DESIGN AND DEVELOPMENT OF WATER BOTTLE BY USING KANSEI ENGINEERING AND KANO MODEL

NURUL AFIQAH BINTI MOHD ANAS

BACHELOR OF MANUFACTURING ENGINEERING TECHNOLOGY (PROCESS & TECHNOLOGY) WITH HONOURS

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Faculty of Mechanical and Manufacturing Engineering Technology

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A thesis submitted in fulfillment of the requirements for the degree of Bachelor Manufacturing Engineering Technology (Process & Technology) with Honours

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2022

DECLARATION

I declare that this thesis entitled “Design And Development Of Water Bottle By Using Kansei Engineering And Kano Model” is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature : 

Name : NURUL AFIQAH BINTI MOHD ANAS

Date : 18/1/2022

APPROVAL

I hereby declare that I have checked this thesis and, in my opinion, this thesis is adequate in terms of scope and quality for the award of the degree of Bachelor of Manufacturing Engineering Technology (Process & Technology) with Honours.

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Date : 28 JANUARY 2022

DEDICATION

Alhamdulillah

Praise to Allah for the strength, guidance and knowledge that was given by Allah for me to complete this study.

&

To my beloved parents, family and my siblings, for every support that was given to me.

MOHD ANAS BIN BAHARUM

JURAIZA BINTI ABDUL AZIZ

To my supervisor,

TS DR KAMARUL BIN AMIR MOHAMED

for his guidance and advice in completing this research.

&

To all people who support me throughout my journey

ABSTRACT

Nowadays, product design and development are geared at providing high-quality products and services at an affordable price to worldwide consumers. Successful product design is always the outcome of a perfect correlation between the designer's vision and the users' perception. This study was carried out in order to improve a design for a water bottle based on consumer emotions and perceptions applying the Kansei Engineering (KE) method to meet the expectations of the consumer. Kansei Engineering was used to gather and analyse consumer perceptions in to include it into design components (Kansei Word). Kansei engineering is a technique for converting human feelings and opinions expressed by user into design criteria. Significant Kansei words that have an effect on consumer satisfaction will become design priorities in the future. The purpose of this thesis is to comprehend and use the Kansei Engineering technique, as well as to study methods for incorporating the technology into the water bottle development process. However, KE is insufficient to analyse the data collected, but it still does not know what are required for product function. Furthermore, the Kano Model method was used to determine the functional of a water bottle and the correlation between the Kansei Word. The Kano Model's objective is to classify consumer expectations in the context of new product development and to evaluate the extent to which products produced in the direction of those expectations satisfy. Three objectives were presented in reference to the major purpose of this research: first, to study Kansei engineering and its implementation toward the design on product development. The second goal is to collect and analyse data from the questionnaire that is related to the product design aspect. The final goal of this research is to create a 3D model for a water bottle design. In this study, two surveys were conducted: a preliminary survey and a main survey. At the preliminary survey, five Kansei words were carried out of 15 Kansei words, which are (Safe, Practical, Comfortable, Durable, and Simple), as well as the top five design water bottle for 25 of design. The main survey was conducted to collect data on the chosen design and the Kano model (Functional) of the product. Using SPSS software, analyse the results to determine the relationship between the two variables Kansei word and Kano. According to the results, the most important features that should be included in future designs are 'Water level indicator, Handle Strap, Lid Attached, Bottle Car Holder, and Easy to Clean.' Following that, a morphological chart was used to create three concept designs base on the significant for a new water bottle, and the concept 2 was choose by PUGH matrix approach was used to determine which final design.

ABSTRAK

Hari ini, produk direka bentuk dan dibangunkan untuk menyediakan produk dan perkhidmatan berkualiti tinggi kepada pengguna di seluruh dunia pada harga yang berpatutan. Reka bentuk produk yang berjaya sentiasa hasil daripada korelasi sempurna antara visi pereka bentuk dan persepsi pengguna. Kajian ini dijalankan untuk menambah baik reka bentuk botol air berdasarkan sentimen dan persepsi pengguna, menggunakan pendekatan Kejuruteraan Sensitif (KE) untuk memenuhi jangkaan pengguna. Kansei Engineering digunakan untuk mengumpul dan menganalisis persepsi pengguna ke dalam komponen reka bentuk (Kansei Word). Kejuruteraan persepsi ialah teknik yang menterjemahkan perasaan dan pendapat manusia yang dinyatakan oleh pengguna ke dalam kriteria reka bentuk. Perkataan persepsi penting yang mempengaruhi kepuasan pengguna akan menjadi tumpuan reka bentuk masa hadapan. Tujuan disertasi ini adalah untuk memahami dan menggunakan teknik kejuruteraan persepsi, serta menyiasat cara untuk memasukkan teknik ini ke dalam proses pembangunan botol air. Walau bagaimanapun, analisis KE terhadap data yang dikumpul tidak mencukupi, ia masih tidak tahu apa yang diperlukan oleh fungsi produk. Selain itu, pendekatan model Kano digunakan untuk menentukan perkaitan antara fungsi botol air dan perkataan persepsi. Matlamat model Kano adalah untuk mengkategorikan jangkaan pengguna dalam konteks pembangunan produk baharu dan menilai kepuasan produk yang dihasilkan ke arah jangkaan ini. Tiga objektif dicadangkan untuk tujuan utama kajian ini: Pertama, mengkaji kejuruteraan persepsi dan pelaksanaannya untuk pembangunan dan reka bentuk produk. Objektif kedua adalah untuk mengumpul dan menganalisis data daripada soal selidik yang berkaitan dengan aspek reka bentuk produk. Matlamat utama penyelidikan ini adalah untuk mencipta model 3D untuk reka bentuk botol air. Dalam kajian ini, dua tinjauan telah dijalankan: tinjauan primer dan tinjauan primer. Dalam tinjauan awal, 5 perkataan sentimental daripada 15 perkataan sentimental telah dijalankan, iaitu (selamat, praktikal, selesa, tahan lama dan ringkas), dan lima botol air reka bentuk teratas bagi 25 reka bentuk. Penyiasatan utama dijalankan untuk mengumpul data model Kano (fungsi) reka bentuk dan produk yang dipilih. Menggunakan perisian SPSS, keputusan dianalisis untuk menentukan hubungan antara dua pembolehubah Kansei word dan Kano. Mengikut keputusan, ciri paling penting yang perlu disertakan dalam reka bentuk masa hadapan ialah "penunjuk aras air, tali pemegang, sambungan penutup, rak botol dan kemudahan pembersihan Selepas itu, tiga reka bentuk konsep telah dibuat berdasarkan kepentingan botol air baru menggunakan gambar rajah morfologi, dan konsep 2 dipilih menggunakan kaedah matriks PUGH untuk menentukan reka bentuk akhir.

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In the Name of Allah, the Most Gracious and Most Merciful. Alhamdulillah, I am thankful to Almighty Allah (Subhanahu Wa Taa'la) who give me a strength and spirit throughout my life letting me to fulfil this research. Thanks for His blessing, guidance and His kindness.

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LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

KE-	Kansei Engineering
SD-	Semantic Differentia
EMG	Measured By Electromyograph
EEG	Heart Rate, Electroencephalography
ERP	Event-Related Potential
FMRI	Functional Magnetic Resonance Imaging
PMA	Pugh Matrix Analysis
PM	Pugh Matrix

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CHAPTER 1

INTRODUCTION

1.1 Introduction

People are now aware of the need of drinking enough water. Generally, using a plastic water bottle is considered convenient because it is easy to carry and portable. In the United States, more than half of people drink used plastic water bottles it comes 1500 units of plastic water bottles are consumed every second (Matt alderton, 2019).But that convenience comes to a significant problem: pollution for humans, the environment, and marine life. Plastic bottles contain Bisphenol A (BPA). To produce hard and clear plastic need used BPA chemical. BPA is an endocrine disruptor that has been proven to be hazardous to human health (Mark Acosta, 2010).

Bottles of plastic water are often made of crude oil, which emits pollutants such as nickel, benzene, and ethylene oxide during the manufacturing process. This damages the atmosphere and contaminates the air we breathe. The production of plastic water bottles needs 1,5 million barrels of oil per year, humans use. In addition, when transporting drinking water into supermarkets, trucks emit more toxins and use diesel. Every year, 26 billion plastic bottles are produced, equivalent to 30 million tonnes. Sadly, the majority of the waste dumps do not end up in recycling centres. A plastic container takes ages, if not centuries, to degrade - to melt into the ground. The bottles in today's waste dumps are a long time with it together (Mark Acosta, 2010).

Due to prevent the crisis, people should be encouraged to welcome into their lives a reusable water bottle. Save money by reusable bottles. Bulk bottled water costs $9.47/gallon for a one-serve option, and 0.005/gallon for drinking water. This is 200 times the original water

price. Go green and save money. Consumers consider sensory value when they purchase higher-quality goods. To satisfy this important market need, new products of dual nature that meet all functional requirements must be increasingly developed (Be Bottle, 2020).

In order to collect and analyse links among customer impressions and goods, Kansei engineering is an effective technique. Kansei Engineering was found by Mitsuo Nagamachi fo at Japan's Hiroshima Universit. Kansei Engineering may convert consumers' emotional needs for current goods or services into realistic design strategies that allow us to adapt to latent consumer needs. This approach aims to get customers' views on current products and then develop new concepts or new products (Lokman & Sciences, 2010).

Many Kansei engineering products have been well-sold in Japan. With this approach, a primary research goal is to gather views or feelings from customers about the water bottles. A bottle of water is a tube used for drinking water, liquids, or other drinks. A bottle of water helps a person drink and carry a drink to another location. A bottle of water or bottle is mainly made of plastic, glass, or metal. There are differences in the water bottle, such as the various materials, the cap style, and the bottle height. Most users like the stainless-steel material which are more attractive of a water bottle. This thesis would assess how to enhance the design of a water bottle with stainless steel using the Kansei technology. For more details, it shows that of plastic water bottles end up in landfills

Figure 1. 1 Landfill of Water Bottle

1.2 Problem Statement

The worldwide economic growth, particularly in Malaysia, has encouraged industries to create more innovations in order to survive (Rahma Kusuma et al., 2018). The methods of product design have grown more complicated and quickly changed. The product picture illustrates the important role in the preferences and buying decisions of customers under these circumstances. Several modern product design approaches were used to achieve the perceptions of the customer. Most of the study in Kansei Engineering focuses on proposing different methods to consider consumer feelings that are influenced by the rational product conception. Many researchers have carried out this body appearance methodology. In addition, Kansei Engineering (KE) has attracted the attention of researcher advocates in Malaysia and Indonesia, as evidenced by scholarly conversations and literature (Rahma Kusuma et al., 2018).

Because about 60 percent of the body is made of water, it is important to drink enough to maintain the balance of body fluids, which helps transport nutrients in the body, control body temperature, digest food, and more (Water Science School, 2019).The easiest way to remember to drink more water is to carry a water bottle at all times. However, most water bottles on the market are unattractive. The design focuses more on the volume of the water bottle, and the shape is not at all attractive. It is somehow impossible to hold bottled water because it is too big and heavy. A water bottle with a beautiful design, such as an appealing body shape and a well-shaped lid, would attract consumers to purchase. The most appropriate product for customers will determine when the customer itself able to design their own water bottle using Kansei engineering elements during the survey. Additionally, the water bottle's product development will take into account the customers' opinions and feelings.

1.3 Research Objective

Three main objectives must be met by the end of this research.

i) To study the Kansei engineering method and Kano model in product design.

ii) To analyse data using a questionnaire by applying Kansei word embeded with Kano model

iii) To develop a 3D prototype of water bottle design using kansei engineering (Emotion) embeded with Kano mode (Satisfaction).

1.4 Scope of Research

This project would concentrate on the consumer demand for the product's quality and manufacturing dimension. This survey will be carried out on respondents using the PSM I and PSM II projects. The purpose of this research is to analyse the kansei engineering approach and to apply it to an existing product, a water bottle. At the conclusion of these study phases, the product sample could be identified.

A questionnaire was needed to examine consumer satisfaction in developing a water bottle to complete the project. Relation between customer's desire, feeling and judgement with the product will be study further about Kansei Engineering in product development. It is based on the questionnaire that was distributed by gathering samples from consumers who were interested in the domain product water bottle using a Google form. Its same method is used to collect data for the sentiment survey, which is a Google form. The results of the sentiment survey will be analysed using Minitab to determine the relationship between word opinion and product.

Using the data analysed, create a new water bottle with an appealing design while keeping the function and relevance intact. After obtaining the finalised relevant design, use solidworks software to create the design. Finally, the final questionnaire was designed to generate consumer feedback.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter aims to clarify the literature review on water bottle design develop research studies using the Kansei Engineering approach. Preliminary study, and Kansei engineering philosophy, the approach will be covered in this report. Kansei engineering aims to develop or improve products and services by translating the customer's psychological feelings and needs into the domain of product design as a parameter (Nagamachi, 1992). Aside from that, the preliminary thesis is focused on previous studies that have a good reputation. The following topics, Kansei engineering philosophy, will clarify the fundamentals of a theory relating to analysis from the test book, thesis, journal, case study, technical document, report, and broadcasting. Each source was selected based on the appropriateness of the study. At the end of this chapter, the element will be narrow down the customer satisfaction and picked following the scope of the research.

2.2 Kansei Engineering

Kansei Engineering is first and foremost a product development process that converts customer impressions, sentiments, and requests on current goods or concepts into design solutions and actual design specifications (Development & Engineering, 2002). Kansei is a Japanese term that refers to a consumer's psychological feeling and picture of a new product. When a consumer wants to buy anything, the customer has an image of the object in mind, such as "luxurious, beautiful, and stable". Kansei Engineering technology enables customer image and feelings to be implemented in the new product, resulting in a good product that

matches the customer's image. Kansei Engineering is defined as "translating technology of a consumer's feeling (Kansei) of the product into physical design features (Nagamachi, 2003).

Kansei is an internal sensation that for the time being can only be quantified by externalization procedures. As a result, a set of standard measurement procedures was created. Kansei is most commonly measured by identifying and quantifying meaning in words used to define and separate each psychological and emotional need. This represents a person's thought and serves as an outward description for each Kansei element. Furthermore, Kansei Engineering is a product development methodology that converts customers' perceptions, emotions, sensations, and desires of existing products or concepts into concrete design specifications. This methodology incorporates effective features that were previously included during the development phase (Lokman et al., 2013).

Manufacturers must satisfy consumer's psychological requirements in addition to the objectively determined physical features of their products. Kansei Engineering aims to create goods that meet people's physical, psychological, and emotional demands. This will make the product seem more appealing (Lokman et al., 2013). Kansei Engineering attempts to create a new product based on consumer feelings and desire. This technology has four points: first how to grasp the consumer's feeling (Kansei) about the product in terms of ergonomic and psychological estimation, second how to identify the design characteristics of the product from the consumers' Kansei, third how to build Kansei Engineering system as an ergonomic technology, and the last how to adjust the product design to the current societal change (Nagamachi, 2020).

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2.2.1 Backgroud of Kansei Engineering

The Japanese language has two alphabets (Hiragana and Katakana) plus Kanji characters. Kanji has its origins in Chinese culture, and each character communicates a complete meaning. A Kanji character, on the other hand, typically has numerous meanings, and only the combination and arrangement with other signs gives a definitive interpretation.

The Japanese phrase 'Kansei' is made up of two different Kanji-signs, 'Kan' and 'Sei,' which together signify sensitivity or sensibility. However, the expression obtains its final meaning in a technical or psychological context before being used here. Kansei is divided into two signs etymologically, with the second sign deriving from two additional signs. For more details, shows that etymology of kansei in Figue 2.1.

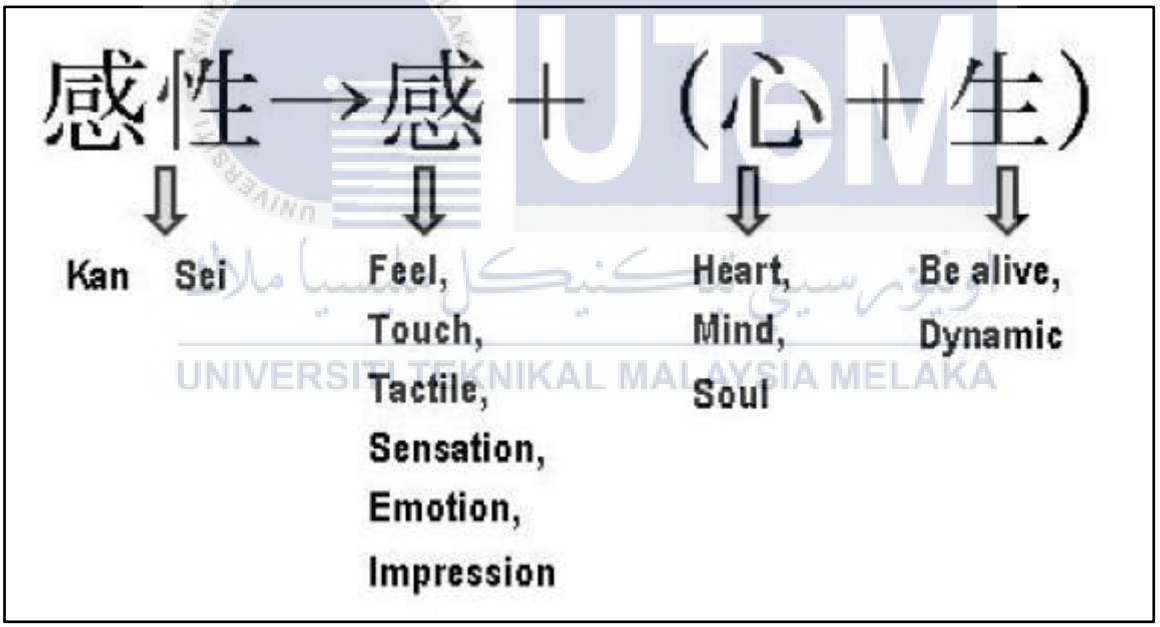

Figure 2. 1 Etymology of Kansei (Rahma Kusuma et al., 2018).

In addition, Kansei Engineering has been embraced and applied by a growing number of colleges and businesses since its inception in the early 1970s. In Japan alone, there are currently roughly 1000 scientists collaborating with Kansei Engineering, including roughly 100 academics and around 300 engineers from various companies (Development & Engineering, 2002).

2.2.2 Basic of Kansei Engineering

Kansei engineering is comparable to psychology in that it represents the consumer's point of view. Based on Nagamachi, it has a relation to human engineering in terms of translating the visual into understandable design characteristics. Kansei engineering is defined as "a mechanism that technologically translates consumers'" Kansei into product design aspects". It is a procedure that begins with gathering the consumer's Kansei and then determines its relationship to the product design". Following that, a database or rule base is built that clearly defines the link, allowing product development to be carried out by referring to it each time. This has already been replicated in the car sector, home appliances, construction machinery, and costumes. It's even been done in landscaping (Indonesia & Number, 2018). Kansei's sequence begins with gathering sensory-related functions such as sensations, emotions, and intuition, referring to the fifth senses (hearing, taste, vision, smell, and, skin sensation). For more detail, shows depicts the Kansei and fifth sense processes inside the brain structure in Figure 2.2 (Lokman et al., 2020).

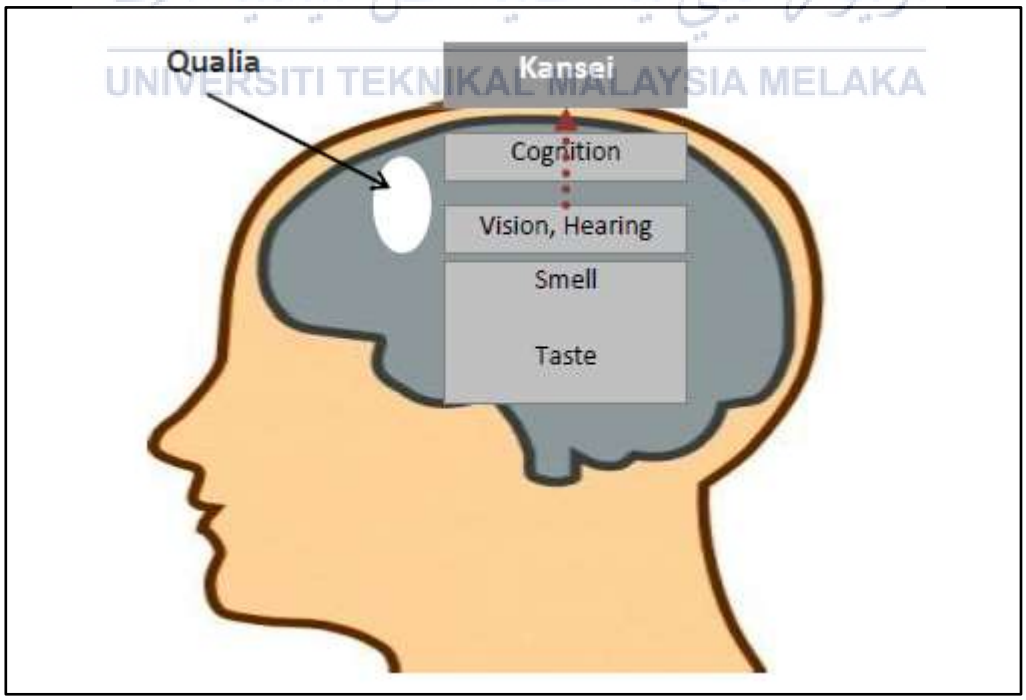

Figure 2. 2 The Process of Kansei (Lokman et al., 2020).

2.2.3 Measuring of Kansei Engineering

The Kansei is a unique mental structure. Understanding the Kansei of others is not always easy and requires a great deal of empathy and expertise (Schütte, 2005). Kansei process cannot be readily measured because it is implicit. What can be seen are the causes and results of the Kansei process, rather than Kansei itself. Kansei may thus only be measured indirectly and partially by assessing sense activities, internal components, and psycho-physiological and behavioural reactions (Lokman & Sciences, 2010).

Kansei studies measure sense activities by assessing the impact of a specific sense stimulation on brain activity. Physiological measurements are made by assessing responses to specific external stimuli. Responses can be physiological or behavioural (measured by electromyography (EMG), heart rate, electroencephalography (EEG), event-related potential (ERP), or functional magnetic resonance imaging (fMRI) or expressive (measured by electromyography (EMG), heart rate, electroencephalography (EEG), event-related potential (ERP), or functional magnetic resonance imaging (fMRI) (body or facial expression) (Lokman & Sciences, 2010).

Psychological tests (Eysenck, 1964), semantic differential scales approach (Osgood et al., 1957), or other questionnaires (Nagamachi, 2003; Ishihara et al., 2005; Lévy et al., 2007) can be used to collect psychological data. There is a way in Kansei Engineering KE where people are asked to express their Kansei in words when they view things or when they wish to buy things in the future. These terms are known as “Kansei Words” (KW). For more details, shows many gateway choices for reaching Kansei in Figure 2.3.

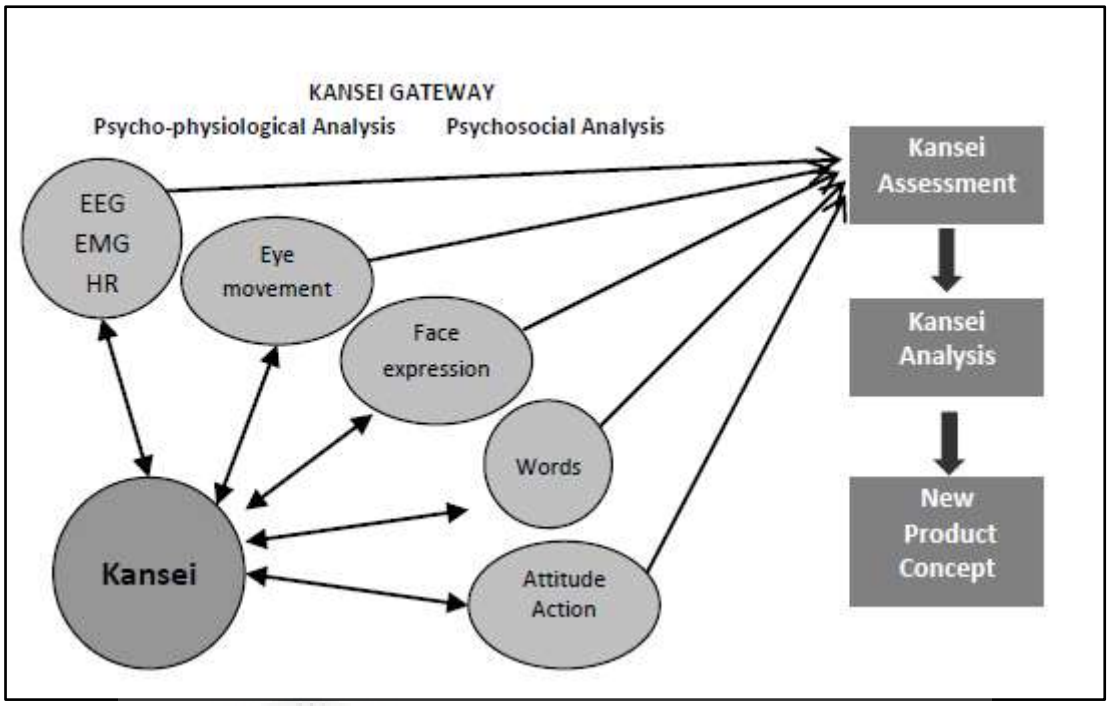

Figure 2. 3 Kansei Gateway (Lokman & Sciences, 2010).

