

Innovation Design and Development of Emotional Ceramic Tableware Based on QFD

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ABSTRACT

In today's fast-paced era, the requirements for a product's form and performance are no longer the sole criteria for measuring its quality. They are also directly linked to whether it can provide users with a positive feedback experience. Integrating the concept of emotional design into interaction innovation, always prioritizing the user experience, has become a new direction in modern ceramic tableware product design. This paper summarizes the current state and design of ceramic tableware, employs the KJ Method to investigate user needs, and conducts need analysis based on the three-level theory of emotional design. Utilizing the Quality Function Deployment (QFD) theory, it maps user need elements to the quality deployment elements of tableware, calculates their weights, and prioritizes quality issues to be addressed based on these weights. Through this method, the paper derives insights and reflections for the innovative design of ceramic tableware, combining QFD principles with emotional design to chart a direction for future design development.

KEYWORDS

QFD; Emotional Design; Ceramic Tableware; User Experience; Innovation Development

1. INTRODUCTION

In today's fast-paced era, the requirements for a product's form and performance are no longer the sole criteria for measuring its quality. They are also directly linked to whether it can provide users with a positive feedback experience. Technological advancements have spurred mass machine production, making it difficult for people to experience a sense of human touch in everyday products [1]. In product design, being people-oriented, making products suitable for humans, satisfying both users' physiological characteristics and maximizing their psychological needs, thereby bringing about emotional changes, is a new developmental direction in modern product design. Therefore, in ceramic tableware design, whether emotional communication exists and whether it embodies emotional design thinking are crucial questions. Designing ceramic tableware by creating interesting atmospheres and employing appropriate artistic design techniques to resonate with consumers, enhance their appeal, inject new vitality into people's dining tables, and add energy to the monotonous and busy modern urban life represents a new starting point for ceramic tableware.

2. RELATED DESIGN CONCEPTS

2.1. Definition of Quality Function Deployment Theory (QFD)

Quality Function Deployment (QFD) is a systematic and objective design methodology. Its primary function is to maximize the fulfillment of user needs during the product design and development

process. Its core lies in utilizing the data analysis system of the House of Quality model to transform subjective user needs into objective design requirements, obtain the importance ranking of design requirements, and provide reliable data support for design and production [2]. This technique has seen significant development in the United States and is recognized worldwide [3].

2.2. Concept of Emotional Design

Emotional design aims to evoke resonance in users from aspects such as color, appearance, material, and operation method when using a product, making users more willing to use it. The most widely applied framework in emotional design is Professor Donald Norman's "Three-Level Theory" proposed in Emotional Design (i.e., Visceral, Behavioral, Reflective levels) [4]. Users' experience with a product progresses step by step from the visceral level to the behavioral level and then to the reflective level [5]. The visceral level involves sensory stimuli caused by external factors, such as the product's shape, color, and material; the behavioral level relates to the user mastering skills, solving problems, and experiencing a sense of accomplishment during use—essentially, the experience of convenience and ease of use; the reflective level creates an emotional attachment in the user's mind through the combined influence of the visceral and behavioral levels.

2.3. Emotional Ceramic Tableware Design Process Based on QFD Theory

Tableware is an indispensable part of human life. After thousands of years of development, modern ceramic tableware can largely meet the maximum demands of contemporary society for functionality and quality. However, with technological progress, users' craving for emotional experiences has also intensified [6]. From the perspective of emotional design, the main steps for innovative ceramic tableware design are shown in Figure 1

