Scale in KE approach and developed towards the KM approach by pairing questions for functional and dysfunctional.

4.1.1 Final design of product study development

The methodology process in Figure 3.1 is applied to find the main priority elements of design, where it is based on the characteristics of the best design available on existing products spectacles on the market now. A s a result, the main requirement which is the round and square-shaped spectacles are gained based on the pre-result among the final design of spectacles survey. The second step, the process of spectacles design development is started by investigating the other elements which are added characteristics of product as consists of Full Frame, Half Frame and Rimless.

4.1.2 Final Kansei Words (KW) of SD Emotional Word Development

Kansei Words is word used to represent certain feelings of the customer regarding the object that the word represent. A valid Kansei Word is the word that is understandable by the customer and would mostly represent their feeling toward the object. In order to obtain a valid Kansei Word, by referring to methodology in Figure 3.3, the process in Phase 1 is used in order to grab and gain the customer word. There are four steps involved in this process, starting with the combined result of words from the survey and the database of words and word grouping or analysis as a final process involved as described below. For the preliminary study, the total number of 50 students that own the spectacles are randomly selected as the respondent.

a) Interview/Preliminary Test 1

The purpose of the preliminary test 1 is to catch random words that are usually used by every person to represent the spectacles. First, to list down the 30 different words that are logically represented a spectacle as shown in the table 4.2 below. Second, there are some examples of spectacles design proposed out of 30 designs in the market (as shown in Figure xx) and asked to the respondents to answer based on words represent their best feelings. Every word that is called by the respondents according to the list will be marked, while those are not will be recorded. Table 4.3 shows the words expressed by the respondents that were not listed in the 30 words as proposed.

Table 4.1: 30 Kansei Word database.

Kansei Words					
1	Attractive	11	Flashy	21	Safety
2	Beautiful	12	Lightweight	22	Sensual
3	Bold	13	Glamorous	23	Sporty
4	Casual	14	Gorgeous	24	Stylish
5	Classic	15	Hot	25	Sleek
6	Cool	16	Intellectual	26	Sophisticated
7	Comfortable	17	Modern	27	Practical
8	Designer	18	Mysterious	28	Trendy
9	Edgy	19	Lovely	29	Youthful
10	Feminine	20	Premium	30	Robust

Table 4.2: Kansei Words from respondents.

Attractive	Beautiful	Intellectual	Cool	Smart
Comfortable	Trendy	Lightweight	Casual	Stylish

b) Second Interview/Preliminary Test 2

Based on the conducted preliminary test 2, the words selected by the respondents to represent the spectacles were then combined with the design proposed. These words were used in the preliminary surveys. 50 respondents were asked to select the listed words related to the pen design according to their feelings. Every word is ticked by the respondent was listed down and their frequencies were calculated, based on this point, the words grouping are done to reduce the number of selected words as much as possible for questionnaires developed. The grouping carried out is due to is a different word that may have a same meaning or represent the same thing. For example, comfortable and ergonomic, although both words are different, but they basically have the same meaning. The word resulted from grouping will be used in the main questionnaire of the survey.

Table 4.3 shows the final six design proposed that is chosen by the respondents to incorporated into the main surveys.

Table 4.3: The final six designs from the surveys.

Round Spectacles		
Design 1- Full Frame	Design 2 - Half Frame	Design 3 - Rimless
		
Square Spectacles		
Design 4 - Full Frame	Design 5 - Half Frame	Design 6 - Rimless
		

Table 4.4 shows the five final Kansei Words which will be used in the questionnaire of the survey.

Table 4.4: Results of Kansei Word Grouping

Comfortable
Attractive
Stylish
Beautiful
Lightweight

The Semantic Differential Technique is used to act as the antonyms words towards the five final of Kansei words. The process involved is shown in methodology to Figure 3.1, it elaborated about the process to build the SD emotional word development (Phase 2) based on Kansei words. These of 30 words in antonyms (Table 4.4) were used in conducting the other survey towards the 50 respondents based on their feeling what the exact of antonyms (opposite) words based on their feelings. The six final of antonyms words in Table 4.6 And meaning (antonyms and synonyms) is selected resulted on the highest ranking. The result combined with Kansei words as pairwise words in SD Scale (Table 4.7). Nevertheless, the

weighted scale of seven is used for the preference final product design by respondent (Figure 4.1) and the summary of the Kansei Words, meaning and antonyms (SD Emotional Word Development) as in Table 4.7.

Table 4.5: 30 of antonyms words.

Kansei Words					
1	Boring	11	Modest	21	Trouble
2	Ugly	12	Heavy	22	Painful
3	Pale	13	Repulsive	23	Chic
4	Formal	14	Hideous	24	Flashy
5	Typical	15	Unfashionable	25	Lacklustre
6	Tacky	16	Lowbrow	26	Unsophisticated
7	Miserable	17	Outdated	27	Useless
8	Old-fashioned	18	Apparent	28	Outmoded
9	Dull	19	Poor	29	Mature
10	Masculine	20	Moderate	30	Fragile

Table 4.6: Results of antonyms words

Miserable
Boring
Simple
Ugly
Heavy

Table 4.7: Results of word grouping based on pairwise.

Miserable	-	Comfortable
Boring	-	Attractive
Simple	-	Stylish
Ugly	-	Beautiful
Heavy	-	Lightweight

How much do you like this design?								
Strongly Dislike	1	2	3	4	5	6	7	Strongly Like

Figure 4.1: Product preference scale.

4.1.3 Final Kano attributes of functional product development: New approach to develop Kano questionnaire

Kano is in the second part in the questionnaire (Appendix C1). This result is a new way in developing the Kano questionnaire compared to the old one (Fall, 1993) which is the emotional feeling (Kansei) is also put in the Kano statement, Table 4.9 and 4.10. In this section, the respondents were asked in two different conditions, which are functional, where it is related to the condition about the spectacles used if there existed, and dysfunctional; where it is related to condition if there do not exist. Kano form is functional as non-linearity of satisfactory condition of customer related to the existed and non-existed condition.

The Kano question is to determine the respondents feeling according to the parameter given. Five questions are developed for both functional and dysfunctional parts. The development of Kano is started after the selection of words in Kansei phase is completed. The meaning and antonyms words in phase 2 have been developed to be used in the development of Kano. The Kano statement is coming out in Functional and Dysfunctional domain, which are as follows:

Table 4.8: Summary results of SD emotional word development

No	Kansei Words (KW)	Meaning	Synonyms and Antonyms	
			Positively correlated to KW	Negatively correlated to KW
Word 1	**Comfortable** SD word: Miserable – Comfortable **(MC)**	Giving comfort or physical relief; relaxed or free from pain	• Good • Light • Pleasant	• **Miserable** • Uncomfortable • Unpleasant
Word 2	**Attractive** SD word: Boring – Attractive **(BA)**	Very pleasing in appearance; charming	• Appealing • Pleasant • Colourful	• **Boring** • Dull • Monotonous
Word 3	**Stylish** SD word: Simple – Stylish **(SS)**	Being in the latest fashion or current style	• Fashionable • Modern • Smart	• **Simple** • Old-fashioned • Dowdy
Word 4	**Beautiful** SD word: Ugly – Beautiful **(UB)**	Having beauty; very pleasing to the eye, ear, mind	• Pretty • Gorgeous • Charming	• **Ugly** • Plain • Repulsive
Word 5	**Lightweight** SD word: Heavy – Lightweight **(HL)**	Having little weight	• Light • Weightless • Feathery	• **Heavy** • Weighty • Hefty

i. In Functional element of Kano Method, the statement is constructed as:
'A spectacle with full frame *(design element)* makes me feel comfortable *(KW)* as it provides physical relief when wearing *(function)*.'

ii. In Dysfunctional element of Kano Method, the statement is constructed as:
'A spectacle without full frame *(design element)* makes me feel miserable *(KW)* when wearing *(function)*.'

Both statements above are indirectly given the combination between the perceived attributes qualities (Kano) and the emotional (Kansei) response. As results, the Table 4.9 and Table 4.10 shown below are consisted with the Dysfunctional and Functional statement of Kano.

Table 4.9: Five questions of Functional (F) statements

No	Functional Statement
1	A spectacle with full frame makes the customer feels comfortable as it is providing physical relief when wearing.
2	A spectacle with half frame gives a way of being attractive and pleasing to the eye to the customer when wearing.
3	A spectacle with rimless makes the customer feels lightweight when wearing it.
4	A round spectacle makes the customer feels so stylish, smart and fashionable when wearing.
5	A square spectacle makes the customer look beautiful while wearing and pleasing to the eye.

Table 4.10: Five questions of Dysfunctional (D) statements

No	Dysfunctional Statement
1	A spectacle without full frame makes the customer feels miserable when wearing.
2	A spectacle without half frame makes the customer looks boring and uninteresting to the eye while wearing
3	A spectacle that is not rimless makes the customer feel heavy when wearing
4	A spectacle that is not round makes the customer looks so simple and plain when wearing
5	A spectacle that is not square makes the customer looks ugly while wearing.

4.2 Identification Result of The Developed Model in The Real Situation, Case Study: Spectacle Product

In this section, the developed model is applied into the real situation to analyse the reliability, and the data analysis. A daily life product is used as case studies which is spectacle product, as a real situation feature to apply the developed structural model. A set of questionnaires consist of the demography, the results of Kano (subtopic 4.2.3) and the results of Kansei Words in Semantic Differential Scale (subtopic 4.2.2) towards finalised six design of spectacle proposed (subtopic 4.2.1). All the data survey is analysed by using Average Analysis as a mathematical approach and Statistical Package for Science (SPSS) as statistical approach.