The term "Kansei" employed in KE refers to a structured mind state that contains emotions and images of tangible objects like items or the surrounding environment. The Kansei are all adjectives that describe the emotions of particular products: "luxury," "elegant," "flashy," "young and like in "that outfit seems luxury and exquisite," or "that car appears flashy and for the young." Although Kansei is usually used as an adjective, nouns and brief phrases can be utilised as well (Lokman & Sciences, 2010).

Kansei engineering research begins with the collecting of kansei words linked to the design domain, followed by product evaluation utilising these kansei words (Guo et al., 2020).

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2.2.4 Methodology Kansei Engineering

Product emotion has been identified as a key factor in consumer satisfaction and market success. For many years, Japan has consistently been ahead of other countries in the development of new and creative products. Their success is mainly reliant on their ability to respond to the demand of the consumer's implicit wants, that is the Kansei, through the deployment of technology known today as kansei engineering. The principles for Kansei engineering implementation include numerous processes that may require the use of tools and methodologies from several disciplines such as marketing, psychology, and statistics (Lokman & Sciences, 2010).

It's a methodology that incorporates emotive elements into the development process from the start. Kansei engineering has been used in the development of a wide range of products. Furthermore, in Japan, Kansei engineering is now a well-established and mature design approach as well as a commercially available service. In Japan, Korea, and Europe, the majority of Kansei studies are conducted (Matsubara & Nagamachi, 1997).

For more detail, shows the kansei engineering framework produced by the author to describe the ideas in adopting kansei engineering previously practised. Following that, the approaches employed in each phase of KE implementation are shows in Figure 2.4

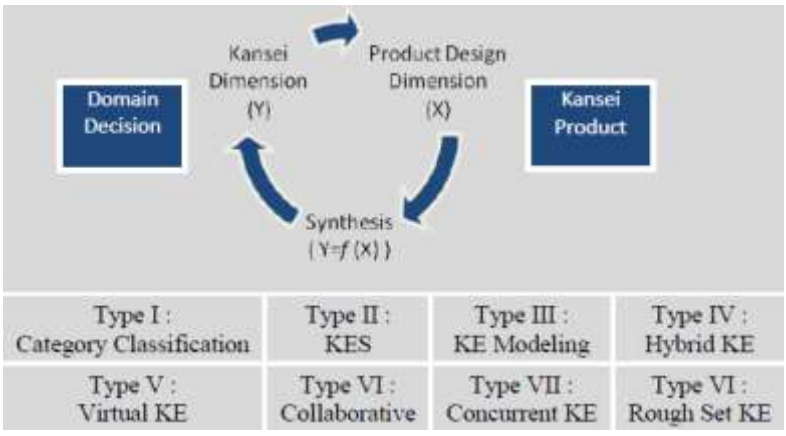

Figure 2. 4 Kansei Engineering Framework.(Adiyanto et al., 2019).

2.2.5 Type of Kansei Engineering

Nagamachi (1997)gathered all of these applications on Kansei Engineering and categorised them by tools and work areas. It distinguished so-called Kansei Engineering kinds from these groups. There are a variety of Kansei Engineering kinds available today:

i) Type I : Category classification

Category classification is a methodology for breaking down a new product's targeted concept to the related subjective Kansei to the objective design specifications. The approach employs a qualitative research method based on the KJ Method, sometimes known as an affinity diagram. Mazda's construction of the world's most successful sports automobile in history, the Miata, is a famous example of this category implementation(Lokman & Sciences, 2010).

ii) Type II : Kansei Engineering System (KES)

A Kansei Engineering System is a computer-aided method of connecting the user's Kansei to the properties of a product. Kansei Engineering Systems are expert programmes that help design judgments on a variety of items in many circumstances. A typical KES consists of four linked databases for Kansei words, images of the objects under consideration, design and colour, and knowledge about how the various data are related to one another. For more detail, shows in Figure 2.5 is a Kansei Engineering System scheme.

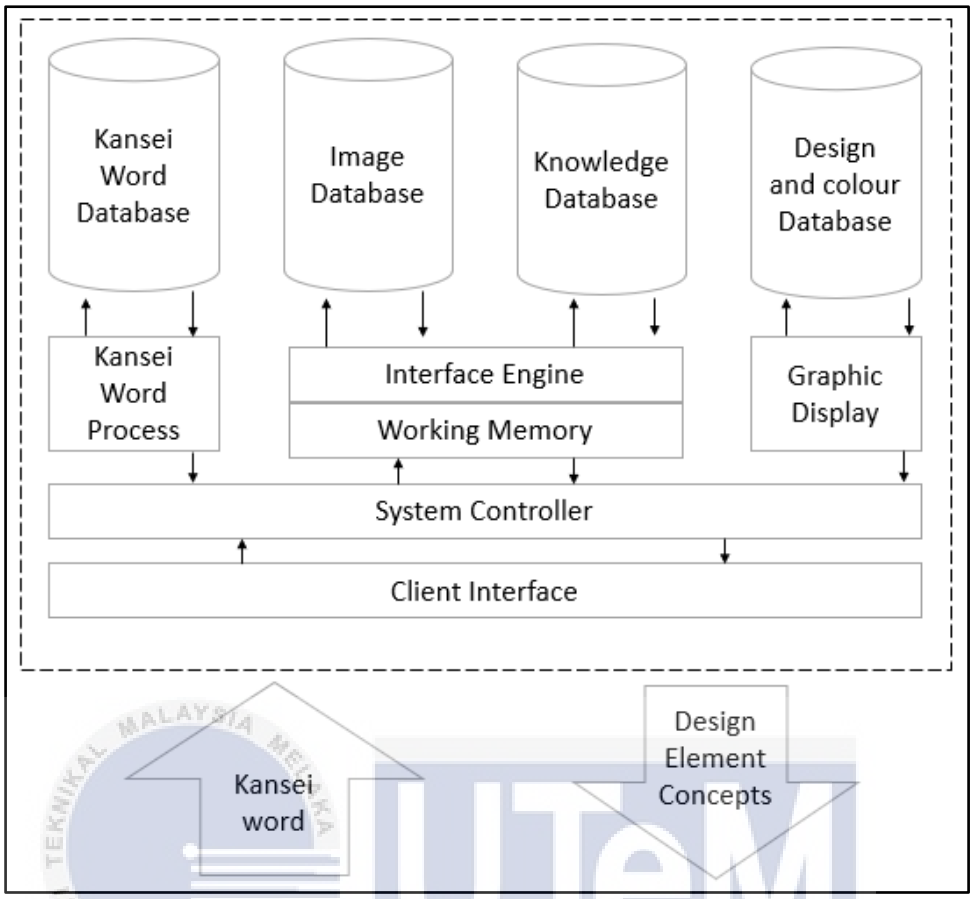

Figure 2. 5 Principle of a Kansei Engineering System

iii) Type III : Kansei Engineering Modelling

In a computerised system, this sort of kansei engineering employs mathematical modelling as logic. This is mostly used to handle fuzzy logic in order to create machine intelligence. Word sound diagnostic system is an example of this kansei engineering type's implementation (Engineering et al., 2009). In this technique, the mathematical model functions as if it were a type of logic, similar to the rule-base. Sonya Electric Co tried to use Kansei Fuzzy Logic as machine intelligence in a colour printer. The intelligent colour printer was made up of a camera, a computer, and a colour printer system that used fuzzy logic to diagnose the colour of the original photo and print out the more attractive colour picture. Nagamachi has created a computerised diagnosis

method based on fuzzy integral and fuzzy measure logic for Japanese language feelings (Nagamachi, 2015).

iv) Type IV : Hybrid KE

A Kansei Engineering System (KES) that combines Forward KES and Backward KES generates a hybrid kansei engineering system. Kansei Engineering Type II is a computerised KES that enable customers to choose whatever product best suits their emotions. The flow of Type II is from Kansei to the customer's design specifics. Also, the designers want to decide the design. The designer first defines the new product design picture and, together with the KES, identifies the product design parameters. This direction is called "Forward Kansei Engineering". The designer is curious how well their design and image fit the kansei. The computerised suggestion offers a wonderful design notion for the designers to apply. This is the "Backward Kansei Engineering" direction. The designer is able to obtain design requirements from the Kansei words using Forward Kansei Engineering with the hybrid Kansei Engineering System. The designer more creatively bases their own notion on the result shown by the system and makes reference to the system's proposal. Then, the designer enters into the system with their new design on the product and the designer is recognised by a system of image recognition from Backward Kansei Engineering. For more detail, shows in Figure 2.6 the two Kansei directions in Kansei Engineering which is referred to as "Hybrid Kansei Engineering".

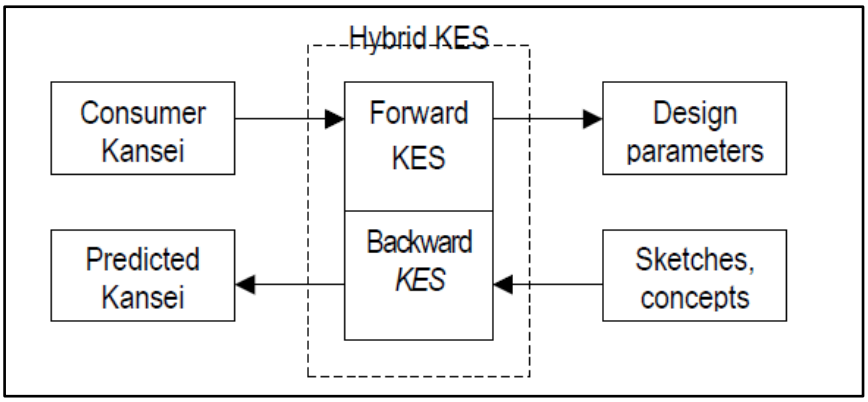

Figure 2. 6 Diagram of Hybrid Kansei Engineering System (Nagamachi, 2015).

v) Type V : Virtual KE

Kansei Engineering Type V is a new methodology combining the engineering of Kansei with technology for virtual reality. Virtual reality is now a highly popular technology, which allows people to go through the computer design that is exhibited by means of HMD and data gloves. Virtual reality is a popular technology. This process involves creating the Kansei environment, incorporating the new product, and then inviting customers to the new product's virtual area. Kansei Engineering is responsible for the virtual space and the product. The new product can therefore be checked within the virtual space by the customer. For example, Nagamachi built a Kansei kitchen system for Virtual Engineering with Matsushita Works Co. (Nagamachi et al.,1996). This system allows the kitchen to adapt to the customer's image by using the Kansei Engineering System. In addition, the customer uses the computer graphics and analyses the virtual kitchen using the computer's virtual picture (Nagamachi, 2015).

vi) Type VI : Collaborative

Collaborative Kansei Engineering Design (IKDS) is an Internet-friendly Kansei Engineering System. It is possible to make KES publicly evaluable with the use of certain Group Product Systems, namely the internet, so that the views of customers and

designers are united. This can shorten and simplify the early stages of development. While it is still to be developed, IKDS should provide a great many advantages, such as participants' collaborative work, speed of product development, effective customer dialogue or the participation of many people, offering a variety of ideas (Development & Engineering, 2002).

vii) Type VII: Rough Set KE

Rough Sets KE is the best way for Kansei data to be treated ambiguously. In general, Kansei with nonlinear features can be separately processed with this kind, and group-based decisions in if-then style can be determined by. For example, the beer design can be seen in the study (Lokman & Sciences, 2010).

2.2.6 Application of Kansei

There is a broad field of applications in Kansei Engineering. Kansei Engineering has been employed to upgrade their goods by several predominantly Japanese corporations in many domains. Kansei Engineering's record in the industry extends from automotive sector to fabric and furniture producers to package design, and Kansei Engineering applications in residences and flat design. Most Kansei Engineering investigations, which are scientifically recorded, are available in English but are available in about 30 publications for example (Development & Engineering, 2002).

2.2.6.1 Automotive Industry

In the automotive sector, companies including Mazda, Ford, Nissan and Honda collaborated on projects. Jindo and Hirasago completed a front-end vehicle design project (Jindo and Hirasago, 1997). Matsubara researched the car exterior (Matsubara et al., 1999) and conducted a car exterior design comparison between European and Japanese Kansei (Matsubara et al., 1998) in cooperation with Nottingham University. A research by

Ishihara (Ishihara et al., 2001) assessed the emotional influence of various instrument panels of passenger cars on the user. In cooperation with Nissan speedometer design and metre cluster layout, Jindo and Hirasago also researched passenger car dashboards (Development & Engineering, 2002).

2.2.6.2 Electronic Device

One of Kansei Engineering's biggest success stories is Sharp's video camera with an adjustable external LCD display (Nagamachi, 1997). Not only that Kansei Engineering examined colour copiers as well (Fukushima et al., 1995). Digital image processing is an associated field where (Takahata 1997) completed various investigations (Development & Engineering, 2002).

2.2.6.3 Home Equipment

In the home-equipment industry, various research was conducted to construct a kitchen design KES (Imamura et al. 1997) and (Matsubara and Nagamachi 1996). Detailed washing machines were studied (Ishihara et al. 1998b). Skogman (2002) compared various types and vacuum cleaner brands at Electrolux, Sweden. Furniture like office chairs was also evaluated by Kansei (Jindo et al., 1995). Nishikawa et al investigated the layout of the bathroom with special attention to comfort and space. Finally, full home and apartment layouts in cooperation with ECR Consultant (Nagamachi et al., 1998) and (Nagamachi and Nishino, 1999). In Sweden, a comparison study was conducted between Linköping University and Skanska AB on several presenting approaches for flats (Development & Engineering, 2002).

2.2.6.4 Architecture

Several other applications of Kansei Engineering are recorded in architecture. A series of studies focuses on bridges and their surroundings (Ichitsubo et al.,1998) examined the emotional effects of various bridge shapes, and he explores the relationship between a bridge and its surrounding landscape in another study (Ichitsubo et al., 2001). Another stage examines the effects of distinct landscapes (Development & Engineering, 2002).

2.2.7 Kansei Product

When emotion is integrated with product design, it is representing Kansei Product. The inspiration behind Professor Mitsuo Nagamachi of the University of Hiroshima was at that time the fact that most development methods of products did not show enough understanding of the feelings of the consumer to satisfy their emotional demands. He has developed a new approach for designing and developing products that meet the senses and desires of consumers. He says companies will not survive themselves if they do not produce items that are responsive to the different feelings of the consumer (Nagamachi, 2003). Inspired by this notion, he invented a technique that allows consumer sentiment and emotion to be integrated into product design, Kansei Engineering (K.E.). This technology is designed with an emotional approach to human well-being. 'Kansei' is a product made by the implementation of the K.E to incorporate human sensations and emotions into physical characteristics such as form and colour (Engineering et al., 2009).

2.3 Kano Model

Today, innovation is identified as a significant notion. Certain goods have unusually limited life cycles. Products lose consumer popularity for a variety of reasons (change of requirements, tastes, preferences etc.) As can be seen from this, the consumer requirement serves as the starting point for product creation. It is critical to understand client demands and wants and their distinctions in order to handle these needs. Customers should be prioritised not only to meet but also to understand their needs(Bilgili et al., 2011). In the 1980s, a group of Japanese scientists led by Professor Noriaki Kano observed that certain consumer criteria affected only their satisfaction, while others affected only their displeasure(Madzík et al., 2019). The researchers' objective is to establish a link between the criteria satisfied by products or services and customer satisfaction. The Kano model's key elements are illustrated in Figure 2.7. The horizontal axis of the graphic illustrates how closely a product element meets a customer requirement, while the vertical axis reflects how satisfied customers are with the product or service. There are three primary categories of requirements: must-be, one-dimensional, and appealing. Action (Qiting et al., 2005).

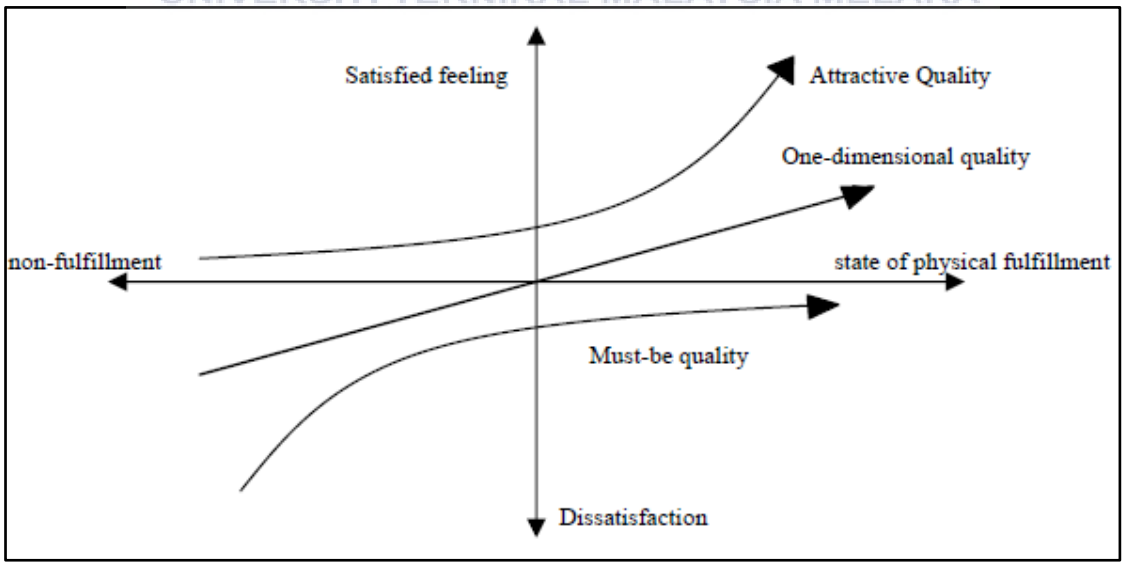

Figure 2. 7 Relationship between Attribute, Emotional Satisfaction and Functional Fulfillment (MacDonald et al., 2006)

2.3.1 Kano Model Principal

In order to be able to categorize requirements or quality attributes into these groups, it is necessary to use the Kano questionnaire(Madzík et al., 2019). The classification procedure in the original version of the theory of appealing qualities is based on a survey utilising a Kano questionnaire.

This questionnaire is comprised of pairs of questions pertaining to customers' needs. As a result, each question is divided into two sections: how do you feel if that feature is included in the product (the functional version of the question), and how do you feel if that feature is not included in the product (dysfunctional form of the question) [18]. This question shows how non-compliance with the condition impacts the respondent's (dis)satisfaction. There are a total of 25 alternative responses to a favourably and negatively phrased inquiry (5 5). An Evaluation Sheet containing all 25 possible combinations is utilised to classify the requirement. Figure 2.8 shows the categorization approach schematically.

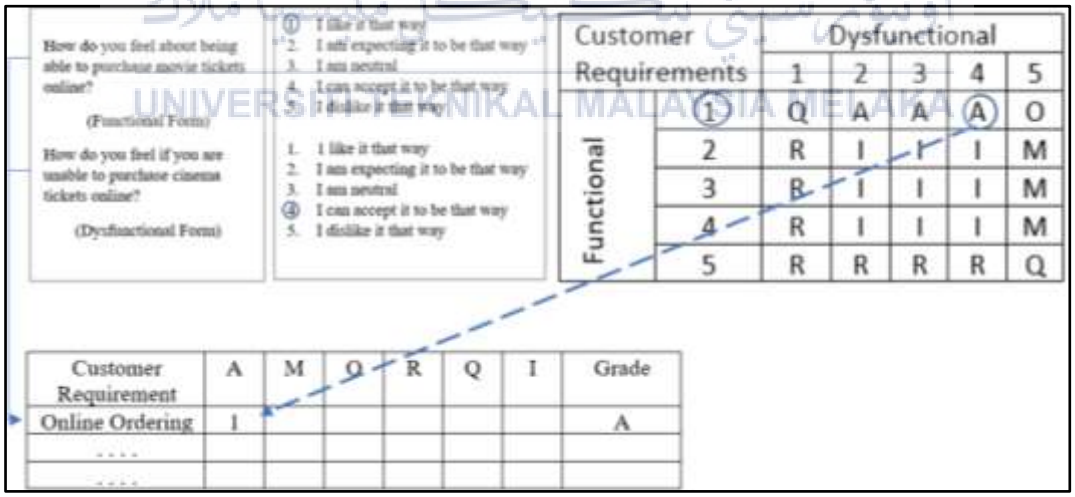

Figure 2.8 Categorization of a requirement using Kano approach

Thus, the requirement must be evaluated from both sides—whether it is met and if it is not. This means that the Kano questionnaire will always contain twice the number of analysed needs. Thus, the previously stated approach results in categorization of each respondent's investigated demand. Of course, respondents' perspectives vary, and it is very possible that the same condition is regarded as appealing by one responder but as necessary by another. In such situations, the sort of demand that results is determined by the most numerous category (Madzík et al., 2019).

2.3.2 The Kano Model's Requirement Types and Methods of Categorization

The Kano Approach is predicated on the idea that a customer's level of functional and emotional satisfaction with a product is related to the customer's evaluation of the product's quality. It claimed that the required levels of functional and emotional pleasure varied among product attributes and that designers should aim for the optimal combination of functional and emotional fulfilment when creating product attributes. The following is Kano originally presented the Kano categories as a graph illustrating the relationship between product features and an individual's emotional and functional requirements fulfilment (MacDonald et al., 2006).

I. 'Must-be'

customer-specified needs that are not specified. While these conditions should be satisfied automatically, satisfying them alone would not ensure customer happiness. This type of requirement establishes a minimum standard of performance for a product or service that the company must meet (Madzík et al., 2019).

II. 'One-dimension'

One-dimensional criteria boost customer satisfaction linearly and are frequently conveyed clearly by the consumer. These requirements are of the "standard type"—

they can be defined by the consumer even before the product or service is used (Madzík et al., 2019).

III. ‘Attractive’

These needs are the product characteristics that have the biggest impact on a customer's level of satisfaction with a certain product. Attractive criteria are not communicated or expected openly by the customer. Compliance with these standards results in greater than proportional satisfaction. However, if they are not met, there is no sense of dissatisfaction (MacDonald et al., 2006).

IV. ‘Indifferent

If a feature of a product is rated as "Indifferent," it suggests that it does not give consumers with either satisfaction or displeasure (MacDonald et al., 2006).

V. ‘Reverse’

Customer needs are unwanted, and if the product satisfies them, customer satisfaction diminishes. It is possible that certain functions/attributes of the product or service contradict the customer's desires and expectations (Madzík et al., 2019).

VI. ‘Questionable

requirements that the client is unlikely to grasp (consumer indicates that their will be extremely satisfied if the demand is met, but will also be disappointed if it is not). The majority of research ignore this category of needs since it is never invoked in subsequent reasoning (Madzík et al., 2019).

2.3.3 Customer satisfaction coefficient (CS coefficient)

The Kano model is constrained by its qualitative evaluation of customers ’ satisfaction. This constraint precludes a quantitative assessment of customer satisfaction in terms of whether requirements are met or not. Numerous enhancements to the original Kano model have been made to integrate quantitative customer happiness evaluations. The Kano model has been

enhanced by establishing the customer satisfaction coefficient (CS) for a certain demand. The CS explains whether satisfying consumers may be increased by meeting product needs or whether completing product criteria only prevents customers from becoming. The CS indicates the average effect of a product requirement on the level of satisfaction of all users or customers. It includes the level to which a product feature may influence user or customer happiness, or, on the other side, the degree to which a product requirement or feature's non-fulfillment may influence user or customer displeasure(Mkpojiogu & Hashim, 2016). This CS coefficient is calculated as follows.

$$\text{Enhance Satisfaction Coefficients} = \frac{A+O}{A+O+M+I}$$

$$\text{Reduce Dissatifaction Coefficients} = \frac{O+M}{(A+O+M+I)\times(-1)}$$

The CS-coefficient of customer dissatisfaction is preceded by a minus sign to indicate its detrimental effect on customer satisfaction if this product quality is not met. The positive CS coefficient has a value between 0 and 1; the closer it is to 1, the greater the influence on customer satisfaction. A positive CS-coefficient that approaches zero indicates that the influence is negligible. At the same time, one must consider the negative CS-coefficient. If it approaches zero, the effect on customer discontent is particularly high if the analysed product characteristic is not met. A number close to 0 indicates that failure to meet this characteristic does not result in dissatisfaction (Mkpojiogu & Hashim, 2016).

2.4 Morphological Chart

The morphological chart method is based on Fritz Zwicky's General Morphological Analysis (GMA) technique for investigating unquantifiable issue complexes. The method is used to decompose a problem into sub-functions, generate several sub-solutions for each sub-function (design divergence), and then pick and combine the appropriate sub-solutions into alternative overall solutions. This method is suggested for usage in particular during the concept formulation stage, when the solution space is expanded in search of all potential methods for a subfunction; this includes a search for form, as the name (morph-) implies. Richardson, Summers, and Mocko (2011) summarise the benefits of the morphological chart method as follows: expanding the design space to be explored, generating novel concepts that would not have been considered otherwise, and representing a diverse range of concepts to allow for consideration of unexpected component pairings.

The morphological chart is a table in which the first column identifies the sub-functions and the heading row's columns contain numbers representing sub-solutions (usually about six) shows in Figure 2.9. The process begins by identifying the sub-functions that the final solution is anticipated to fulfil, which can be accomplished using a variety of ways, including function analysis, brainstorming, defining product design specifications, and customer requirement analysis. When filling in the morphological chart, it is expected to evaluate all conceivable ways of fulfilling a sub-function, which works best when the sub-functions are viewed as autonomous as feasible. Sub-functions are stated at the same degree of abstraction, preferably without reference to actual components(Smith et al., 2017).

	Sub-solution 1	Sub-solution 2	Sub-solution 3	Sub-solution 4	Sub-solution 5	Sub-solution 6
Sub-function 1						
Sub-function 2						
Sub-function 3						
Sub-function 4						
Sub-function 5						
Sub-function 6						
Sub-function 7						
Sub-function 8						

Figure 2. 9 A typical morphological chart representing eight sub-functions and six sub solutions.