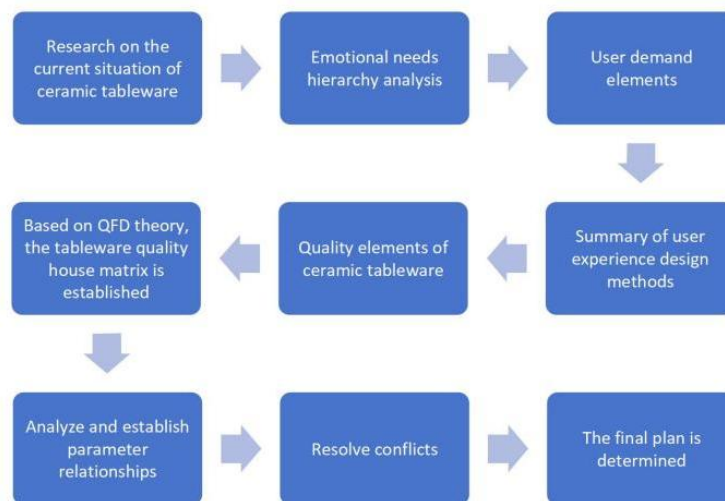


Figure 1. Main Steps of Ceramic Tableware Innovation Design

3. CURRENT SITUATION AND PROBLEMS OF CERAMIC TABLEWARE

3.1. Market Situation Analysis

Tableware is one of the most commonly used household items. It must not only manifest the product's function but also meet requirements for beautifying living spaces and ensuring safety. A household item with a good user experience can indirectly enhance the quality of life and happiness. Currently, innovation in the tableware market is primarily focused on materials and craftsmanship. The basic functional requirements of modern tableware are no longer sufficient; it also plays another vital role in regulating spatial atmosphere. This indicates that as technology advances and living standards

improve, the development of daily-use ceramic tableware has evolved from merely satisfying basic human needs to encompassing aesthetic demands and emotional appeals, reflecting specific spiritual and cultural connotations at different stages. Considering the current state and development trends of modern household ceramics, we should design according to contemporary aesthetic requirements [7].

3.2. Problems in Ceramic Tableware Design

Ceramic tableware design emphasizes practicality, aiming to meet mass needs. Since the founding of the People's Republic of China, the development of ceramics has gradually shifted from traditional handicrafts to industrialization. The development of daily-use ceramics has further progressed onto an industrial path. This mass production model provides convenience for people's lives but, compared to contemporary daily-use ceramic design, also presents several problems.

- (1) Monotonous Forms. China's daily-use ceramic tableware lacks novelty in style. Most products on the market are similar, featuring simple and conservative styles with traditional and outdated decorative content;
- (2) Insufficient Product Quality. Forms and decorations lack the artistry and spirituality of modern ceramic art, resulting in generally poor overall quality;
- (3) Poor User Experience. Product experience design interacts with user behavior patterns, requiring users to continuously learn how to use new products. Traditional ceramic tableware has certain limitations in form and application, leading to a lack of creative experience. We must keep pace with the times, continuously innovate, and create daily-use ceramic tableware that meets modern life and spiritual needs.

3.3. Design Trends of Ceramic Tableware under Emotional Needs

The development of the technological revolution has accelerated product updates. The design field constantly proposes new concepts, pointing the way for future design. While satisfying daily life needs, there is also significant room for improvement in emotional interaction, making tableware use more interesting and focused on human emotional experiences. In emotional design, experiential feeling is also a form of emotional design, representing design requirements proposed at the behavioral and reflective levels. Experience design is a hot topic in recent years, driven by user experience needs, where users gain a sense of pleasure when using the product.

4. USER NEED ANALYSIS FOR EMOTIONAL CERAMIC TABLEWARE PRODUCTS

The User Experience Professionals Association defines user experience as: "All elements perceived by users during their interaction with a product, service, or system." The central concept of "user experience" is the experience itself—a wonderful feeling a person has emotionally, physically, intellectually, and even spiritually [8]. Based on the three-level theory, this paper conducts an in-depth study of user emotions. The user experience of emotionally resonant tableware products refers to the rational understanding and emotional feelings accumulated by users throughout the entire process of using the product. It includes the intuitive perception of the ceramic tableware and various emotional experiences during and after use.

4.1. Sensory Needs at the Visceral Level

In contemporary society, people not only focus on a product's function and practicality but also on its symbolic meaning and added value. Under certain conditions, a product's intrinsic value often surpasses its practical value [9]. However, the relationship between the user and the product is

realized through external factors such as appearance, material, and color. Visceral-level design stems from human intuition, originating from human sensations. It is the foundation and cornerstone of a product.

4.2. Functional Needs at the Behavioral Level

People develop certain habits over long-term life, each with individual characteristics but also possessing underlying universality. Analyzing the connection between user behavior patterns and tableware design from the perspective of behavioral-level usage needs is paramount. It analyzes the motivation for users to use tableware from the following three angles [10]: Motivation for using tableware, Behavior of using tableware, Environment of using tableware [11].