4.2.1 Data of respondents

The questionnaire is distributed in Universiti Teknikal Malaysia Melaka (UTeM) and equipped with three sections in which, Section One (1) consists of the questions related to personal information such as Gender, Age and Current Status of Education while Section Two (2) is about functional and dysfunctional statements of the spectacle product and Section Three (3) is related to the spectacle designs. By applying statistical approach, the data of questionnaire is analysed using statistical software (SPSS v.29) and Microsoft Excel to identify its reliability, frequency, mean, median and standard deviation as well as the correlation and presented into graphs and tables.

1) Sample size

It is crucial that this study must have a sufficient sample size. This is required to guarantee that the study has a good basis for identifying a statistically significant result to represent the demography connected to the case given and to ensure that enough resources are deployed. A study that has an inadequate sample size will have a poor possibility of discovering a statistically significant result and hence will constitute a waste of important resources.

Therefore, the final questionnaires are distributed among the students of Universiti Teknikal Malaysia Melaka (UTeM) which ages range around 18 to 30 years old. The number of samples taken is based on the number assumed by students in UTeM. To complete the surveys, 50 people are selected to answer the questionnaire. By assuming the rate of participants' own spectacles is 90%, by using the formula in Equation 4.1, the sample should be taken is 50 respondents.

$$SS=\frac{Z^2\times p(1\text{-}p)}{C^2} \qquad \text{Equation 1.1}$$

Where,

Z = Z value (example, 1.96 for 95% confidence level) = 95%

P = percentage picking a choice, expressed as decimal = 50 person (0.5 used for sample size needed)

c = confidence interval, expressed as decimal = 6.3

2) Analysis of data: Reliability Test

Reliability refers to the consistency of measurement results when the measurement is repeatedly conducted on individuals or groups within a population (Dalyanto *et al.,* 2021). The greater the association between scores obtained through repeated measures, the more reliable the scale. In this study, Cronbach's alpha was used to test the reliability of each variable. Cronbach's alpha is a reliability measure that ranges from zero to one, with a minimum acceptable level of 0.60. The reliability levels, as indicated by Cronbach's alpha, are presented in the following table.

Table 4.12: Cronbach's Alpha value and its reliability level (Dalyanto *et al.,* 2021).

Cronbach's Alpha Value	Reliability Level
0.0 – 0.20	Less Reliable
>0.20 – 0.40	Somewhat Reliable
>0.40 – 0.60	Reliable Enough
>0.60 – 0.80	Reliable
>0.80 – 1.00	Very Reliable

The result of reliability test showed the constructs attribute or variable from all dimension questions gives the Cronbach Alpha 0.904 as shown in Table 4.13 are reliable.

Table 4.13: Reliability test of final questionnaire

Cronbach's Alpha	N of items
0.904	40

Meanwhile, Table 4.14 depicts the values of Cronbach's Alpha of the Kano Method and Kansei Engineering. For Functional attribute, the Cronbach's Alpha value obtained is 0.595 which is reliable enough while for Dysfunctional, the value obtained is somewhat reliable which is 0.459. Each element of Kansei Engineering achieved the value of >0.60 which means, all the data are valid and reliable.

Table 4.14: Values of Cronbach's Alpha

		CRONBACH'S ALPHA	
NO	**PRODUCT CRITERIA**	**FUNCTIONAL**	**DYSFUNCTIONAL**
KANO METHOD			
1	A spectacle with full frame	0.595	0.459
2	A spectacle with half frame		
3	A spectacle with rimless		
4	A round-shaped spectacle		
5	A square-shaped spectacle		
KANSEI ENGINEERING			
1	Miserable-Comfortable	0.651	
2	Boring-Attractive	0.671	
3	Simple-Stylish	0.617	
4	Ugly-Beautiful	0.708	
5	Heavy-Lightweight	0.710	

4.2.2 Preference Design Analysis

Every design is analysed based on all the Kansei Words selected in the questionnaire. These steps are done to determine which Kansei Words affecting most in each design. The resulting analysis of design shows the main reason customer would choose the spectacle product based on the final design showed in Table 4.3. This could help in understanding the way the customer thinks and feels against the design shown to them.

Figure 4.3 shows the graph of the preference choice among the respondent by using average analysis towards Design 1. In Design 1, the most affected Kansei Words is by Miserable and Comfortable (MC). The graph depicted that by the maximum average value is 5.26 towards the Miserable-Comfortable (MC) than the minimum value obtained towards Boring-Attractive (BA) which is 4.76.

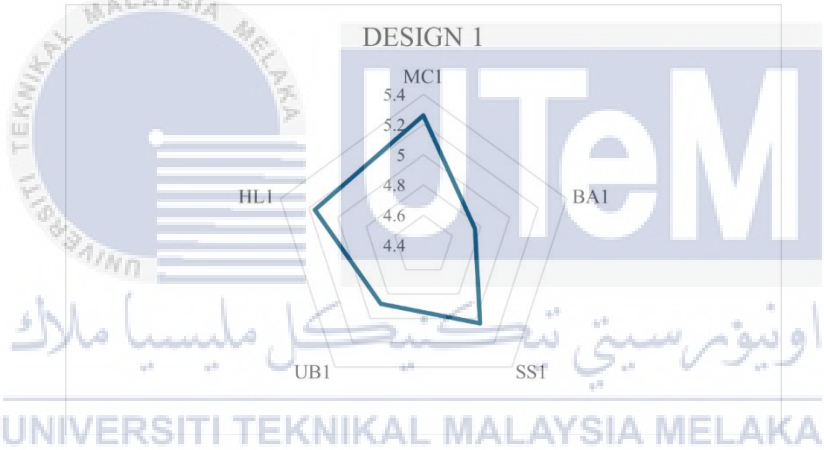


Figure 4.3: Preference by average analysis towards Design 1

In addition to the preference choice, the Table 4.15 shows the average and median values to identify the tendency of Kansei Words towards Design 1. Between both Miserable-Comfortable (MC), the tendency is more towards the Kansei Words of Comfortable by the average value of 5.26 > 4.00 (midpoint). This case means that most of the respondent agrees that Comfortable represents the emotional design feeling towards Design 1.

Table 4.15: Values of average and middle point of Kansei Words towards Design 1

Kansei Words	Values of Average	Midpoint
MC-1	5.26	4.00
BA-1	4.76	
SS-1	5.04	
UB-1	4.88	
HL-1	5.16	

Figure 4.4 shows the graph of preference choice among the respondent by using average analysis towards Design 2. In Design 2, the most affected Kansei Words is by Heavy and Lightweight (HL). The graph depicted that by the maximum average value is 4.36 towards the Heavy-Lightweight (HL) than the minimum value obtained towards Boring-Attractive (BA) which is 3.98.

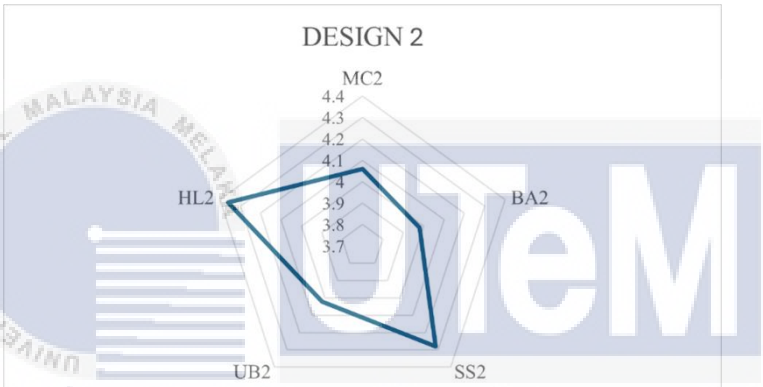


Figure 4.4: Preference by average analysis towards Design 2

In addition to the preference choice, the Table 4.16 shows the average and median values to identify the tendency of Kansei Words towards Design 2. Between both Heavy-Lightweight, the tendency is more towards the Kansei Words of Lightweight by the average value of 4.36 > 4.00 (midpoint). This case means that most of the respondent agrees that Lightweight represents the emotional design feeling towards Design 2.

Table 4.16: Values of average and middle point of Kansei Words towards Design 2

Kansei Words	Values of Average	Midpoint
MC-2	4.06	4.00
BA-2	3.98	
SS-2	4.28	
UB-2	4.02	
HL-2	4.36	

Figure 4.5 shows the graph of the preference choice among the respondent by using average analysis towards Design 3. In Design 3, the most affected Kansei Words is by Boring and Attractive (BA) as well as Simple and Stylish (SS). The graph depicted that by the maximum average value is 4.90 towards the Boring-Attractive (BA) and Simple-Stylish (SS) than the minimum value obtained towards Miserable-Comfortable (MC) which is 4.66.

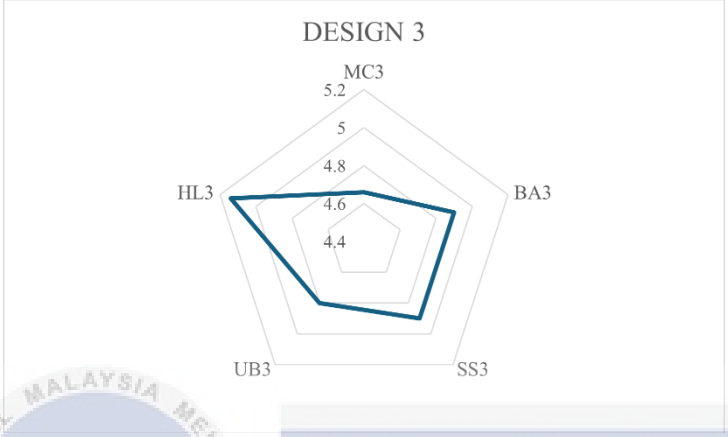


Figure 4.5: Preference by average analysis towards Design 3

In addition to the preference choice, the Table 4.17 shows the average and median values to identify the tendency of Kansei Words towards Design 3. Between both Boring-Attractive (BA) and Simple-Stylish (SS), the tendency is more towards the Kansei Words of Attractive and Stylish respectively by the average value of 4.90 > 4.00 (midpoint). This case means that most of the respondent agrees that Attractive and Stylish represent the emotional design feeling towards Design 3.