2.5 PUGH Matrix

Analyses of the Pugh matrix PUGH 1991 is an effective decision-making strategy for the management of a digital library project who is faced with a challenge with various dimensions and components. As with the other methods, Pugh matrix analysis (PMA) is used to analyse alternative solutions logically according to present criteria. When there are a large number of viable alternatives and potentially numerous intervening factors to consider, the PMA process assists the project team in selecting the best feasible option or options (Cervone, 2009).

The Pugh Matrix (PM) is a form of Matrix Diagram that enables the comparison of multiple design candidates, ultimately determining which design candidate best fulfils a set of criteria.

The Pugh Matrix is straightforward to use and is based on a series of pairwise comparisons of design candidates to the number of criteria or requirements. Additionally, it is capable of handling a huge number of decision criteria. The following step is to establish a reference point for comparison (Dange et al., 2018).

While this baseline is frequently the existing product or service, when building a new product or service, it must be one of the alternative criteria identified. For each factor comparison, the present option is rated as being better (1), the same (0), or worse than the baseline (21). Additionally, finer rating scales such as 3, 2, 1, 0, 21, 22, 23 can be used to produce a seven-point scale. Based on the Figure 2.10 shows that PUGH Matrix table (Cervone, 2009).

	Factor 1 – no jargon	Factor 2 – services	Factor 3 – searching	Total +	Total -	Overall Total	Weighted Total
Weight							
Prototype 1							
Prototype 2							
Prototype 3							

Figure 2. 10 PUGH Matrix

2.6 Summary of Literature

Founded on the previous literature, the studies related to designing a product by using Kansei Engineering methods have already existed but not for water bottle selection. The previous research only looked at product design with Kansei Engineering.

This research was carried out to evaluate the kansei word in order to innovate the bamboo alarm clock. The main goal of this research is to design an alarm clock based on the "othok-othok" traditional toy that originated in Java, namely in Yogyakarta. "Othok-othok" is composed of assembled bamboo and produces music when turned. However, as a result of the influence of modern toys, the "othok-othok" has faded. The author proposed that the alarm clock be innovated because the alarm clock function has existed in all types of gadgets. While sales of othok-othok toys and alarm clocks are currently declining. In this study, the Kansei engineering method was used to translate consumers' feelings and impressions into bamboo alarm clock. The study method employed is a survey that is distributed to identify the "kansei word" till 25 respondents agree with this invention. The questionnaire is divided into three sections: kansei word identification, physical design specification, and physical design parameter validation. To innovate the bamboo alarm clock, the type 1 category classification of kansei engineering are apply. Using factor analysis, eight kansei words were sorted into two factors. For factor 1, there are traditional, creative, unique, and natural options. Traditional design was chosen for factor 1 because it has a higher factor loading than the others. Kansei word has clear, exclusive, creative, and interesting in factor 2. Because clear and exclusive have nearly the same factor loading, we can name th0is factor elegant because clear and exclusive are both contained in the cluster elegant (Kamarul and Lokman, 2010). The mapping approach was utilised to determine the physical form of an innovative alarm clock based on the kansei word factor to analyse the data for design. The new alarm clock was validated using

the Stuart Maxwell test of marginal homogeneity. This test was designed to determine whether or not there are substantial variations between user needs and innovative alarm clocks (Shergian & Immawan, 2015).

This research focuses entirely on the visual features of the drill as described in pictures. Only existing drills on the market were chosen for inclusion in the study. The term "battery drill/cordless/rechargeable drills for home appliances" is used in this research. This study's targeted audience is young individuals between the ages of 20 and 30. A large number of adjectives from many sources such as publications, manuals, ads, product reviews, online user forums, brochures, dictionaries, and other information resources relevant to the machine tool industry. A total of 156 words were collected from the resources. After identifying and removing synonyms and words with similar meanings, there were a total of 112 words. Following the evaluation of each term, 25 kansei words describing the semantic domain of portable battery drills were chosen. The purpose of this study was to investigate showroom attraction for convention. 47 drills found on the market today were studied. These were classified based on many characteristics such as shape, proportions, materials, and detailing. The drill's key components were the battery house, shaft, engine house, and chuck. The shape analysis method was utilised to determine battery drill characteristic information. To begin, the shape of the battery drill was separated into a number of separate aspects, which were referred to as primary elements. Then, each element was analysed and subdivided into secondary elements; if necessary, the secondary elements were also subdivided into additional sub elements, and a new form was generated by re-arranging these elements; finally, the new shape was evaluated. For semantic categorization, the data was processed using a factor analysis. Mean values for the twenty-five kansei word each of thirteen drill samples were included in the input data. This raw material data is simplified via factor analysis, which reveals links between words (Kansei rating). SPSS 11.0 was used to extract factors (components) using

principal component analysis (Statistical Package for Social Science). The factor loading value of the higher level kansei words is shown in a 3-D graphic. This can be used to determine the relationship between the words as indicated by Osgood. Within the vector space, related words will be discovered in clusters (Grimsaeth et al., 2010).

The goal of this research was to improve the design of ceramic souvenirs to best suit the wants of customers using the kansei engineering and kano model concepts. This research focused on the design ceramic applying kansei engineering Type I is category classification to capture the user perspective on the product. Kansei engineering was used to collect and express consumer impression, with the kansei word functioning as a design element. This survey was conducted among persons in public places, including both male and female genders, economic levels, and ages, and generated 40 respondents. Respondents' personal information, as well as their responses to each visual sample of ceramic design, were entered into the questionnaire. To construct a collection of stimuli for this study, 40 images of ceramics souvenirs were used. The kansei words are collected from books, journals, magazines, and other media. The questionnaire provided 20 Kansei words to describe users' emotional reactions to the ceramics souvenir. The questionnaire assesses Kansei words with Semantic Differential (SD) scale with a 5-point scale. Using the SPSS 19.0 programme, the obtained data is processed for factor analysis and conjoint analysis. The amount of Kansei words was reduced using factor analysis, and the relationship between words and Kansei word combinations and design aspects was determined using conjoint analysis. Furthermore, this study classified or categorise Kansei words based on consumer perception into qualities in the Kano Model, which helped in the statistical and calculation analysis. 16 Kansei words were selected from the 20 acquired for the evaluation of reduced form factor analysis for two primary criteria, namely performance and appearance. Only the appearance factor was considered for future design development for the two primary factors, as it is contained inside the area linear attributes in the modified Kano

model diagram. Based on the result indicates that the most popular souvenir is a drinking mug or cup with a basic parabolic-shaped design, artificial exploration with two-dimensional and textured glaze decoration, as well as coloured blocks (Tama et al., 2015).

Previously conducted research on sunglasses selections from e-commerce websites incorporated the kansei engineering process. Apply a a concept typeI – category classification of Kansei Engineering, which is capable of connecting emotional appeal expressed through Kansei Words with physical design features through item or category classification. The age range of the intended consumer group is 18-44 years. Kansei words were compiled using a 5-point SD scale consisting of 30 kansei words. Then, with the assistance of staff from the National University of Malaysia's Optometry and Vision Science Program, 20 specimens are selected based on the distinctive shape, style, and colour. Following the collection of kansei words and specimens, item classification was performed. Due to the nature of this study, which focused on the visual emotional appeal of e-commerce merchandise, category classification was limited to the physical properties visible in our specimen image.Built a survey website utilising the URANUS system and invited 75 individuals (aged 18 to 34) to rate Kansei word appeal on a 5-point SD scale for each of twenty examples. To analyse the data, a factor analysis was utilised to identify a small number of components that will carry a significant amount of weight. The five factors tested in this research contribute a total of 86.43 percent. Factor 1 contributes 48.36 percent, whereas factor 2 contributes 22.80 percent. Meanwhile, the remaining elements are substantially less significant. As a result, we can reliably create the principal component sphere of Kansei words using factors 1 and 2. The experiment data are subjected to Principal Component Analysis in order to determine the link between Kansei words and specimens. To determine the most influential design features, Partial Least Squares (PLS) method is implemented. The PLS method is adopted using data from the Kansei words survey and the item or category classification. A relationship is established between the four

Kansei words selected and the design aspect described in the category. According to PLS analysis, the design element having the greatest influence on the kansei word is two colour patterns, and the colour of the frame is blue, orange, or yellow with a half or thin frame (Chuan et al., 2013).

The purpose of this research is to use kansei engineering to improve consumer preference in fried banana packaging. The primary function of the packaging is to maintain the physical product. Function as a safeguard to ensure that the actual product is not harmed. Attractive packaging is one feature that can be used to attract the interest of consumers. Because packaging is a component that can provide consumers a first impression, author decided to focuses in producing a food packing. The approach uses combines emotions and feelings with product design, resulting in product design that is influenced by consumer emotions. The Kansei Engineering approach is used to translate consumer wants into product specifications, and the focus of research investigations is the design of packaging with the attributes of customers preference. Kansei words were gathered in order to collect data through field observations and direct customer interviews. Based on observations and interviews, the author obtained up to eight kansei words for the packaging of fried banana products. Following that, the questionnaire was developed utilising the kansei word pairs from the packaging image. The design element questionnaire responses were used to build the design element package image. The MANOVA Test was used to analyse the semantic differential questionnaire. The MANOVA test will determine which product design best matches to the consumer psychology feeling. In addition, the results of the semantic differential questionnaire were carried out. By using a factor analysis, we were able to minimise the amount of data. SPSS software for Windows 15 was used for factor analysis. The results show that packaging design number three is a design concept based on psychological emotional customer preferences expressed through

the kansie word, which includes colourful, unique, attractive, packaging size, patterned, information, cleanliness, and recyclable (Adiyanto et al., 2019).

The project is to create a baby product according to kansei engineering requirements. Product success are based on consumer preferences and market demand. If a product's design meets expectations, it will be successful. The product must meet two crucial criteria. First, meet fundamental performance, perceived quality, capacity, and appearance standards. Second, a great design will draw customers in. Human sensations or emotions were taken into consideration when developing this baby bag. Designed baby bags now play a key role in achieving customers' expectations. This investigation employed questionnaires and interviews. Researchers first chose two bags at random from the market: A and B. Identify the purpose of each component of the baby bag by utilising two random bags and classifying them as bottle pockets, garment pockets, bottle heater pockets, diaper pockets, top grips, side grips, and shoulder grips. We got the kansei word from the results of a consumer study. Questionnaires are distributed in three stages. Questionnaire 1 is used to elicit respondents' opinions of the product's role in Kansei terms. Questionnaire 2's goal is to obtain respondents' views on Kansei words and their design category features. Thirdly, the third questionnaire helps determine respondents' ideas about Kansei words and the other design element categories. Respondents who were members of the community received questionnaires. Only 39 questions were completed. Only 39 questions will go on to the next step. 22 kansei words that were chosen showed a 90% reliability level. Using Kansei words as design features can help determine which product design components are connected. The regression processing consists of two phases: the correlation significance and the regression coefficient. Regression analysis shows which independent factors influenced the kansai word's influence. finding whether there is a linear relationship between dependent variable are Kansei word and independent variable category of product design features. Neat, unique, comfortable, safe, modern, smooth, elegant,

antique, simple, beautiful, casual, spacious, creative, colourful, durable, fashionable, soft, and strong, according to the results (Janari & Rakhmawati, 2016).

This study focuses on the feel of food packaging materials in Thailand utilising Kansei Engineering. Wrap food to preserve and safeguard food sold in stores, as well as cover unpeeled or peeled fruit at home. This study will use kansei engineering to examine how customers' emotions are affected by various food packaging items in Thailand. The process materials, including the definition of the product sample, are prepared prior to initiating the process. The questionnaire was utilised for its ability to evaluate all of the semantic qualities. Every kansei word was given a Likert rating ranging from +3 to -3. All participants were briefed on the questionnaire completion process and Kansei word meaning. Researchers employed Principal Component Analysis (PCA) to examine the relationships between Kansei word variables and product samples. The data was obtained from multiple sources, including magazine articles, catalogues, and review publications. Following the conversations, the team proposed six pairings of adjectives that made the individuals feel better: dislike-like; rough-smooth; stable-flexible; tight-wrinkled; fine-fiber; refined-natural Fuji apples were used in this experiment as they have a firm skin and maintain their shape when touched by participants. The professional team chose nine various types of food packaging materials, such as plastic bags, aluminium foil, plastic film, paper, plastic foam, banana leaves, wax paper, plastic net, and plastic air bubbles. 36 people from RMUTL agreed to take part in the trial. 16 males and 18 to 30 years in age. The participants agree that the most-liked food wrap a plastic foam, while the least-liked one is paper. Aluminum foil is sturdier, but plastic foam is more pliable. Finally, the plastic foam was the most popular wrapping that consumers preferred, both tactilely and by way of identification (Kittidecha et al., 2016).

This previous research is to proposes an integrative model of Kansei Engineering, Kano and SERVQUAL incorporating robust design methodology for service design and

improvement. The purpose of this research is to present an integrative model of Kansei Engineering-based robust design for logistics services and discuss its possible relevance through the use of an illustrative numerical example. Today's market for services is extremely competitive. Services are deemed significant because they incorporate characteristics and demands such as availability, reliability, insurance, and satisfaction. As service industry growth is expanding, the research on this subject is critical. As a result, several services on the market provide identical functions and quality. Thus, it causes considerable challenges in picking the best and separating the alternative. method that looks into consumers' underlying demands and quantifies them into consumers' wants and desires is applied. Additionally, it can be connected with other service tools to provide flexibility, given the variability of consumer requests. Service design and development are comprised of two critical components: I Kansei/affective aspects/emotional affects and (ii) service attributes/properties. There are numerous essential service attributes that the researcher assumes, including the cleanliness of the customer's helmet and the web-based application interface.A modular system for helmet, as well as an integrated system for helmet, will be produced, such as: I interactive applications, and (ii) non-interactive applications. The best level combination of each service attribute will be utilised through the utilization of a huge reaction (the larger the better) and design. The results show that the contribution, both theoretically and practically, is how to limit noise and boost the effectiveness of the suggested logistical service improvements (Hartono & Santoso, 2018).

These researchers focused into how kansei words were used to develop a new jamu ready to drink- bottle drink. The primary goal of this study is to develop a new jamu beverage ready-to-drink bottle design that can serve as an extra component in increasing consumer purchase levels. Kansei engineering is a method used by researchers to connect consumers' kansei to physical and visual product features. This strategy will convert the consumer's image or feelings into actual design components. A survey was given to consumers to gather feedback

on the physical packaging of jamu in ready-to-drink packages. The primary strategy is to collect kansei words. This study begins with data collection using questionnaires distributed to 105 respondents. A questionnaire using Kansei words generated from previously described research. A data adequacy test is performed to verify whether the acquired data can be used as a sample. The validity test is next run to evaluate whether the received data is correct and to define the product image. The reliability test was then conducted to see whether the questionnaire could be utilised more than once. Furthermore, the anti-image correlation analysis factor test is to be seen with the sample adequacy criterion. Last but not least, a rotational component matrix test exists and will be classified into numerous factors. Following testing and the eventual acquisition of 18 kansei phrases depending on consumer wants, there are searchers who offer herbal medicine container designs that are ready to drink. The jamu bottle ready-to-drink design offers the head of the bottle on the edge of the bottle, with a slope of 45°. Customers will find it easy to drink. The material utilised is thermoplastic since it is recyclable. Jamu bottle with orange design and 330ml water bottle capacity. The small size bottles size bottle is light, convenient to carry anywhere, and easy to store (Rahma Kusuma et al., 2018).

The goal of this research is to create a portable shopping trolley with a scooter to reduce the effects of nerve injuries (carpal tunnel syndrome) in Rita Pasaraya Tegal. The purpose to developing shopping trolley is to minimize and reduce fatigue is quite a lot. Researchers are investigating creating a portable shopping trolley with a scooter attachment. Portability means simplifying the storage and carrying, whereas a scooter is beneficial for lowering tiredness. In this research, Kansei Engineering (product design and development methodology) is applied. It can either translate human behaviour toward market products or new product concepts. To make kansei engineering work, the researcher collects data for a sample of 30 customers who purchase at Rita Pasaraya Tegal. The samples are taken at random from a population of men

and women aged 20 to 40. To collect Kansei words The questionnaire is distributed to consumers at Rita Pasaraya Tegal.The second stage is to analyse the main data, which is the collected Kansei words. A statistical analytic method is used to examine the Kansei words. Product mapping is the third step. Kansei words that have already passed the statistical test are then separated into stages in order to specify the characteristics of the design that will be constructed. The final step is to create the new product. The new design is visualised into a product image after receiving the necessary specifications. There were four statistical tests conducted for this research. Finding out the level of validity and consistency is done through validity and reliability. Next test is factor analysis. This is used to separate Kansei words into many elements. After these tests, the test is given. First, evaluate kansei words using the Significance value of Bartlett's Test of Sphericity and Kaiser-Meyer-Olkin (KMO) value. The Stuart Maxwell test is for marginal homogeneity. This is used to discover the gap between design concepts and customer desires. Results of this investigation show that creating a shopping trolley with a scooter is acceptable design, strong, durable, and safe (Kisanjani & Purnomo, 2019)

Kansei Engineering (KE) literature review summary

No	Year	Author	Title	Method	Data Analysis	Product
1	2015	Shergian, Achmad Immawan, Taufiq	Design of Innovative Alarm Clock Made from Bamboo with Kansei Engineering Approach	Interpret feeling and impression of consumers into parameters the product	Mapping concept. Conducted reliability and validity data, factor analysis for grouping kansei words. Stuartm Maxwell.	Alarm clock feature: Divided into two factors, were traditional design (which consist of traditional, creative, unique and natural) and elegant design (which consist of clear, exclusive, artistic, and interesting).
2	2010	Grimsaeth, kjetil Gangwar, mayank Baggerud, bjørn Narain, rakesh	Kansei Engineering Based Emotional Product Design: An Illustration by a Battery Drill Case-Study	Semantic analysis. Collect from the different sources like magazines, manuals, product review, user forums on the internet brochures and information resources related to machine tool industries.	Extraction of factor(components) with the help of SPSS 11.0 (Statistical Package for Social Sciences)	Battery drill feature: Classic, modern, elegant, lifestyle, reliable, ergonomic drill should have an engine house in multiple material without clean details shaft in multiple material
3	2015	Tama, Ishardita Pambudi Azlia, Wifqi Hardiningtyas, Dewi	Development of Customer Oriented Product Design using Kansei Engineering and Kano Model: Case Study of Ceramic Souvenir	Kansei word obtained through book, journals, magazines and other media. Distribute questionnaire to getting customer opinions.	SPSS 19.0 software for conjoint analysis. Conjoint analysis is used to determine the relationship between the design elements with Kansei words	Souvenir- Drinking mug/ cup with basic parabolic-shaped design, artificial exploration with 2D and textured glaze decoration, as well as coloured blocks.

No	Year	Author	Title	Method	Data Analysis	Product
4	2013	Chuan, Ngip Khean Sivaji, Ashok Shahimin, Mizhanim Mohamad Saad, Nursyakinah	Kansei Engineering for e-commerce Sunglasses Selection in Malaysia	Kansei Engineering Type I which is capable of relating emotional appeal in the form of Kansei Words to physical design characteristics using item/category classification.	Factor Analysis (FA). The cumulative contribution of principal Component Analysis (PCA). Partial Least Square (PLS)	Sunglasses with light coloured things or half frame with overall colour count. The colour blue, orange and yellow more attractive
5	2019	Adiyanto, Okka Jatmiko, Hapsoro Agung Erni	Development of food packaging design with kansei engineering approach	Kanssei engineering to gauge customer sentiment in Thailand by evaluating tactile interactions and packaging materials	Analysis factor used to reduce data to small. Performed using SPSS software. MONOVA Test reveal the product design that best suits the feelings of consumer psychology.	Redesign food packing for fried banana based on kansei word feature colourful, unique, attractive, packing size, patterned, with information, cleanliness and recyclable.
6	2016	Janari, D. Rakhmawati, A.	Developing Baby Bag Design by Using Kansei Engineering Method	Approaches for this baby bag that take into consideration human feelings or emotions about the product by using two random baby bag sample.	statistical test, double binary logistics. -Correlation significance -Regression coefficient	Final result for the baby bag design feature; space for clothes, space for baby's diaper, baby's bottle is suggested to design

No	Year	Author	Title	Method	Data Analysis	Product
7	2016	Kittidecha, Chaiwat Marasinghe, Ashuboda Chandrajith Koichi, Yamada	Application of Kansei Engineering to Tactile Sense in the Thai Food Wrapping Materials	There was a questionnaire which was used to evaluate all of the semantic attributes. Each kansei word was evaluated on a seven-level Likert scale ranging from +3 to -3.	Principal Component Analysis (PCA)	The plastic foam was the most popular wrapper that customers liked by tactile and identified mostly by the descriptors flexible, winkled, and fiber.
8	2018	Hartono, Markus Santoso, Amelia	Kansei engineering-based robust design model for logistics services	Kansei/affective aspects/emotional impacts. service attributes/properties.	Kansei Engineering, Kano and SERVQUAL	The contribution, both theoretically and practically, is how to limit noise and boost the effectiveness of the suggested logistical service improvements.
9	2018	Rahma Kusuma, Sasmita Mafazati Ahsani, Nisa Budiman, Hardiyanti	Design Of Jamu Beverages in Bottle Ready-To-Drink Through Sustainable Manufacturing with Kansei	Connect the kansei of consumers to physical and visual product attributes.	Adequacy test. Validity test. Reliability test. Rotated component matrix	The ready-to-drink design features a head on the edge of the bottle with a 45° slope. It is quite simple to drink. This substance is recyclable, making it thermoplastic. 330ml bottle of Jamu with a tangerine pattern. Small bottles are light, convenient to carry anyplace, and simple to store.

No	Year	Author	Title	Method	Data Analysis	Product
10	2019	Kisanjani, Alex Purnomo, Hari	Designing Portable Shopping Trolley with Scooter Using Kansei Engineering Approach	Taken random sample of data using questionnaire.	Validity and reliability, Factor analysis using Significance value of Bartlett's Test of Sphericity and Kaiser-Meyer-Olkin (KMO) value, Stuart maxwell	Shopping trolley with a scooter is acceptable design, strong, durable, and safe.
11	2021	N. Afiqah	Design and Development of Water Bottle By Using Kansei Engineering and Kano Model	Kansei engineering and Kano Model	The collected data were analysed using the SPSS data analysis software.	Water bottle with the following characteristics should be included: 'Water level indicator, handle strap, attached lid, bottle car holder, and easy to clean.

2.4 Summary

As a conclusion to this chapter, a quick summary of Kansei Engineering would be provided. Additionally, this chapter describes in full the technique of Kansei Engineering., including the principal of Kansei Engineering., which serves as the foundation for developing the research framework used in this study. Finally, to achieve superior quality and client satisfaction, a methodology or procedure for executing the activity is required.

CHAPTER 3

METHODOLOGY

3.1 Preparation of Study

In this chapter, the method used for this project is to introduce three different method phases, which are for phase 1 is study about kansei engineering, phase 2 is making are suvey by using questionnaire, and phase 3 is develop a design. Every single method for each phase in this methodology is obtained by following the objective in this project. In phase 1, student needs to research studies on Kansei engineering. Water bottles have been chosen for design and development in this project by using the Kansei engineering method. In phase 2, a methodology was used in analyzing the data from the questionnaire using Minitab software. During this phase, data for the two questionnaires will be given; the first questionnaire contains general information about the previous product on the market. The second questionnaire will create the data from the first questionnaire and then categorise it using Kansei words. The final part of methodology phase 3 is to create a new design for the product and build a prototype.

The overall research process is simplified as shows in Figure 3.1 framework of research. Work procedures start from research on Kansei engineering, data collection, data analysis, design development until producing the prototype.

