Aug 11th, 12:00 AM

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Citation

Börekçi, N., and Korkut, F. (2020) Morphological Exploration of the Turkish Tea Glass for Engaging Design Solutions, in Boess, S., Cheung, M. and Cain, R. (eds.), *Synergy - DRS International Conference 2020*, 11-14 August, Held online. <https://doi.org/10.21606/drs.2020.382>

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Morphological Exploration of the Turkish Tea Glass for Engaging Design Solutions

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doi: <https://doi.org/10.21606/drs.2020.382>

Abstract: This paper discusses the pedagogical approach followed for an educational project focusing on engaging design solutions for tea glass sets in the Turkish context. The project aimed at incorporating local values, usage patterns and rituals to enhance user experience and user-product interaction, reinforce product value, meaning and longevity, and develop more engaging and sustainable solutions. The project was conducted in collaboration with a major glass manufacturing company and involved 28 junior year industrial design students. Eighty preliminary and final design solutions for tea glass sets were analysed. The approaches that students adopted for addressing engaging practices and sustainability were gathered under tea drinking practices, tea serving practices, and marketing of the tea glass sets. The strategies followed by the students to differentiate their designs included analogies and historic precedents, body proportions, contour lines, differing inner and outer walls, axial asymmetry, visual and tactile patterns, and atypical typologies.

Keywords: turkish tea glass; engaging design; morphological analysis; design ideation

1. Introduction

Since the late 1960s, there has been a significant increase in the use of single-use throw-away items for packaging, as well as for serving hot and cold drinks and beverages, substituting glass with paper or plastic alternatives (Lamagna, 2019). Throw-away cups are used more and more in many public places such as restaurants, bakeries, tea and coffee shops, as well as institutional canteens, vending machines and workplace kitchenettes (Wright, Gregory & Kalaian, 2011). They are preferred for being lighter, taking less space in storage, and eliminating the burden of cleaning and storing after usage in high numbers, as they can be simply thrown away. But, alongside the health-related concerns that come with these substitute materials for throw-away cups, their usage also ends with large quantities of waste, leading to disastrous environmental consequences (The Guardian, 2018). They

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also lead to changes in the daily practices and rituals of serving and consuming foods and beverages, affecting the local and cultural values associated with them.

Today, drinking tea in slim-waisted glasses is a widespread daily practice in Turkey, and tea is a favourite hot drink at any time of the day. Turkish society has been introduced to the samovar and tea farming in the late 19th century through Russian economic relations (Sözenler, 2018). The Turkish Republic started tea farming in the 1940s in the Eastern Black Sea region. Whereas the society was mostly familiar with the Turkish coffee consumed in homes as well as in coffee houses (Birsell, 2017), it did not take long for the 20th-century Turkish society to embrace tea brewed in samovars and drunk in the typical small tulip-shaped glasses. Today, the average tea consumption per person is about 1300 glasses in a year (Akyıldız, 2019), and 400 million tea glasses are sold within the local market each year (Radikal, 2009), making this tiny bulbous glass the most popular tableware item in the local market.

1.1 Preparing and Drinking Turkish Tea

The Turkish tea is typically brewed in a two-piece teapot (Figure 1). The bottom part is larger in volume and is used to boil water. The top part is smaller in volume and is used to brew the tea leaves. After placing the desired amount and batch of tea leaves, boiling water is added to the top pot and left to brew for around 15-20 minutes, while the bottom pot boils water on the stove keeping the top pot hot. When the leaves no longer float on the tea and sink into the pot, the tea is considered ready to be served.

Tea is served in bulbous thin-waisted tea glasses (Figure 1). The glass forms a wide-section bulb from the base upwards at the bottom part, then curves into a thinner section waist, and opens up conically for a wider rim in the top part. First, the brew is poured into the glass in a small amount (around one-fourth of volume), with the help of a strainer to collect the tea leaves. Then hot water is added until rim to lighten and thin the brew. The wide bottom part of the tea glass before the waist is used as a reference for the amount of brew to be poured. The amount of brew in reference to the amount of hot water changes the strength of the tea. A serendipitous functional benefit of the bowl curve turning into a narrower waist is to keep the tea leaves not caught by the strainer in the bowl section as the tea glass is tipped toward the mouth for a sip. Transparency of the tea glass is essential to be able to see while filling the glass with tea for an appreciated taste and colour. The sign of a well-brewed tea is its colour, a clear and bright reddish-brown, sometimes referred to as “rabbit’s blood.” Some prefer the tea glass full up to the brim, while others prefer an amount of the glass left empty, for the lip not to burn from contact with hot glass. This room is called the “lip margin.”