Table 4.17: Values of average and middle point of Kansei Words towards Design 3

Kansei Words	Values of Average	Midpoint
MC-3	4.66	4.00
BA-3	4.90	
SS-3	4.90	
UB-3	4.80	
HL-3	5.14	

Figure 4.6 shows the graph of the preference choice among the respondent by using average analysis towards Design 4. In Design 4, the most affected Kansei Words is by Simple and Stylish (SS). The graph depicted that by the maximum average value is 5.38 towards the Simple-Stylish (SS) than the minimum value obtained towards Heavy-Lightweight (HL) which is 5.18.

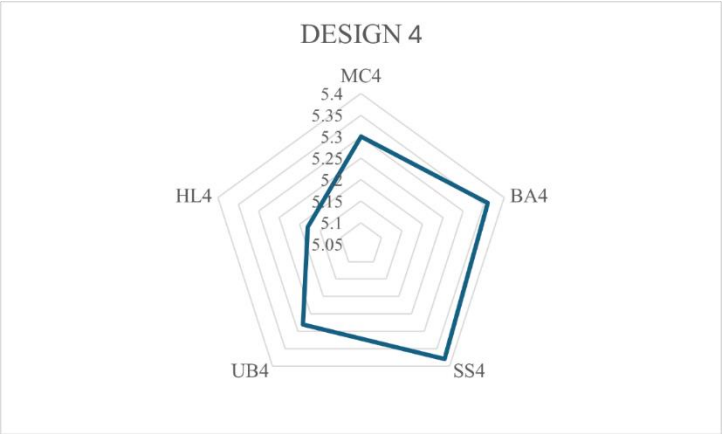


Figure 4.6: Preference by average analysis towards Design 4

In addition to the preference choice, the Table 4.18 shows the average and median values to identify the tendency of Kansei Words towards Design 4. Between both Simple-Stylish (SS), the tendency is more towards the Kansei Words of Simple by the average value of 5.38 > 4.00 (midpoint). This case means that most of the respondent agrees that Stylish represents the emotional design feeling towards Design 4.

Table 4.18: Values of average and middle point of Kansei Words towards Design 4

Kansei Words	Values of Average	Midpoint
MC-4	5.30	4.00
BA-4	5.36	
SS-4	5.38	
UB-4	5.28	
HL-4	5.18	

Figure 4.7 shows the graph of the preference choice among the respondent by using average analysis towards Design 5. In Design 5, the most affected Kansei Words is by Heavy and Lightweight (HL). The graph depicted that by the maximum average value is 4.16 towards the Heavy-Lightweight (HL) than the minimum value obtained towards Ugly-Beautiful (UB) which is 3.70.

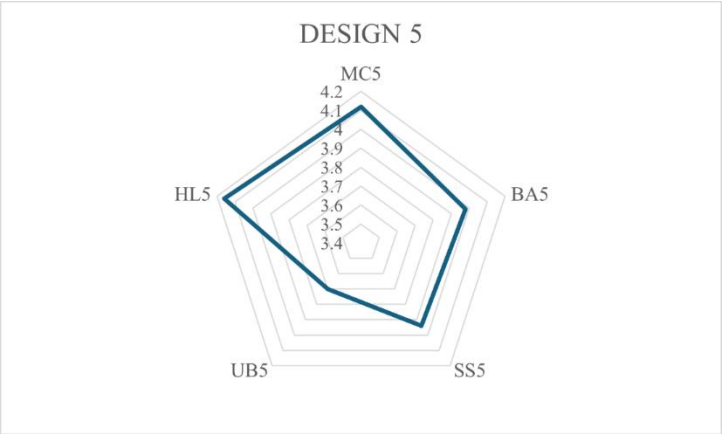


Figure 4.7: Preference by average analysis towards Design 5

In addition to the preference choice, the Table 4.19 shows the average and median values to identify the tendency of Kansei Words towards Design 5. Between both Heavy-Lightweight, the tendency is more towards the Kansei Words of Lightweight by the average value of 4.16 > 4.00 (midpoint). This case means that most of the respondent agrees that Lightweight represents the emotional design feeling towards Design 4.

Table 4.19: Values of average and middle point of Kansei Words towards Design 5

Kansei Words	Values of Average	Midpoint
MC-5	4.12	4.00
BA-5	3.98	
SS-5	3.94	
UB-5	3.70	
HL-5	4.16	

Figure 4.8 shows the graph of the preference choice among the respondent by using average analysis towards Design 6. In Design 6, the most affected Kansei Words is by Simple-Stylish (SS). The graph depicted that by the maximum average value is 5.36 towards the Simple-Stylish (SS) than the minimum value obtained towards Miserable-Comfortable (MC) which is 5.02.

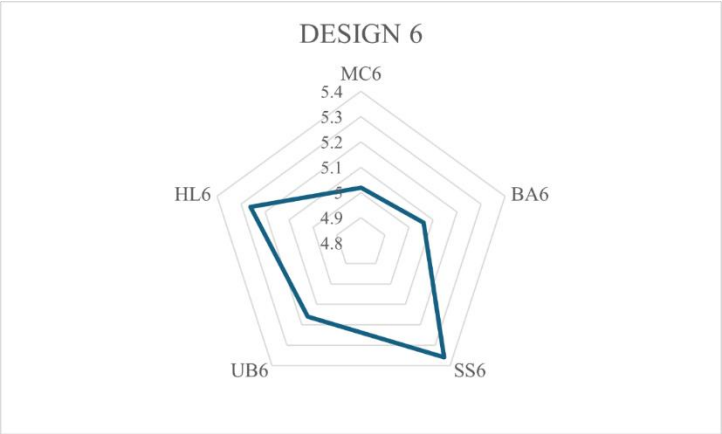


Figure 4.8: Preference by average analysis towards Design 6

In addition to the preference choice, the Table 4.20 shows the average and median values to identify the tendency of Kansei Words towards Design 6. Between both Simple-Stylish (SS), the tendency is more towards the Kansei Words of Stylish by the average value of 5.36 > 4.00 (midpoint). This case means that most of the respondent agrees that Stylish represents the emotional design feeling towards Design 6.

Table 4.20: Values of average and middle point of Kansei Words towards Design 6

Kansei Words	Values of Average	Midpoint
MC-6	5.02	4.00
BA-6	5.06	
SS-6	5.36	
UB-6	5.16	
HL-6	5.26	

In conclusion, Table 4.21 shows the percentage result of design analysis, where the Design 1 are most affected by Kansei Words of Miserable-Comfortable (MC) with percentage of 20.96% while Design 4 and Design 6 are affected by Simple-Stylish (SS) with the percentage of 20.30% and 20.73% respectively. Design 2, Design 3 and Design 5 are affected by Heavy-Lightweight (HL) with the percentage of 21.06%, 21.07% and 20.90% respectively. As a result, Heavy-Lightweight (HL) has the highest impact influence of words as it represents the emotional feeling preferred towards the designs.

Table 4.21: Percentage results of analysis by design

By Design						
	MC	**BA**	**SS**	**UB**	**HL**	**TOTAL**
Design 1	20.96%	18.97%	20.09%	19.45%	20.53%	**100.00%**
Design 2	19.61%	19.23%	20.68%	19.42%	21.06%	**100.00%**
Design 3	19.10%	20.08%	20.08%	19.67%	21.07%	**100.00%**
Design 4	20.00%	20.23%	20.30%	19.92%	19.55%	**100.00%**
Design 5	20.70%	20.00%	19.80%	18.59%	20.90%	**100.00%**
Design 6	19.41%	19.57%	20.73%	19.95%	20.34%	**100.00%**

Table 4.22 depicts the percentage results of analysis by words where the highest percentage is Design 4 towards the Kansei Words of Ugly-Beautiful (UB) which the value obtained is 19.12%.

Table 4.22: Percentage results of analysis by words

By Words					
	MC	**BA**	**SS**	**UB**	**HL**
Design 1	18.51%	16.98%	17.44%	17.53%	17.61%
Design 2	14.29%	14.19%	14.81%	14.44%	14.91%
Design 3	16.40%	17.48%	16.96%	17.24%	17.57%
Design 4	18.65%	19.12%	18.62%	18.97%	17.71%
Design 5	14.50%	14.19%	13.63%	13.29%	14.22%
Design 6	17.66%	18.05%	18.55%	18.53%	17.98%
Total	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**

Based on the discussion above, the steps are done to determine which Kansei Word affecting the most in each design. Likewise, Table 4.21 and Table 4.22 present the most preference design by the correspondent. The results are determined by the average analysis approach. The analysis identified that the most preference design by average analysis is Design 4 with the average and percentage value of 5.32 and 18.92% respectively and followed by Design 6 with the average and percentage value of 5.22 and 18.56% respectively.

Table 4.23: Preference results by average analysis

	Value of Average	Percentage (%)	Rank
Preference 1	4.82	17.14	3
Preference 2	4.04	14.37	5
Preference 3	4.74	16.86	4
Preference 4	5.32	18.92	1
Preference 5	3.98	14.15	6
Preference 6	5.22	18.56	2

The validation of the final design is needed by carrying out the post-test towards Design 4, Design 6 and Design 1.