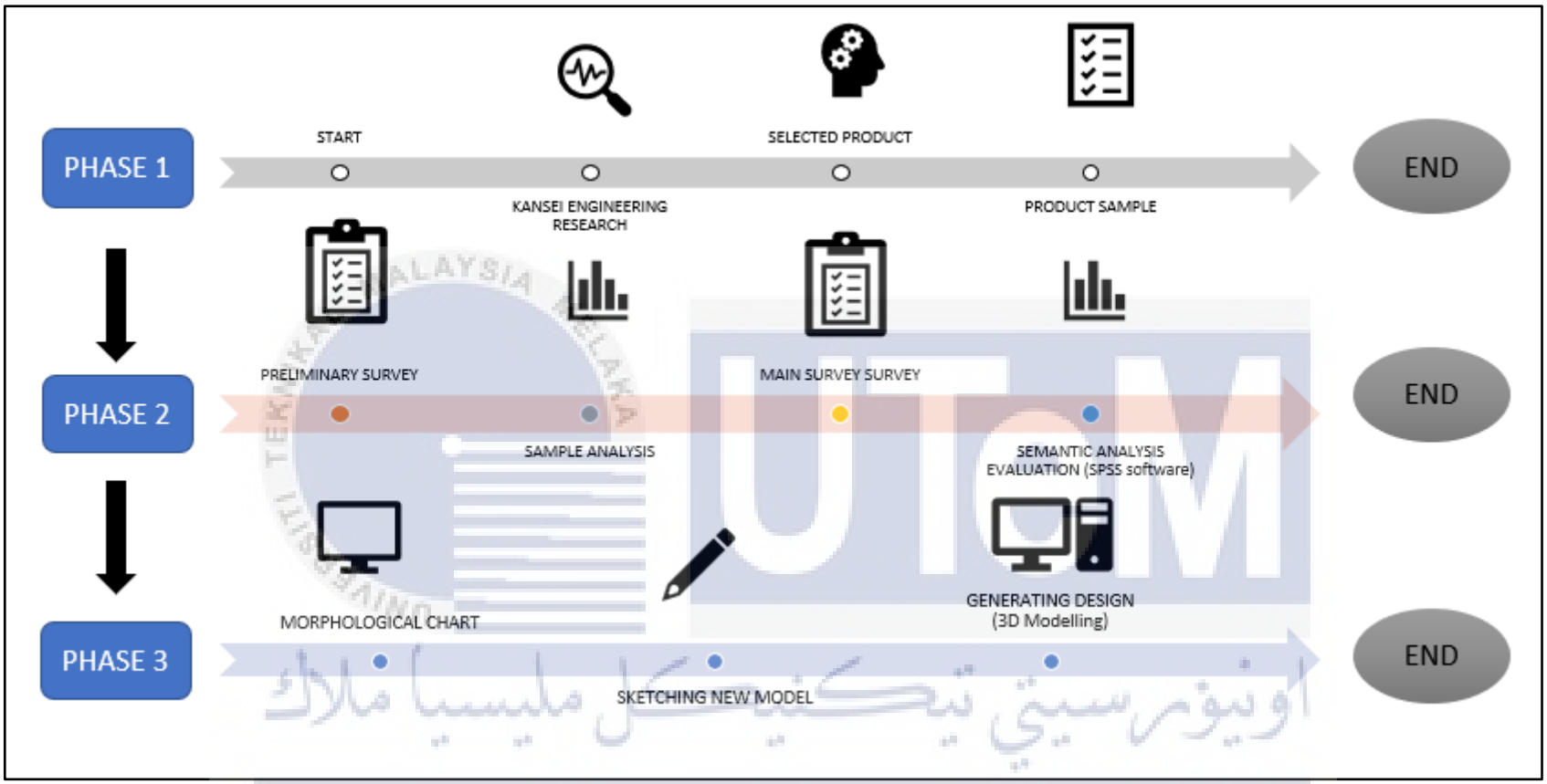

Figure 3. 1 Framework of Research

3.2 Planning of Study

Kansei Engineering (KE) is a product development methodology that converts customers' perceptions, emotions, sensations, and desires of existing products or concepts into real design criteria. By using a questionnaire to obtain data and implementing it with the kansei word (KW). KE is used to assess feelings and to show the relationship between certain product attributes that respond to interded feelings. Kansei Engineering knowledge is gradually developed by literature study, case studies, and finally deployment in real products and retesting. The following investigations were planned utilising an evolutionary approach that obtained additional knowledge about the Kansei Engineering technique based on the findings of prior study sets.

3.3 Phase 1: Understanding on Kansei Engineering

This step reflects researching the Kansei Engineering that implements to improvise a product design and development. With Kansei Engineering will improvise an existing product by related the consumer feeling. It is considered to connect with the first objective of this research. For more detail, shows the flowchart in Figure 3.2.

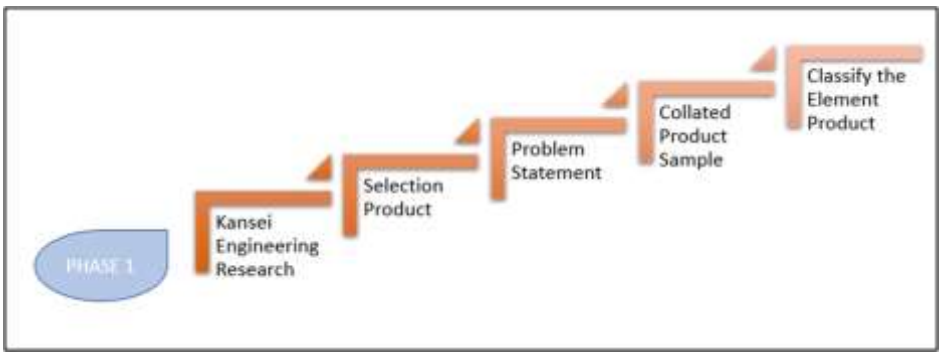

Figure 3. 2 Process flow for Phase 1

3.3.1 Research and Study of Kansei Engineering

This phase step reflects research studies about Kansei engineering to improvised a design development product. The aim of Kansei engineering is improvement and development of the product by implementing the consumer psychological feeling. First, the research is to understand and identify the different types of Kansei Engineering and approach the method to this project. Analyze the selection product and finalize the main product, the water bottle, as the domain reaches the object. Following that, a sample of the previous product domain was gathered as a guide using internet analysis and an online shopping website. There are several different kinds of water bottles on the market, which research on the internet. Several types of product samples were selected and categorized according to the category of stainless-steel water bottles. From this point forward, the product's elements were grouped by part. Respondents find it easy to complete surveys. Figure 3.2 shows the description for the first phase.

3.3.2 Shortlish of Product Design

The product development perspective of Kansei Engineering must be clarified, as the industry's principal focus is on product development. The term "product" derives from the Latin word "productum," which literally translates as "result" or "benefit." Throughout the industrial revolution, it became synonymous with industrially produced artefacts. The phrase is now used to refer to services as well. Kansei Engineering was originally focused exclusively on artefacts; however, recent research on internet-based services has demonstrated that Kansei Engineering has a much larger application. The purpose of this

product selection is to determine the product design for the newly developed product. This part is devoted to market and online research in order to choose the best choice for an existing water bottle.

3.3.3 Kansei Word Collection

Kansei is a word that summarizes the consumer's emotions and desires. A collection of Kansei words relating to the water bottle is made. Typically, a Kansei word is an adjective or a sentence that expresses an emotion regarding the primary product. The first stage in obtaining data in the form of kansei words is to do an internet search, journal entry, and evaluation of an online shopping website. Create a six-point semantic differential scale using Kansei words to determine which Kansei word the consumer chose for the water bottle. Table 3.1 shows the collection of Kansei word

Table 3. 1 Kansei word Collection for Water Bottle

Attractive	Beautiful	Classy	Colourful	Comfortable
Cool	Durable	Elegant	Impressive	Modern
Practical	Safe	Simple	Stylish	Trendy

3.3.4 Collecting Product Sample

The product domain was a choice to develop a new product by using the Kansei Engineering approach. The water bottle is the main product design to develop using the Kansei Engineering concept. The water bottle sample was collected; there are several primary material types: plastic, glass, aluminium, and stainless steel. There are also 15 different kinds of water bottles available in various styles and shapes. And there are 15 different lid water bottle shapes to pick in the market. The standard size of water bottles in market is 500ml or 16.9 oz, is the most popular pure life bottle size. This information was gathered by internet research and evaluation of the surroundings when browsing for products on an online shopping website and reading reviews from bloggers.

3.3.4.1 Type of Water Bottles

After considering the various materials for water bottles, the next step is to evaluate the various styles. There are several alternatives. water bottle type in market.

Table 3. 2 Type Of water Bottle

Type of water bottles	Description
Squeeze/ sport	Teams and fitness centres rely on the easy squeeze of a sports bottle. Gatorade offers iconic green and orange squeeze bottles that are often used by professional athletes.
BPA-free	Experts are debating the harmful effects of plastic, and new discoveries are being made all the time. Regardless, it's always a good idea to look for BPA-free water bottles to ensure your water is clean and healthy.
Built-in infuser	Water bottles with infusers have a designated space for fresh fruit like strawberries, blueberries, or raspberries. This adds a sweet, refreshing taste to your water.
insulated	Water with ice is great with insulated bottles are fantastic. It keeps the drink cool longer
Collapsible	Collapsible water bottles fold down or roll up for easy storage in your bag or suitcase. They're a great choice for traveling or short outdoor hikes.
Eco-Friendly	Go green and carry a water bottle made from recycled materials. Drinkware that's made using leftover plastic is much better for the environment in the long run.
Slim	Stainless steel water bottles tend to have a slim and trim design. The best part about this style is it will always fit in car's cupholder.
Wide	Wide bottles typically have more space for water. Some have weighing lines on the side to keep track of how much user drink during the day.
Colour Changing	Consider using a colour-changing water bottle at a fundraiser. They'll be a huge hit with the kids in attendance!
Glow in the Dark	Glow-in-the-dark water bottles will be a hit with everyone. Turn off the lights and bask in the cool, luminescent glow.
Shaped	A water bottle with a unique shape is sure to turn heads. You can find one that looks like your favorite character, or something unique like balls or lightbulbs.
Digital	The entire world is becoming digital, so it only makes sense for water bottles to follow the trend. A smart bottle can tracks your water intake and hydration levels.

3.3.4.2 Different Type of Lid Water bottles

While it may not appear so, the lid of your water bottle can potentially make or break your purchase. If you live an active lifestyle, go with a lid that attaches to your bag. Children, on the other hand, benefit from lids that contain an integrated straw.

Table 3. 3 Type of Water Bottle Lid

Type of Lid	Picture of Lid	Type of Lid	Picture of Lid
Push-pull		Flip up Cap	
Flip-Up Straw		Pull over Cap	
Attached Carabiner		Slide	
Screw-On		Push Button	
Screw-On Cap		Straw with Cap	

Screw on with Straw		Built-in Handle	
Hinged Cap		Cork	

3.3.5 Category the Element Product

A Kansei category of a product is broken down in the tree structure to obtain design information using the Category Classification method.The objective of this product classification is to collect all Kansei words from real life situations for consumer feedback and market research. The manufacturer's quality is also being evaluated by studying some customer replies and reviews in order to identify the aspects that may effect customer contentment or discontent.

3.4 Phase 2 : Data Analysis

The main goal is to analyze data using the Kansei engineering survey, which includes creating survey questionnaires 1 and 2. Questionnaire 1 is developed through the collection of data for the research instrument survey for the product sample. In general, the data from consumers that choose different product designs on the market and collect the general information about the respondent is provided in questionnaire1. For more details, shows the overall flow diagram for the second phase in The Figure 3.3.

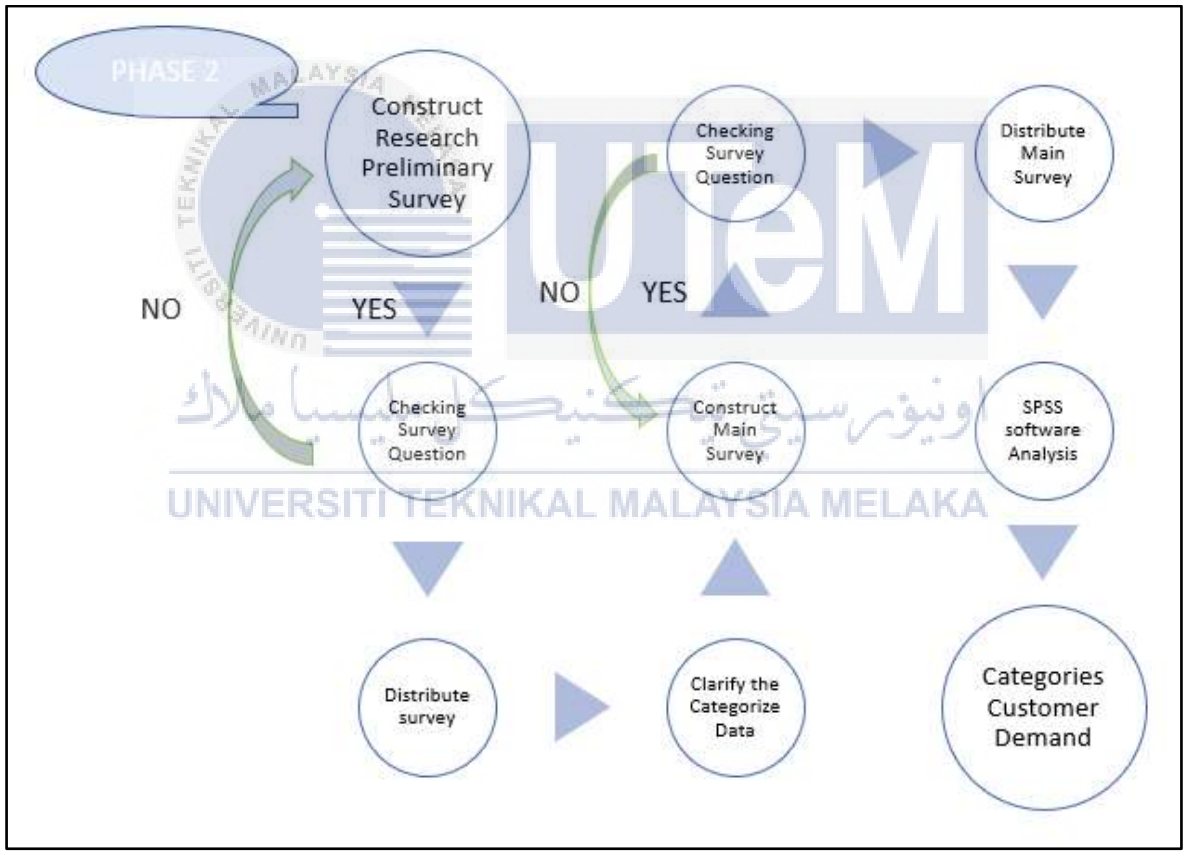

Figure 3. 3 Process Flow for Phase 2

3.4.1 Data Collection Process

As a development methodology for this project, Kansei Engineering type 1 (classification category) is used for data collection. Research accompanied by a statistical analysis of data collected from the sample involves the flow of this methodologic. The process includes three steps. The first stage is to pick Kansei words, followed by a Kansei survey, which consists of a subjective assessment of consumer expectations of the different sample websites as questionnaires containing the Kansei words obtained. The third stage of the project is where the sample data are statistically analyzed. In this phase only 2 surveys are needed to obtain data for improved product development.

3.4.1.1 Preliminary Survey (Questionnaire 1)

As a development methodology for this project, Kansei Engineering type 1 (classification category) is used for data collection. To collect data, a preliminary survey was conducted. The survey was separated into two sections, the first of which is about general responder information. This section is divided into three sections: demography, product background, and consumer perception. Demography included questions about gender, age, race, and occupation. Then, for product background, questions were asked regarding the material, water bottle owned, preferred water bottle, colour favoured, and water bottle capacity. The final section asked about consumer perceptions of the most important factors and conditions to consider when purchasing a water bottle. The second section asks questions about the design profile. This portion is divided into two parts: the favourite kansei word that represents the respondent's emotional expression toward the water bottle and the selection

of five of the twenty-five design water bottles that the respondent prefers. The shape, cover, handle, pattern, and capacity of the water bottle are some of the features that may influence the respondent's emotion. The appendix contains an example of a questionnaire. As a development methodology for this project, Kansei Engineering type 1 (classification category) is used for data collection. To collect data, a preliminary survey was conducted. The survey was separated into two sections, the first of which is about general responder information. This section is divided into three sections: demography, product background, and consumer perception. Demography included questions about gender, age, race, and occupation. Then, for product background, questions were asked regarding the material, water bottle owned, preferred water bottle, colour favoured, and water bottle capacity. The final section asked about consumer perceptions of the most important factors and conditions to consider when purchasing a water bottle. The second section asks questions about the design profile. This portion is divided into two parts: the favourite kansei word that represents the respondent's emotional expression toward the water bottle and the selection

of five of the twenty-five design water bottles that the respondent prefers. The shape, cover, handle, pattern, and capacity of the water bottle are some of the features that may influence the respondent's emotion. The appendix contains an example of a questionnaire.

3.4.1.2 Distribute Questionnaier 1

This section involves distributing the first questionnaire to respondents. The respondents are then asked to answer the questionnaire based on their comprehension. A random sample of individuals receives the questionnaire. The questionnaires produced various market examples of water bottles

3.4.1.3 Clarify the Categorize

In Kansei Engineering., the term "Kansei" refers to an ordered state of mind in which thoughts and memories are kept in the mind against tangible things such as goods or the world. Kansei word is a term that can reflect a consumer's feelings and demand. Kansei words related to water bottles have been collected. After analyzing the research preliminary survey (Questionnaire 1), the Kansei word would be applied to the main survey (Questionnaire 2). For more details, shows that once the research preliminary results (Questionnaire 1) are obtained, a kansei word will be constructed to represent the product (Questionnaire 2) in Figure 3.4

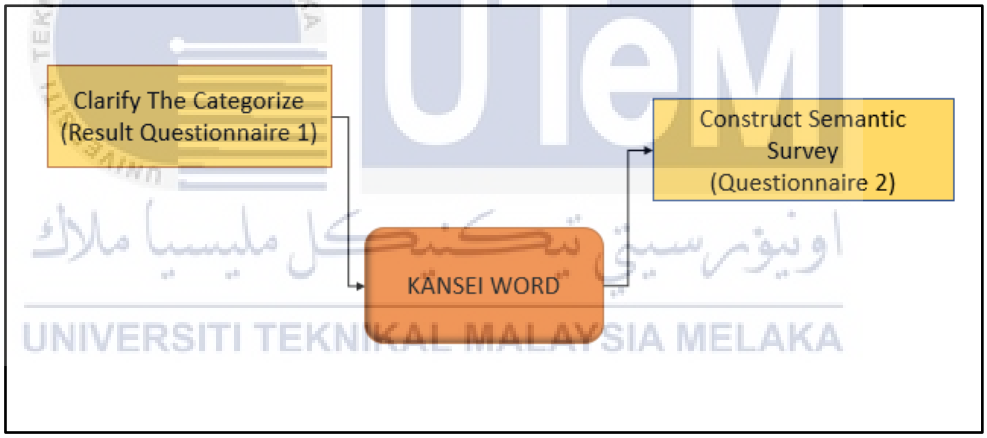

Figure 3. 4 Flow the MainSurvey

3.4.1.4 Main Survey (Questionnaire 2)

Doing an interpretation of the data gathering assists in the development of a main survey. The preliminary survey results will be used to guide the main survey. The product and kansei word with the highest preliminary survey score will be selected for a carry questionnaire. When using the Kona Model method, is predicated on the idea that a customer's level of functional and emotional satisfaction with a product is related to the customer's evaluation of the product's quality and questions in this survey are more focused on the chosen product and the functional of the product. Furthermore, employing the Kansei word and Kano term allowed respondents to choose points on each Kansei word and Kano term of the number of the current scale with the respondent's expectation of the product.

3.4.1.4 Distribute Questionnaire 2

This section involves distributing the second questionnaire to respondents. The respondents are then asked to answer the questionnaire based on their comprehension. A random sample of individuals receives the questionnaire. The questionnaires produced various market examples of water bottles based on kansei word.

3.4.2 Data Analysis using Statistical Package for Social Sciences (SPSS)

SPSS is an IBM-developed statistical tool that is frequently used by academics and academicians worldwide. This statistical package is extremely user-friendly, and it enables the conduct of a variety of statistical tests. This statistical software performs comparison and correlational statistical tests for univariate, bivariate, and multivariate analysis using both parametric and non-parametric statistical techniques(Ong & Puteh, 2017). Designers can compile or enter primary or secondary data acquired in the same way that Microsoft Excel does. Its navigation bar makes it simple to assess the data that has been entered. SPSS is capable of performing a wide variety of statistical analyses(Shi & Conrad, 2009).

I. Correlation

Correlation analysis is used to determine the strength of the association between the two variables. However, it does not explain which variable is the cause and which is the effect. Correlation between two variables is referred to as simple correlation, whereas correlation between more than two variables is referred to as partial or multiple correlation. Correlation can be investigated in two ways: diagrammatically or mathematically.

3.5 Phase 3

In this phase, the main focus is to produce a new design for the product research and development a prototype. A new concept based on data collection will be created at this point, and a new design product will be sent to respondents for an investigation. For more details, shows the framework of phase 3 in figure 3.7.

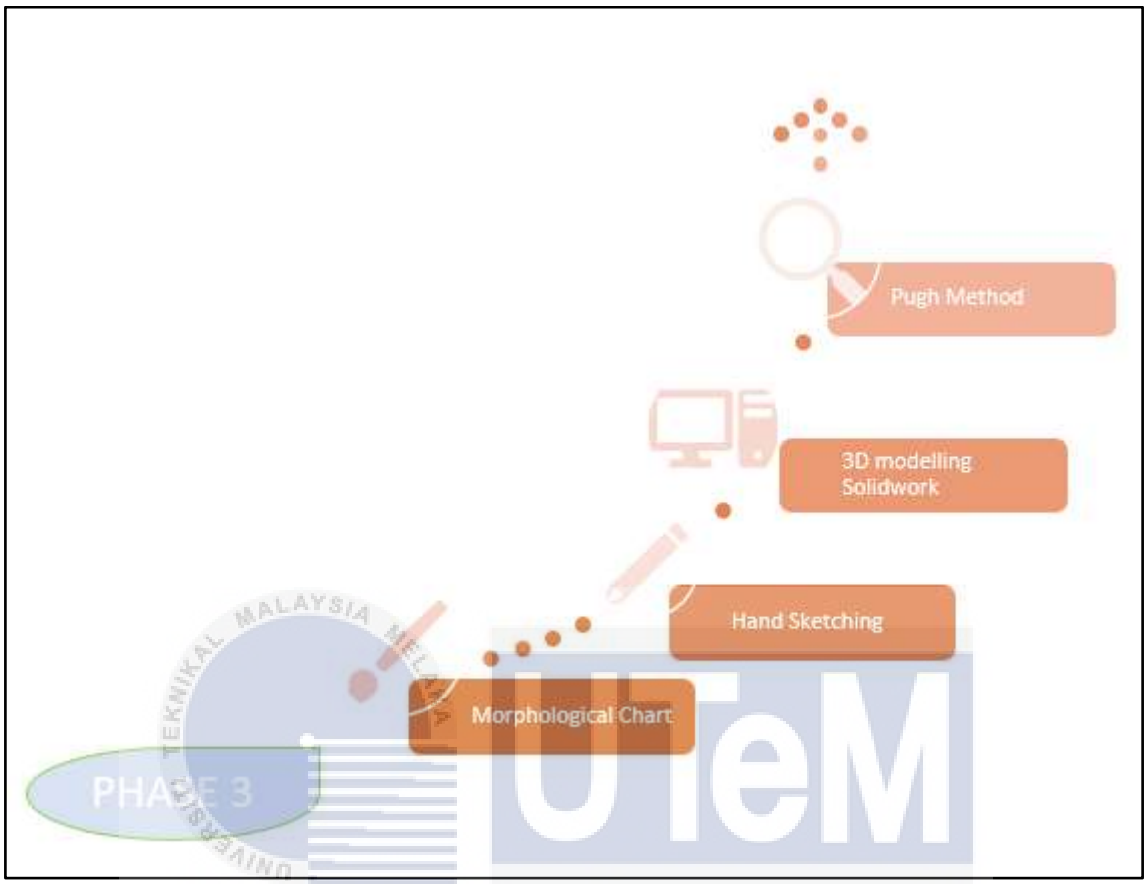

Figure 3. 5 Process Flow for Phase 3

3.5.1 Concept Development: Morphological Chart

Used morphological chart method to develop a new design water bottle. A morphological chart is a visual technique to capture the required product functionality and investigate alternate techniques and combinations of obtaining that functionality. There may be several different solutions for each element of product function. The chart expresses these solutions and gives a framework for considering additional combinations. Morphological charts, also known as idea combination tables or function-means tables are a design tool used to provide a list of integrated conceptual design solutions for a design problem. A table

is created by breaking down the design challenge and listing all of the important functions in a column. Each function's means are listed in rows to the side(Smith et al., 2006).

Following the creation of a morphological chart, a mix of ideas will be used to build a version of a new concept design in order to reduce the scope. A design concept is an enhancement or invention to a product that enhances or innovates the aesthetic, functionality, or mechanical physical operation of the product. The concept is developed first, followed by various sketches to envision the product.

3.5.2 Sketching

In this phase, will create a new design by following the result for the concept of morphological chart.Sketching is a great tool since it frequently assists in the discovery of the most effective solutions to a design problem. Even though it is tough to freestyle a complex design in mid-air without first ironing out the details. For this objective, sketching will remain an important element of the design and development process. The data from main survey will be translated into a sketch model in this step, selected of the kansei words will be used to construct the new concept design. The definition will be based on the most prevalent market's wants and preferences.

3.5.3 3D Modelling

The information obtained from analysis and research can be used to generate new ideas by defining market demand and developing product specifications that will persuade consumers to use the Kansei Engineering tool. To create the new design drawing with complete and detailed measurements, 3D modelling is applied, which is based on the concept of morphological chart. Solidworks software was used to create 3D CAD modelling and documentation.

3.5.4 PUGH Matrix

After developing the 3D modelling, choose which design should represent the user's feelings and psychological demands. Using the PUGH Matrix for decision making, designers can select the most plausible and practical alternative from the list of options presented. To do so, however, designers must first determine the most important criteria for making a final selection on alternatives, and then choose the best one based on these criteria.

CHAPTER 4

RESULT AND DISCUSSION

4.1 Introduction

This chapter discusses and describes the outcomes of the study, as well as the process of determining the consumers' preferences and emotional expressions through the translation of Kansei words using questionnaire. Based on the results of the survey, this project will investigate customer preferences for product design using Kansei Engineering toward the expression of emotion using Kansei words. The survey was conducted to collect information about customer preferences for several types of water bottle design. The developed questionnaires were then distributed to respondents. Furthermore, in design development, the consumer requirements are analysed applying the semantic differential (SD) method. SD is the most often used measurement tool in user-centred design methodologies to determine the emotional worth of items. SD has been used in KE to address the connection between emotions and products in water bottle design. Then analysed and manipulated using the Statistical Package of Science Software (SPSS v.22) to obtain the necessary statistical information, such as validity, reliability, and correlation between the customer's demographic information (demography) and the water bottle design preferences articulated through Kansei Engineering's emotional expression and the customer's emotional feeling.

To perform this survey, the sample size was determined using the Google Form and distributed over social media platforms such as WhatsApp, Facebook, Instagram, and Twitter. As a consequence of the evaluation, the 25 water bottle designs were compared to

the consumer preferences based on their feelings. The questionnaire was sent and the results were analysed using software built utilising the collected data from the respondents. Additionally, the Kansei phrases and emotional expressions convey the customer's reaction to the product's design and their preferences for the product's design and development (design profile).

