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STUDY ON THE EFFECT OF HANDLE IN PORCELAIN TEA CUP FOR ITS OVERALL DESIGN AND FUNCTIONALITY

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Abstract: Tea consumption has been an integral part of cultures around the world for centuries, and porcelain teacups have been an essential part of the tea-drinking experience. This research paper focuses on the impact of porcelain teacup handle design on the overall functionality and design of the teacup, specifically from a product design perspective. The study aims to identify how the development of the porcelain teacup handle affects consumer behavior and preferences through aspects such as form, shape, size, proportions, and ergonomics. Using randomly selected teacup designs manufactured by Dankotuwa Porcelain PLC, qualitative, quantitative, and comparative analyses were conducted using methods such as questionnaires, interviews, observations, and surveys. The research findings aim to contribute to the future design and production of porcelain teacups, facilitating innovation of a feasible product with high-quality and improved user experience.

Keywords: *Consumer behavior, Functionality aspect, Handle design, Porcelain teacups*

1. Introduction

Tea culture has been an integral part of human society for centuries, and porcelain teacups have played a significant role in this experience. Porcelain teacups are considered a symbol of elegance, style, and sophistication, and they are used by people all around the world to enjoy their tea. However, the design of the teacup handle has a critical impact on the functionality and overall aesthetic appeal of the porcelain teacup.

This research paper focuses on the impact of porcelain teacup handle design on the overall functionality and design of the teacup, specifically from a product design perspective. The study aims to identify how the development of the porcelain teacup handle affects consumer behavior and preferences through aspects such as form, shape, size, proportions, and ergonomics. The research aims to contribute to the future design and production of porcelain teacups, facilitating innovation and improved functionality.

The findings of this research paper will provide valuable insights into how the design of porcelain teacup handles can impact consumer behavior and preferences. This research aims to contribute to the future design and production of porcelain teacups, facilitating innovation and improved functionality. Furthermore, this research paper will also help to promote the importance of preserving cultural heritage associated with porcelain teacups.

2. Background

2.1 SRI LANKAN BEVERAGE CULTURE

Sri Lanka has a rich history of beverage culture dating back centuries. From coconut shells and clay cups to porcelain tea cups, the evolution of drinking vessels in Sri Lanka reflects the country's cultural and social changes over time. Archaeological evidence found in excavations in Anuradhapura and Tissamaharama, Sri Lanka, shows that separate bowls were used for drinking different beverages made out of clay, similar to modern porcelain ware used for drinking. (Silva et al., 2008)

With the colonization of Sri Lanka by the British, the tea culture and porcelain tea cups were introduced and widely accepted by the Sri Lankan society. Tea is the second most consumed beverage in Sri Lanka, and a person drinks at least three cups of tea daily. It is both a poor man's and a rich man's beverage of choice and has become an integral part of Sri Lankan society. Tea is associated with hospitality, and every household, without exception, serves tea to guests. It is also served at festivals and social gatherings throughout the country. The typical Sri Lankan tea set includes six cups and six saucers, a sugar bowl, a creamer, and a teapot. However, in general, only a cup and saucer are used for serving tea (Sumuduni & Piyumali, 2015).

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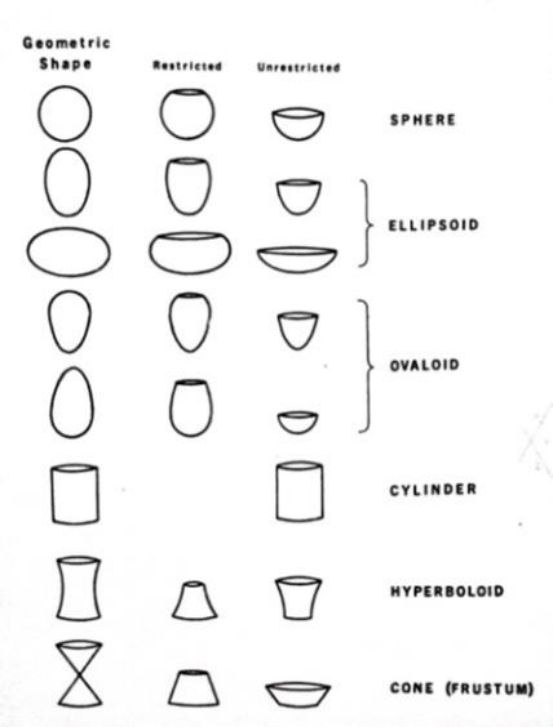


Figure 1: Morphological types of pottery
(Source – De Silva, N & Dissanayake, R.B (2008). (P. 25), A Catalogue of Ancient Pottery From Sri Lanka, Geometric solids as reference for vessel shape description (After Rice, 1987 p.219), Maharagama/Sri Lanka: Tharanjee Prints.)