4.2.3 Kansei Words (KW) representative

The previous discussion identified the design analysis towards the Kansei Words, while in this subtopic, further discussion is required on the five Kansei Words. The Kansei Words that have been selected and used in the questionnaire is developed in Table. Every word is analysed individually to determine each word that would be give the best representation of the designs proposed.

a) Miserable vs. Comfortable (MC)

Table 4.24 shows the analysis result of the pairwise Kansei Word for semantic differential of Miserable-Comfortable (MC) using average analysis. The analysis decided that Design 4 has the highest value impacted by MC that is 5.30 in average or 18.65%. It can be concluded that the most affected words of Miserable-Comfortable (MC) is on the Design 4. In contrast, the least affected words of MC are on the Design 2 that is 4.06 in average or 14.29%. This pairwise word represent the level of comfort towards spectacles designs based on the user feeling. Most of the respondents agreed that all of the designs proposed are emotionally comfortable to be wore rather than miserable.

Table 4.24: Results of average analysis on Miserable-Comfortable (MC)

	Values of Average	Percentage (%)	Midpoint
MC-1	5.26	18.51%	4.00
MC-2	4.06	14.29%	
MC-3	4.66	16.40%	
MC-4	5.30	18.65%	
MC-5	4.12	14.50%	
MC-6	5.02	17.66%	

b) Boring vs. Attractive (BA)

Table 4.25 shows the analysis result of the pairwise Kansei Word for semantic differential of Boring-Attractive (BA) using average analysis. The analysis decided that Design 4 has the highest value impacted by BA that is 5.36 in average or 19.12%. It can be concluded that the most affected words of Boring-Attractive (BA) is on the Design 4. In contrast, the least affected words of BA are on the Design 2 and Design 5 that is 3.98 in average or 14.19%. This pairwise word represent the level of attractiveness towards spectacles designs based on the user feeling. Most of the respondents agreed that the Design 1, Design 3, Design 4 and Design 6 proposed are emotionally attractive to be wore rather than boring, with the average value of 4.76, 4.90, 5.36 and 5.06 respectively as the middle point value is 4.00 compared to Design 2 and Design 5 are considered as emotionally boring as the average values obtained below than the middle point.

Table 4.25: Results of average analysis on Boring-Attractive (BA)

	Values of Average	Percentage (%)	Middle Point
BA-1	4.76	16.98%	4.00
BA-2	3.98	14.19%	
BA-3	4.90	17.48%	
BA-4	5.36	19.12%	
BA-5	3.98	14.19%	
BA-6	5.06	18.05%	

c) Simple vs. Stylish (SS)

Table 4.26 shows the analysis result of the pairwise Kansei Word for semantic differential of Simple-Stylish (SS) using average analysis. The analysis decided that Design 4 has the highest value impacted by SS that is 5.38 in average or 18.62%. It can be concluded that the most affected words of Simple-Stylish (SS) is on the Design 4. In contrast, the least

affected words of SS are on the Design 5 that is 3.94 in average or 13.63%. This pairwise word represent the level of stylishness towards spectacles designs based on the user feeling. Most of the respondents agreed that all the design proposed except Design 5 are emotionally stylish to be wore rather than simple, with the average values exceed the middle point value of 4.00 compared to Design 5 is considered as emotionally simple as the average values obtained below than the middle point.

Table 4.26: Results of average analysis on Simple-Stylish (SS)

	Values of Average	Percentage (%)	Middle Point
SS-1	5.04	17.44%	4.00
SS-2	4.28	14.81%	
SS-3	4.90	16.96%	
SS-4	5.38	18.62%	
SS-5	3.94	13.63%	
SS-6	5.36	18.55%	

d) Ugly vs. Beautiful (UB)

Table 4.27 shows the analysis result of the pairwise Kansei Word for semantic differential of Ugly-Beautiful (UB) using average analysis. The analysis decided that Design 4 has the highest value impacted by UB that is 5.28 in average or 18.97%. It can be concluded that the most affected words of Ugly-Beautiful (UB) are on the Design 4. In contrast, the least affected words of UB are on the Design 5 that is 3.70 in average or 13.29%. This pairwise word represent the level of beautifulness towards spectacles designs based on the user feeling. Most of the respondents agreed that all of the designs proposed except Design 5 are emotionally beautiful to be wore rather than ugly, with the average values exceed the middle value of 4.00 compared to Design 5 is considered as emotionally ugly as the average values obtained below than the median.

Table 4.27: Results of average analysis on Ugly-Beautiful (UB)

	Values of Average	Percentage (%)	Middle Point
UB-1	4.88	17.53%	4.00
UB-2	4.02	14.44%	
UB-3	4.80	17.24%	
UB-4	5.28	18.97%	
UB-5	3.70	13.29%	
UB-6	5.16	18.53%	

e) Heavy vs. Lightweight (HL)

Table 4.28 shows the analysis result of the pairwise Kansei Word for semantic differential of Heavy-Lightweight (HL) using average analysis. The analysis decided that Design 6 has the highest value impacted by HL that is 5.26 in average or 17.98%. It can be concluded that the most affected words of Ugly-Beautiful (UB) are on the Design 6. In contrast, the least affected words of HL are on the Design 5 that is 4.16 in average or 14.22%. This pairwise word represent the level of lightweight towards spectacles designs based on the user feeling. Most of the respondents agreed that all of the design proposed are emotionally lightweight to be wore rather than heavy, with the average value above the middle point value is 4.00

Table 4.28: Results of average analysis on Heavy-Lightweight (HL)

	Values of Average	Percentage (%)	Middle Point
HL-1	5.15	17.61%	4.00
HL-2	4.36	14.91%	
HL-3	5.14	17.57%	
HL-4	5.18	17.71%	
HL-5	4.16	14.22%	
HL-6	5.26	17.98%	

In conclusion, Design 4 is the best design because most of the emotional feeling (Kansei) is impacted or occurred in this design, followed by Design 6. Design 4 should be given a main priority in the spectacle product development because the relationship existed towards all the emotional design and Design 4 is represented by Comfortable, Attractive, Stylish and Beautiful while Design 6 represented by Lightweight.

4.2.4 Attributes classification based on Kano Model (KM)

The Kano question is divided into two sections which are Part A that focuses on the Functional aspect, which pertains to the features of the spectacle while they are present, while Part B focuses on the Dysfunctional aspect, which pertains to the features of the spectacle when they are absent. The Kano model served to measure the level of consumer satisfaction with both existing and non-existing features, particularly in terms of non-

linearity. Each kind consists of approximately five questions. The Kano inquiry aims to assess the level of preference towards the presented attributes.

The data ranking in Kano is determined by using the customer satisfaction (CS) coefficient, as described by Sauerwein et al. (1996). Alternatively, it is important to determine if completing a product demand leads to higher satisfaction or if fulfilling the criterion only prevents customer dissatisfaction. The CS-coefficient measures the degree to which a product feature can impact satisfaction or, in the case of its absence or customer discontent (DS). It can be calculated using Equation 4.2 and 4.3 as shown below:

$$\text{Satisfaction Coefficient (CS+)} = \frac{(A+O)}{(A+O+M+I)} \quad \text{Equation 4.2}$$

$$\text{Dissatisfaction Coefficient (CS-)} = (-1)\frac{(O+M)}{(A+O+M+I)} \quad \text{Equation 4.3}$$

4.2.4.1 Kano Model of customer satisfaction (CS) and dissatisfaction (DS)

The customer satisfaction (CS) coefficient states whether satisfaction can be increased by meeting a product requirement, or whether fulfilling this product requirement merely prevents the customer from being dissatisfied (Berger *et al.,* 1993). By referring to the results of CS-DS value in Table 4.31, the results of the values can be seen, and the ranking of top priorities can be identified. Table 4.29 presents the Kano evaluation table to classify Kano categories on each element of the spectacles.

Table 4.29: Kano Evaluation Table.

Customer Requirements			Dysfunctional				
			1	2	3	4	5
			Like	Must be	Neutral	Live with	Dislike
Functional	1	Like	Q	A	A	A	O
	2	Must be	R	I	I	I	M
	3	Neutral	R	I	I	I	M
	4	Live with	R	I	I	I	M
	5	Dislike	R	R	R	R	Q

Customer Requirements:
A: attractive, O: one-dimensional, M: must-be, Q: questionable result, R: reverse and I: indifferent

The customer requirements are classified by using Kano evaluation table as in the Table 4 based on the combination of customer response to both questions of Functional and Dysfunctional. The value of each category of Kano towards Kansei attributes is shown as in the Table 4. These results of Kano categories is incorporated into the Equation to find the coefficient of Customer Satisfaction (CS) and Dissatisfaction (DS).

Table 4.30: Results of Kano categories

	A	M	O	I	R	Q	MAX	HIGHEST
K1	8	3	12	25	1	1	25	I
K2	7	1	0	40	1	1	40	I
K3	10	3	2	31	4	0	31	I
K4	6	3	4	29	8	0	29	I
K5	15	4	3	27	1	0	27	I

The results indicated that the Indifferent characteristics obtained the highest tabulated data among all the outcomes. This category means that the customer needs to be more apathetic or unconcerned about these factors. Customers are still determining whether their needs are satisfied or not (Cheng and Chiu, 2007). Nevertheless, they are unwilling to allocate further funds towards this feature (Berger et al., 1993).

Besides, by using Equation 4.2 and 4.3, CS and DS values can be determined by incorporating the results of Kano categories obtained. Table 4 shows the values of Kano attributes mainly on the Kano mean, Functional and Dysfunctional respectively as well as the Customer Satisfaction (CS) and Dissatisfaction (DS). The results showed that K1 is the attributes that is needed to be considered first for the improvement as the values CS-DS obtained is the highest among the others which is 0.729.