The tea glass is small in size and therefore accepts little volume. Generally, many glasses of tea are drunk one after the other, though, tea drinking is a slow process done in numerous sips, and the glass is never finished in one gobble. Taking sips while drinking tea is a repetitive action of placing and replacing the glass on its saucer. The tea glass typically pairs with its saucer, which can be made from porcelain, glass, metal, or plastics. The typical

and culturally noteworthy saucer is the red and white petal formed porcelain saucer with gold gilded flower patterns at the centre and on the white petals (Figure 1). According to Güneş (2012) the red of the petals on the saucer refers to the colour of the well-brewed tea, whereas the white colour matches with the brightness and transparency of the tea. Tea is served with sugar, which may be cubes, granules, or what is known as the sugar rocks, and can also be served with slices of lemon. Cubes and granules are stirred into the tea, while sugar rocks are bitten with each sip of tea. Therefore, the tea glass needs a saucer for the sugar cubes or rocks, lemon slice, and also to rest the teaspoon that will be used more than once.

The tea glass is never held while presenting it; it always comes with a saucer while transferring from host to guest. In a crowded group, tea is served on a tray, and when everyone finishes, the glasses are collected on the tray to be refilled with tea. A service concern is for the tea glasses not to get mixed up and return to their original drinkers. Some practices for ensuring this, include using tea glasses of different forms, patterns and colours, using different saucers and teaspoons, and using small distinguishable accessories attached to the glasses. When a guest no longer wants his/her glass to be refilled, s/he places the teaspoon on the rim of the glass as an indication. During an extended tea service, fresh tea is brewed every time the top pot finishes.

Figure 1. Turkish teapot, tea glass and saucer.

Although tea making, serving and drinking practices still maintain their distinct local character outlined above, intensifying after the 1980s, these practices have been altered and diversified with economic liberalization, rapid urbanization, and introduction of alternative paraphernalia including mugs, disposable cups, tea bags and locally designed Turkish tea machines particularly in office environments. “Tea universe” in today’s Turkey is a hybrid universe embodying global as well as local products and practices (Öğüt, 2009; Timur & Er, 2006).

1.2 Motivation for the Study

Based on the sustainability concerns mentioned earlier, and on the popularity of the Turkish tea glass in the local market, we decided to work on an educational project on the design of Turkish tea glass sets. The challenges for us were working with glass as the material, working on mono-body products (those with no components), and working on the design

of a well-explored glass typology allowing limited design interventions. This paper describes the design process of this educational project and discusses the methodological strategies followed for overcoming these challenges towards the delivery of diverse and engaging design solutions for tea glasses. First, the paper describes the methods and procedures offered by the design studio tutors for the generation of diverse design ideas. Secondly, the paper presents the design approaches and strategies followed by students in responding to the sustainability considerations, and in the diversification of their design ideas from those of their peers and from products available in the market. The paper concludes with the implications of the methodological approach in the exploration of engaging and sustainable design solutions on design divergence in industrial design education.

2. The Project

The project was carried out in the 2017-18 academic year, with 28 junior year industrial design students at Middle East Technical University in collaboration with LAV, a major Turkish glass manufacturer. The topic of the project was “Tea Serving as a Sustainable and Engaging Practice.” Regarding the increasing usage of throw-away single-use paper or plastic cups in public facilities in Turkey, it was found necessary to reconsider tea serving and drinking practices along with the basic accessories involved: tea glass, saucer and sugar bowl. The project addressed design for sustainability considerations in terms of developing engaging design solutions. Design solutions incorporating local values, usage patterns and rituals enhance user experience and product-user interaction, reinforce product value, meaning and longevity, and lead to more engaging and thus sustainable solutions. Tea serving and drinking as a focal practice offer rich scenarios for envisioning engaging design solutions.

The target user group was local users, and the usage environment was households, offices, cafeterias, tea houses and outdoor vendors. The tea glass and saucer set, and the sugar bowl were expected to be marketed separately while being the members of the same product family. The main goal of the project was to rethink serving tea, and to develop engaging and thus sustainable design solutions incorporating local values, usage patterns and rituals. The project duration was a total of eight weeks. The project process included the stages of design research, idea generation, technical feedback, and design iteration, development and finalisation (Figure 2).

2.1 Design Research

For the design research phase, students were asked to form nine teams. Teams first carried out field observations and interviews about tea serving and drinking practices, and tea sets and accessories used in private and public spaces, with diverse users and in different use environments (Figure 3, Left). Each team prepared a poster presentation to share the outcomes with the class. Teams were also asked to conduct a literature search on different topics assigned to each, using print sources, online sources, the literature, and a field survey.

The topics ranged over from glass manufacturing to tea culture. Again, teams prepared a poster presentation for the class (Figure 3, Right).

Following the discussions on insights gained as a result of the design research, the students continued working on their projects individually.

Figure 2 The design process followed for the project.

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Figure 3 Left: User observation poster (Team 8). Right: Literature search poster (Team 4).