4.2 Developing Questionnaires

The purpose of this study is to develop a questionnaire to measure the customer's emotional response to a product design that represents the product's characteristics. Data for these investigations were gathered randomly via Instagram, Facebook, Twitter, and WhatsApp posts, as well as from the Universiti Teknologi Malaysia (UTeM). Two questionnaires were created: one for the preliminary survey and another for the main survey. The preliminary survey must be conducted first in order to establish the questionnaire technique, and then the major survey can be conducted. This survey's questionnaire requests necessary personal information, Kansei words and their definitions, and product design preference.

4.3 Preliminary Test

Preliminary survey is conducted to gain the data before to the main survey in order to determine consumer preference for the questionnaire prepared. The whole set of probability questions will be placed and sorted for the greatest possible response during the preliminary test. The preliminary survey will elicit information about the respondent's background, the product's history, consumer perceptions, and design profile. Kansei words and product preferences were incorporated into the design profile. Kansei words and their meanings were determined using three dictionaries: Oxford, Longman, and Merriam-Webster. The preliminary survey consisted of approximately 15 Kansei words and their meanings. The goal of this questionnaire is to determine which Kansei words customers used to communicate their emotions and preferences regarding the water bottle design.

4.3.1 General Information

The questionnaire is distributed randomly to respondents from any target category, and it is done so through the use of Google Forms. From the questionnaire that collected, about 100 questionnaires were getting back and analysed. This preliminary survey part was divided into two sections: general respondent information and design profile. The first portion is divided into 3 segments: demography, product history, and consumer perception.

I. Gender

According to the preliminary survey result, 62 (65%) of the 100 responses are female, while the remaining 35(35%) are male. Figure 4.1. and Table 4.1 shows that the percentage of male and female is quite similar each other.

Table 4. 1Statistic Frequency of Gender

Gender	Frequency	Valid Percent
Female	65	65
Male	35	35

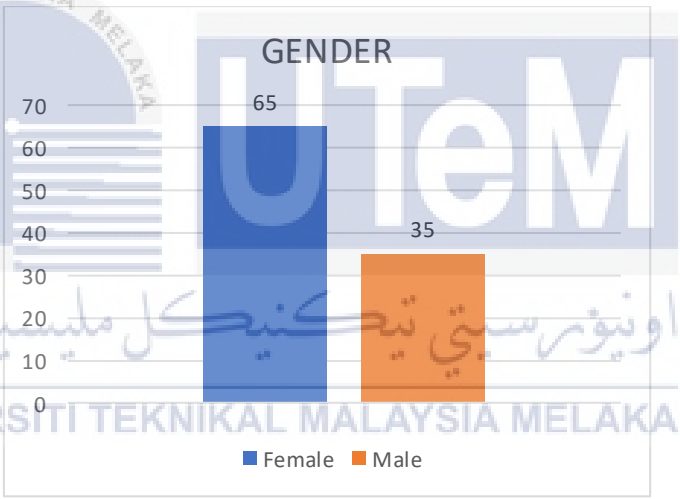

Figure 4. 1 Histogram Graph Frequency of Gender

II. Age

The Figure 4.2 histogram graph and Table 4.2 shows depicts the age range of those who completed the survey. There are age groups to pick from: those below 18 years old, those between the ages of 18 to 24 years old, those between the ages of 25 to 35 years old and those 35 years old and above. The histogram graph Figure 4.2 clearly demonstrates the higher percentage at the age range of 18-24 years old, with 49 of responses with 49 percent. It can be stated that the majority of survey respondents are young adults. By following the group of 35 years old and above came in second with 35 percent of the responses.

Table 4. 2 Statistic Frequency of Age

Age	Frequency	Valid Percent
Below 18 years old	4	4
18-24 years old	49	49
25-35 years old	15	15
35 years old and above	35	35

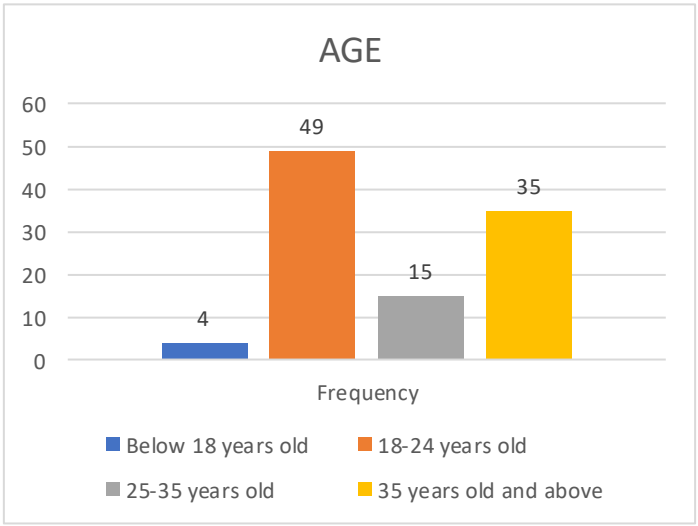

Figure 4. 2 Histogram Graph Frequency of Age

III. Race

Table 4.3 and Figure 4.3 shows the histogram graph that depicts the frequency of race that responds to the survey. The pie chart in Table 4.3 and Figure 4.3 illustrates the frequency with which each race responds to the survey. With 88 responses and an 88 percent response rate, it is apparent that the Malay race has the largest portion of respondents. Following that, the Chinese race had six respondents and the Indian race had four. Then, by responding to two responses, the final section deals with other races.

Table 4. 3 Statistic Frequency of Race

Race	Frequency	Valid Percent
Malay	88	88
Chinese	6	6
Indian	4	4
Other	2	2

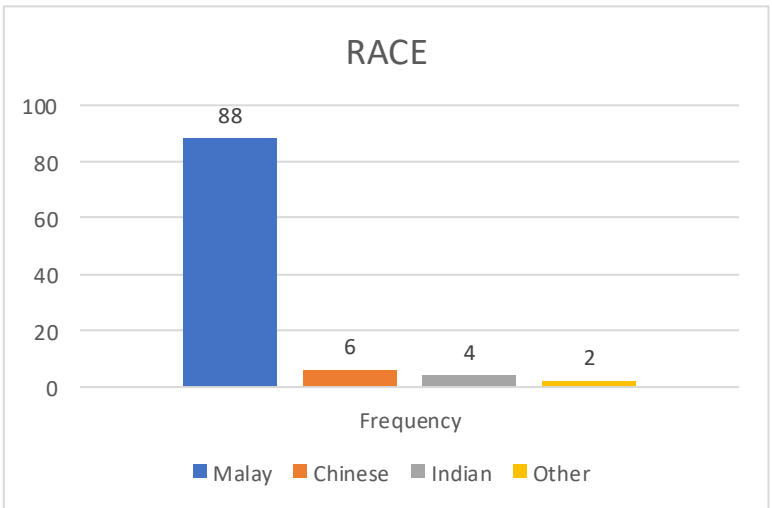

Figure 4. 3 Histogram Graph Frequency of Race

IV. Occupation

The frequency of occupation from respondents is shown in Table 4.4 and Figure 4.4 histogram graph. The student group receives the most votes with 50 responses. Continues with underemployment (19 respondents) and self-employment (16 respondents). Following that are the unemployed (8 respondents) and professionals (5 respondents). Retired respondent contributes 2 responses

Table 4. 4 Statistic of Occupation

Occupation	Frequency	Valid Percent
Student	50	50
Unemployed	8	8
Under Employment	19	19
Self-Employed	16	16
Profession	5	5
Retired	2	2

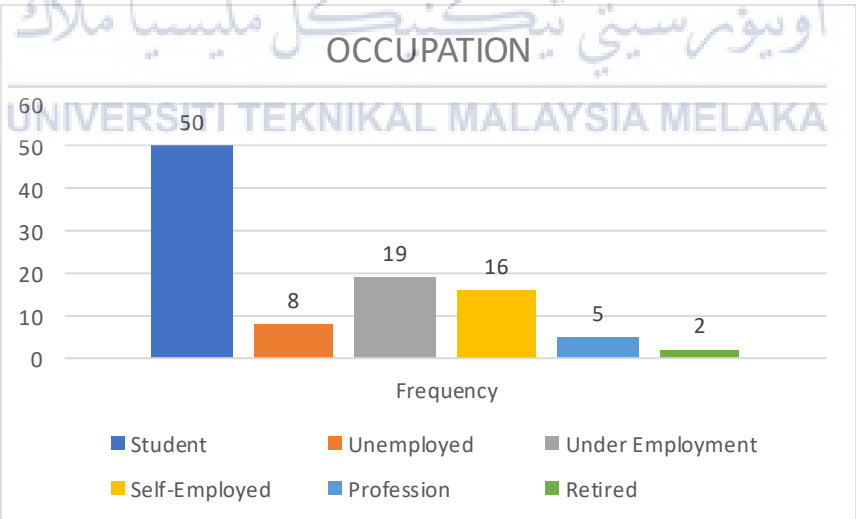

Figure 4. 4 Histogram Graph Frequency of Occupation

V. Material Preference

The frequency of material preference is shown in Table 4.5 and the histogram graph in Figure 4.5. According to table 4.5, the most preferred material by respondents is plastic, with 52 respondents, followed by continuous with a stainless-steel material, with 26 respondents. The material glass received 15 respondents, while aluminium received only 7 respondents.

Table 4. 5 Statistic Frequency of Material Preference

Material	Frequency	Valid Percent
Plastic	52	52
Aluminium	7	7
Stainless Steel	26	26
Glass	15	15

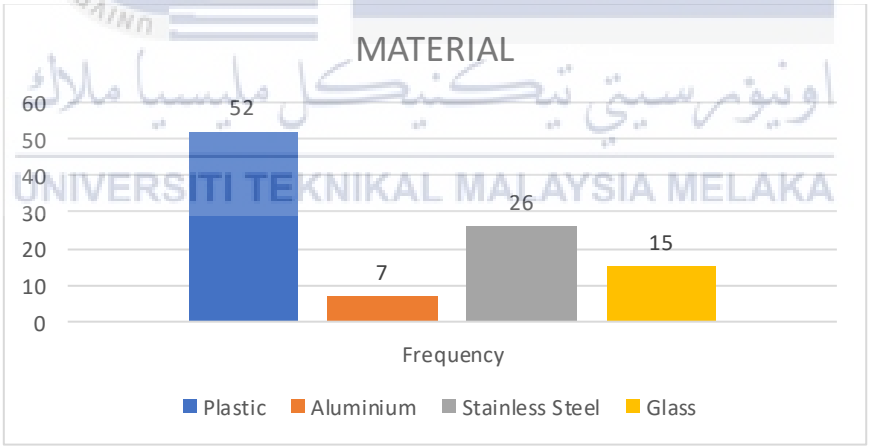

Figure 4. 5 Histogram Graph Frequency of Material Preference

VI. Owned of Water Bottle

The histogram graph of an owned water bottle is shown in Figure 4.6 and Table 4.6. According to the results, 55 percent of respondents own at least one to two water bottles. The data then shows that 24 respondents have more than four water bottles and that 20 respondents have three to four water bottles on their own. Only 1 respondent does not own a water bottle.

Table 4. 6 Statistic Frequency of Owned Water Bottle

Owned	Frequency	Valid Percent
None	1	1
1-2 pcs	55	55
3-4 pcs	20	20
More than 4 pcs	24	24

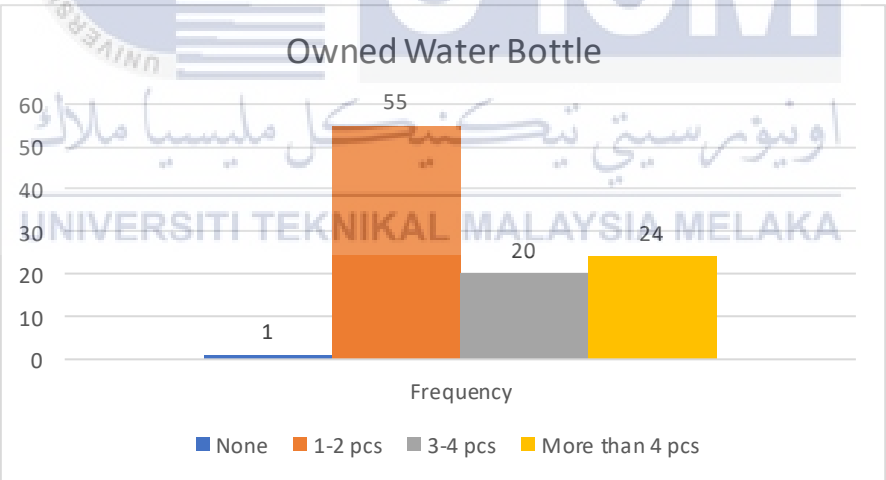

Figure 4. 6 Histogram Graph of Owned Water Bottle

VII. Prefer

The histogram graph of preference to buy a water bottle is shown in Table 4.7 and Figure 4.7. According to the histogram graph, design receives the highest number of responses, with 60 respondents indicating design as a consumer preference. Following that, 19 respondents voted on price and brand as their preferred factors when purchasing a water bottle. Only two people voted on colour as a consumer preference.

Table 4. 7 Statistic Frequency of Preference Consumer

Preference	Frequency	Valid Percent
Price	19	19
Design	60	60
Brand	19	19
colour	2	2

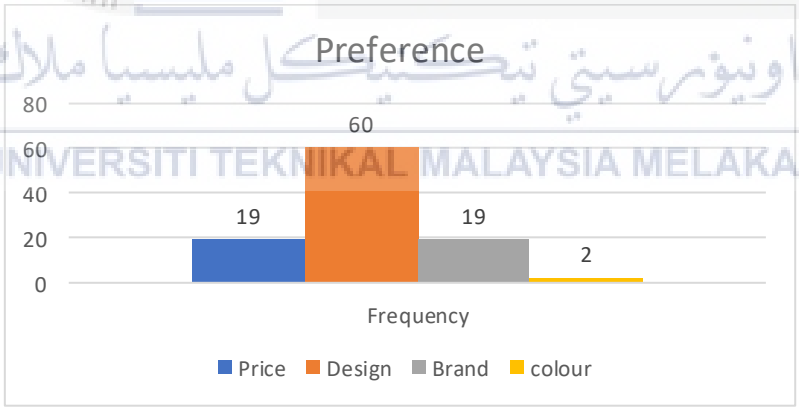

Figure 4. 7 Histogram Graph of Preference Consumer

VIII. Indicator

This part will investigate further about the water bottle's product. According to Table 4.8 and Figure 4.8, shows that histogram graph of needed indicator water level feature, the majority of respondents prefer that the water bottle have a water level indicator. The 86 percent of respondents that voted yes to the water level indication demonstrate this. However, just 14 of those who voted against the water level indicator.

Table 4. 8 Frequency of Water Level Indicator Needed

Indicator	Frequency	Valid Percent
Yes	86	86
No	14	14

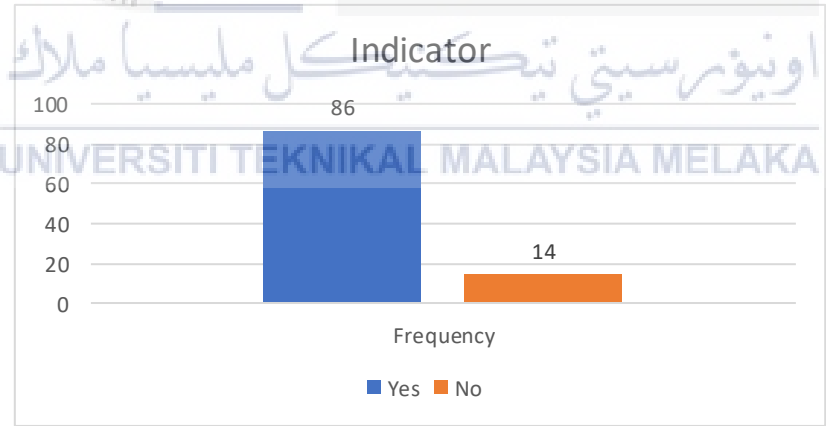

Figure 4. 8 Histogram Graph of Water Level Indicator Needed

IX. Preferable Colour

Based on Table 4.9 and Figure 4.9, a histogram graph of the frequency of water bottle colour is shown. According to the histogram graph in Figure 4.9, with 59 respondents, the respondent likes transparent or semi translucent as their colour water bottle. Blue is the second most popular colour, with 18 respondents, and black is the third most popular, with 10 respondents. Following that, the red colour received 8 responses, the orange colour received 3, and the purple colour received only 2 responses.

Table 4. 9 Statistic Frequency of Preferable Colour

Colour	Frequency	Valid Percent
Blue	18	18
Red	8	8
Orange	3	3
Transparent/White	59	59
Black	10	10
Purple	2	2

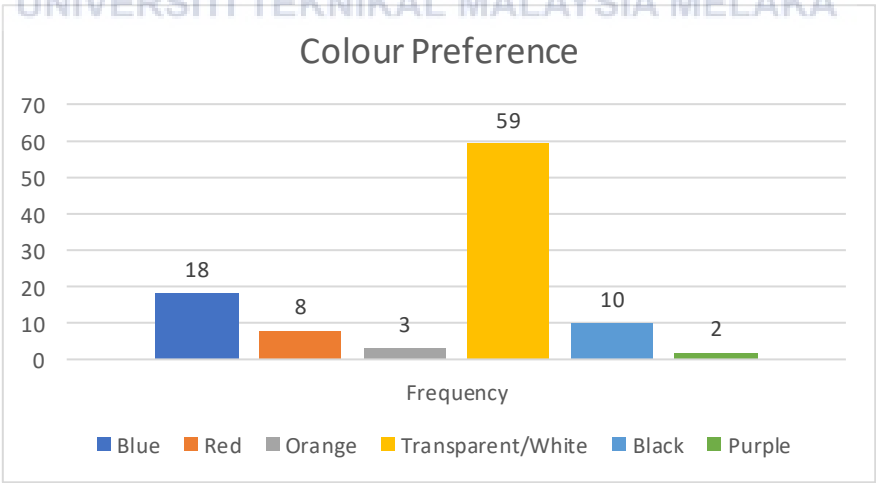

Figure 4. 9 Histogram Graph of Preferable Colour

X. Capacity of Water Bottle

The histogram graph of capacity water bottle that consumers prefer is shown in Table 4.10 and Figure 4.10. According to the graph in Figure 4.10, 48 of the respondents choose a water bottle with a capacity of 1000ml. The second most popular water bottle volume is 700ml, which received 24 responses, followed by 500ml, which received 20 responses. Only 8 people responded to the 900ml capacity water bottle.

Table 4. 10 Statistic Frequency of Capacity Water Bottle

Size	Frequency	Valid Percent
500 ml	20	20
700 ml	24	24
900 ml	8	8
1000 ml	48	48

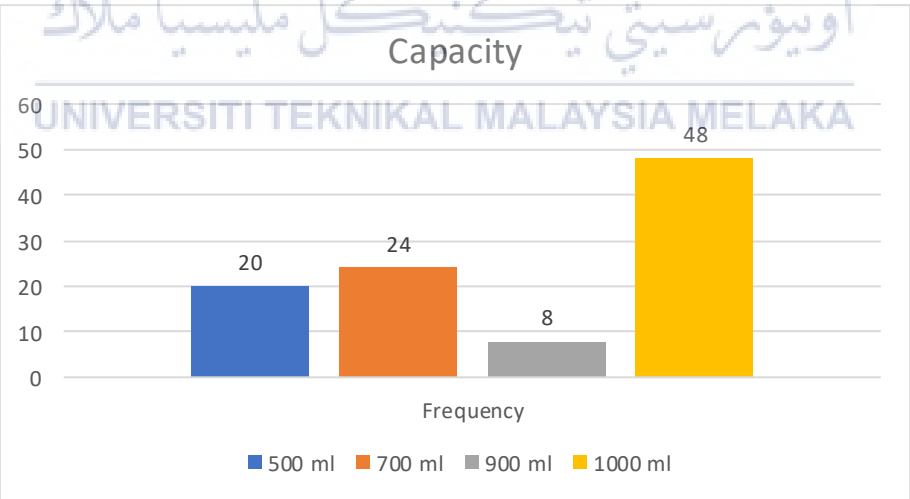

Figure 4. 10 HistogramGraph of Capacity Water Bottle

XI. Priorities

The histogram graph of the consumer's priorities while purchasing the water bottle is shown in Table 4.11 and Figure 4.11. Before purchasing the product, the semantic differential (SD) on a scale of 6 was used to determine the priorities. According to the graph in Figure 4.11, the size of the water bottle has a significant impact on the consumer before purchasing the water bottle, with 35 respondents rating it on a scale of 6. Durability is the second most important consideration before purchase, with 33 respondents rating it as a 6 on a scale. Following with 31 respondents on a scale of 6 are votes that design is a priority before purchasing.

Table 4. 11 Statistic Frequency of Priorities Before Purchasing

PRIORITIES	Scale 1	Scale 2	Scale 3	Scale 4	Scale5	Scale 6
Price	6	7	14	24	18	30
Brand	9	11	17	30	14	19
Durability	6	4	11	19	27	33
Design	3	7	9	24	26	31
Size	6	2	18	17	22	35

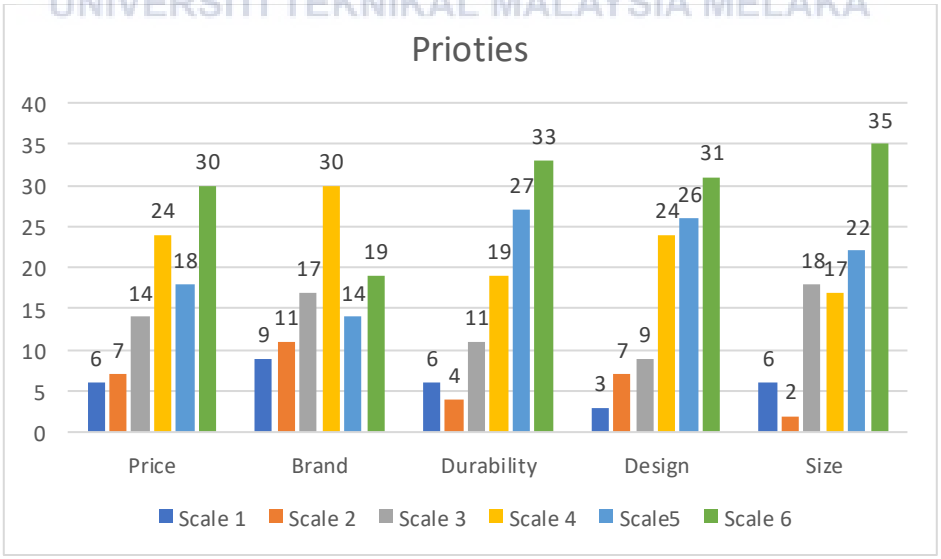

Figure 4. 11 Histogram Graph of Priorities Before Purchasing

XII. Situation

The histogram graph of the situation or condition that caused the user to purchase the water bottle is shown in Table 4.12 and Figure 4.12. Before purchasing the product, a semantic differential (SD) with a 6 scale was used to determine the situation or condition that makes consumer purchase. According to table 4.12, the material of the water bottle may impact the condition that makes the consumer purchase, with 31 of the respondents voting on a scale of 6. 29 of the respondents voting on a scale of 6 voting that when there is a sale or discount, it may impact the situation that makes the consumer purchase. Following that, the shape of the water bottle may have an impact on the situation, with 27 of the respondents rating it on a scale of 6.

Table 4. 12 Statistic Frequency of Condition or Situation that Make Purchase

CONDITION	Scale 1	Scale 2	Scale 3	Scale 4	Scale5	Scale 6
Attractive shape	6	8	21	19	22	24
Sale/discount	6	14	19	18	14	29
uniqueness	5	10	23	21	15	26
Cheap/ Expensive	5	17	18	15	19	26
Shape of water bottle lid	3	14	23	15	18	27
Material	5	8	20	12	24	31

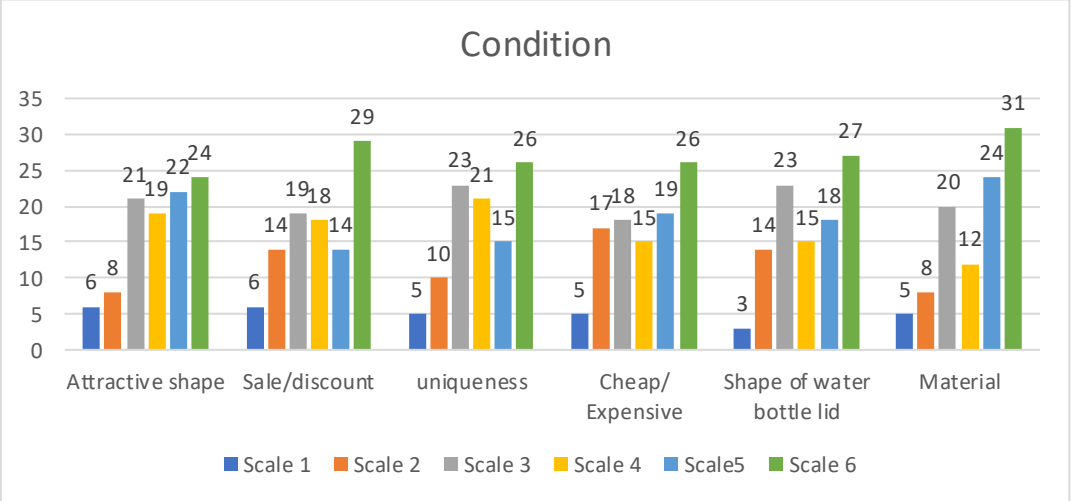

Figure 4. 12 Histogram Graph of Condition or Situation that Make Purchase

4.3.2 Design Profile

There is a design profile section in the preliminary survey that contributes two parts: the Kansei word and product preference. The questions in this section are mainly concerning the Kansei word that respondent chooses and the form of water bottle that respondent prefers.