Table 4.31: Values of Kano attributes

NO	PRODUCT CRITERIA	KANO MEAN		CS	DS	CS-DS
		Functional	Dysfunctional	Better	Worse	
1	A spectacle with full frame	2.14	3.64	0.417	-0.313	0.729
2	A spectacle with half frame	2.50	3.08	0.146	-0.021	0.167
3	A spectacle with rimless	2.58	3.20	0.261	-0.109	0.370
4	A round-shaped spectacle	2.82	2.96	0.238	-0.167	0.405
5	A square-shaped spectacle	2.22	3.48	0.367	-0.143	0.510
	AVERAGE	2.45	3.27	0.286	-0.150	

Although K1 is ranked as the top priority in the CS-DS ranking, according to Table 4, it falls within the Indifferent (I) category in the Kano classification. In the average category classification, as shown in Table 4 4.31, the value depicted is 2.14. This means that if the effort for improvement K1 is implemented, customers will be satisfied, or their satisfaction will increase. This is because the mean value falls between "It Must-be That Way" and "I Like it That Way" with respect to the design elements provided. It can also be regarded as a means of expressing their emotions.

According to Berger et al. (1993), the Kano Model assigns the highest priority to the satisfaction traits in the order of Must-Be, One-Dimensional, Attractive, and Indifferent. Therefore, the concentration for improvement priorities falls under the "Must-Be" category. However, as all the respondents' answers are classified as "Indifferent," this indicates that the need for adjustments is not necessary.

Based on the results of ranking CS-DS, the conclusion can be made, there two criteria that need to be considered first in a spectacle product development which are K1 (A spectacle with full frame) and K5 (A square-shaped spectacle).

Table 4.32: Results of Ranking CS-DS in Kano

	CS	DS	CS-DS	Rank	Kano Category
K1	0.417	-0.313	0.729	1	I
K2	0.146	-0.021	0.167	5	I
K3	0.261	-0.109	0.370	4	I
K4	0.238	-0.167	0.405	3	I
K5	0.367	-0.143	0.510	2	I
Max	**0.417**	**-0.313**			
Min	**0.146**	**-0.021**			
Average	**0.286**	**-0.150**			

4.2.5 Integration/Correlation of KE and KM

This research utilises Pearson's correlation coefficient to statistically analyse the integration of KE and KM and investigate the interaction between several research variables (Blaikie, 2003; Veal, 2005). The association can be quantified using the correlation coefficient (Veal, 20025). Veal (2005) states that the relationship between the variables can manifest in various forms. A correlation coefficient of 1.0 indicates a perfect positive correlation, meaning that two variables increase together in a precise and consistent manner. Conversely, when the correlation coefficient has a value of -1.0, it indicates a complete negative correlation between two variables, meaning that as one variable increases, the other variable decreases. Table 4.33 displays the range of coefficients for Pearson correlation.

Table 4.33: Coefficient range of Pearson correlation

COEEFICIENT RANGE	STRENGTH OF ASSOCIATION
± 0.75 - ± 1.00	Very Strong
± 0.50 - ± 0.74	High
± 0.25 - ± 0.49	Small but definite relationship
± 0.00 - ± 0.24	Slight, almost negligible

In this study, correlation analysis is conducted to determine the highest correlation priority between Kansei Engineering (KE) and Kano Model (KM) concerning spectacle

product development. Specifically, the study examines the relationship between Functional and Dysfunctional elements in relation to Kansei Words.

Table 4.34 and Table 4.35 shows that Kano Model (KM) represented in the Functional (F) and Dysfunctional (D) codes which are F1 to F5 and D1 to D5 respectively against the Kansei Words code of Miserable-Comfortable (MC), Boring-Attractive (BA), Simple-Stylish (SS), Ugly-Beautiful (UB) and Heavy-Lightweight (HL). The results suggested that there is correlation existed among Kano Method (KM) represented in Functional and Dysfunctional elements to the Kansei Words (KW).

Table 4.34: Relationship between Functional against Kansei Words (KW)

Correlations						
		MC	BA	SS	UB	HL
F1	Pearson Correlation			-0.271		
	Sig. (2-tailed)			0.057		
F2	Pearson Correlation					
	Sig. (2-tailed)					
F3	Pearson Correlation					
	Sig. (2-tailed)					
F4	Pearson Correlation					
	Sig. (2-tailed)					
F5	Pearson Correlation					
	Sig. (2-tailed)					
**. Correlation is significant at the 0.01 level (2-tailed).						

Based on the table above, there is a negative moderate correlation between FI and Simple-Stylish (SS) as such the Pearson correlation coefficient for F1 (a spectacle with a full frame) and SS (Simple-Stylish) is -0.271 while the significance level (p-value) indicates whether the correlation coefficient is statistically significant. A p-value of 0.057 means that there is a 5.7% chance that the observed correlation occurred by random chance. In this case, the p-value is 0.057, which is slightly above the conventional threshold of 0.05 for statistical significance. Hence, the correlation is not statistically significant at the 0.05 level. Although the correlation is not statistically significant, the negative coefficient suggests that there is a tendency for spectacles with a full frame to be perceived as less stylish or simpler) as the full frame perception increases.

Table 4.36: Relationship between Dysfunctional against Kansei Words (KW)

Correlations						
		MC	BA	SS	UB	HL
D1	Pearson Correlation				.279*	
	Sig. (2-tailed)				0.05	
D2	Pearson Correlation					
	Sig. (2-tailed)					
D3	Pearson Correlation					
	Sig. (2-tailed)					
D4	Pearson Correlation					
	Sig. (2-tailed)					
D5	Pearson Correlation					
	Sig. (2-tailed)					
*. Correlation is significant at the 0.05 level (2-tailed).						
**. Correlation is significant at the 0.01 level (2-tailed).						

The results indicate a positive correlation between Ugly-Beautiful (UB) and D1and it is statistically significant at -0.279 ($p < 0.05$). This suggests that moderate positive linear relationship between UB and D1. The positive and significant connection between D1 and UB indicates that any change in the perception of the spectacle without a full frame (D1) is consistently accompanied by a matching change in the perception of it being Ugly-Beautiful (UB). More precisely, when customer experience the sight without a full frame, they prefer to assess it more favourably as "Beautiful" rather than "Ugly," but the correlation between the two is only moderately strong.

4.3 Evaluation and Validation of The Developed Model

The second survey is conducted purposely as a confirmation towards the final design. The survey is to determine the accuracy pertinent to the results obtained. The post-test is done towards three final preferences designs by the respondent which are Design 1, Design 4 and Design 6. Five Subject Matter Experts (SME) that has been working in the eyewear industry around five to twenty years are involved to complete the surveys. Besides, Kansei Words, demography and Kano section are also included in the questionnaire. The same previous method which is average analysis is used to analyse the post test results.

Figure 4.9 shows the graph of the preference choice among the respondent by using average analysis towards Design 1. In Design 1, the most affected Kansei Words is by Miserable and Comfortable (MC). The graph depicted that by the maximum average value is 5.80 towards the Miserable-Comfortable (MC) than the minimum value obtained towards Boring-Attractive (BA) which is 3.20.

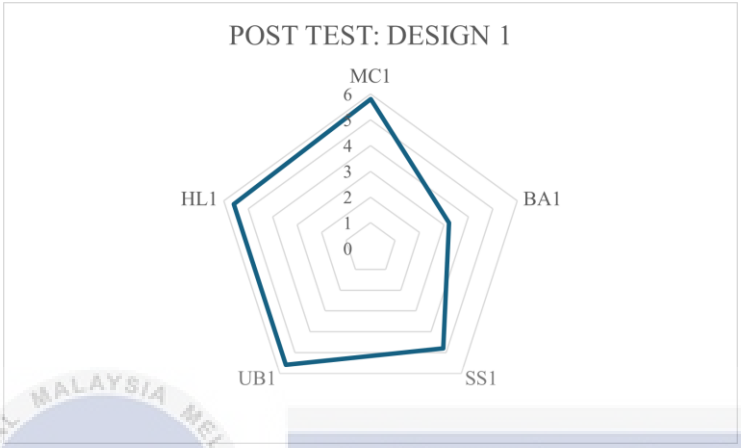


Figure 4.9: Preference by average analysis towards Post Test Design 1

In addition to the preference choice, the Table 4.35 shows the average and median values to identify the tendency of Kansei Words towards Design 1. Between both Miserable-Comfortable, the tendency is more towards the Kansei Words of Comfortable by the average value of 5.80 > 4.00 (middle point). This case means that most of the respondent agrees that Comfortable represents the emotional design feeling towards Design 1.

Table 4.35: Values of average and middle point of Kansei Words towards Post-Test Design 1

	Values of Average	Midpoint
MC-1	5.8	4.00
BA-1	3.2	
SS-1	4.8	
UB-1	5.6	
HL-1	5.6	

Figure 4.10 shows the graph of the preference choice among the respondent by using average analysis towards Design 4. In Design 4, the most affected Kansei Words is by Miserable and Comfortable (MC). The graph depicted that by the maximum average value is 5.20 towards the Miserable-Comfortable (MC) than the minimum value obtained towards Boring-Attractive (BA) which is 3.80.

