Optimization Design of Purple Clay Teapot Based on KANO Model

Xinyu Ruan*, Qinghua Zhong

Beijing University of Chemical Technology, Beijing, 100029, China
Corresponding author: 1103205982@qq.com

Abstract: Purple clay teapot is a unique clay handicraft in China, which is both artistic and useful, but with the development of society, people's requirements for its practicality are getting higher and higher. Through literature research and preliminary user surveys, it can be found that as a work of art, it has a high cultural value, while as a product with use value, its development has great limitations and does not really take care of the needs of modern users. By using the kano model to analyze user data, it is concluded that the electric heating function and the smooth product appearance are what users just need. On the basis of using traditional teapot-making technology, design of temperature and power supply should be added consider. The final optimized design of the purple clay teapot also consider the production of different teas, optimize the product shape with simple and comfortable visual effects. This is also aimed at injecting vitality into the purple clay teapot industry and helping it expand consumer groups.

Keywords: Purple clay teapot, Product design, KANO model

1. Introduction

Purple clay teapot is a kind of clay handicraft, it has been around for more than five hundred years since it came out. However, due to the rapid development of modern society, the pace of people's life has been different from before, and the fast-paced life has become an undeniable social status quo. In the past, purple clay teapots were loved by many literati because of their unique cultural value, and using them for tea even required a set of inherent processes. In modern times, more and more people have the demand of drinking tea to refresh themselves and keep in good health. The ordinary people who simply likes to drink tea will inevitably find it time-consuming and exhausting to cover all the details of the process. Therefore, it is necessary to optimize the purple clay teapot and design a pot that is more suitable for the needs of modern people.

2. Analysis of the current situation

2.1. Status of development of purple clay teapot

Purple clay is the raw material of purple clay teapot. Different from the material of other tea-making tools, it is naturally generated and rich in a variety of minerals, which is beneficial to human health. The purple clay produced in Yixing area of China is recognized as having the best quality, and its main components are quartz, biotite, hematite. This composition of purple clay has a double layer stomatal structure, good air permeability, strong adsorption capacity, compared with other areas of the clay is relatively more fine [1]. During the Northern Song Dynasty, the Yixing area already started to produce purple clay teapot because of its unique purple clay teapot. In 2006, the State Council released the first batch of the national intangible cultural heritage list, and the traditional Yixing purple clay teapot-making process was listed, which is a recognition of the tradition, uniqueness, ethnicity and sociality of this craft [2]. Since the emergence of the culture of purple clay teapots, they have enjoyed a great reputation at home and abroad, and the industry has become an important representative of the cultural industry in Yixing.

2.2. Current status of the problem

As of the data survey of the third economic census in Yixing area in 2019, there are currently 6,904

individual operators in the Yixing area in the purple clay ceramic industry, employing 21,700 people [3]. This shows that Yixing has formed an industrial agglomeration and has a monopoly on the industry. However, the teaching methods for practitioners are too single, and most practitioners need to learn the craft from a master first, rather than through systematic vocational and technical training. Most of them lack theoretical knowledge of design, and there is a lack of high-end professional technical personnel in the industry. Because of this, the progress of modeling design in the industry has been slow and the innovation of purple clay teapots has been limited, leading to the solidification of its consumer base. Barriers need to be broken, and it is of great significance to explore a design method for the purple clay teapot based on user experience.

3. Research methods

The research is mainly divided into two stages. The research methods used in the first stage are literature research. By consulting a large amount of literature in the early stage, including classics, periodicals, and patents, and looking for similar cases on the Internet, determine the research process and the actual implementation situation. This stage will lay a solid theoretical foundation for the entire research process.

In the second stage, the questionnaire survey method was adopted to publish the questionnaires through the online platform. More than 100 questionnaires were collected within one day. The results are shown in Figure 1.
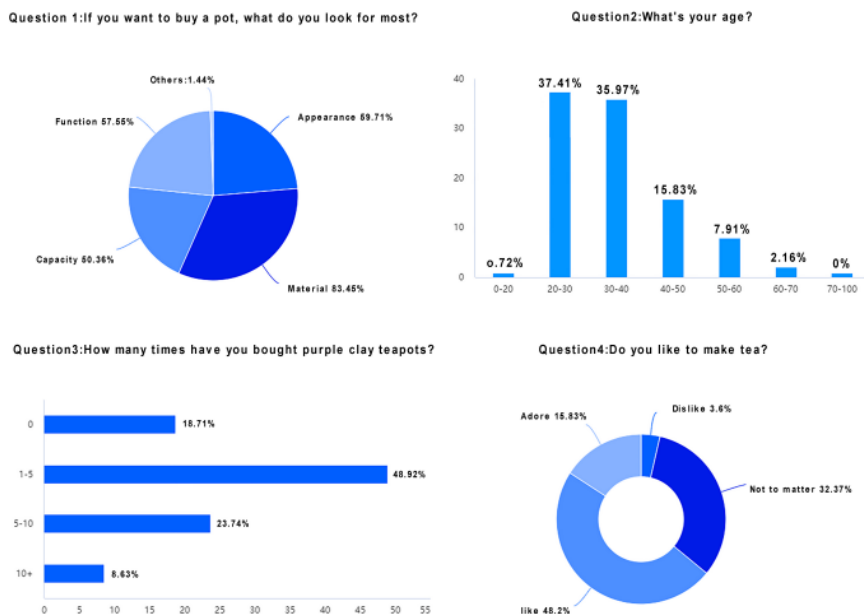