(1) Motivation for Using Tableware.

During meals, people need suitable tableware to assist them. Ceramic tableware is often used in banquets or family gatherings to enhance the dining atmosphere; design should consider the tableware's aesthetics and coordination. In everyday dining, people expect ceramic tableware to fully meet basic functional needs, such as plate size and depth, bowl capacity, etc., to accommodate different types of food.

(2) Analysis of Behavior When Using Ceramic Tableware

During the use of ceramic tableware, users perform a series of operations and behaviors—this constitutes user usage behavior. To accommodate various user requirements, designers must design product details from the operational and behavioral levels. Needs range from lower to higher levels, including physiological needs, safety needs, convenience needs, emotional needs, etc. Designers need to understand user behavior patterns and ergonomic principles, integrating them with product design to create reasonable and enjoyable ceramic tableware products [12]. Based on this, by analyzing user behavior at each stage of the dining process, consumer demands for new products can be identified. The functional system of ceramic tableware mainly includes plates, bowls, dishes, and cups. Based on investigation and comprehensive analysis, it can be further refined and improved.

(3) Environment for Using Ceramic Tableware

The environment for using ceramic tableware should consider the characteristics of the dining venue. The form, appearance, color, and material of the tableware are all important. In formal banquets, family gatherings, or everyday dining, attention should be paid to the tableware's form, decoration, material, and function [13]. For everyday dining, ceramic tableware design should be simple and easy to use, facilitating handling and cleaning. The color and form of the tableware should not only coordinate with the dining environment's decorative style but also possess the function of beautifying the space and regulating the atmosphere. For example, in a warm environment, ceramic tableware colors can choose soft warm tones, such as beige, light yellow, or light blue, which can create a comfortable and intimate dining atmosphere. The form of the tableware should be simple and rounded, conforming to ergonomic design for easy grasping and use.

4.3. User Experience Needs at the Reflective Level

Feelings at the visceral and behavioral levels are the immediate sensations users experience during use. In contrast, reflective-level experiences can bring about continuous emotional projection, enhancing user loyalty to the product and forming a long-term connection. In the emotional design of ceramic products, the designer acts as the user's guide, transforming materials and concepts into products through design methods. Based on the three emotional levels, the quality elements for the emotional design of ceramic products are summarized in Figure 2.

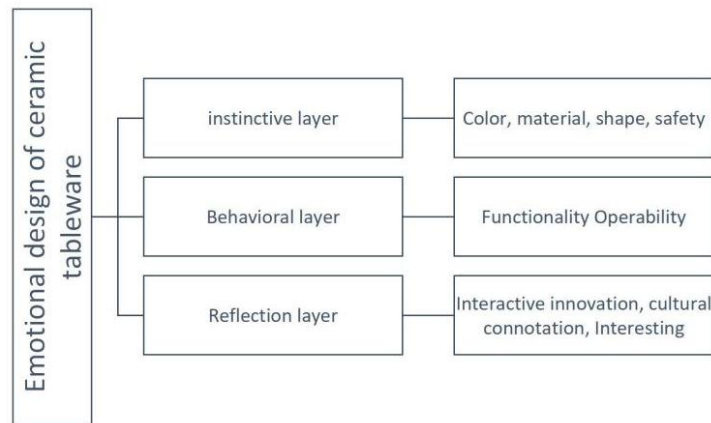


Figure 2. Deployment of Ceramic Tableware Quality Elements

5. INNOVATIVE DESIGN OF CERAMIC PRODUCTS BASED ON QFD

5.1. Emotional User Experience Design Methods

Being user-centered requires consideration of users' physiological, psychological, behavioral, and other factors. In emotional design methods, experiential design should proceed from the following angles: (1) Product Role Setting. Enabling users to engage in emotionally interactive behaviors and conveying emotion. This is the theoretical basis integrating interaction design, emotional design, consumer behavior, and consumer psychology. (2) Expression of Interactive Experience. Using more creative ways for human-product interaction, focusing on reflective-level experiences. (3) Quality Requirement Elements. Classifying and organizing the quality elements of ceramic tableware according to the visceral, behavioral, and reflective levels: Visceral level includes safety, color, form, material, craftsmanship; Behavioral level includes functionality, ease of operation; Reflective level includes interactive innovation, cultural significance, and fun.