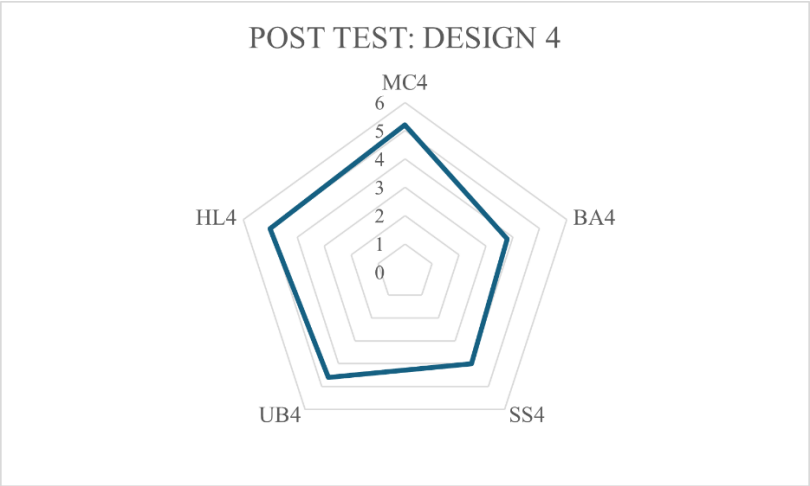


Figure 4.10: Preference by average analysis towards Post Test Design 4

In addition to the preference choice, the Table 4.36 shows the average and median values to identify the tendency of Kansei Words towards Design 4. Between both Miserable-Comfortable, the tendency is more towards the Kansei Words of Miserable by the average value of 5.20 > 4.00 (middle point). This case means that most of the respondent agrees that Comfortable represents the emotional design feeling towards Design 4.

Table 4.36: Values of average and middle point of Kansei Words towards Post-Test Design 4

	Values of Average	Midpoint
MC-4	5.2	4.00
BA-4	3.8	
SS-4	4.0	
UB-4	4.6	
HL-4	5.0	

Figure 4.11 shows the graph of the preference choice among the respondent by using average analysis towards Design 6. In Design 6, the most affected Kansei Words is by Heavy-Lightweight (HL). The graph depicted that by the maximum average value is 6.20 towards the Heavy-Lightweight (HL) than the minimum value obtained towards Simple-Stylish (SS) which is 3.0.

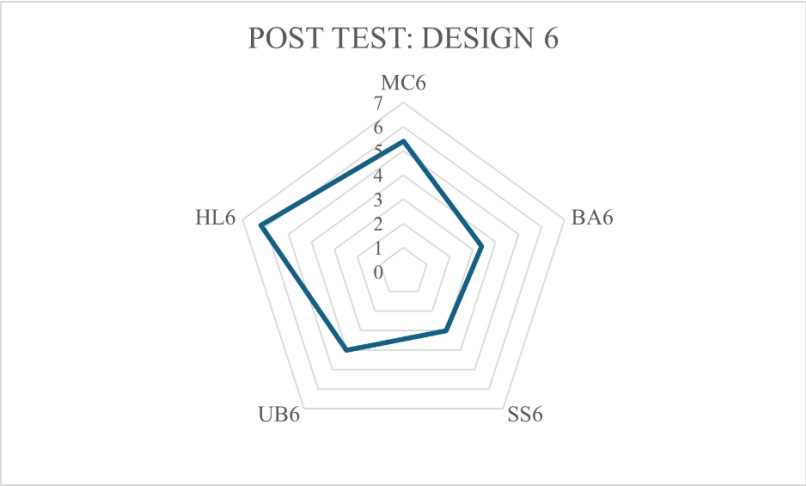


Figure 4.11: Preference by average analysis towards Post Test Design 6

In addition to the preference choice, the Table 4.37 shows the average and median values to identify the tendency of Kansei Words towards Design 6. Between both Heavy-Lightweight (HL), the tendency is more towards the Kansei Words of Lightweight by the average value of 6.20 > 4.00 (middle point). This case means that most of the respondent agrees that Lightweight represents the emotional design feeling towards Design 6.

Table 4.37: Values of average and middle point of Kansei Words towards Post-Test Design 6

	Values of Average	Midpoint
MC-6	5.4	4.00
BA-6	3.4	
SS-6	3.0	
UB-6	4.0	
HL-6	6.2	

Table 4.38: Preference results by average analysis

	Value of Average	Percentage (%)	Rank
Preference 1	5.60	37.84%	1
Preference 4	4.80	32.43%	2
Preference 6	4.40	29.73%	3

Table 4.39: Preference word results by average analysis

	MC	BA	SS	UB	HL
Preference 1	5.8	3.2	4.8	5.6	5.6
Preference 4	5.2	3.8	4	4.6	5
Preference 6	5.4	3.4	3	4	6.2

In Kano approach, the Indifferent and Attractive attributes existed towards the Kano category as shown in the Table 4.40 which for Indifferent, it does not bring satisfaction or dissatisfaction while for Attractive attributes, it delights customers when the features are present but do not cause dissatisfaction when absent. Likewise, the results shown the main priority to SME in Kano is towards the K4 (A square-shaped spectacles) based on the ranking results. The results also depict that K4 has the maximum value of Customer Satisfaction (CS) attributes.

Table 4.40: Results of Ranking CS-DS in Kano

	CS	DS	CS-DS	RANK	KANO CATEGORY
K1	0.200	-0.200	0.40	3	I
K2	0.000	-0.333	0.33	4	I
K3	0.200	-0.400	0.60	2	I
K4	0.600	-0.200	0.80	1	A
K5	0.00	0.000	0.00	5	I
Max	**0.600**	**-0.400**			
Min	**0.000**	**0.000**			
Average	**0.200**	**-0.227**			

In conclusion, based on average analysis in Table, Design 1 (A spectacle with full frame) is the best design selected to be wore or purchased among the SME that gives the feeling of Beautiful (Kansei) while wearing and the main priority needed in design development process is focuses on K4 (A square-shaped spectacle) as it has the highest CS value and it is Attractive attribute which it delights customers when the features are present but do not cause dissatisfaction when absent.

4.4 Conclusion

The conclusion of this chapter, it gives a brief explanation regarding the data and results that gain against Kansei, Design and Kano Model.

Table 4.41: Result of data analysis of Main Survey

	Design	Kansei	Kano
Main Priorities	Design 4	Lightweight of emotional	Full Frame (K1) (Indifferent Attribute)

Table 4.42: Results of Data Analysis of Post Test

	Design	Kansei	Kano
Main Priorities	Design 1	Comfortable of emotional	Square-shaped Spectacle (K4) (Attractive Attribute)

CHAPTER 5
CONCLUSION AND RECOMMENDATION

This chapter explain the result obtained from the survey and the recommendation. In this chapter, every objective determined are answered using analysis process towards the results of survey conducted in which the product design characteristics were investigated, analysed, evaluated and validated towards the customers' preferences characteristic related to the design of product articulated using Kansei Engineering (KE) and Kano Method (KM). The purpose of using Kansei Engineering (KE) and Kano Method (KM) in this project is to find out the customer preferences towards spectacles. Average analysis for mathematical approach by utilising Microsoft Excel. The Statistical Package for the Social Science (SPSS) software was used to help an analysis required in process of the data of the questionnaire such as demography of respondents, Kansei Engineering and Kano Method towards the products.

5.1 Conclusion

The first objective is to identify the customer preferences of the spectacles based on Kansei Engineering. Based on the research results, through the preliminary test, six designs are finalised out of 30 designs proposed on each type of spectacles which are Round and Square that consisted of Full Frame, Half Frame and Rimless features. The final five Kansei Words are also determined through the preliminary test which are Comfortable, Attractive, Stylish, Beautiful and Lightweight and their antonyms of Miserable, Boring, Simple, Ugly and Heavy. Based on Kansei Engineering perspective, the customer preferences is identified where Design 4 is the preferred design chosen as it obtained the highest average values of 5.32 with the representative of emotional feeling of Lightweight with the percentage of 18.92%

Furthermore, the second objective is to analyse the customer design preferences based on the product characteristics by integrating Kansei Engineering (KE) and Kano Model (KM). Based on the ranking of CS-DS, K1 (A spectacle with full frame) gained the highest value which is 0.279 to the Dysfunctional element which indicating that the customer preferred the feature of full frame to be absence from the product development of spectacle. However, since it is Indifferent attribute, therefore it will not give impact on the customer satisfaction or dissatisfaction since they do not care about this feature.

Lastly, the third objective is to validate the customer preferences using pre and post surveys method. Post-test is conducted among the Subject Matter Expert (SME) to validate the customer preferences during the main survey. Table 4.43 presents the validated result of data analysis of Post Test.

Table 4.43: Customer preferences from the post test.

	Design	Kansei	Kano
Main Priorities	Design 1	Comfortable of emotional	Square-shaped (K4) (Attractive Attribute)

In addition to the sustainability element, the integration of Kansei Engineering and the Kano Model in the design of spectacles can greatly improve sustainability by ensuring that products are not only aesthetically and emotionally pleasing, but also environmentally conscious by reducing waste through customization and precision. By employing Kansei Engineering, manufacturers can gain insight into client preferences and emotional reactions, enabling them to create spectacles that are better aligned with customer wants. This, in turn, leads to a reduction in overproduction and waste. Meanwhile, the Kano Model facilitates the prioritisation of characteristics that are of utmost importance to customers. This guarantees the efficient allocation of resources, preventing the inclusion of superfluous characteristics that could result in the squandering of materials and energy.

Therefore, the integration of Kansei Engineering and the Kano Model in the design of spectacles promotes sustainability by ensuring that goods are both emotionally and functionally aligned with client desires, while also encouraging the use of sustainable

materials and efficient manufacturing techniques. This comprehensive strategy not only improves customer satisfaction but also promotes environmental preservation and resource optimisation, resulting in more sustainable product creation.