I. Kansei Word

Kansei's words were selected for this study, with 15 kansei words included in three similar meanings but in various dictionary terms. Cambridge, Oxford, and Merriam Webster are the dictionaries utilised for Kansei's words. Respondents should select five Kansei words that express their emotions when selecting a product in this area. Following that, the word will be rearranged by the highest number selected by the respondent. Tables 4.13 provide an example of a Kansei Words table and three types of dictionaries used in this section.

Figure 4.13 shows the result of Kansei words chosen by the respondent from a list of 15 words. The highest ranking Kansei words in this graph are safe, practical, comfortable, durable, and simple. Meanwhile, the Kansei words with the lowest score include colourful, elegant, impressive, and trendy. The highest ranked Kansei words will be chosen based on the results for designing questionnaires for the main survey.

Table 4. 13 The Kansei Words That Are Being Used For The Respondent To Choose Five Out Of 15 Kansei Words

Kansei Word		Meaning
1 Attractive	1A	Having attributes or characteristics that attract one's attention
	1B	Pleasant to look at
	1C	Having a feature or quality that people like.
2 Beautiful	2A	Physical appearance is considered extremely attractive
	2B	Possessing qualities that give great pleasure to see, hear, think about, etc.
	2C	Wonderful; very pleasing and satisfying
3 Classy	3A	Fashionable and expensive
	3B	Stylish and sophisticated
	3C	Having qualities that make someone or something special and attractive
4 Colourful	4A	Fashionably attractive or impressive
	4B	Marked by steady dispassionate calmness and self-control
	4C	Good combination of colour
5 Comfortable	5A	Making you feel physically relaxed; pleasant to wear, use, bring, etc
	5B	Making you feel physically relaxes, without any pain.
	5C	Affording or enjoying physical comfort
6 Cool	6A	In a way that people admire, very attractive, fashionable, interesting, etc., used to indicate approval.
	6B	Fashionably attractive or impressive
	6C	Having the image of being cool
7 Durable	7A	Able to withstand wear, pressure, or damage; hard-wearing/ hard used
	7B	Able to last long time without becoming damaged
	7C	Staying in good condition for a long time, even if used a lot.
8 Elegant	8A	Of a high grade or quality
	8B	Attractive and exciting in an interesting way
	8C	Graceful and stylish in appearance
9 Impressive	9A	Having the power to excite attention, awe, or admiration
	9B	Grand, imposing, or awesome
	9C	Special, important, or very large
10 Modern	10A	Denoting a current or recent style or trend in art, or other cultural activity marked by a significant departure from traditional styles and values
	10B	Characterized by or using up-to-date technique, idea or equipment
	10C	Made or done using the most resent design or methods.
11 Practical	11A	Convenient to handle use; useful
	11B	Relating to, or manifested in practice or action.
	11C	victual
12 Safe	12A	Not likely to cause or lead to harm or injury not involving danger or risk
	12B	Not likely to cause any physical injury and harm
	12C	Secure from threat pf danger, harm, or loss
13 Simple	13A	Made in a plain style, without a lot of decoration or unnecessary things added
	13B	Plain, basic, or uncomplicated in form, nature or design without much decoration or ornamentation
	13C	Readily understood performed
14 Stylish	14A	Fashionably and elegant and sophisticated
	14B	Admired by many people
	14C	Influenced by fashionable people
15 Trendy	15A	Latest trend
	15B	Popular or fashion at particular time
	15C	Not really elegance

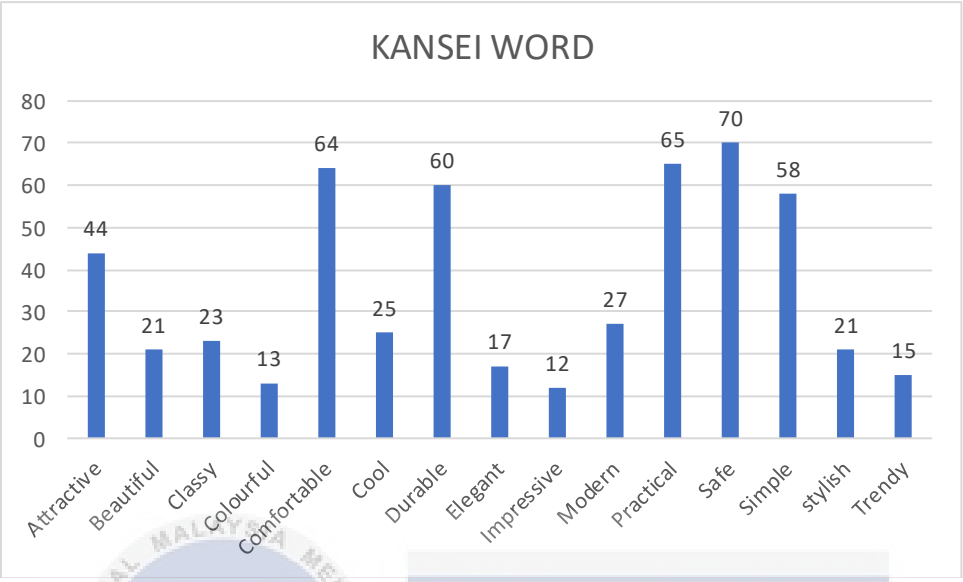

Figure 4. 13 Result of Kansei Word

II. Design Preference

In this section, the researcher will select 25 design water drinking bottles to conduct the design preferences research study. This bottle is organised based on its function, criteria, and design.

Figure 4.15 and table 4.14 shows the early survey results for water bottle design. According to Table 4.14, the top five design preferences chosen by respondents are design A2 (24 respondents), B5 (29 respondents), C4 (30 respondents), D1 (29 respondents), and E5 (43 respondent). The highest rate design picked by the respondent will be finalised and sorted for the main survey questions based on the results in the tabulate data. Each design is sorted based on design preferences and criteria based on the result data.

Figure 4. 14 Selected Design of Water Bottle in Preliminary Survey

4.4 Main Survey

The questionnaire is distributed at random to responders from any target category in this section, and it is done so using Google Forms. Approximately 86 questionnaires were returned and analysed from the collected questionnaires. The main survey was divided into three sections: demography, product attributes, and water bottle functionality.

4.4.1 General Information

This section is divided into five sections that discuss the respondent demographics and product attributes. Demography includes gender, age, and occupation, whereas product attributes include pricing preference and capacity water consumption.

I. Gender

According to the survey, 45 respondents (52.3%) are male, while the remaining 41 respondents (47.7%) are female. Figure 4.16 and Table 4.15 reveal that the statistical frequency of male and female is very close.

Table 4. 14 Statistic Frequency of Gender

Gender	Frequency	Valid Percent
Male	45	52.3
Female	41	47.7

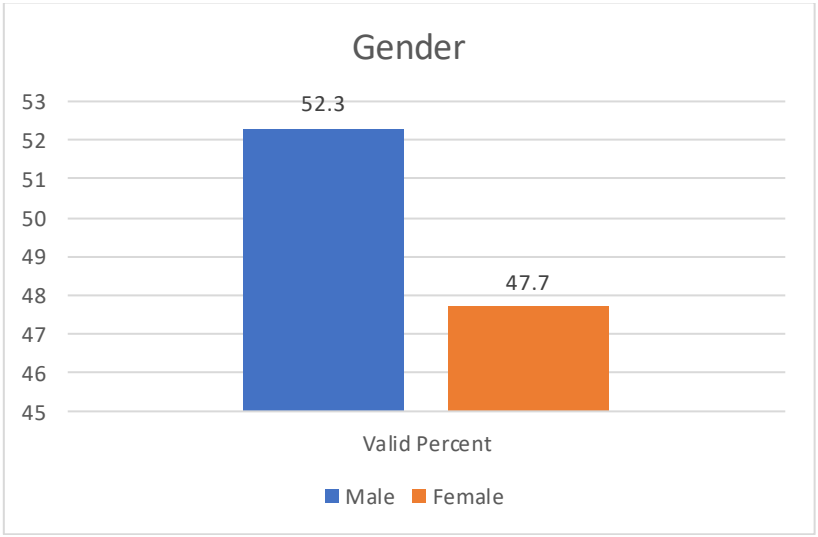

Figure 4. 15 Histogram Frequency Graph of Gender

II. Age

Table 4.16 and Figure 4.15 histogram graph indicate the age range of those who completed the survey. There are four age categories to pick from: those under the age of 18, those between the ages of 18 and 24, those between the ages of 25 and 35, and those over the age of 35. The histogram graph in Figure 4.15 clearly shows the larger percentage at the age range of 25-34 years old, with 39 respondents accounting for 45.3 percent. The group of 18–24-year-olds came in second with 38 respondents (44.2 percent). The majority of respondents are young adults and adults, according to the data.

Table 4. 15 Statistic Frequency of Age

Age	Frequency	Valid Percent
Below 18 years old	2	2.3
18-24 years old	38	44.2
25-34 years old	39	45.3
35 years old and above	7	8.1

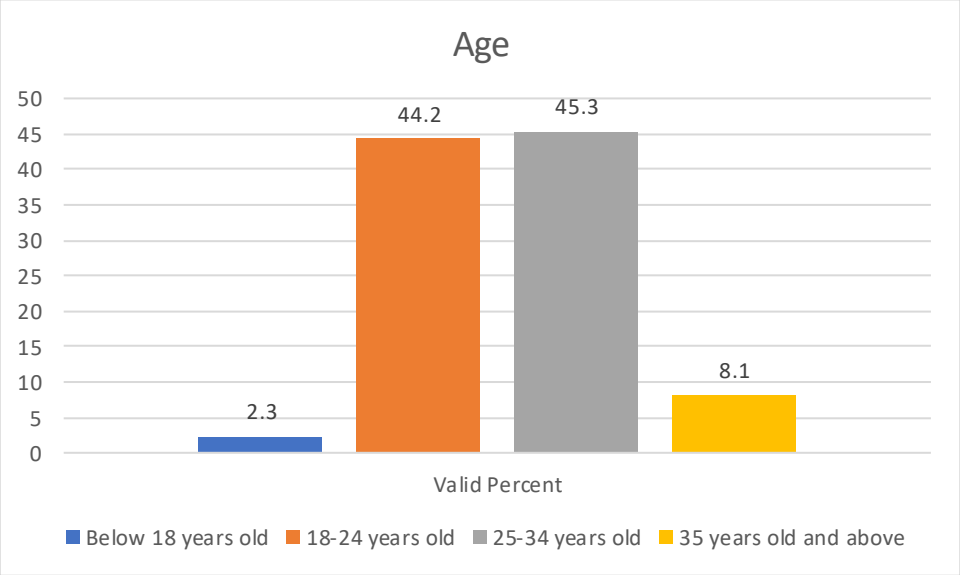

Figure 4. 16 Histogram Frequency Graph of Age

III. Occupation

Table 4.17 and Figure 4.16 histogram graph indicate the frequency of occupation among respondents. The student group receives the most votes, with 48 responses and a 55.8 percent response rate. Underemployment (24 respondents) is at 27.9 percent. The profession (6 respondents) comes with 7 percemt, followed by self-employment (4 respondents) with 4.7 percent. Respondents who are retired and unemployed account for 2.3 percent of all responses.

Table 4. 16 Statistic Frequency of Occupation

Occupation	Frequency	Valid Percent
Student	48	55.8
Unemployed	2	2.3
Under Employment	24	27.9
Self- Employed	4	4.7
Profession	6	7
Retired	2	2.3

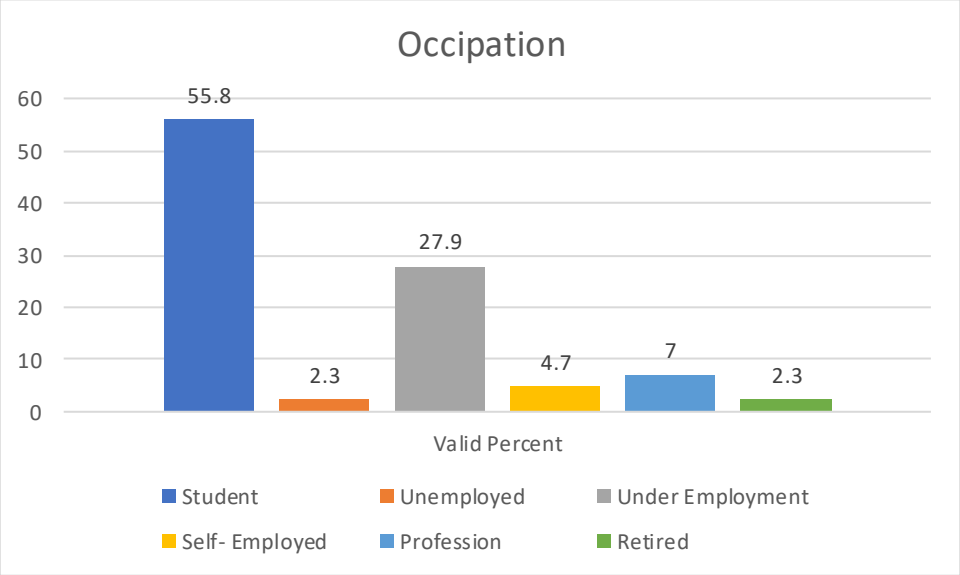

Figure 4. 17 Histogram Frequency Graph of Occupation

IV. Preference Price

The histogram graph in Table 4.19 and Figure 4.18 shows the pricing preference. The price preferred range of RM36 to RM44 earned the most votes (33.7 percent), with 29 respondents, followed by RM18-RM25 (32.6 percent), with 28 respondents. It is possible to say that there is only one value difference. In other words, the respondent is preferred if the price of their water bottle is between RM18-RM25 and RM36-RM44.

Table 4. 17 Statistic Frequency of Price Preferred

Price Preferred	Frequency	Valid Percent
RM18-RM25	28	32.6
RM26-RM34	21	24.4
RM36-RM 44	29	33.7
More than RM45	8	9.3

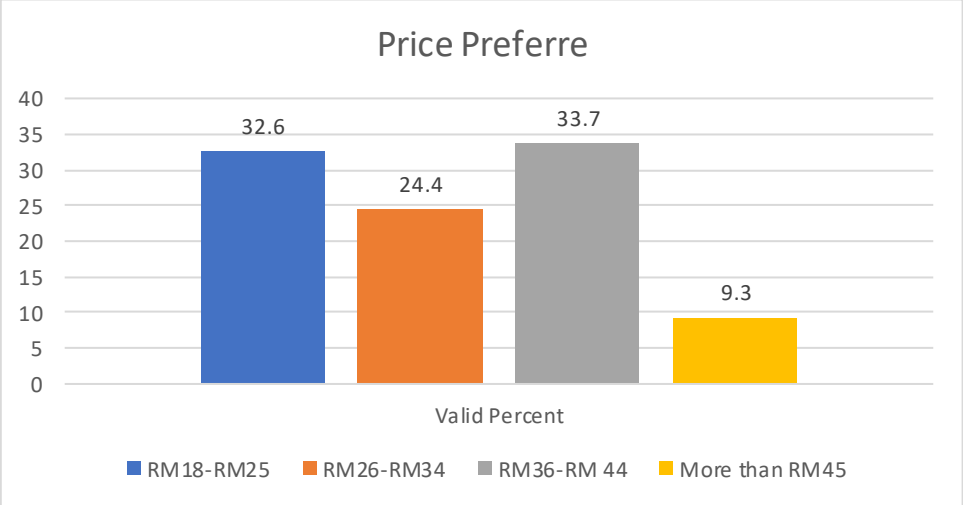

Figure 4. 18 Histogram Frequency Graph of Price Preferred

V. Water Consume

Table 4.20 and Figure 4.19 depict a histogram graph of the respondent's water consumption. There are four groups in this section: less than 500 ml, more than 1 litre, less than 2 litres, and more than 2 litres. According to the histogram graph, more than 2 litres of water are consumed by 36 of the respondents, accounting for 41.9 percent. Following that, 31 respondents consume less than 2 litres of water, bringing the total to 36 percent. More than 1 litre of water is consumed by 16 of the respondents (18.6 percent), whereas less than 500ml is consumed by 3 of the respondents (3.5 percent). In other words, the majority of respondents drink 1.5 litres or more of water every day.

Table 4. 18 Statistic Frequency of Water Consumption.

Water Consume	Frequency	Valid Percent
Less than 500 ml	3	3.5
More than 1 Litre	16	18.6
Less than 2 Litre	31	36
More than 2 Litre	36	41.9

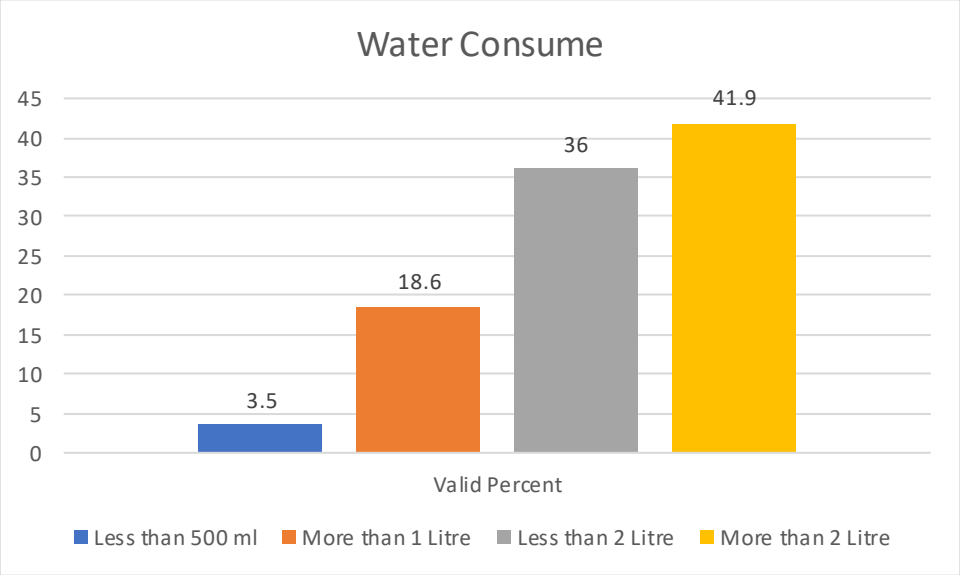

Figure 4. 19 Histogram Frequency Graph of Water Consumption.

4.5 Data Analysis

The data analysis process identifies Kano Model attributes and determining their relationship to Kano (function and dysfunction) and Kansei word. The data analysis process is dependent on the results of the preceding section's data processing. The data analysis was divided into two sections based on product attribute: function and dysfunction and Kansei words.

4.5.1 Analysis Correlation Between Kano and Kansei word towards the water bottle

The following section analyses the significant correlation between twelve Kano terms and five Kansei terms. According to the five Kansei terms chosen, which are Safe, Practical, Comfortable, Durable, and Simple, each word will be analysed in relation to the corresponding Kano term.

DESIGN A

The relationship between Kano's model and Kansei's words concerning the Design A questionnaire is shows in Table 4.21. The table displays fourteen significant correlations, seven at the 1% level of significance and the remaining seven at the 5% level of significance. At the Kansei word ‘Practical’ have five correlations with Kano word which is ‘Handle Strap, Lid Attached, Shape Practical and Minimal, Brightly Colour and Translucent and Matte Colour” with 2 level of significant. The value of correlation Lid Attached is -0.236 and Matte colour is -0.272 at 5% significant level. Then correlation of Handle Strap is -0.294, Shape Practical and Minimal is -0.309 and last one brightly colours and translucent is -0.290 with the significant level is 1%, showing that the correlation is moderate and

weakly significant but in the negative direction. That also indicates that the relationship between the Kansei term 'Practical' and the Kano term 'Handle Strap, Lid Attached, Shape Practical and Minimal, Brightly Colour and Translucent and Matte Colour is moving in the other direction or has an inverse correlation. In other words, when the Kansei term 'Practical' becomes more prevalent, the Kano term 'Handle Strap, Lid Attached, Shape Practical and Minimal, Brightly Colour and Translucent and Matte Colour' becomes less prevalent. When Design A was stripped of its handle strap, lid attachment, practical and basic shape, vividly coloured and translucent and matte colour', it appeared to be more practical.

Then the Kansei term 'Comfortable' has four significant correlations with the Kano term 'Handle Strap, Practical and Minimal Shape, Bright and Translucent Colour, and Matte Colour'. Where the correlation coefficient for Handle Strap is -0.228 at the 5% level of significance. Following that, the correlations between Practical and Minimal Shape are -0.331, Brightly Colour and Translucent are -0.302, and Matte Colour is -0.343 at the 1% level of significance and indicating that the strength of correlation is moderate and weak significant but in negative value. This also implies that the relationship between the Kansei and Kano terms 'Comfortable' and 'Handle Strap, Practical and Minimal Shape, Bright and Translucent Color, and Matte Color' is moving in the opposite direction or has an inverse relation. In other words, as the Kano term 'Handle Strap, Practical and Minimal Shape, Bright and Translucent Color, and Matte Color' becomes more prevalent, the Kansei term 'Comfortable' becomes less prevalent. A more comfortable design is one that does not include a handle strap, a functional and simple shape, a bright and translucent colour, and a matte colour.

The Kansei term 'Durable' has two significant correlations with the Kano terms 'Bright Color and Translucent and Matte Color. Brightly Color and Translucent have a correlation coefficient of -0.217 and Matte Color has a correlation coefficient of -0.262, all of which are significant at the 1% level, suggesting that the relationship is weak but significant in a negative direction. In other words, when the Kano word Bright Colour and Translucent and Matte Colour increase, Kansei word 'Durable' is decrease.Next, is 'Simple' in Kansei word has three significant correlations with the Kano word 'Water Indicator Level, Handle Strap and Matte Colour'. The two of correlation significant is in level 1% which is water level indicator get -0.229 and handle strap is -0.221. Then, matte colour where the value -0.290 and in 5% significant level.In other terms, when the Kano word Water Indicator Level, the Handle Strap, and the Matte Colour grow while the Kansei word decreases.

Table 4. 19 Correlation of Kansei Word and Kano Term Toward Design A

Correlation	SAFE	PRACTICAL	COMFORTABLE	DURABLE	SIMPLE
WATER LEVEL INDICATOR	-0.189	-0.113	-0.19	-0.121	-.229*
HANDLE STRAP	-0.085	-.294**	-.228*	-0.208	-.221*
STRAW	-0.006	0.018	0.003	-0.008	0.079
GRIP	-0.078	-0.141	-0.188	-0.118	-0.152
LID ATTACHED	-0.056	-.236*	-.217*	-0.178	-0.077
FLIP SPOUT	0.067	0.047	-0.039	0.021	-0.077
SCREW SPOUT	0.148	0.159	0.170	0.138	0.189
BOTTLE CAR HOLDER	0.069	-0.012	-0.053	-0.005	-0.143
SHAPE PRACTICAL AND MINIMAL	-0.141	-.309**	-.331**	-0.183	-0.158
EASY TO CLEAN	0.107	-0.013	0.003	0.010	0.016
BRIGHTLY COLOUR AND TRANSLUCENT	-0.205	-.290**	-.302**	-.217*	-0.086
MATTE COLOUR	-0.202	-.272*	-.343**	-.262*	-.290**

Design B

According to design B, Table 4.22 shows a correlation between the Kano term and the Kansei word. The table that follows reveals that there are sixteen significant correlations with the indicators of 1% and 5% of level significant. The Kano term of Handle Strap has four significant correlations with Kansei words, which are 'Safe, Practical, Comfortable, and Durable,' with the values Safe (-0.236), Practical (-0.260), Comfortable (-0.257), and Durable (-0.231). The level of correlation is weak in negative values and 5% level of significant. That is, when the water bottle does not have a hand strap, it is more safe, comfortable, practical, and durable.

Based on the result, there are four significant correlations in shape practical and minimal were in level 5 percent. The correlation between the Kano term 'Shape Practical and Minimal' and the Kansei word is 'Safe, Practical, Comfortable, and Durable.' Where the correlation value is Safe (-0.25), Practical (-0.251), Comfortable (-0.266), and Durable (-0.267). The correlation indicator has a weak negative value. In the word, when the term Kano 'Shape Practical and Minimal' increases, the term Kansei 'Safe, Practical, Comfortable, and Durable' decreases.

Following that, there are three significant correlations between Kano term ‘brightly colour and translucent’ and Kansei word at the 1% and 5% level of significance. The significant correlation between the Kano word 'Brightly Colour and Translucent' and the Kansei word is 'Practical, Comfortable, and Durable,' with the values Practical (-0.261) and Comfortable (-0.216) at the 5% level of significance. Then, the value of Durable is -0.297 at the 1% level of significant. The values of correlation are in weak in the negative value. That

means, when the value of Kano ‘Brightly Colour and Translucent’ are rises, the Kansei word ‘Practical, Comfortable, and Durable’ are falls.

Last but not least, there are five significant in Kano phrase 'Matte Color' with two levels of significance of 1% and 5%. The correlation between the Kano phrase 'Matte Color' and the Kansei word is 'Safe, Practical, Comfortable, Durable, and Simple,' with Safe (-0.261) and Comfortable (-0.227) at 5% significant and weak negative correlation level. Then, at the level of significance, the values of Practical (-0.279), Durable (-0.319), and Simple (-0.360) are %, and the level of correlation is weak and moderate negative. In other words, as the value of Kano 'Matte Color' rises, the value of Kansei 'Safe, Practical, Comfortable, Durable, and Simple' falls.