Porcelain tableware has been manufactured in Sri Lanka under various brands for a long time, with a wide range of body shapes and unique decorating techniques. Their accesses to high-quality raw materials such as quartz, feldspar, dolomite, and China clay, as well as partnerships with international companies, have enabled them to maintain their position in the global market. Sri Lankan porcelain ware is known for its unique translucent whiteness, high scratch resistance, and high thermal shock resistance, making it highly sought after (Samanthi, 2017).

2.2 PORCELAIN TEACUP

A tea cup usually comprised of four parts: the lip, the body, the handle, and the footer. Each component is important to the usability and functionality of the tea cup. Teacups are not only functional but also have aesthetic qualities that enhance the tea-drinking experience. The thickness of the lip of the teacup affects how the tea is tasted, with a thinner lip encouraging mindful sipping for maximum exposure to the tea's aroma. The shape of the cup can also affect the temperature of the tea, with a wide-rimmed cup cooling tea faster and a tall, narrow cup retaining warmth and concentrating aroma (Kwan, 2016). Most teacups have a raised foot and a saucer to provide stability and a platform to place the cup. The handle of a porcelain tea cup refers to the attached component that allows the user to hold and grip the cup comfortably. It is typically a curved or looped structure extending from the side of the cup, designed to provide a secure and ergonomic grip while preventing direct contact between the hand and the heated cup walls. The handle serves as a functional element that enhances the overall usability and practicality of the tea cup.

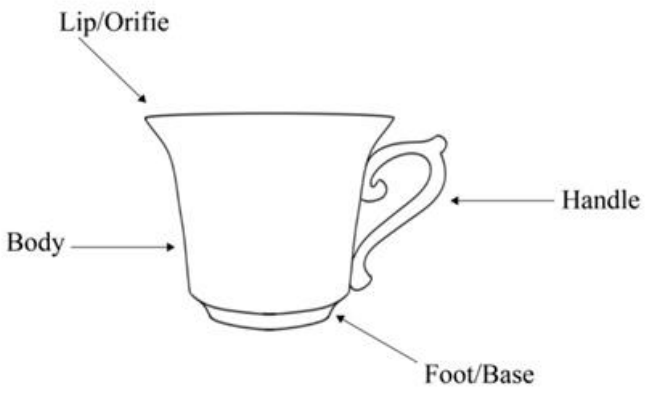


Figure 2: Anatomy of a Porcelain teacup
(Source: Author Creation)

2.3 DANKOTUWA PORCELAIN PLC

Dankotuwa Porcelain PLC holds significant importance for the research study on the effect of the handle in porcelain tea cups for their overall design and functionality. As one of the leading manufacturers of porcelain tableware in Sri Lanka, Dankotuwa Porcelain PLC has a long-standing reputation for producing high-quality porcelain products. Their expertise in manufacturing porcelain tea cups, including their unique designs and exceptional quality, makes them an ideal subject for this research.

With over three decades of experience in the industry, Dankotuwa Porcelain PLC has established itself as a prominent brand in Sri Lanka and has gained recognition both domestically and internationally. Their commitment to utilizing advanced technology and modern equipment ensures the production of exquisite porcelain items that reflect the rich cultural heritage of Sri Lanka.

Studying the tea cups manufactured by Dankotuwa Porcelain PLC, researchers can analyze the various handle designs and their impact on the overall design and functionality of the cups. The company's reputation, unique designs, commitment to sustainability, and wide availability of their products make them an important and suitable subject for this study.

2.4 FUNCTIONALITY ASPECT OF PORCELAIN TEACUP HANDLES

This study discusses the functionality aspect of porcelain teacups, focusing on the importance of the cup's handle. The handle not only adds to the aesthetic appeal of the cup, but also preserves the interaction between the user and the cup. The contribution of the handle of the tea cup is very important to the functionality of the tea cup. The author emphasizes the need to consider how the handle interacts with the user, including how it changes with variations in the cup's body form and how it can be held for the best user experience.