5.2 Recommendation

Several improvements were suggested for future research. Firstly, it is advisable to increase the population and sample size of the respondents in the surveys by including students from educational institutions in all states of Malaysia. By utilising a bigger sample size, the study would yield precise insights into the variations among respondents (depending on their demographics) regarding their preferences for spectacle design products, as well as the emotional expressions conveyed by Kansei Words.

Secondly, it is recommended to include the mechanism of the spectacle into the product development such as nose pad and material used as it is one of the important part of the spectacles as it is significantly affect the usability, comfortability and overall satisfaction of spectacle products because it might give significant impact to overall customer satisfaction and product functionality. Consequently, this approach ensures that both fundamental and innovative features are addressed, leading to a well-rounded product that meets and exceeds customer expectations.

Last but not least, the use of graphic software such as AutoCAD or CATIA to design spectacles instead of using the pictures from online resources offers several significant advantages, particularly in terms of customization, originality, and precision in the product development. It ensures that the final product is not only high-quality and unique but also tailored to meet the specific needs and preferences of customers. This approach fosters innovation, strengthens brand identity, and offers significant legal and operational advantages over using generic designs from online resources.

REFERENCES

Berger, C., Blauth, R. E., & Boger, D. (1993). Kano's methods for understanding customer-defined quality. *Center for Quality Management Journal,* 2(4), 3-36.

Chuan, N. K., Sivaji, A., Shahimin, M. M., & Saad, N. (2013). Kansei Engineering for ecommerce Sunglasses Selection in Malaysia. Procedia - Social and Behavioral Sciences, 97, 707–714. https://doi.org/10.1016/j.sbspro.2013.10.291

Dahlgaard, J. J., & Mitsuo Nagamachi. (2008). Perspectives and the new trend of Kansei/affective engineering. The TQM Journal, 20(4), 290–298. https://doi.org/10.1108/17542730810881285

Dahlgaard, J. J., Schütte, S., Ebru Ayas, & Su Mi Dahlgaard-Park. (2008). Kansei/affective engineering design: A methodology for profound affection and attractive quality creation. TQM Journal, 20(4), 299–311. https://doi.org/10.1108/17542730810881294

Desmet, P. M. A., & Hekkert, P. (2019). The Basis of Product Emotions. Design and Emotion: The Experience of Everyday Things, 2nd Edition, 45-57.

Dinda Karina Yohanny, & Ambar Mulyono. (2022). An established scholar review towards kansei engineering for railway product design. https://doi.org/10.2991/978-94-6463-126-5_8

Dou, R., Zhang, Y., & Nan, G. (2016). Application of combined Kano model and interactive genetic algorithm for product customization. Journal of Intelligent Manufacturing, 30(7), 2587–2602. https://doi.org/10.1007/s10845-016-1280-4

Fevi Syaifoelida, Yahaya, S. H., Haeryip Sihombing, & Yuhazri, M. Y. (2014). The integration framework of kansei engineering (KE) and kano method (KM) for product development. https://doi.org/10.3850/978-981-07-8859-9_33

Gong, X., Guo, Z., & Xie, Z. (2022). Using kansei engineering for the design thinking framework: Bamboo pen holder product design. Sustainability (Switzerland), 14(17). https://doi.org/10.3390/su141710556

H Sihombing, A Syafika, Sulaiman, S., Salleh, M. R., Yaakob, M. Y., Upm Serdang, Selangor Darul, & Ehsan Malaysia. (2017). The product design preferences based on Kansei engineering: Car products in Malaysia (pp. 200–201).

Hartono, M. (2016). The extended integrated model of Kansei Engineering, Kano, and TRIZ incorporating cultural differences into services. International Journal of Technology, 7(1), 97–104. https://doi.org/10.14716/ijtech.v7i1.1789

Hartono, M., Prayogo, D. N., & Saylendra, G. A. (2022). Integration of text mining, railqual, kano model, and kansei engineering for train service excellence. IEEE International Conference on Industrial Engineering and Engineering Management, 2022-December, 62–66. https://doi.org/10.1109/IEEM55944.2022.9989862

Ishak, A., Ginting, R., Suwandira, B., & Fauzi Malik, A. (2020). Integration of Kano Model and Quality Function Deployment (QFD) to Improve Product Quality: A Literature Review. IOP Conference Series: Materials Science and Engineering, 1003, 012025. https://doi.org/10.1088/1757-899x/1003/1/012025

Ishihara, S., Matsubara, T., Mitsuo Nagamachi, & Matsubara, Y. (2011). Kansei analysis of the Japanese residential garden and development of a low-cost virtual reality Kansei engineering system for gardens. Advances in Human-Computer Interaction, 2011. https://doi.org/10.1155/2011/295074

Jagusiak-Kocik, M. (2022). Using the advantages of the KANO model in the process of designing a modern summer house. Budownictwo O Zoptymalizowanym Potencjale Energetycznym, 11(2022.11), 49–56. https://doi.org/10.17512/bozpe.2022.11.06

Ji, P., Jin, J., Wang, T., & Chen, Y. (2014). Quantification and integration of Kano's model into QFD for optimising product design. International Journal of Production Research, 52(21), 6335–6348. https://doi.org/10.1080/00207543.2014.939777

Kun Chieh Wang, & Fang Rong Ju. (2013). An innovative design methodology KKBDCA for affective product development. Mathematical Problems in Engineering, 2013. https://doi.org/10.1155/2013/629708

Lee, L., Burnett, A. M., Panos, J. G., Paudel, P., Keys, D., Ansari, H. M., & Yu, M. (2020). 3-D printed spectacles: potential, challenges and the future. Clinical and Experimental Optometry, 103(5), 590–596. https://doi.org/10.1111/cxo.13042

Lucelindo Dias Ferreira, & Daniel Capaldo Amaral. (2015). A full example of technical procedure to application of the Kansei Engineering. Product Management & Development, 13(2), 103–118. https://doi.org/10.4322/pmd.2015.009

Mitsuo Nagamachi. (1996). Kansei engineering and its applications. The Japanese Journal of Ergonomics, 32(6), 286–289. https://doi.org/10.5100/jje.32.286

Mitsuo Nagamachi. (2006). Kansei engineering and rough sets model. Lecture Notes in Computer Science (Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics), 4259 LNAI, 27–37. https://doi.org/10.1007/11908029_4

Óscar López, Murillo, C., & González, A. (2021). Systematic literature reviews in kansei engineering for product design—a comparative study from 1995 to 2020†. Sensors, 21(19). https://doi.org/10.3390/s21196532

Pillay, R., Hansraj, R., & Rampersad, N. (2020). Historical Development, Applications and Advances in Materials Used in Spectacle Lenses and Contact Lenses. Clinical optometry, 12, 157–167. https://doi.org/10.2147/OPTO.S257081

Sireli, Y., Kauffmann, P., & Ozan, E. (2007). Integration of Kano's Model Into QFD for Multiple Product Design. IEEE Transactions on Engineering Management, 54(2), 380–390. https://doi.org/10.1109/tem.2007.893990

Soheir Backar. (2019). Integrative framework of kansei engineering (KE) and kano model (KM) applied to light bulb changer. The Academic Research Community Publication, 2(4), 430–439. https://doi.org/10.21625/archive.v2i4.392

Suzianti, A., & A. Aldianto. (2020). Redesign of product packaging with kansei engineering: Empirical study on small-medium enterprises in indonesia. Makara Journal of Technology, 24(2), 65. https://doi.org/10.7454/mst.v24i2.2990

Xin, C., Li, Z., Hao, L., & Li, Y. (2023). A comprehensive review on additive manufacturing of glass: Recent progress and future outlook. Materials & Design, 227, 111736. https://doi.org/10.1016/j.matdes.2023.111736

Xiong, Z., Liu, M., Weng, Y., & Liu, Y. (2018). Research of customer product form preference based on kansei engineering. Journal of Physics: Conference Series, 1087(6). https://doi.org/10.1088/1742-6596/1087/6/062051

Xue, L., Yi, X., & Zhang, Y. (2020). Research on optimized product image design integrated decision system based on Kansei engineering. Applied Sciences (Switzerland), 10(4). https://doi.org/10.3390/app10041198

Yang, C., Liu, F., & Ye, J. (2023). A product form design method integrating Kansei engineering and diffusion model. Advanced Engineering Informatics, 57. https://doi.org/10.1016/j.aei.2023.102058

Yuhazri, M. Y., Hidayah, W. N., Kamarul, A. M., Haery Sihombing, Tahkims, M. S., & Sulaiman, S. (2019). The profiling of design product using Bezier curve for customers product design preferences. International Journal of Advanced Trends in Computer Science and Engineering, 8(1.3 S1), 214–218. https://doi.org/10.30534/ijatcse/2019/4281.32019

APPENDIX A (Gantt Chart)

FINAL YEAR PROJECT SCHEDULE SEMESTER 2 2023/2024																				
RESEARCH ACTIVITIES	SEMESTER BREAK				SEMESTER 2 (MARCH - JUNE)															
	WEEK 1	WEEK 2	WEEK 3	WEEK 4	WEEK 1	WEEK 2	WEEK 3	WEEK 4	WEEK 5	WEEK 6	WEEK 7	WEEK 8	WEEK 9	WEEK 10	WEEK 11	WEEK 12	WEEK 13	WEEK 14	WEEK 15	WEEK 16
PRODUCT DEVELOPMENT PHASE																				
Understanding the basic fundamental of model structure																				
Survey approach towards the terms of KE																				
Preliminary study towards the product																				
Start to conduct the preliminary survey																				
Analysis preliminary data towards the average analysis																				
Collect the Kansei Word in semantic space																				
Understand the customer satisfaction in KE and KM approach																				
Compile the data, see the result																				
SOFTWARE REFRESH																				
Come out with the integration framework of KE and KM																				
Final survey (test and validate the framework)																				
Analysis the final data in stastical approach																				
Analysis in SPSS																				
See the result and run the post test																				
Start with Chapter 4																				
PRESENTATION																				
Slide preparation																				
Presentation Day																				
PROJECT COMPLETION																				
Complete the final report																				

APPENDIX B (Main Survey)

Main Survey

UNIVERSITI TEKNIKAL MALAYSIA MELAKA (UTeM)

The purpose of this survey is to find out how do you feel (Kansei) towards a spectacles' design. This survey is a main survey which will be used to complete the thesis related to 'Design Profile'. The purpose of this questionnaire is to identify and investigate emotional product (Kansei Engineering) based on customer's preferences (around 18-30 years) in the eyewear industries.