2.2 Design Ideas Portfolio

An intense idea generation stage was carried out for the development of diverse and numerous ideas. The project was primarily a search for form; therefore, it was important for the students to make 2D exploration with freehand sketching before making final design decisions (Tovey, 2012). The 2D exploration was supported with 3D prototyping (simple paper-based and clay-based models) to envisage the forms for spatial manipulation.

Product Form Analysis: Students were first asked to carry out a product form analysis to understand the morphology of the tea glass set items. They brought glassware samples to class to form a shared product library. From this pool each chose two examples of tea glasses, one saucer, and one sugar bowl, took their photographs, scaled these photographs to full scale, made print outs, then measuring both the actual glass and the printouts, they made 3:1 scaled technical drawings with half-sections for each item (Figure 4, Left). While transferring the curves of the glass items from 1:1 to 3:1 scale, the students had the chance to analyse the contours of the product and its sections, building awareness on the design decisions related to the production processes of glass, and also the usage of patterns on the form. On these technical drawings, they used tracing paper to variate the geometrical configurations including proportions of various parts, such as bowl, waist and rim, and the possible effects of changing curve radii.

Sketching and Prototyping Workshop for Sugar Bowls: The following session involved a one-day workshop for 2D freehand sketching and simple 3D prototyping. The particular focus was sugar bowls. The workshop was carried out by an invited lecturer. The task given to students was the making of numerous sketches on A6 size paper, exploring forms, and searching for proportions. The outcomes of the session were two sugar bowl design solutions and their mock-ups (Figure 4, Right).

Figure 4 Left: Example of product form analysis. Right: Example of sketching workshop outcomes.

Morphological Chart: The following session was carried out for idea generation on tea glasses using the morphological chart method. The morphological chart is a table used for exploring various form alternatives for the components of a product (Roozenburg & Eekels, 1995; Wright, 1998; Smith, Richardson, Summers & Mocko, 2012). This exploration is done by first decomposing the product and identifying around 8 to 12 sub-functions. Then, these sub-functions are listed on the first column of the table. For each row representing a sub-function, six alternative sub-solution ideas are sketched. When the chart is complete, there will be many ideas of partial products or components. The final step is to combine the selected sub-solutions into an overall solution, adapting the sub-solutions to each other and to the overall design in terms of characteristic features, product usability and production processes. As the tea glass is a single piece object that does not have any obvious functional components, in deciding on the sub-functions, we looked at the form and determined the physical features. We gave the students a list of sub-functions for a tea glass for them to use in their morphological charts (Table 1). The expected outcome of the session was six alternative tea glass design solutions, together with their saucers, and mock-ups of two selected alternatives (Figure 5).

Table 1 List of sub-functions for tea glasses

A: Sub-function 1	Variations in form based on vertical proportions
B: Sub-function 2	Variations in form based on diameters of characteristic body sections
C: Sub-function	The contour of the body (vertical curvatures and lines)
D: Sub-function 4	The form of the rim
E: Sub-function 5	The form of the base
F: Sub-function 6	The form of the waist
G: Sub-function 7	Patterns as surface treatments (e.g., graphic applications, frosting, laser etching, engraving, sandblasting, gilding)
H: Sub-function 8	Patterns as form (relief designs)
I: Sub-function 9	Handles / glass holders
J: Sub-function 10	Stem / foot
K: Sub-function 11	Saucer: variations in top view
L: Sub-function 12	Saucer: variations in section incl. the way the tea glass meets the saucer

Figure 5 Left: Example of a morphological chart. Right: Example of outcomes for the morphological chart exercise.

2.3 Design Detailing and Finalisation

Visit from Firm and Expert Feedback: The design ideas portfolios prepared by the students in the idea generation stage of the project were evaluated in class by the experts from the collaborating firm. Distributing into four parallel critique tables, the experts gave design and technical feedback to students on their 2D and 3D prototypes (Figure 6, Left). Also, an expert on 3D digital modelling carried out a seminar with the students to help them with their glass modelling and rendering skills (Figure 6, Right).

Factory Visit to Firm: We also conducted a visit to LAV's manufacturing plant in Kütahya to get a first-hand look at the production processes. From then on, the students continued with the development of their design ideas.

Figure 6 Left: Expert feedback given in the studio. Right: Seminar on 3D digital modelling and rendering of glass.