5.2. Based on Quality Deployment Theory

During the need investigation process, what users mention are explicit needs—specific requirements users have for the product. Implicit needs are built upon explicit needs; when explicit needs are met, implicit needs are also satisfied. When providing interactive innovation for ceramic tableware at the reflective level, it can also satisfy its fun aspect—interactivity is an explicit need, while fun is an implicit need. After understanding the quality elements of ceramic tableware, the three emotional levels are integrated into the user need data. Based on Maslow's hierarchy of needs analysis, from high to low, they are: physiological needs, safety needs, belongingness and love needs (emotional needs), esteem needs, self-actualization needs^[14]. Mapping Maslow's need levels to user need descriptions, expanding them for comprehensive consideration, and rating the importance of user needs (safety, functionality, interactivity, ease of use, fun, innovation, cultural significance, craftsmanship) on a scale of 1-7 yields a ranking. Establishing the ceramic product quality deployment by correlating product quality requirements with user needs, the quality elements for the emotional design of ceramic tableware are shown in Table 1.

As shown in the table, in emotional design, the ceramic quality elements urgently needing resolution are tableware material, cultural significance, interactive innovation, fun, and ease of operation. Ease of operation and interactive innovation form a pair of negatively correlated contradictions. Users become familiar with fixed ways of using a product; often, changes brought by interactive innovation do not necessarily make usage more convenient. However, integrating cultural significance is a design approach aligned with future human development trends.

Table 1. Quality Elements for Emotional Design of Ceramic Tableware

Strongly correlated: 5 Correlation: 3 Weak correlation: 1		Importance (ki)	Emotional design quality elements of ceramic tableware										
			instinctive layer				Behavioral layer			Reflection layer			
			safe	color	Material	sculpt	functionality	Easy to operate	susceptibility	Interactive innovation	use environment	Culture	Interesting
User requirements elements	security	8	5		3	3	3				5		
	functionality	7	1				5	1	3	1	1	5	1
	Interactivity	6					3	5	5	5		5	5
	Easy to use	5			3		5	5	5	3		5	
	Interesting	4		3	5				5	5		5	5
	Innovation	3						3	5	5		5	5
	Culture	2						5	5	5		5	5
	Craftsmanship	1	3	1		5							5
The importance of user needs		50	13	59	29	102	81	121	97	47	135	87	

Ceramic tableware design can convey and stimulate users' emotions through the reasonable application of constituent elements such as product form, color, decoration, and material. This makes the product compatible with human physiology and psychology, enabling consumers to obtain intimate, pleasant, and vibrant emotional experiences.

5.3. Reflections on Ceramic Tableware Innovation Design

5.3.1. Exquisite Selection of Form

Ceramic tableware stimulates human senses through its form, material, weight, glaze color, sound, hardness, luster, etc. Human sensory organs produce corresponding reactions—this is an aesthetic process. Whether it's simple, rough pottery or pure white, exquisite porcelain, it brings completely different feelings. Material selection must harmonize with the vessel's shape and decoration. In design, the advantages of various ceramic materials should be accurately reflected. For example, materials with good qualities like being lightweight, white, and translucent, such as fine white porcelain and bone china, possess characteristics of refinement, smoothness, nobility, and delicacy, making them the preferred choice for household and public settings, imparting a sense of roundness and purity. Selection should be based on the closeness of the association between the chosen material and human emotions. Generally, in patterns, the modulation and variation of materials can add artistic conception, allowing people to feel intense emotions. Designers must fully understand consumers' psychological needs during use to continuously create organic forms imbued with vitality. In design, form is the most important component, possessing greater visual impact. The combination of line lengths, curves, and straights in ceramic forms constitutes its external style. A slight difference in lines can convey feelings of plumpness or thinness, robustness or frailty, thereby expressing different aesthetics. If the curve of the belly has a subtle difference, the shape of the lower part can appear clumsy or agile, or it might feel insufficiently substantial or sturdy. Even a slight difference can make the entire form produce a different effect, even affecting people's emotions.