3. Methods and Methodology

The research design has 5 phases. (1): Planning phase, (2): Literature review, (3): Background Study, Data collection on user perceptions of the product form and materials, (4): Data Analysis, and, finally, (5): Conclusions and Suggestions. Phases (1) to phase (3) of the study have been planned for data collection and identifying the theoretical and practical aspects. The study has backed up early findings in several key areas, including teacup form and function, ergonomics, anthropometric data related to teacup handling, user interaction, functionality, and usability of porcelain teacup handles.

The main objective of the study is to discover how the overall design of porcelain teacup handles influences functionality and usability. This study was done with the employees of Dankotuwa Porcelain, who are experts in manufacturing porcelain tableware and randomly taken domestic users of porcelain tableware.

User observations, questionnaires, and some narrative interviews were used to collect the relevant data to understand the theoretical background of the manufacturing process of porcelain teacups. Not only has that but also when handling the teacups users' perceptions of its form and functions were examined. Don Norman (2003) proposed an emotional system comprised of three different yet interconnected levels. Visceral, behavioral, and reflective levels are included in this category. These three stages have been used to collect and analyze the data.

Data regarding the materials and form of porcelain teacups, in particular, have been gathered at the visceral level. The behavioral level is used to identify the effectiveness of the Tea cup and handle. Therefore, using these criteria, it has been discussed how porcelain teacups should be used and handled from the perspective of the user. Data regarding the user's emotional influence on the product has been acquired under the reflective level

3.1 PRACTICAL AND ETHICAL CONSIDERATIONS OF DESIGN APPROACH

Sample selection was based on porcelain tableware industry expert recommendations and contextual evidence, and the primary data gathering involved natural observation. Domestic users were chosen as participants, and permission was granted by the relevant authorities at Dankotuwa Porcelain PLC. The survey questions were carefully planned to protect participants' privacy, and all participants were informed in advance of the data collection process. Access to employees and survey arrangements were carried out with permission and supervision to avoid disruptions to the factory's production line.

3.2 AREA OF THE RESEARCH

The study was conducted on Dankotuwa Porcelain PLC (DPPLC), a Sri Lankan company that has been in the porcelain tableware industry for 38 years and has a strong reputation for its products. DPPLC supplies its products to both domestic and international markets, including over 40 global tableware brands. The company has a wide range of tableware products, including teacups, breakfast cups, coffee cups, espresso cups, and tea tasting cups. However, the study focused specifically on teacups manufactured by DPPLC, which have unique designs for each cup, including different handle designs. The company's B2B segment ensures that Dankotuwa tableware is widely available across Sri Lanka. Information on DPPLC's products and operations was obtained from the company's annual report for the calendar year 2021/22.

3.3 RESEARCH LIMITATIONS

The research will focus on the design aspect of porcelain tea cups with a special emphasis on cup handles from a functional standpoint, specifically in the local context. Only teacups were considered for data gathering, while other types of cups and customized products were not included. A total of 11 teacups with different handle designs were used as samples for the study that designed manufactured by Dankotuwa Porcelain PLC, based on market trends and demands existed in the market of tableware industry and manufactured after Converted DPPLC to a Public Quoted Company by special resolution in 1994.

3.4 PARTICIPANT IDENTIFICATION AND SAMPLING PROCEDURE

The research study involved a group of individuals who served as the subjects for data collection. These participants were given the opportunity to complete questionnaires in-person, which allowed for the gathering of relevant data. The preliminary study, conducted in consultation with experts from Dankotuwa Porcelain PLC, served as a pilot survey to gain insights into the design and manufacturing process of teacups.

For the main data-gathering phase, participants with experience using teacups in their daily lives were randomly selected as subjects. By incorporating both quantitative and qualitative analysis methods, the data collected could be effectively examined. Quantitative analysis involved analyzing data in percentages, while qualitative analysis considered various perspectives and ideologies.

4. Results and Discussions

The study was focused on the design aspect, functionality and the usability of the porcelain teacups with special reference to the handles. Randomly selected 11 different teacups designed and manufactured in Dankotuwa Porcelain PLC were chosen for the research.