Figure 1: Excerpts from questionnaire results

With a basically equal proportion of men and women among the people who filled out the questionnaire, most people pay more attention to the material, appearance and function when choosing a pot, and those who are interested in the optimized design of purple clay teapots are concentrated in the age group of 20 to 40 years old. Most of them have bought one to five teapots, and 18% have never bought a teapot but still showed great interest in teapot design and participated in the questionnaire. This questionnaire found that the majority of people have a positive attitude towards the innovative design of purple clay teapots and are interested in purple clay teapots with more functions and more modern aesthetic appearance. Then continue to distribute questionnaires on the network platform for detailed research. The results of this questionnaire will be analyzed combined with the kano model. A total of 150 original questionnaires were distributed, covering 23 regions in China including Beijing, Shanghai, Guangzhou, Jiangsu, etc. Some problematic questionnaires were excluded, and 139 questionnaires were finally recovered.

4. Data analysis

4.1. KANO model

The Kano model (see Figure 2) was proposed by Noriaki Kano of Tokyo University of Science in 1984. This model can effectively analyze the impact of user requirements on user satisfaction by describing user requirements qualitatively and quantitatively, and reflect the relationship between product performance and user satisfaction. It classifies the attributes of user requirements into: Attractive Quality (A), One-dimensional Quality (O), Must-be Quality (M), Indifferent Quality (I), and Reverse Quality (R) [4].
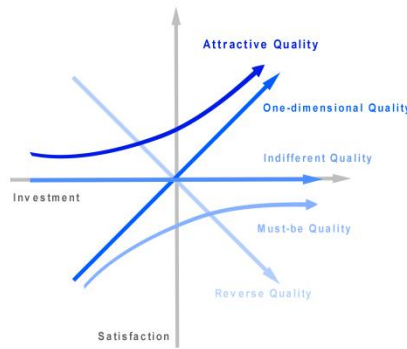

Figure 2: KANO model

Among them,Must-be Quality (M) refers to the requirements that users think should have, when the product has this element, user satisfaction usually does not increase, but if it does not have, user satisfaction will be significantly reduced; One-dimensional Quality (O)refers to when the product has a certain element, user satisfaction will increase, when it does not have, user satisfaction will be reduced;Attractive Quality (A) is to instruct users to excited about the product features, and providing exciting needs in the product will significantly increase user satisfaction with the product.

Attractive Quality (A) is a product feature that excites users, and providing exciting demand in the product will greatly increase users' satisfaction with the product, but if the product does not show exciting demand, users will not be less satisfied with the product; Indifferent Quality (I) means that whether the product has a certain element or not, it will not affect users' satisfaction with the product; Reverse Quality (R) means that if the product has a certain element, users' satisfaction will be reduced, and vice versa, it will be increased [5].

4.2. User requirements analysis based on kano model

According to the requirements of KANO model, the questionnaire was set up. The table below shows whether the purple clay teapot has "brief style" as an example Table 1.

Table 1: Whether the purple clay teapot has "simple style".

Evaluation	Like	As it should be	No matter	Reluctantly accepted	Dislike
Have brief style	√				
No bridf style					√

Based on the questionnaire survey results, the different levels of user needs are studied and analyzed by constructing Kano model, which provides the basis for the optimal design of the purple clay teapot, combined with the Kano evaluation results classification control table for evaluation, as shown in Table 2. From Table 2, it can be seen that a set of two-way questions may have six demand attributes: R/O/A/I/R/Q. The number of people with each demand attribute is obtained from the results of questionnaires filled out by 139 people.