5.3.2. Aesthetic Color Matching

Color has a corresponding relationship with human emotions. People can utilize color psychology and emotional associations to create rich associations, aiding the aesthetic function of ceramic products. Different combinations of colors also evoke different associations. The warmth or coolness of color tones influences psychological feelings: red and yellow series bring a festive atmosphere, while green and blue series have a cooling, calming effect. The warmth/coolness of color is also related to the object's surface texture. Smooth, glossy materials like porcelain, metal, and silk tend towards cool tones; rough-surfaced materials like leather and wool tend towards warm tones. In product design, color is often the first trigger point for communication between the product and the consumer. Product color design should capture color combinations that meet the psychological needs of consumers of different ages and levels, striving to grab consumer attention at first sight. For example: Children's products should choose lively, bright colors with strong yet unified contrasts to

easily win children's favor; conversely, dull, cold colors will be neglected by children. Designers also need to understand different groups to select appropriate colors.

5.3.3. Diversity of Decoration

The ultimate goal of decoration is to make the form more beautiful and richer. Successful forms possess emotion; appropriate decoration can enhance the charm and personality of the form. Different decorative effects can also bring people different feelings. For example, ordinary teapots: some are decorated only on the body, some on the spout and handle, and some simply showcase the beauty of the material without any added decoration. A landscape decoration can evoke tranquility, flowers and birds suggest magnificence, and auspicious patterns convey tradition—all decorations bring different emotional pursuits. Some decorative items use luxurious techniques, such as Medusa (a figure from Greek mythology) as a theme, conveying a romantic and mysterious style. Flowing lids, wing-shaped handles, and a forward-surg-ing posture give the product a certain cultural atmosphere. However, in some cases, decoration can also play an auxiliary role. Using the seven colors of the rainbow as decoration is also a symbol related to quality of life. For instance, in social or home settings, confusion can arise when there's no clear marking or indication, leading to mistakes with cups and beverages. The "Rainbow" marking design cleverly solves the problem of ambiguous identification. Using lines of varying color intensity on multiple cup bodies makes them clear, easy to remember, and recognizable, requiring basically no alteration. These works all reflect the designer's humanistic care.

5.3.4. Combination of Composite Materials and Traditional Craftsmanship

All design is related to materials, and material is the fundamental condition for ceramic product design. With the continuous development of technology, new materials constantly emerge, bringing designers new experiences and creations. The use of composite materials is gradually entering people's field of vision to meet increasingly higher consumption needs. In the material selection for daily-use ceramic tableware, the combined application of two materials can not only enrich the forms of ceramic products but also, based on the differences in materials, create new sensations visually and tactilely. During the creative process, the relationship between the whole and the parts must be correctly grasped to achieve overall harmony. Every material must undergo processing to be produced. From the clay-coil building and hand-throwing of pottery to modern industrialized, mechanized mass production, the development of science and technology has brought great convenience to human life but also many problems. The emergence of industrial production has weakened traditional handicraft. The quality of industrially produced ceramic products needs reassessment. High-quality daily-use ceramic tableware is not well represented in the market; most products are mass-market.

5.3.5. Cultural Significance

The revival of traditional culture has made more and more young people pay attention to it. Simultaneously, the revival of traditional culture has provided a new trend for various industries [15]. For example, the tableware designs for the APEC state banquet and the G20 summit, whether in form or symbolic language, reflect strong traditional cultural elements. The overall design highlights West Lake elements, Jiangnan scenery, and the grandeur of a major nation. The 2016 G20 Hangzhou Summit "Prosperous Era" series of leader's porcelain employed the decorative technique of "colored-ground with reserved panels" (se di kai guang), a common method in famille rose porcelain. It reserves blank spaces in circular, fan-shaped, or other shapes on certain parts of the vessel and then decorates patterns within these reserved areas. The "Prosperous Era" series features ink-wash paintings of the West Lake within the panels, while the body is adorned with the Hundred Flowers pattern. The designer expresses the beauty of April on a single vessel—understanding the language of flowers, comprehending the heart of spring, capturing the most beautiful season on earth. Especially in recent years, with the growing international influence of Chinese culture, "Guo Feng" (national style) and "Guo Chao" (China-chic) have surged one after another. As the saying goes, "What is national is also global." The vitality in the use of decorative patterns is unprecedented. This vitality stems precisely from the fact that patterns originate from life, summarized by the people over

thousands of years of practical living. In other words, patterns are the shared emotional expression of people within a specific scope, encompassing the ordering, flattening, and rhythmizing of life images and even idealized world imaginings, possessing universality.