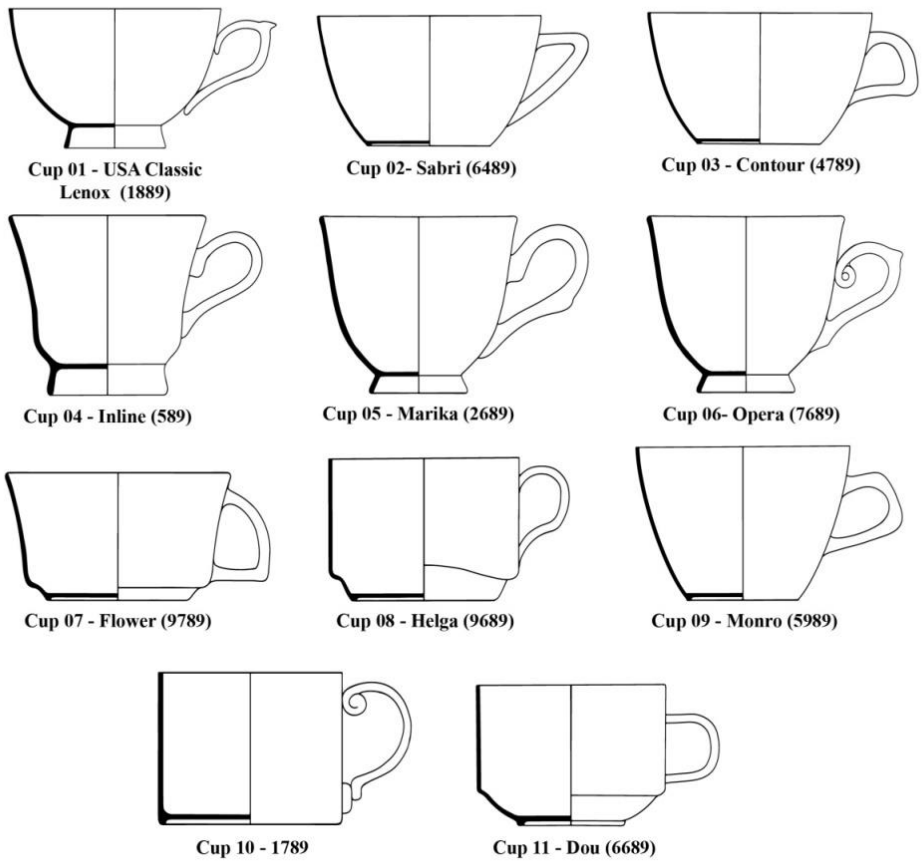
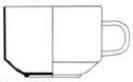
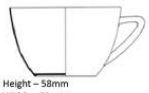
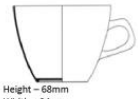


Figure 3: Randomly selected teacups of DPPLC
(Source: Author Creation)

Five porcelain teacups with special functional qualities were selected for user observation and exploration of functionality and usability based on the preferences of the respondents' appearance.