4.3. Better-Worse coefficient analysis

In order to judge the degree of influence of the designed and optimized user requirements on user satisfaction and dissatisfaction, the value of Better-Worse coefficient is calculated to determine the importance of user requirements. The formula for calculating the Better-Worse coefficient is as follows:

$$Better = (O + A)/(O + A + I + M) \qquad (1)$$

$$Worse = -(O + M)/(O + A + I + M) \qquad (2)$$

The Better-Worse coefficient reflects the effect of the increase or decrease in demand items on satisfaction. The Better coefficient is the proportion of Attractive Quality (A) and One-dimensional Quality (O) in the overall qualities, the larger the value is, the more obvious the demand is. The Worse coefficient is the proportion of One-dimensional Quality (O) and Must-be Quality (M) in the overall qualities, and the larger the absolute value is, the greater the impact of the demand item on the overall satisfaction which is the key to achieve user satisfaction [6]. Fill the statistically derived KANO attribute data into the Better-Worse formula to obtain the Better-Worse coefficient, and the results were shown in Table 2.

Table 2: The optimized purple clay teapot's Better-Worse coefficient and attributes classification table.

Requirement point	Kano attribute value						Better	Worse
	M	O	A	I	R	Q		
P1 Reservation	11	8	43	56	13	8	0.432	-0.161
P2 Constant temperature	10	13	54	40	12	10	0.573	-0.197
P3 Electrical heating	9	14	38	55	11	12	0.448	-0.198
P4 Automatic power off	9	24	42	41	10	13	0.569	-0.284
P5 Temperature sensing	6	18	45	49	7	14	0.534	-0.203
P6 Suitable for different tea	6	8	58	48	10	9	0.550	-0.117
P7 Split power supply	10	15	46	49	8	11	0.508	-0.208
P8 Voice prompt	4	9	44	51	17	14	0.490	-0.120
P9 Display screen	4	17	42	49	16	11	0.527	-0.188
P10 Brief style	11	10	51	43	12	12	0.530	-0.183
P11 Smooth outline lines	21	7	40	47	12	12	0.409	-0.243
P12 Bionic design	7	5	45	59	14	9	0.431	-0.103
P13 Traditional technology	8	18	51	43	7	12	0.575	-0.217

The Better coefficient is usually positive, the larger its value is and the closer it is to 1, the stronger the effect of improving user satisfaction is, and the faster the satisfaction will rise; The Worse coefficient is usually negative, the larger its absolute value is and the closer it is to 1, the greater the impact on user dissatisfaction is, the stronger the effect of reducing the satisfaction is and the faster the satisfaction will decline. After getting the Better-Worse coefficient, the absolute value of the Worse coefficient is used as the horizontal axis, the Better coefficient is used as the vertical axis, and the average value of the Better coefficient and the Worse coefficient is used as the origin of the axes to draw a four-quadrant diagram (see Figure 3).

Figure 3: Four-quadrant diagram

In planning the optimal design elements of the purple clay teapot, based on the order of importance: Must-be Quality (M)>One-dimensional Quality (O)>Attractive Quality (A) >Indifferent Quality (I). The four quadrant diagram drawn by the Better-Worse coefficient can visually and clearly see in which quadrant the different demand points are in, and finally compare the KANO attribute data to derive the final attributes of thirteen user demand points. Among them, point 3/11 is a necessary attribute. Therefore, the smooth product shape lines and the function of electric heating must be considered in the optimized design of the purple clay teapot. Points 2/4/5/7/9/13 are desired attributes. Therefore, these six points are to be given priority in the design. Point 6/10 belongs to the charm demand attribute, therefore, the simplicity and the temperature required to satisfy different tea types need to be given attention in the design. Point 1, Point 8 and Point 12 are three undifferentiated attributes. Therefore, it is possible to choose whether or not they are needed on a case-by-case basis.

5. Optimized design practice for purple clay teapots

5.1. Design solution

This product is a purple clay teapot (see figure 4) optimized by modern technology, with various functions such as heating, keeping warm, steaming different teas, aiming to provide modern users with a more convenient, safe and high-quality tea drinking experience.
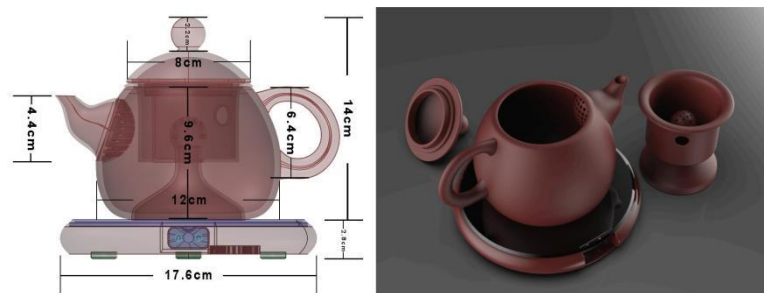