5.3.6. Ease of Operation

A set of excellent daily-use ceramic tableware, while meeting customer needs, should also strive for simplicity and elegance. Firstly, because the shape of daily-use ceramic tableware is constrained by its functionality, designers must consider the customer's usage experience. Most ceramic shapes are circular—simple, practical, and easy to store. In decoration, simple yet beautiful decorative content should be applied according to the ceramic form itself to achieve harmony between shape and decoration. Contemporary society advocates simple forms; China's Ru ware and Cizhou kiln ware are typical representatives of this style.

5.3.7. Functionality

Function is the soul of thought. For an excellent ceramic tableware set, functionality is paramount. Although, under traditional design thinking, it is difficult to make breakthroughs in the overall functional design of ceramic tableware forms, in modern society, with continuously improving living standards, the focus on functionality and research into details also bring new considerations to ceramic tableware design. Its characteristics and quality are manifested in ceramic vessels. The former represents people's most basic spiritual needs, while the latter represents higher demands. The fun-oriented design of ceramic tableware in terms of functionality involves integrating various humanistic concepts into specific functions, allowing people to feel fun during use, thereby gaining public support and affection.

(1) Fun in Material Function

The material function of a product refers to its utility—simply put, what the product does and how it is used. As a type of food vessel, ceramic tableware satisfies basic usage functions. The breakthrough point in design is sought during the use process to evoke emotional changes in people and achieve an effect of adding fun. As shown in Figure 5, the Finding Cheska porcelain tableware set features a relatively simple and modern form, achieving a combination of shapes between independent products. When used individually, it satisfies the basic functions of tableware; when combined, it presents another form, achieving a combination of points, lines, and planes—much like a daily life jigsaw puzzle. Perhaps at first glance, one might not sense the fun in this product, at most considering it a fine piece. Only through personal use can one experience the cleverness of the design. This design creates an interaction between the consumer and the product, enhancing the product's fun aspect.

(2) Fun in Spiritual Function

Spiritual function refers to aesthetic and cultural functions. The fun aspect of ceramic tableware in spiritual function means that through product development, meaning is endowed, thereby enhancing people's aesthetic taste and cultural depth. For example, the ceramic tableware designed by Polly George incorporates the environment as part of the tableware design into the ceramic product, creating special emotional associations. At first glance, this exquisite tableware inevitably makes people think of the delicious food placed upon it, as if even birds can smell its aroma. Observant individuals will notice that this tableware is not only beautiful but also full of imaginative space, providing users with a sense of joyful enjoyment.

Evidently, good design must not only satisfy basic usage functions but, more importantly, establish a fun-filled communication relationship between function and emotion. This allows the product not only to endow it with pleasing aesthetics through its external form but also to delve into people's inner world, eliciting emotional and visual satisfaction, gaining psychological recognition from consumers, and evoking the pursuit of a new life through the experience of fun.

6. CONCLUSION

Technological progress has brought increased product functionality but also increased operational complexity. Users have limited cognitive capacity for new products. Adherence to convention restricts product innovation, while excessive innovation makes operation cumbersome. Many operational errors stem from requirements exceeding users' cognitive limits. However, unconsciously designed products are based on the user's cognitive level.

This paper, based on emotional design, studies the design of ceramic tableware. According to users' visceral, behavioral, and reflective levels, user behavior is divided into motivation for using tableware, behavior of using tableware, and environment of using tableware. Based on this, combined with Maslow's hierarchy of needs, user needs for product usage are summarized and investigated. Finally, the QFD theory is used to establish the House of Quality, improve the user experience of emotional ceramic tableware, and propose research methods for innovative design. Currently, the functionality and quality of ceramic tableware have reached a relatively high level through continuous innovation. However, when facing work and life pressures, users need warm emotional design to alleviate feelings of restlessness.

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