Your participation is voluntary, and all information provided by you will be strictly kept confidential. Therefore, I would like to humbly ask you to participate in this study.

I would like to thank you for your participation as well as support. And I would like to apologize for any inconvenience caused.

SECTION 1: General information about you. (Please tick (✓) the boxes as the answer selected)

1. Gender: ☐ Male ☐ Female
2. Age: ☐
3. Current Status: ☐ <Diploma (or equivalent) ☐ Undergraduate (bachelor's degree)
   ☐ Post-Graduate (master's degree/PhD) ☐ Employed
   ☐ Other: _____

SECTION 2: Select the answers based on the scale description.

1	2	3	4	5
I LIKE it that way	It MUST-BE that way	I am NEUTRAL	I CAN ACCEPT THAT WAY	I DISLIKE IT THAT WAY

A. FUNCTIONAL

No.	Question	Answer				
1	A spectacle with full frame makes the customer feels comfortable as it is providing physical relief when wearing.	1	2	3	4	5
2	A spectacle with half frame gives a way of being attractive and pleasing to the eye to the customer when wearing.	1	2	3	4	5
3	A spectacle with rimless make the customer feels lightweight when wearing it.	1	2	3	4	5
4	A round spectacle makes the customer feels so stylish, smart and fashionable when wearing.	1	2	3	4	5
5	A square spectacle makes the customer looks beautiful while wearing and pleasing to eye	1	2	3	4	5

B. DYSFUNCTIONAL

No.	Question	Answer				
1	A spectacle without full frame makes the customer feel miserable when wearing.	1	2	3	4	5
2	A spectacle without half frame makes the customer looks boring and uninteresting to the eye while wearing.	1	2	3	4	5
3	A spectacle that is not rimless makes the customer feel heavy when wearing.	1	2	3	4	5
4	A spectacle that is not round makes the customer looks so simple and plain when wearing.	1	2	3	4	5
5	A spectacle that is not square makes the customer looks ugly while wearing.	1	2	3	4	5

SECTION 3: This part should be filled when the respondent sees the design shown through the display. The respondent is required to rate each design [between 1 (Less) to 7 (High)] according to each Kansei Words provided.

DESIGN 1 – ROUND SPECTACLES (FULL FRAME)									DESIGN 2 – ROUND SPECTACLES (HALF FRAME)									DESIGN 3– ROUND SPECTACLES (RIMLESS)								
																										
Miserable	1	2	3	4	5	6	7	Comfortable	Miserable	1	2	3	4	5	6	7	Comfortable	Miserable	1	2	3	4	5	6	7	Comfortable
Boring	1	2	3	4	5	6	7	Attractive	Boring	1	2	3	4	5	6	7	Attractive	Boring	1	2	3	4	5	6	7	Attractive
Simple	1	2	3	4	5	6	7	Stylish	Simple	1	2	3	4	5	6	7	Stylish	Simple	1	2	3	4	5	6	7	Stylish
Ugly	1	2	3	4	5	6	7	Beautiful	Ugly	1	2	3	4	5	6	7	Beautiful	Ugly	1	2	3	4	5	6	7	Beautiful
Heavy	1	2	3	4	5	6	7	Lightweight	Heavy	1	2	3	4	5	6	7	Lightweight	Heavy	1	2	3	4	5	6	7	Lightweight
How much do you like this design?																										
Strongly Dislike	1	2	3	4	5	6	7	Strongly Like	Strongly Dislike	1	2	3	4	5	6	7	Strongly Like	Strongly Dislike	1	2	3	4	5	6	7	Strongly Like

DESIGN 4 – SQUARE SPECTACLES (FULL FRAME)									DESIGN 5 – SQUARE SPECTACLES (HALF FRAME)									DESIGN 6 – SQUARE SPECTACLES (RIMLESS)								
																										
Miserable	1	2	3	4	5	6	7	Comfortable	Miserable	1	2	3	4	5	6	7	Comfortable	Miserable	1	2	3	4	5	6	7	Comfortable
Boring	1	2	3	4	5	6	7	Attractive	Boring	1	2	3	4	5	6	7	Attractive	Boring	1	2	3	4	5	6	7	Attractive
Simple	1	2	3	4	5	6	7	Stylish	Simple	1	2	3	4	5	6	7	Stylish	Simple	1	2	3	4	5	6	7	Stylish
Ugly	1	2	3	4	5	6	7	Beautiful	Ugly	1	2	3	4	5	6	7	Beautiful	Ugly	1	2	3	4	5	6	7	Beautiful
Heavy	1	2	3	4	5	6	7	Lightweight	Heavy	1	2	3	4	5	6	7	Lightweight	Heavy	1	2	3	4	5	6	7	Lightweight
How much do you like this design?																										
Strongly Dislike	1	2	3	4	5	6	7	Strongly Like	Strongly Dislike	1	2	3	4	5	6	7	Strongly Like	Strongly Dislike	1	2	3	4	5	6	7	Strongly Like

APPENDIX C (Post Test)

Post Survey

UNIVERSITI TEKNIKAL MALAYSIA MELAKA (UTeM)

The purpose of this survey is to find out how do you feel (Kansei) towards a spectacles' design. This survey is a preliminary test which will be used to complete the thesis related to 'Design Profile'. The purpose of this questionnaire is to identify and investigate emotional product (Kansei Engineering) based on customer's preferences (around 18-30 years) in the eyewear industries.

Your participation is voluntary, and all information provided by you will be strictly kept confidential. Therefore, I would like to humbly ask you to participate in this study.

I would like to thank you for your participation as well as support. And I would like to apologize for any inconvenience caused.

SECTION 1: General information about you. (Please tick (✓) the boxes as the answer selected)

1. Gender: ☐ Male ☐ Female
2. Age: ☐
3. Current Status: ☐ <Diploma (or equivalent) ☐ Undergraduate (bachelor's degree)
   ☐ Post-Graduate (master's degree/PhD) ☐ Employed
   ☐ Other: _____

SECTION 2: Select the answers based on the scale description.

1	2	3	4	5
I LIKE it that way	It MUST-BE that way	I am NEUTRAL	I CAN ACCEPT THAT WAY	I DISLIKE IT THAT WAY

A. FUNCTIONAL

No.	Question	Answer				
1	A spectacle with full frame makes the customer feels comfortable as it is providing physical relief when wearing.	1	2	3	4	5
2	A spectacle with half frame gives a way of being attractive and pleasing to the eye to the customer when wearing.	1	2	3	4	5
3	A spectacle with rimless make the customer feels lightweight when wearing it.	1	2	3	4	5
4	A round spectacle makes the customer feels so stylish, smart and fashionable when wearing.	1	2	3	4	5
5	A square spectacle makes the customer looks beautiful while wearing and pleasing to eye	1	2	3	4	5

B. DYSFUNCTIONAL

No.	Question	Answer				
1	A spectacle without full frame makes the customer feel miserable when wearing.	1	2	3	4	5
2	A spectacle without half frame makes the customer looks boring and uninteresting to the eye while wearing.	1	2	3	4	5
3	A spectacle that is not rimless makes the customer feel heavy when wearing.	1	2	3	4	5
4	A spectacle that is not round makes the customer looks so simple and plain when wearing.	1	2	3	4	5
5	A spectacle that is not square makes the customer looks ugly while wearing.	1	2	3	4	5

SECTION 3: This part should be filled when the respondent sees the design shown through the display. The respondent is required to rate each design [between 1 (Less) to 7 (High)] according to each Kansei Words provided.

DESIGN 1 – ROUND SPECTACLES (FULL FRAME)								DESIGN 4 – SQUARE SPECTACLES (FULL FRAME)								DESIGN 6 – SQUARE SPECTACLES (RIMLESS)							
																							
Miserable	1	2	3	4	5	6	7	Comfortable	Miserable	1	2	3	4	5	6	7	Comfortable	Miserable	1	2	3	4	5	6	7	Comfortable
Boring	1	2	3	4	5	6	7	Attractive	Boring	1	2	3	4	5	6	7	Attractive	Boring	1	2	3	4	5	6	7	Attractive
Simple	1	2	3	4	5	6	7	Stylish	Simple	1	2	3	4	5	6	7	Stylish	Simple	1	2	3	4	5	6	7	Stylish
Ugly	1	2	3	4	5	6	7	Beautiful	Ugly	1	2	3	4	5	6	7	Beautiful	Ugly	1	2	3	4	5	6	7	Beautiful
Heavy	1	2	3	4	5	6	7	Lightweight	Heavy	1	2	3	4	5	6	7	Lightweight	Heavy	1	2	3	4	5	6	7	Lightweight
How much do you like this design?									How much do you like this design?									How much do you like this design?								
Strongly Dislike	1	2	3	4	5	6	7	Strongly Like	Strongly Dislike	1	2	3	4	5	6	7	Strongly Like	Strongly Dislike	1	2	3	4	5	6	7	Strongly Like