Table 4. 20 Correlation of Kansei Word and Kano Term Toward Design B

Correlation	SAFE	PRACTICAL	COMFORTABLE	DURABLE	SIMPLE
WATER LEVEL INDICATOR	-0.177	-0.124	-0.189	-0.144	-0.210
HANDLE STRAP	-.236*	-.260*	-.257*	-.231*	-0.156
STRAW	0.079	0.036	0.030	0.046	0.089
GRIP	-0.087	-0.039	-0.059	-0.084	-0.152
LID ATTACHED	-0.185	-0.111	-0.151	-0.195	-0.106
FLIP SPOUT	-0.169	-0.090	-0.078	-0.095	-0.037
SCREW SPOUT	0.034	0.049	0.081	-0.019	0.005
BOTTLE CAR HOLDER	-0.097	0.000	-0.039	-0.160	-0.075
SHAPE PRACTICAL AND MINIMAL	-.250*	-.251*	-.266*	-.267*	-0.174
EASY TO CLEAN	-0.033	0.008	0.003	-0.055	-0.017
BRIGHTLY COLOUR AND TRANSLUCANT	-0.207	-.261*	-.216*	-.297**	-0.189
MATTE COLOUR	-.261*	-.279**	-.227*	-.319**	-.360**

DESIGN C

The correlation between Kansei word and Kano term based on design C is shown in Table 4.23. There are eleven significant differences between Kansei and Kano terms, with two levels of significance of 1% and 5%. The Kansei word 'Safe' has one significant correlation with the Kano term 'Flip Spout,' with a value of -0.234 at the 5% significant and weak correlation level.

Following that, there are four significant correlations between Kansei word 'Practical' and Kano term 'Lid Attached,' 'Shape Practical and Minimal,' 'Brightly Colour and Translucent,' and 'Matter Colour.' At 5% level of significant and weak correlation of level, the value of lid attached (-0.223) and brightly coloured and translucent (-0.254). Then there's the value of shape practical and minimal (-0.332), which is moderate but in negative value, and matter colour (-0.296), which is a weak negative correlation with both at the 1% level of significance. There are two significant correlations between the Kansei word 'Comfortable' and the Kano word 'Shape Practical and Minimal' and 'Matte Colour', with the value 'Shape Practical and Minimal' (-.253) and 'Matte Colour' (-0.275) at the 5% level of significant and weak correlation.

Next, the correlation between Kansei word ‘Durable’ and Kano word ‘Shape Practical and Minimal’ have two significant corrections. At the 5% level of significant and weak negative correlation, 'Shape Practical and Minimal' is -0.253 and 'Matte Colour' is -0. 275.As a result, there are two significant correlations between the Kansei word 'Simple' and the Kano terms 'Water Level Indicator' and 'Flip Spout’. The 'Flip Spout' has a value of -0.283 at the 1% level of significance, and the 'Water Level Indicator' has a value of -0.213

at the 5% level of significance, indicating a weak negative connection. In other words, when the value of the Kano term rises but the value of the Kansei term falls.

Table 4. 21 Correlation of Kansei Word and Kano Term Toward Design C

Correlation	SAFE	PRACTICAL	COMFORTABLE	DURABLE	SIMPLE
WATER LEVEL INDICATOR	-0.048	-0.058	-0.015	-0.082	-.213*
HANDLE STRAP	-0.014	-0.069	-0.004	-0.064	-0.092
STRAW	0.098	0.007	-0.037	0.054	0.086
GRIP	-0.066	-0.142	-0.149	-0.139	-0.151
LID ATTACHED	-0.146	-.223*	-0.184	-0.152	-0.162
FLIP SPOUT	-.234*	-0.179	-0.153	-0.097	-.283**
SCREW SPOUT	0.177	0.143	0.093	0.081	0.117
BOTTLE CAR HOLDER	0.047	-0.010	0.087	-0.020	-0.088
SHAPE PRACTICAL AND MINIMAL	-.241*	-.332**	-.262*	-.253*	-0.209
EASY TO CLEAN	-0.060	-0.076	-0.052	-0.097	-0.138
BRIGHTLY COLOUR AND TRANSLUCANT	-0.197	-.254*	-0.189	-0.198	-0.095
MATTE COLOUR	-0.178	-.296**	-.215*	-.275*	-0.194

DESIGN D

According to Design D, the results of the correlation between Kano term and Kansei word are shown in Table 4.24. There are twelve significant correlatio between Kano and Kansei terms, with two levels at 1% and 5%. There are two correlations significant between Kano's 'Water Level Indicator' and Kansei's word 'Safe' and 'Durable.' The values of 'Safe (-0.243) and 'Durable (-0.250) at the 5% level of significance and weak negative correlation, respectively.

As a result, there are four significant correlations between the Kano term 'Shape Practical and Minimal' and the Kansei word 'Safe, Practical, Durable, and Simple'. The correlation kansei word values are 'Safe (-0.237) and 'Simple (0.235) at the 5% level of significant and weak negative correlation, respectively. Then, at the 1 % level of significance, the value of Kansei words 'Practical (-0.338)' and 'Durable (-0.294)' at indicators of moderate and weak correlation but in negative value.

Last but not least, there are four significant correlations between the Kano word 'Matte Color' and the Kansei word 'Practical, Comfortable, Durable, and Simple'. Correlation values of 'Practical (-0.258),' 'Comfortable (-0.232),' 'Durable (-0.220),' and 'Simple (-0.247)' at 5% level significant and weak negative correlation. In fact, when the value of the Kano term rises, the value of the Kansei term falls.

Table 4. 22 Correlation of Kansei Word and Kano Term Toward Design D

Correlation	SAFE	PRACTICAL	COMFORTABLE	DURABLE	SIMPLE
WATER LEVEL INDICATOR	-.243*	-0.182	-0.203	-.250*	-.306**
HANDLE STRAP	-0.166	-0.167	-0.116	-0.151	-0.154
STRAW	0.024	-0.019	-0.031	0.032	0.031
GRIP	-0.159	-0.159	-0.124	-0.170	-0.144
LID ATTACHED	-0.054	-0.053	-0.029	0.068	0.025
FLIP SPOUT	0.015	-0.027	0.007	0.068	-0.043
SCREW SPOUT	0.118	0.031	0.015	0.032	0.031
BOTTLE CAR HOLDER	-0.086	-0.041	-0.020	-0.011	-0.134
SHAPE PRACTICAL AND MINIMAL	-.237*	-.338**	-0.212	-.294**	-.235*
EASY TO CLEAN	-0.016	-0.166	-0.097	-0.062	-0.097
BRIGHTLY COLOUR AND TRANSLUCANT	-0.126	-0.116	-0.070	-0.103	-0.077
MATTE COLOUR	-0.183	-.258*	-.232*	-.220*	-.247*

DESIGN E

According to Table 4.25, shows that there are five significant correlations between Kano term and Kansei word based on Design E. Showing that the outcome of the Kano term 'Water Level Indicator' has two significant correlations with the Kansei phrase 'Comfortable and Simple'. At the 5% level, the correlation values for 'Comfortable' are -0.213 and 'Simple' are -.0214, indicating considerable and weak negative correlations.

Following that, the results show that there are three significant correlations between the Kano phrase 'Matte Color' and the Kansei word 'Safe, Practical, and Durable,' with the values 'Safe (-0.224), Practical (-0.245), and Durable (-0.260).' at a 5% level of significance and in a weak negative correlation. In other words, when the value of the Kano term rises while the value of the Kansei term falls.

Table 4. 23 Correlation of Kansei Word and Kano Term Toward Design E

Correlation	SAFE	PRACTICAL	COMFORTABLE	DURABLE	SIMPLE
WATER LEVEL INDICATOR	-0.117	-0.079	-.213*	-0.094	-.214*
HANDLE STRAP	-0.130	-0.181	-0.021	-0.046	-0.013
STRAW	0.036	0.015	0.162	0.077	0.067
GRIP	-0.136	-0.158	-0.081	-0.102	-0.100
LID ATTACHED	-0.095	-0.207	-0.011	-0.116	-0.052
FLIP SPOUT	-0.159	-0.059	-0.073	-0.135	-0.120
SCREW SPOUT	0.002	-0.068	0.032	0.000	0.049
BOTTLE CAR HOLDER	-0.206	-0.149	-0.162	-0.149	-0.117
SHAPE PRACTICAL AND MINIMAL	-0.077	-0.189	-0.093	-0.060	-0.019
EASY TO CLEAN	-0.074	-0.148	0.005	-0.035	-0.075
BRIGHTLY COLOUR AND TRANSLUCANT	0.035	-0.152	0.027	0.023	-0.014
MATTE COLOUR	-.224*	-.245*	-0.148	-.260*	-0.196

4.5.2 Analysis Correlation Between Kansei and Kansei

This section explores the connection between Kansei words and Kansei words in respect to the design chosen. Five Kansei words were chosen and incorporated into the questionnaire, including Safe, Practical, Comfortable, Durable, and Simple. Based on the Kansei word, each of the words will be thoroughly analysed in order to identify which particular word better represents the suggested design.

Design A

The correlation between two Kansei words is shown in Table 4.26 and Figure 4.20 are Design A. According to the data above, there is a correlation between five variables at the 1% level of significance. However, as shown in the table data above, the correlation coefficient Pearson's r value looked to be only strongly positive for significant correlation coefficient. The connection between the overall consumer view and the kansei word "comfortable" is 0.870. The r value indicates that Design A has a favourable emotional preference. This feature is derived from Design A, which is present on the shape of a water bottle. Particularly on the body and handle of the water bottle, which are shaped differently than other water bottle shapes.

Figure 4. 20 Design A of Water Bottle

Table 4. 24 The Correlation Between Kansei Word and Kansei Word toward Design A

KANSEI	Safe	Practical	Comfortable	Durable	Simple	Overall
D1_Safe	1	.725**	.800**	.833**	.762**	.717**
D1_ Practical	.725**	1	.865**	.827**	.701**	.832**
D1_Comfortable	.800**	.865**	1	.828**	.765**	.870**
D1_Durable	.833**	.827**	.828**	1	.788**	.836**
D1_Simple	.762**	.701**	.765**	.788**	1	.751**
D1_Overall	.717**	.832**	.870**	.836**	.751**	1

Design B

Table 4.27 shows the correlation between two Kansei words and Figure 4.21 are Design B of water bottle. According to the data above, at the 1% level of significance, there is a correlation between five variables. However, as illustrated in table above, Pearson's r value appeared to be only highly positive for significant correlation coefficients. The correlation coefficient between the overall consumer perspective and the kansei word "comfortable" is 0.913. The r score implies that Design B elicits positive emotional reactions. This characteristic is derived from Design B, which appears on the shape of a water bottle's lid. Particularly on the water bottle's lid, which is formed differently than the rest of the container.

Figure 4. 21 Design B of Water Bottle

Table 4. 25 The Correlation Between Kansei Word and Kansei Word toward Design B

KANSEI	Safe	Practical	Comfortable	Durable	Simple	Overall
D2_Safe	1	.837**	.858**	.830**	.785**	.841**
D2_ Practical	.837**	1	.901**	.873**	.783**	.884**
D2_Comfortable	.858**	.901**	1	.856**	.834**	.913**
D2_Durable	.830**	.873**	.856**	1	.835**	.849**
D2_Simple	.785**	.783**	.834**	.835**	1	.831**
D2_Overall	.841**	.884**	.913**	.849**	.831**	1

DESIGN C

The correlation between two Kansei terms is shown in Table 4.28 and Figure 4.22 shows the Design C of water bottle. There is a correlation between five variables, according to the data above, at the 1% level of significance. Pearson's r value, however, appeared to be strong positive only for significant correlation coefficients, as seen in the table above. Between the kansei words "practical" and "comfortable," a correlation coefficient of 0.901 exists. According to the r value, Design C generates strong emotional responses. This feature is developed from Design C, which can be seen on the shape of water bottles and straws. Particularly on the handle and the straw of the water bottle, which are shaped differently than the remainder of the container

Figure 4. 22 Design C of Water Bottle

Table 4. 26 The Correlation Between Kansei Word and Kansei Word toward Design C

KANSEI	Safe	Practical	Comfortable	Durable	Simple	Overall
D3_Safe	1	.831**	.802**	.825**	.844**	.771**
D3_ Practical	.831**	1	.901**	.874**	.826**	.887**
D3_Comfortable	.802**	.901**	1	.855**	.815**	.843**
D3_Durable	.825**	.874**	.855**	1	.853**	.824**
D3_Simple	.844**	.826**	.815**	.853**	1	.791**
D3_Overall	.771**	.887**	.843**	.824**	.791**	1

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Design D

The correlation between two Kansei terms is shown in Table 4.29 and Figure 4.23 are Design D of water bottle There is a correlation between five variables, according to the data above, at the 1% level of significance. Pearson's r value, however, appeared to be strong positive and moderate positive for significant correlation coefficients, as seen in the table above. Between the kansei words "durable" and "comfortable," a correlation coefficient of 0.865 exists. According to the r value, Design D generates strong emotional responses. This feature is developed from Design D, which can be seen on the shape of water bottles and handle. Particularly on the handle of the water bottle, which are shaped differently than the remainder of the container.

Figure 4. 23 Design D of Water Bottle

Table 4. 27 The Correlation Between Kansei Word and Kansei Word toward Design D

KANSEI	Safe	Practical	Comfortable	Durable	Simple	Overall
D4_Safe	1	.714**	.773**	.787**	.833**	.696**
D4_ Practical	.714**	1	.766**	.778**	.759**	.838**
D4_Comfortable	.773**	.766**	1	.865**	.842**	.798**
D4_Durable	.787**	.778**	.865**	1	.813**	.763**
D4_Simple	.833**	.759**	.842**	.813**	1	.775**
D4_Overall	.696**	.838**	.798**	.763**	.775**	1

Design E

The correlation between two Kansei terms is shown in Table 4.30 and Figure 4.24 are Design E of water bottle There is a correlation between five variables, according to the data above, at the 1% level of significance. Pearson's r value, however, appeared to be strong positive and moderate positive for significant correlation coefficients, as seen in the table above. Between the Kansei words "durable" and "comfortable," a correlation coefficient of 0.858 exists. According to the r value, Design E generates strong emotional responses. This feature is developed from Design E, which can be seen on the shape on pattern of water bottles. Particularly on the pattern of the water bottle, which are shaped differently than the remainder of the container.

Figure 4. 24 Design E of Water Bottle

The Correlation Between Kansei Word and Kansei Word toward Design E

Table 4. 28 The Correlation Between Kansei Word and Kansei Word toward Design E

KANSEI	Safe	Practical	Comfortable	Durable	Simple	Overall
D5_Safe	1	.705**	.824**	.836**	.833**	.818**
D5_ Practical	.705**	1	.734**	.704**	.650**	.681**
D5_Comfortable	.824**	.734**	1	.813**	.858**	.756**
D5_Durable	.836**	.704**	.813**	1	.805**	.795**
D5_Simple	.833**	.650**	.858**	.805**	1	.800**
D5_Overall	.818**	.681**	.756**	.795**	.800**	1

4.5.3 Evaluation and Interpretation

In this section, the questionnaire is evaluated in three stages. The results of the Kano survey after combining the responses to the functional and dysfunctional questions are shown in Table 4.31. Individual product criteria results are provided in Table 4.31, along with the overall distribution of the requirement categories.

A frequency analysis was conducted to ascertain which group possessed the market's demands or requirements for water bottles. Table 4.30 summarises the most often occurring requirement group for each requirement. Following Table 4.5, there are four Must-Have categories: Water Level Indicator (29), Handle Strap (27), Lid Attached (28) and Brightly Colour and Translucent (32). According to the product need, these four Kano functionalities must include a new design. Following that, there have four categories of one-dimensional objects: Grip (26), Bottle Car Holder (43), Practical and Minimal Shape (33) and Easy to Clean (33). (47). While, the Straw (34), the Lid Attached (28), the Flip Spout (35) and the Screw Spout (32) are all indifferent.

Table 4. 29 The Result of Evaluation

Product Requirement	A	O	M	I	R	Q	Total	Category
WATER LEVEL INDICATOR	10	22	29	23	0	2	86	M
HANDLE STRAP	11	20	27	23	3	2	86	M
STRAW	5	20	25	34	2	0	86	I
GRIP	12	26	22	24	1	1	86	O
LID ATTACHED	3	21	28	28	4	2	86	M&I
FLIP SPOUT	5	20	22	35	3	1	86	I
SCREW SPOUT	10	14	24	32	4	2	86	I
BOTTLE CAR HOLDER	4	43	21	17	0	1	86	O
SHAPE PRACTICAL AND MINIMAL	4	33	26	22	0	1	86	O
EASY TO CLEAN	1	47	17	18	1	2	86	O
BRIGHTLY COLOUR AND TRANSLUCANT	5	17	32	27	2	3	86	M
MATTE COLOUR	6	22	25	31	1	1	86	I

CS Coefficient

The customer satisfaction coefficient measures the amount to which satisfaction increases when a product need is met or drops when a requirement is not met. It is beneficial to understand the average impact of a product or service need on overall customer satisfaction. This coefficient is calculated as follows questionnaire. If the two or three most compelling requirements for each consumer category are met, the outcome is an unbeatable combination of product features. The average impact on discontent should be calculated by adding the must-be and one-dimensional columns and dividing by the same normalisation factor.

Enhanced Satisfaction Coeffects $= \frac{A+O}{A+0+M+I}$

Reduced Dissatisfaction Coefficient $= \frac{O+M}{(A+O+M+I)\times(-1)}$

The CS-coefficient of customer dissatisfaction is preceded by a minus sign to indicate its detrimental effect on customer satisfaction if this product quality is not met. The positive CS coefficient has a value between 0 and 1; the closer it is to 1, the greater the influence on customer satisfaction. A positive CS-coefficient that approaches zero indicates that the influence is negligible. At the same time, one must consider the negative CS-coefficient. If it approaches zero, the effect on customer discontent is particularly high if the analysed product characteristic is not met. A number close to 0 indicates that failure to meet this characteristic does not result in dissatisfaction.

According to table 4.32, there have been two cs coeffects that are close to 1 for enhanced satisfaction coeffects and close to -1 for reduced dissatisfaction coefficients. Whereas easy to clean receives 0.58 for increased satisfaction and -0.77 for decreased discontent. The bottle car holder then receives 0.55 for increasing satisfaction and -0.75 for decreasing unhappiness. In other words, if these two features are not included in future water bottle designs, consumers will be dissatisfied.

Table 4. 30 CS-coefficient Result

Product Requirement	A	O	M	I	Total	Category	Enhanced Satisfaction	Reduced Dissatisfaction
WATER LEVEL INDICATOR	10	22	29	23	86	M	0.38	-0.61
HANDLE STRAP	11	20	27	23	86	M	0.38	-0.58
STRAW	5	20	25	34	86	I	0.30	-0.54
GRIP	12	26	22	24	86	O	0.45	-0.57
LID ATTACHED	3	21	28	28	86	M&I	0.3	-0.61
FLIP SPOUT	5	20	22	35	86	I	0.30	-0.51
SCREW SPOUT	10	14	24	32	86	I	0.3	-0.48
BOTTLE CAR HOLDER	4	43	21	17	86	O	0.55	-0.75
SHAPE PRACTICAL AND MINIMAL	4	33	26	22	86	O	0.44	-0.69
EASY TO CLEAN	1	47	17	18	86	O	0.58	-0.77
BRIGHTLY COLOUR AND TRANSLUCENT	5	17	32	27	86	M	0.27	-0.60
MATTE COLOUR	6	22	25	31	86	I	0.33	-0.56

4.5.4 Summary of Analysis

1. Summary of correlation analysis Between Kano and Kansei word

Table 4.33 shows that the summary of correlation significant between of the Kano term and Kansei word based on Design A, B, C, D and E. The data of correlation significant in negative value is shown in the table below. The strong correlation is near to 1.0, however the summary data shows that the data is completely negative. When it reaches a negative value, the excellent correlation is close to zero. Following that, the summary table displays the data that is close to zero as the referring design for the future.

Table 4. 31 Summary of Correlation Between Kano and Kansei Word

Kano	Water Level Indicator	Handle Strap	Straw	Grip	Lid Attached	Flip Spout	Bottle Car Holder	Shape Practical and Minimal	Easy to Clean	Brightly colour and translucent	Matter colour
DESIGN 1	-0.229	-0.221			-0.217					-0.217	
DESIGN 2										-0.216	
DESIGN 3	-0.213				-0.223						-0.215
DESIGN 4											-0.220
DESIGN 5	-0.213										

2. Summary of Correlation Analysis Between Kansei word and Kansei word

Table 4.34 summarises the significant correlations between Kansei words and Kansei words based on Designs A, B, C, D, and E. Throughout, each design has its own representative, which, in Kansei words, expresses emotional responses from respondents. According to table 4.7, the majority of designs are based on the comforting kansei word. The data will be used as a referencing design in the future based on the value on the table.

Table 4. 32 Summary of Correlation Between Kansei word and Kansei Word

Kansei Word	Safe	Practical	Comfortable	Durable	Simple	Overall
Design 1			0.870			0.870
Design 2			0.913			0.913
Design 3		0.901	0.901			
Design 4			0.865	0.865		
Design 5			0.858		0.858	

4.6 Morphological Chart

As a result of the correlation between Kansei words and Kano models, as well as the correlation between Kansei words and Kansei words, the morphological chart was contracted. The morphological analysis is used to identify desired product functionality and to evaluate alternative strategies and combinations of strategies for delivering that functionality. Each component of a product's function may have multiple distinct answers. Three concepts are apparent from the same morphological chart. Each concept has its own visual representation of the product.

4.6.1 Concept 1

WATER BOTTLE FEATURES	DESIGN				
	1	2	3	4	5
Water Level Indicator					
Handle Strap					
Lid Attached					
Bottle Car Holder					
Easy to Clean					

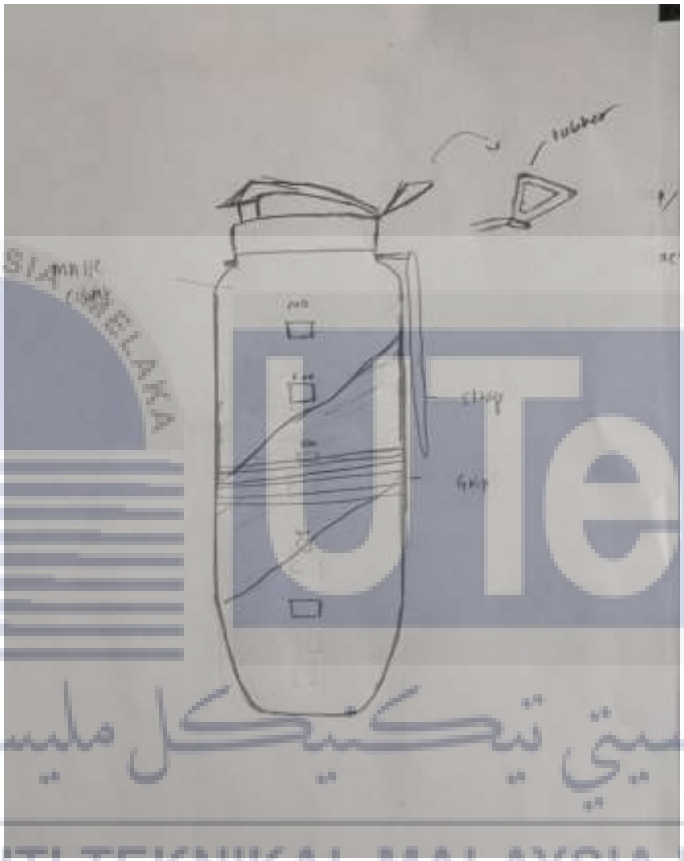
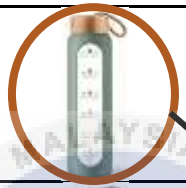


Figure 4. 25 Hand Sketching Concept 1

4.6.2 Concept 2

WATER BOTTLE FEATURES	DESIGN				
	1	2	3	4	5
Water Level Indicator					
Handle Strap					
Lid Attached					
Bottle Car Holder					
Easy to Clean					

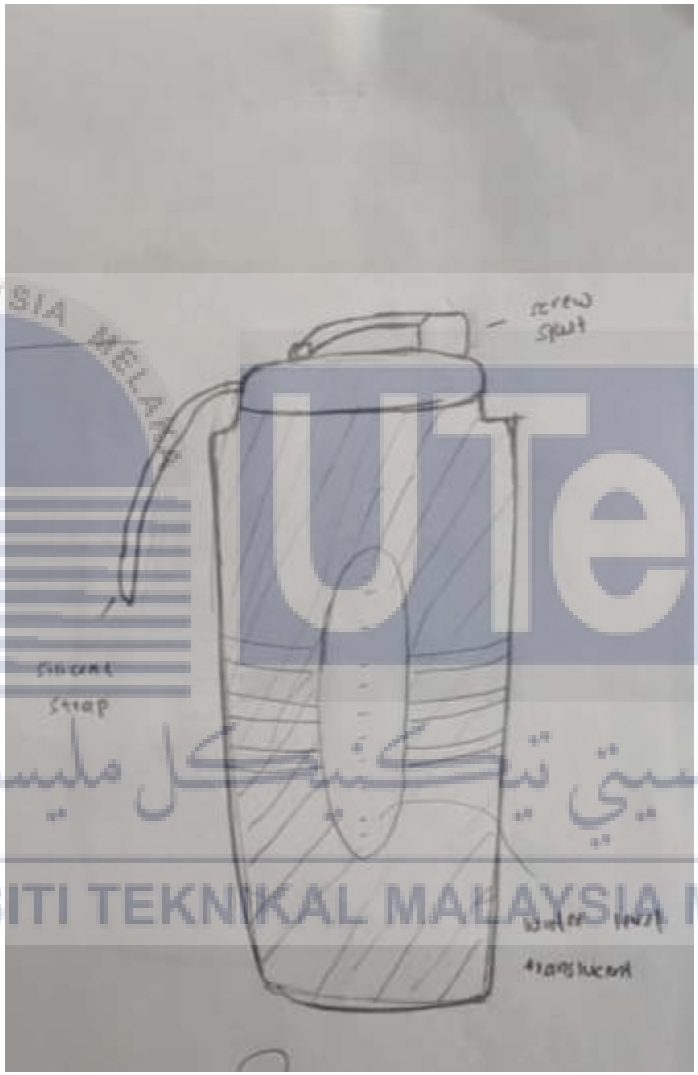


Figure 4. 26 Hand Sketching Concept 2

4.6.3 Concept 3

WATER BOTTLE FEATURES	DESIGN				
	1	2	3	4	5
Water Level Indicator					
Handle Strap					
Lid Attached					
Bottle Car Holder					
Easy to Clean					

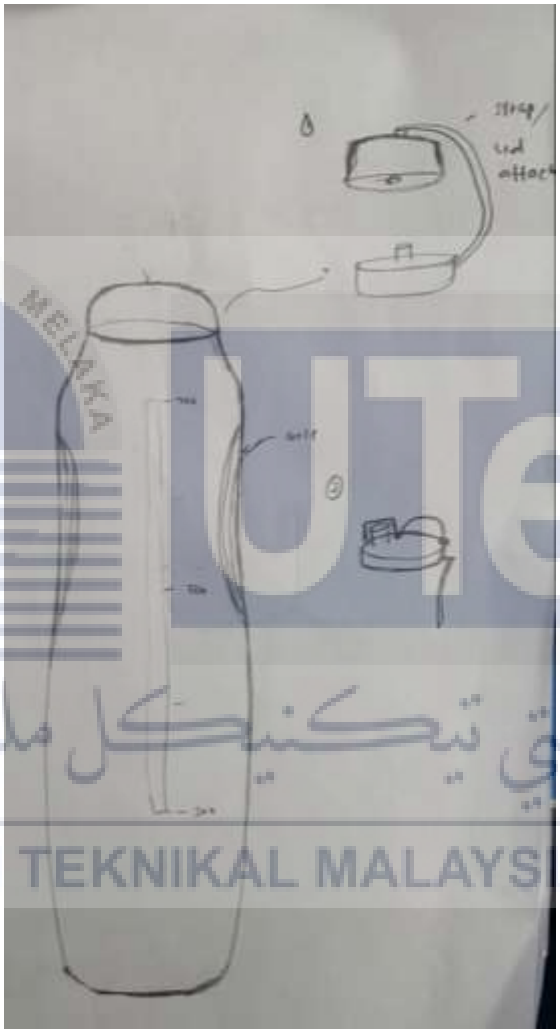


Figure 4. 27 Hand Sketching Concept 3

4.7 PUGH Method

Following the creation of three design concepts based on the morphological chart, the Pugh matrix analysis (PMA) is used to logically assess distinct possibilities based on established criteria. The Pugh Matrix (PM) is a form of Matrix Diagram that allows for the comparison of several design functionalities, ultimately determining which best fits a set of criteria. The Pugh Matrix is simple to use and is based on a series of pair-wise evaluations of design functionalities versus the number of criteria or requirements. Shows below the table 4.33 the form of PUGH method.