Figure 4: Display picture of the optimized intelligent purple clay teapot

5.2. Details show

● Power supply

The separated power supply design makes the power supply separate from the teapot, which is convenient for users to clean the teapot. Power supply with automatic insulation function, just put the teapot on the round base, it can automatically keep the tea at the ideal temperature. This design can also avoid contact between the tea and the power supply, thus avoiding possible accidental injury, not only more beautiful and safer. The bottom of the power supply uses multi-hole heat dissipation, intelligent cooling and noise reduction, in addition to adding a non-slip pad to prevent the power supply from shifting and dangerous situations.

● Spherical filter

The filter can filter out impurities and debris from the tea leaves to improve the quality and taste of the tea. Designing the filter as a sphere can better filter tea leaves. The spherical mesh not only expands the total area of the mesh and increases the water output, but also because it is a half sphere, it will not be clogged by large leaves when making tea.

● Built-in Tea steamer

Designed mainly for fermented and semi-fermented teas, the detachable design allows the built-in tea steamer to be removed separately. This design also prevents the tea leaves from touching the overheated bottom of the teapot, and the steamed tea has a clear color and a sweet and fresh taste.

● Different grades

different teas should be brewed with different water temperature, the water temperature should be low for the tea leaves with tender buds; the water temperature can be higher for the tea leaves with mature leaves. For tea with heavy roasting, the water temperature should be high; for tea with light roasting, the water temperature should be low. The user only needs to gently tap the center of the circle on the touch

screen to switch the gears to make the best tea.

● One-piece design

The overall shape is rounded, which can integrate the parts of the teapot, filter and tea steamer into one, thus improving the beauty and practicality of the product. This design can also reduce the occupied space of the product, which is convenient for users to use and store.
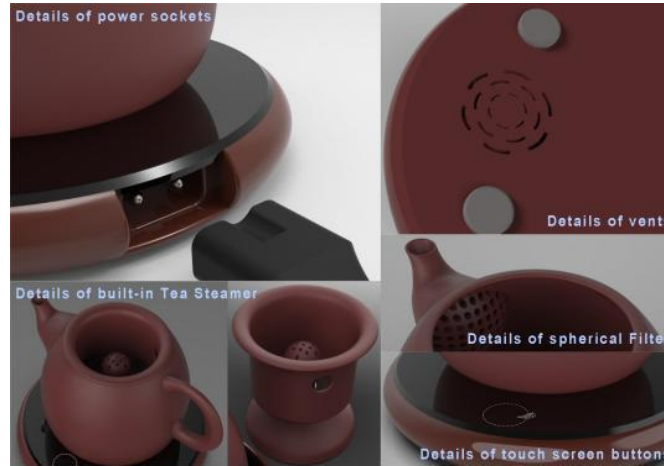

Figure 5: Detail view.

All of these design details (see Figure 5) are designed to improve the performance and experience of using the intellectual purple clay teapot, making it more in line with modern lifestyles and needs.

6. Conclusion

Times are constantly evolving, and product design needs to be closely integrated with the realistic background and current needs. In this paper, through the analysis of consumer needs, the optimal design of the purple clay teapot is studied and discussed, and feasible improvement solutions are proposed, aiming to improve the modernity, practicality and aesthetics of the purple clay teapot, to provide users with a safer, more convenient and high-quality tea drinking experience, and to make a greater contribution to the inheritance and development of traditional tea culture.

References

[1] Juan Yang. On the current situation and future development trend of the purple clay teapot industry [J]. Ceramics Science & Art, 2022, 56(04): 12-14.
[2] Qikun Zhou. The craft of purple clay teapot art compendium[J]. Ceramics Science & Art, 2022, 56(10): 178.
[3] Yicheng Feng. Yixing purple clay industry development status and innovation research[J]. Ceramics Science & Art, 2020, 54(09):56-57.
[4] Kano Noriaki, Seraku Nobuhiko, Takahashi Fumio, et al. Attractive Quality and Must-Be Quality[J]. Journal of the Japanese Society for Quality Control, 1984, 31(04):147-156.
[5] Qing Feng, Suihuai Yu, and Lei Yang. Modeling Design of Emergency Communication Vehicle Based on Kano Model [J]. Journal of Machine Design, 2015, 32(09):111-115.
[6] Zhaolong Li, Yanhui Wang, Shurong Hu, et al. A study on the demand of chinese traditional blue-dyed products based on kano mode[J]. Journal of Silk, 2022, 59(05):103-110.