Table1 : Analysis of selected teacup designs of DPPLC

Cup Type	Part	Description	Functional Quality
Cup 01 – Opera (7689)  Height – 68mm Width – 94mm Thickness – 5mm Handle height – 45mm Handle width – 33mm Handle thickness – 11mm Volume – 230ml Weight – 185g	Body Handle	Ellipsoid shaped body with flaring cavity Deep body with wide belly Loop shaped handle with spiral design at top end. Flat leaf shaped prostration on the top of the handle	✓ Gap between handle hand ✓ Body is enough Handle is wide enough ✓ Good grip ✓ Handle thickness is enough Handle shape is comfortable Weight is comfortable ✓ Empty cup Filled with beverage ✓ Easily stackable
Cup 02 – Duo (6689)  Height – 62mm Width – 84mm Thickness – 4mm Handle height – 30mm Handle width – 25mm Handle thickness – 18mm Volume – 200ml Weight – 180g	Body Handle	Cylindrical shaped body with narrow cavity Shallow body with narrow belly Stackable foot Small Curved handle with broad handle thickness. Flat and smooth surface	Gap between handle and body is enough ✓ Handle is wide enough ✓ Good grip ✓ Handle thickness is enough Handle shape is comfortable Weight is comfortable ✓ Empty cup ✓ Filled with beverage ✓ Easily stackable
Cup 03 – Sabri (6489)  Height – 58mm Width – 99mm Thickness – 4mm Handle height – 45mm Handle width – 25mm Handle thickness – 10mm Volume – 190ml Weight – 196g	Body Handle	Cone (frustum) shaped body with narrow cavity Deep body with wide belly Circular cavity and square foot Angular shaped handle Flat surface with wide handle thickness Flat leaf shaped prostration on the top of the handle	✓ Gap between handle and body is enough ✓ Handle is wide enough ✓ Good grip ✓ Handle thickness is enough Handle shape is comfortable Weight is comfortable ✓ Empty cup ✓ Filled with beverage Easily stackable
Cup 04 – Flower (9789)  Height – 57mm Width – 99mm Thickness – 4mm Handle height – 43mm Handle width – 26mm Handle thickness – 17mm Volume – 260ml Weight – 210g	Body Handle	Hyperboloid shaped body with Flaring cavity Shallow body with wide belly Stackable foot Angular shaped handle Flat surface with wide handle thickness	✓ Gap between handle and body is enough ✓ Handle is wide enough Good grip Handle thickness is enough Handle shape is comfortable Weight is comfortable ✓ Empty cup Filled with beverage Easily stackable
Cup 05 – Monro (5989)  Height – 68mm Width – 94mm Thickness – 5mm Handle height – 45mm Handle width – 33mm Handle thickness – 11mm Volume – 250ml Weight – 197g	Body Handle	Cone (frustum) shaped body with Narrow cavity Deep body with wide belly Circular cavity and square foot Square shaped handle Curved surface with narrow handle thickness	✓ Gap between handle and body is enough Handle is wide enough Good grip ✓ Handle thickness is enough Handle shape is comfortable Weight is comfortable ✓ Empty cup Filled with beverage Easily stackable

4.1 FACTORS CONSIDERED WHEN CHOOSING PORCELAIN TEACUPS

The study examined the factors that influence the choice of porcelain teacups. Six key factors, including colour, body shape, handle design, grip, weight, and size, were identified based on responses to a questionnaire. The grip was the most important factor for the majority of respondents, as it helps keep the teacup steady within the fingers effortlessly. The container's colour also had an impact on how consumers perceived the flavor and quality of the beverage (Yang et al., 2019). The colour of the teacup was also important, with white being the preferred colour as it highlights the cleanliness of the porcelain teacups and enhances the perception of tea quality. The body shape and size of the teacup should be comfortable for the user, and the weight should be bearable when holding the teacup with liquid inside. The study found that the handle design of porcelain teacups is crucial for comfortable handling and an enjoyable tea drinking experience.

The handle should be strong enough to support the weight of the teacup and fit comfortably into the fingers, allowing for effortless holding throughout the entire consumption process. A good grip is also essential for comfortable handling, and respondents expressed that a comfortable handle design with a good grip can greatly enhance their tea drinking experience.

4.2 EFFECTS OF TEACUP HANDLE DESIGNS TO FUNCTIONALITY AND USABILITY

In the second phase of the study, the focus was on the design and functionality of the teacup handles. Respondents were asked questions regarding the types of handles that help with easy grip and comfortable handling. The answers provided were categorized into three types: smooth handles and handles with textures and special design features, cross sections of handles, and narrow handles and broad handles.

Upon analyzing the responses, it was found that handles with textures and special design features were the most popular among the respondents. These handles are designed with decorative elements that enhance the visual appeal of the teacup while also ensuring comfort and ease of use.

The teacup handles are delicately held in place between the thumb and one or two fingers of the hand, but achieving a strong grip can be challenging. To address this, the handles are designed to be in average sizes to eliminate heavy weight and bulky nature, making it easier to hold the teacup steadily and effortlessly. The handle design should also be strong enough to bear the full weight of the teacup and comfortable enough to fit the fingers, allowing for a good grip and effortless handling. This is important to ensure an enjoyable tea drinking experience.