Table 4. 33 PUGH method

Key Criteria	Baseline	Design 1	Design 2	Design 3
Waterlevel indicater	0	0	1	1
Handle strap	0	-1	0	0
Lid attached	0	1	1	0
Bottle car holder	0	0	1	-1
Easy to clean	0	1	-1	0
Total	0	1	2	0

4.7.1 Final Design Development

Figure 4. 28 Final Design in 3D modelling

4.8 Summary

The Kansei words that represent the design profile must be identified as the chapter's conclusion. Determine consumer desired design profile and the Kansei phrase that best represents that design profile. In the primary survey, the Kansei words were utilised to describe the water bottle design for each of the five types of water bottle designs described in this study. Five of the fifteen Kansei words that emerged from the preliminary test came from the respondent. The top five Kansei adjectives chosen were Safe, Comfortable, Practical, Durable, and Simple. Furthermore, respondents must rank the design of the water bottle on a scale of 1 to 6 as their preference.

The major survey will be the Kano model, where the functional and dysfunctional features of the water bottle are analysed. The data were analysed using SPSS to assess the Kano Model's relationship to the Kansei term. On the basis of product design preference for Kansei engineering and the kano model that measures consumer satisfaction. Water level, handle strap, lid linked, brilliantly coloured, and translucent are substantial links between kano and Kansei terms. Unlike design A, design B is brightly coloured and translucent. Design C incorporates a water level indicator and a lid. Design D has only one relevant association matte. The final design is E, which correlates well with the water level indication. The correlation between kansei word and comfortable is high in all designs. Based on the summary table, three concepts were developed using the morphological chart approach. According to this, five characteristics of a water bottle are included in a morphological chart as a guidance. The water bottle is then designed and developed using a morphological chart, idea sketches, a Pugh matrix, an engineering drawing, and finally a prototype.

CHAPTER 5

CONCLUSION

5.1 Introduction

Every set target is answered in this chapter based on the survey and analysis that was carried out. The primary goal of this study is to analyse consumer preferences for product design and attributes using the Kansei Engineering approach, and then construct a design based on the data analysis. To obtain data analysis, the kano model is used in order to evaluate with the SPSS software to determine the relationship between the Kano and Kansei words.

5.2 Conclusion

The primary purpose of this research is to analyse consumer preferences for water bottle designs and to develop a new 3D water bottle design. This study is guided by three primary objectives. The study's goal and conclusion are as follows.

I. To study the Kansei engineering method and its implementation to product design.

As mentioned in the first aim, research on the Kansei Engineering technique has been conducted in terms of the Kansei Engineering method's background, the basic of Kansei Engineering, which is comparable to psychology in that it represents the consumer's point of view. Aside from that, measuring and methodology used with eight types of Kansei Engineering, as well as an overview of literature as stated in Chapter 2, are included.

II. To analyse data using a questionnaire by applying Kansei word.

The second goal focuses on analysing survey data using the kansei word. This section analyses data from two surveys, the preliminary survey and the main survey. The correlation between kano and kansei was determined using SPSS software. The correlation between kano and kansei was performed using the primary data from the main survey. The Kano model method

is a strategy for prioritising features on a product roadmap based on their likelihood to satisfy customers.

III. To develop a 3D modelling design water based on customers emotional.

After analysing the data regarding the correlation between the words kano and kansei. In chapter 3.4, a morphological chart is created by referring to the summary of correlation analysis based on the product survey, and 3 different concepts are created using the alternatives presented in the morphological chart. The concepts are then sorted using a scoring matrix known as the Pugh matrix, and the concept with the highest rank is chosen as the final design. The final design of water bottle, is then created using 3D modelling and rendering software, Solidworks.

5.2 Recommendation

The studies advice is to approach the respondent before answering. The best way to obtain the greatest data is to approach the responder face to face. In this case, we know exactly how the respondent's surroundings respond. According to this, we may determine whether the respondent answered the question or simply ticked without reading and understanding.

The second purpose is to enhance the number of respondents to both surveys. Accordingly, the survey should be widely distributed or the number of respondents increased, since the more data collected, the better and more accurate the final output will be. Additionally, the suitable responder is required to get the highly useful information because the respondent has experience with and expectations for the product.

The final suggestion is to construct a more precise questionnaire. Based on this research, we confront a challenging challenge because the questionnaire that was created is not particular, just asking general questions and not adhering to a real set of emotional questions. By including a specific inquiry, the likelihood of obtaining accurate data increases.

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APPENDICES

APPENDIX A Gantt Chart PSM 1

No	WEEK / ACTIVITY	WEEK 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	**Propose Project Title**															
2	**Register Project Title and Draw Mind Map of Methodology**															
3	**Identify The Problem Statement and Objective**															
4	**Identify Scope Project**															
5	**Write Introduction, Literature Review and Methodology**															
6	**Construct The Questionnaire 1**															
7	**Submit Draft Report PSM 1**															
8	**Distribute The Questionnaire 1**															
9	**Analysed Result and Data**															
10	**Correction Draft Report PSM 1**															
11	**Construct Questionnaire 2**															
12	**Submit PSM 1 Thesis**															

PLANNING ACTUAL

APPENDIX A Gantt Chart PSM

No	WEEK / ACTIVITY	WEEK 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	**Draft the preliminary questionnaire regarding product selection**															
2	**Construct preliminary survey**															
3	**Distribute the questionnaire**															
4	**Collect data preliminary survey**															
5	**Analyse data (will be used in main survey)**															
6	**Draft Main survey questionnaire (respondents' sentiment toward product)**															
7	**Distributed main survey**															
8	**Getting data main questionnaire**															
9	**Analyse main survey data**															
10	**Construct the morphological chart**															
11	**3D modelling product design**															
12	**Report writing**															

PLANNING ACTUAL

PRELIMINARY TEST- WATER BOTTLE DESIGN SURVEY

My valued respondent
I am Nurul Afiqah binti Mohd Anas, a third-year student from Bachelor of Manufacturing Engineering Technology (Process and Technology) at Universiti Teknikal Malaysia Melaka (UTeM). I am conducting a survey to complete a project for BMMU 3764 Bachelor Degree Project 1.

The purpose of this pre-survey (pre-test) is to find out what your emotional (Kansei) on design of water bottle. This survey is preliminary test that will be used to complete the thesis related to the 'Design Profile'. The purpose of this questionnaire is to identify and investigate the emotional product (Kansei Engineering) based on customer preferences in the production of water bottle.
This questionnaire is divided into two sections. Firstly, Section 1 that consists of questions about the general information about respondents, product background and customer preferences. Secondly, Section 2 that consists of the questions about the chosen Words that represent your feelings-personality and the Water Bottle Design Preferences.
Personally, I would want to show my thankfulness in advance for your sincere cooperation and support.
Your faithfully,
Nurul Afiqah binti Mohd Anas

Supervisor : Ts. Dr. Kamarul bin Amir Mohamed
Universiti Teknikal Malaysia Melaka

*Required

SECTION 1: General Information about Respondent

A)DEMOGRAPHY

1. Gender (Jantina) *

Mark only one oval.

- Male (Lelaki)
- Female (Perempuan)

2. Age (Umur) *

Mark only one oval.

- ◯ Below 18 years old
- ◯ 18-24 years old
- ◯ 25-34 years old
- ◯ 35 years old and above

3. Race (Kaum) *

Mark only one oval.

- ◯ Malay
- ◯ Chinese
- ◯ Indian
- ◯ Other: _____

4. Occupation (Pekerjaan) *

Mark only one oval.

- ◯ Student (Pelajar)
- ◯ Unemployed (Tidak bekerja)
- ◯ Under Employment (Bekerja)
- ◯ Self- employed (Bekerja sendiri)
- ◯ Profession (profesion)
- ◯ Retired (Bersara)

B) PRODUCT BACKGROUND

5. Material that you prefer for your water bottle_____ (Bahan yang anda suka pada botol air anda) *

Mark only one oval.

- Plastic
- Aluminium
- Stainless Steel
- Glass

6. How many water bottle you have? (Berapa banyak botol air yang kamu miliki?) *

Mark only one oval.

- None
- 1-2 pcs
- 3-4 pcs
- >4 pcs

7. I prefer to buy water bottle based on___ (Saya lebih suka membeli botol air berdasarkan____) *

Mark only one oval.

- Price
- Design
- Brand
- Colour

8. Do you like an indicator on your water bottle? (Adakah anda suka petunjuk pada botol air anda?) *

Mark only one oval.

- Yes
- No

9. Which color do you would choose for your water bottle? (Warna mana yang akan anda pilih untuk botol air anda?) *

Mark only one oval.

- Blue
- Red
- Orange
- Transparents/ White
- Black
- Purple

10. Which size of water bottle do you prefer? (Saiz botol air mana yang anda suka?) *

Mark only one oval.

- 500 ml
- 700 ml
- 900 ml
- 1000 ml

C) Consumer Perception

On this part, the objective of questionnaire is to explore the individual opinion and preferences when they decide to buy the consumers product is general.

Please rate the words listed below on a scale of 1 to 6 that represent the importance of your preference for water bottle

11. The most priorities when I purchased the product____ (keutamaan paling utama semasa membeli produk___) *

Mark only one oval per row.

	1	2	3	4	5	6
Price						
Brand						
Durability						
Design						
Size						

12. The condition or situation that make me purchase the water bottle is due to _____ (Keadaan atau situasi yang membuat saya membeli botol air adalah disebabkan _____) *

Mark only one oval per row.

	1	2	3	4	5	6
Attractive shape						
Sale/Discount						
Uniqueness						
Cheap/ Expensive						
Shape of water bottle lid						
Material						

SECTION 2 : DESIGN PROFILE

Fill up the box below with the numbers represented of Water Bottle Design and Kansei Word. (See the List Provided)

For your reference, the list below shows the definitions of words

Kansei Word		Meaning
1 Attractive	1A	Having attributes or characteristics that attract one's attention
	1B	Pleasant to look at
	1C	Having a feature or quality that people like.
2 Beautiful	2A	Physical appearance is considered extremely attractive
	2B	Possessing qualities that give great pleasure to see, hear, think about, etc.
	2C	Wonderful; very pleasing and satisfying
3 Classy	3A	Fashionable and expensive
	3B	Stylish and sophisticated
	3C	Having qualities that make someone or something special and attractive
4 Colourful	4A	Fashionably attractive or impressive
	4B	Marked by steady dispassionate calmness and self-control
	4C	Good combination of colour
5 Comfortable	5A	Making you feel physically relaxed; pleasant to wear, use, bring, etc
	5B	Making you feel physically relaxes, without any pain.
	5C	Affording or enjoying physical comfort
6 Cool	6A	In a way that people admire, very attractive, fashionable, interesting, etc., used to indicate approval.
	6B	Fashionably attractive or impressive
	6C	Having the image of being cool
7 Durable	7A	Able to withstand wear, pressure, or damage; hard-wearing/ hard used
	7B	Able to last long time without becoming damaged
	7C	Staying in good condition for a long time, even if used a lot.
8 Elegant	8A	Of a high grade or quality
	8B	Attractive and exciting in an interesting way
	8C	Graceful and stylish in appearance
9 Impressive	9A	Having the power to excite attention, awe, or admiration
	9B	Grand, imposing, or awesome
	9C	Special, important, or very large
10 Modern	10A	Denoting a current or recent style or trend in art, or other cultural activity marked by a significant departure from traditional styles and values
	10B	Characterized by or using up-to-date technique, idea or equipment
	10C	Made or done using the most resent design or methods.
11 Practical	11A	Convenient to handle use; useful
	11B	Relating to, or manifested in practice or action.
	11C	victual
12 Safe	12A	Not likely to cause or lead to harm or injury not involving danger or risk
	12B	Not likely to cause any physical injury and harm
	12C	Secure from threat pf danger, harm, or loss
13 Simple	13A	Made in a plain style, without a lot of decoration or unnecessary things added
	13B	Plain, basic, or uncomplicated in form, nature or design without much decoration or ornamentation
	13C	Readily understood performed
14 Stylish	14A	Fashionably and elegant and sophisticated
	14B	Admired by many people
	14C	Influenced by fashionable people
15 Trendy	15A	Latest trend
	15B	Popular or fashion at particular time
	15C	Not really elegance

13. This section require you to choose FIVE (5) KANSEI WORDS to represent your feelins and expression towards the Water Bottle product. *

Tick all that apply.

- [ ] Attractive
- [ ] Beautiful
- [ ] Classy
- [ ] Colourful
- [ ] Comfortable
- [ ] Cool
- [ ] Durable
- [ ] Elegant
- [ ] Impressive
- [ ] Modern
- [ ] Practical
- [ ] Safe
- [ ] Simple
- [ ] Stylish
- [ ] Trendy

The water bottle design that I prefer are . . . (Reka bentuk botol air yang saya suka adalah . . .)

This section requires you to choose ONE (1) of each row the water bottle design you prefer.

14. Water bottle shape(body) *


A1


A2


A3


A4


A5

Mark only one oval per row.

	A1	A2	A3	A4	A5
A	◯	◯	◯	◯	◯

15. Water bottle lid *


B1


B2


B3


B4

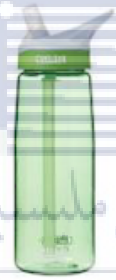

B5

Mark only one oval per row.

	B1	B2	B3	B4	B5
B	◯	◯	◯	◯	◯

16. water bottle with straw *


C1


C2


C3


C4


C5

Mark only one oval per row.

	C1	C2	C3	C4	C5
C	◯	◯	◯	◯	◯

17. Water bottle holder *

Mark only one oval per row.

	D1	D2	D3	D4	D5
D	◯	◯	◯	◯	◯

18. Pattern *

Mark only one oval per row.

	E1	E2	E3	E4	E5
E	◯	◯	◯	◯	◯

WATER BOTTLE DESIGN SURVEY

Dear respondents,

Everyone have a fantastic day. My name is Nurul Afiqah Mohd Anas and I am now studying at Universiti Teknikal Malaysia Melaka. I am now conducting research to identify the emotional expression of water bottle design in preparation for the "Design Profile" examination, which is being directed by Ts. Dr. Kamarul bin Amir Mohamed.
The purpose of this survey is to find out what your emotional (Kansei) on design of WATER BOTTLE product. This survey is preliminary test that will be used to complete the PSM related to the 'Design Profile". The purpose of this questionnaire is to identify and investigate the emotional product (Kansei Engineering) based on customer preferences towards the WATER BOTTLE product. This questionnaire is divided into three sections. First, Section 1 consist of questions about the general information about you as a respondent, product attributes, and product rating preferences. Second, Section 2 consists of 5(five) of product design with Kansei word to articulate the customer preferences on product design based on Kansei Engineering.Third, Section 3
consists of the FUNCTIONAL and DYSFUNCTIONAL questions related to quality attributes of product
based on Kano method.

Your participation is voluntary and all information given by you will be kept strictly as a confidential. Therefore, I would like to ask you to participate in this study.
I would like to thank you for your participation and support. I apologize for any inconvenience

Thank You !

*Required

SECTION 1: GENERAL INFORMATION

A) Demograpgy

1. Gender (Jantina) *

Mark only one oval.

- Male (Lelaki)
- Female (Perempuan)

2. Age (Umur) *

Mark only one oval.

- ◯ Below 18 years old
- ◯ 18-24 years old
- ◯ 25-34 years old
- ◯ 35 years old and above

3. Race (Kaum) *

Mark only one oval.

- ◯ Malay
- ◯ Chinese
- ◯ Indian
- ◯ Other: _____

4. Occupation (Pekerjaan) *

Mark only one oval.

- ◯ Student (Pelajar)
- ◯ Unemployed (Tidak bekerja)
- ◯ Under Employment (Bekerja)
- ◯ Self- employed (Bekerja sendiri)
- ◯ Profession (profesion)
- ◯ Retired (Bersara)

B) Product Attributes

5. Would you like to carry your water bottle with you on your daily routine? (Adakah anda ingin membawa botol air anda dengan anda pada rutin harian anda?) *

Mark only one oval.

- Yes
- No

6. What is your preferred price range for a water bottle?(Apakah julat harga pilihan anda untuk botol air?) *

Mark only one oval.

- RM18 - RM 25
- RM 26 - RM 35
- RM 36 - RM 44
- more than RM45

7. How much plain water do you consume in a single day? (Berapa banyak air biasa yang anda minum dalam satu hari?) *

Mark only one oval.

- < 1 litter
- > 1 litter
- <2 litter
- > 2 litter

8. Which type of water bottle material do you prefer?(Jenis bahan botol air yang anda suka?) *

Mark only one oval.

- Plastic
- Aluminium
- Stainless Steel
- Glass

Please rate the words listed below on a scale of 1 to 6 to indicate the extent to which you agree or disagree with that statement.

Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
1	2	3	4	5	6

9. PRODUCT A *

Mark only one oval per row.

	1	2	3	4	5	6
SAFE	◯	◯	◯	◯	◯	◯
PRACTICAL	◯	◯	◯	◯	◯	◯
COMFORTABLE	◯	◯	◯	◯	◯	◯
DURABLE	◯	◯	◯	◯	◯	◯
SIMPLE	◯	◯	◯	◯	◯	◯
In overall, do you like this product?	◯	◯	◯	◯	◯	◯

10. PRODUCT B *

Mark only one oval per row.

	1	2	3	4	5	6
SAFE	◯	◯	◯	◯	◯	◯
PRACTICAL	◯	◯	◯	◯	◯	◯
COMFORTABLE	◯	◯	◯	◯	◯	◯
DURABLE	◯	◯	◯	◯	◯	◯
SIMPLE	◯	◯	◯	◯	◯	◯
In overall, do you like this product?	◯	◯	◯	◯	◯	◯

11. PRODUCT C *

Mark only one oval per row.

	1	2	3	4	5	6
SAFE	◯	◯	◯	◯	◯	◯
PRACTICAL	◯	◯	◯	◯	◯	◯
COMFORTABLE	◯	◯	◯	◯	◯	◯
DURABLE	◯	◯	◯	◯	◯	◯
SIMPLE	◯	◯	◯	◯	◯	◯
In overall, do you like this product?	◯	◯	◯	◯	◯	◯

12. PRODUCT D *

Mark only one oval per row.

	1	2	3	4	5	6
SAFE	◯	◯	◯	◯	◯	◯
PRACTICAL	◯	◯	◯	◯	◯	◯
COMFORTABLE	◯	◯	◯	◯	◯	◯
DURABLE	◯	◯	◯	◯	◯	◯
SIMPLE	◯	◯	◯	◯	◯	◯
In overall, do you like this product?	◯	◯	◯	◯	◯	◯

13. PRODUCT E *

Mark only one oval per row.

	1	2	3	4	5	6
SAFE	◯	◯	◯	◯	◯	◯
PRACTICAL	◯	◯	◯	◯	◯	◯
COMFORTABLE	◯	◯	◯	◯	◯	◯
DURABLE	◯	◯	◯	◯	◯	◯
SIMPLE	◯	◯	◯	◯	◯	◯
In overall, do you like this product?	◯	◯	◯	◯	◯	◯

SECTION 3

This section will ask you to complete the simple Kano Questionnaire.Kindly mark the rating as the selected response.

1	2	3	4	5
I **LIKE** it that way	It **MUST BE** that way	I'm **NEUTRAL**	I can **LIVE WITH** in that way	I **DISLIKE** it that way

14. a. FUNCTIONAL *

Mark only one oval per row.

	1	2	3	4	5
The water bottle has a water level indicator that shows the time.(Botol air mempunyai penunjuk aras air yang menunjukkan masa.)					
A handle strap is attached to the lid of the water bottle.(Tali pemegang dipasang pada penutup botol air.)					
The water bottle comes with a straw.(Botol air disertakan dengan penyedut minuman.)					
The body of the water bottle is designed with a grip.(Badan botol air direka bentuk dengan cengkaman.)					
The water bottle's lid is attached to the body.(Penutup botol air melekat pada badan.)					
The flip spout as a water bottle cap(Muncung flip sebagai penutup botol air)					
Screw spout as a water bottle cap(Muncung skru sebagai penutup botol air)					
The body size of water bottle can fit with the bottle car holder(Saiz badan botol air boleh muat dengan pemegang botol kereta)					
The shape of the water bottle is practical and minimal.(Bentuk botol air adalah praktikal dan minimum.)					
The water bottle's shape makes it simple to clean and handle.(Bentuk botol air menjadikannya mudah untuk dibersihkan dan dikendalikan.)					
The water bottle is brightly coloured and translucent.(Botol air itu berwarna terang dan lut sinar.)					

The water bottle is matte in colour. (Botol air itu berwarna matte.)					

15. b. DYSFUNCTIONAL *

Mark only one oval per row.

	1	2	3	4	5	6
The water bottle does not include a water level indicator that show the timer.(Botol air tidak termasuk penunjuk aras air yang menunjukkan pemasa.)						
A handle strap does not attach to the lid of the water bottle.(Tali pemegang tidak melekat pada penutup botol air.)						
The water bottle does not have a straw.(Botol air tidak mempunyai penyedut minuman.)						
The water bottle's body is not designed with a grip. (Badan botol air tidak direka bentuk dengan cengkaman.)						
The lid of the water bottle is not attached to the body.(Penutup botol air tidak melekat pada badan.)						
The flip spout is not used as a water bottle cap. (Muncung flip tidak digunakan sebagai penutup botol air.)						
The screw spout is not used as a water bottle cap.(Muncung skru tidak digunakan sebagai penutup botol air.)						
The water bottle's body size will not fit in the bottle car holder.(Saiz						

badan botol air tidak akan muat di dalam pemegang botol kereta.)						
The water bottle's shape is not practical and minimal. (Bentuk botol air tidak praktikal dan minimum.)						
The design of the water bottle makes it difficult to clean and handle.(Reka bentuk botol air menjadikannya sukar untuk dibersihkan dan dikendalikan.)						
The water bottle is not vibrantly coloured and translucent.(Botol air tidak berwarna terang atau lutsinar.)						
The water bottle does not have a matte finish.(Botol air tidak mempunyai kemasan matte.)						

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UNIVERSITI TEKNIKAL MALAYSIA MELAKA

BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA

TAJUK: **PREPARATION AND CHARACTERIZATION OF LINSEED OIL-FILLED UREA–FORMALDEHYDE MICROCAPSULES AND THEIR EFFECT ON MECHANICAL PROPERTIES OF AN EPOXY-BASED COATING**

SESI PENGAJIAN: **2021/22 Semester 2**

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