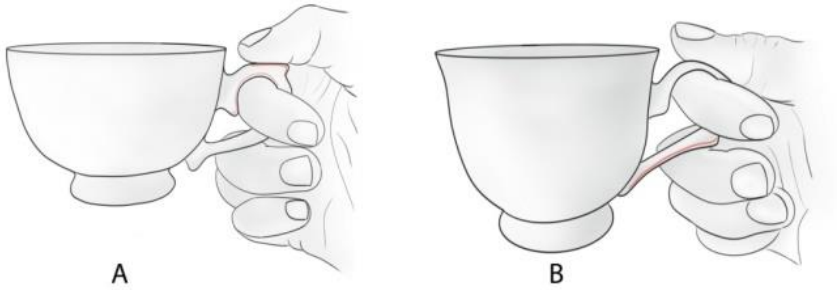


Figure 4: Holding teacups
(Source: author Creation)

Protrusion on top of the handle in image (A) helps to rest the thumb on it and protrusion inside fits the first finger firmly to the interior curve of the handle. The curve in the bottom of the handle in image (B) helps to fits second handle to the outer curve of the handle. These special design features ensure the grip of the handle keep the teacup steady. In summary, the design and functionality of teacup handles play a crucial role in the overall usability and user experience of porcelain teacups.

4.3 PORCELAIN TEACUP - USER INTERACTION

The tactile sensation of holding a teacup and bringing it to the lips affects the taste of the tea. The size and thickness of the rim also impact the psychological response to the taste of the tea. Teacups are held with the dominant hand by pinching the thumb and index finger around the handle, with the middle finger supporting underneath. Placing the thumb on top of the handle and curling the index finger around it, while following the shape of the handle with the middle finger, allows for a balanced grip that lets the user hold the teacup effortlessly while drinking tea.

The size and shape of a teacup handle affects its ease of use, especially for different genders. Men have shorter and larger fingers, making it difficult to hold teacups with narrow handles steady even with the thumb pressing firmly. Women with long and thin fingers find it easier to hold teacups with narrow handles. Holding teacups with broad handles is difficult for men, as they require the support of the middle finger, whereas women can hold them steady with just the thumb, index, and middle fingers.

4.4 PRACTICAL CONSIDERATIONS OF PORCELAIN TEACUPS IN MANUFACTURING

The manufacturing process of porcelain teacups is a complex procedure that involves several practical considerations. Porcelain is a material that undergoes shrinkage due to the removal of moisture during the drying and firing processes. The amount of shrinkage depends on the manufacturing method used for the product. Therefore, a shrinkage allowance has to be given to the actual scale of the product during the product development phase to avoid any issues. Teacups are usually manufactured using the jollying technique of the forming method, and reinforcement is given to the item to prevent it from dropping down during the firing process.

The weight of the handle also has an effect on wrapping the item during the firing process. To prevent the rim of the item from dropping down, reinforcement is used, which melts and flows down to increase the strength of the lower body part of the item. Finally, teacups are fired at a maximum temperature of 1350°C to ensure that all materials start to melt and form a strong, durable product.

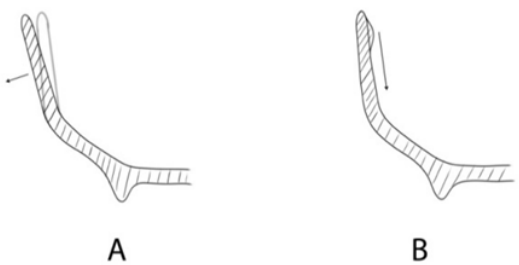


Figure 5: Reinforcement
(Source: Author Creation)

Design experts recommend a convex cross-section for teacup handles and placing them approximately 10mm below the lip of the cup to prevent handle-related defects during manufacturing, such as changes to the cup's circular shape due to handle weight during firing. Additional measures include fixing the handle at a certain angle and placing a reinforcement point where the handle attaches to the cup to increase surface area and minimize handle cracks during manufacturing.

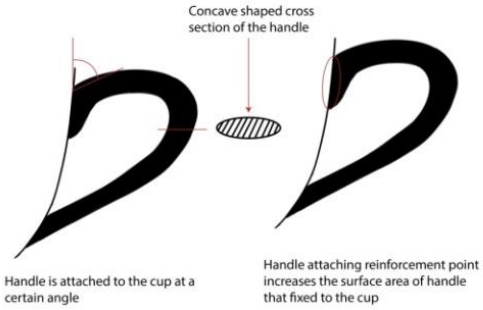


Figure 6: Measures taken for handle attaching
(Source: Author Creation)

4.5 INTERACTION BETWEEN TEACUP, SAUCER AND HANDLE

The design of the foot of a teacup and the center of its saucer are intended to match in order to provide stability to the teacup on the saucer. The handle of the teacup is designed to remain within the diameter of the saucer, and the curve of the saucer is kept from touching the handle to allow for easy handling by the user.

To maintain this design, the handle attachment point is located approximately 10mm below the rim of the teacup. Additionally, the handle is situated lower than the teacup to prevent any disruption when the saucer is placed on top of the teacup. These design features have been developed to minimize any issues that may occur during the use and handling of the teacup and saucer set.

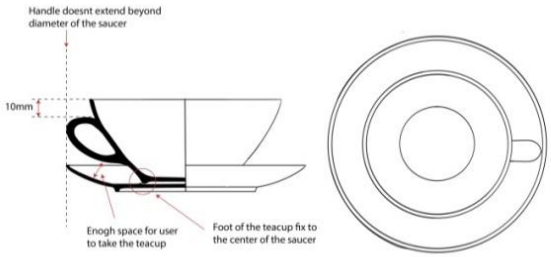


Figure 7: Interaction between teacup and saucer
(Source: Author Creation)

4.6 HANDLE DEFECTS

Observations suggest that the design of the handle in teacups can significantly impact the occurrence of defects during production. Teacups with handles directly connected to the body have higher defect rates compared to those with handle attaching reinforcement points. This indicates that handle design plays a crucial role in achieving a teacup with good finish and quality. By incorporating handle attaching reinforcement points in the design, the occurrence of handle cracks and subsequent defects can be reduced, leading to a higher quality production of teacups.

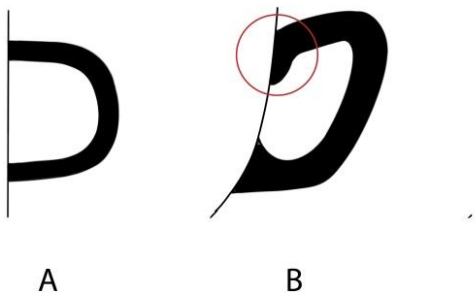


Figure 8: A - Direct fixing, B - Handle attaching reinforcement point
(Source: Author Creation)

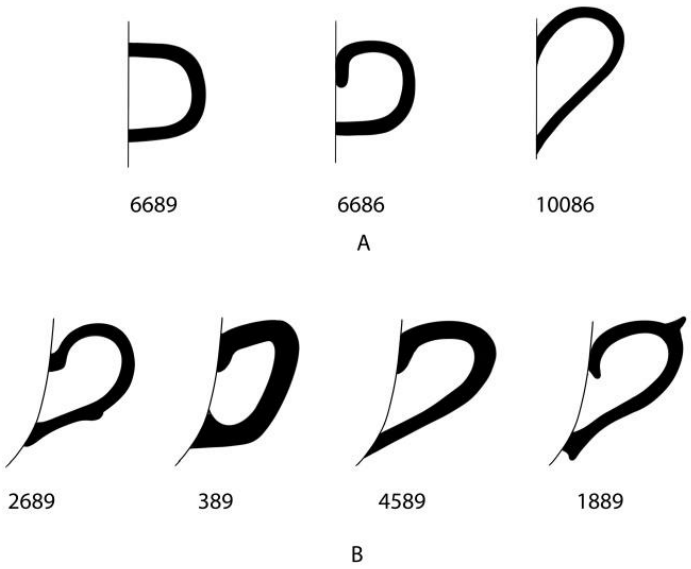


Figure 9: A - Handles with relatively high defects, B - Handles with relatively less defects
(*Source: Author Creation based on randomly selected handle designs of DPPLC*)

5. Concluding Findings

This research has highlighted the significance of handle design in the design, ergonomics, and manufacturing of porcelain teacups. The study found that user comfort, particularly grip and ease of use, is a key factor in the selection of porcelain teacups for regular usage. The results showed that broader handles were preferred by males while narrower handles were preferred by females. Gender differences in grip strength and tactile sensation, as well as variations in finger size and dimensions, were identified as factors that influence the comfort and holding position of the teacup handle.

In addition, the practical considerations of porcelain teacup manufacturing were examined, including shrinkage allowance, reinforcement, handle cross-section, and surface area of attachment. The relationship between the teacup and saucer was also discussed, with the saucer providing support to the teacup in handling.

Overall, this research emphasizes the importance of considering various design aspects when designing teacup handles, including aesthetics, ergonomics, and practical manufacturing concerns. By taking these factors into account, it is possible to create a feasible product with high-quality and improved user experience.

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