Preliminary Evaluation: The preliminary evaluation was carried out two weeks after the factory visit. Experts from LAV attended the evaluation session and provided feedback related to design, production and marketing (Figure 7, Left). For this evaluation, the students were expected to converge their design ideas and suggest two alternative tea glass sets. The submission of two alternative design solutions is a strategy we utilise in studio projects; rather than deciding on a final solution early in the process, we encourage *divergence* (Jones, 1980; Goldschmidt, 2016), and thus thinking in *parallel lines of thought* (Lawson, 2005),

which means thinking on more than one design idea at the same time. The benefits of this strategy are:

- to allow the flow of ideas and design synthesis to extend into the design process, for preventing early made premature design decisions.
- to crosscheck and evaluate significant ideas in reference to one another, and
- to have alternative ideas to transfer and combine from (Cross, 2000) during *convergence* (Jones, 1980; Goldschmidt, 2016), while the final design is being developed.

Design Finalisation and Final Evaluation: Three more weeks were allowed in the calendar for the students to carry out user-product trials, select from among their two design alternatives, work out the design details to finalise their designs, and prepare their final 2D and 3D presentations. For the final evaluation, the students were expected to submit one design solution for a tea glass and saucer set, and a sugar bowl, together with their packaging. The submission requirements for the final jury were presentation boards, technical drawings, and rapid-prototyped, paper-based or clay-based models of all items (Figure 7, Right).

Figure 7 Left: Preliminary evaluation. Right: Final evaluation.

2.4 Analysis of Tea Glass Set Design Solutions

We carried out a visual content analysis (van Leeuwen & Jewitt, 2001; Krippendorff, 2004) on the submissions that the students made both for the preliminary and final juries, to identify the approaches and strategies that they employed for their design solutions. We determined the particular focus as the tea glass designs, as this was the focal element of the product family, affecting the design approach adopted for the other members of the family, namely the saucer and the sugar bowl. Fifty-four (out of 56) preliminary and 26 (out of 28) final submissions for design ideas (80 design ideas in total) were analysed in terms of their formal qualities in combination with functional and tea culture-specific considerations. In our analysis we also took into consideration, when relevant, the names given to the designs, the project descriptions, and the ways in which the designs were presented within their context. The findings were grouped into two major themes: *approaches to engaging practices and sustainability*, and *design strategies*.

3. Approaches to Engaging Practices and Sustainability

Looking at the design solutions offered and their project descriptions, we identified objectives that students adopted as their *approaches to engaging practices and sustainability* while responding to the design problem. We grouped these approaches as *tea drinking practices*, *tea serving practices*, and *marketing of the product sets*.

3.1 Tea Drinking Practices

Tea drinking was considered as a process from pouring tea into tea glass to comfortably and safely drinking tea with repetitive actions of holding, removing from the saucer, sipping, and replacing onto the saucer, all taking into account the typical local practices.

Guidance for adjusting tea strength: Solutions offered specialized patterns (e.g., rings and layers) for marking brew levels on the tea glass indicating the ratio between brew and hot water, for light and strong tea (Figure 8, Left).

Easy access to sugar bowl: Suggesting that sugar granules fall out during service, solutions included wide rims for sugar bowls for ease of access, and also tilted bowls that can be turned to serve in all directions (Figure 8, Right).

Figure 8 Left: Adjusting brew levels with ribs on the glass. Right: Sugar bowl rotating in all directions.

Stirring sugar in tea glass: Solutions considered a wide section for the bottom part of the tea glass to allow space for stirring in sugar with a teaspoon (Figure 9, Left).

Comfortable hold of tea glass: Solutions offered a comfortable hold of the tea glass by holding in one palm, holding within two palms, holding with two fingers from the rim, neck, waist and bowl, pinch holding from a handle, and support-holding from under handles at two sides (Figure 9, Right). Other solutions considered making the tea glass heatproof for the hand with a double-walled base section while slowing down the cooling of the tea.

Figure 9 Left: Wide bowl section for ease of stirring. Right: Different ways of holding tea glass.

Sipping the tea: For a comfortable drink of the hot liquid content, solutions defined a “lip margin” for the tea glass, as well as a specific lip contact area to always drink from the same side on the rim.

Accident-proofing: Solutions offered ribs and indents on various sections of the tea glass to prevent slipping from hand. Others provided a wide or thick sham (base) to prevent the tea glass from tipping over (Figure 10).

Easy replacement of tea glass on the saucer: Another objective addressed was the easy removal of the tea glass and its easy replacement back on the saucer, during the repetitive action required for drinking tea. Having a wide saucer diameter with a deep section, an outward extending conical or wavy skirt to catch the base of the glass, and using radial asymmetry for the form of the saucer, were among the solutions offered for a balanced service and usage (Figure 10).

Figure 10 From left to right: Glass with a wide base, glass with ribs; saucer with a high and wavy skirt; asymmetrical saucer.

3.2 Tea Serving Practices

Tea serving was considered as a presentation medium of the tea glass set, also contributing to the tea drinking experience in terms of usage, visual appeal, and hosting rituals.

The set with a focal item: The tea glass sets had a focal item which mostly was the tea glass, but in some solutions, the sugar bowl or the saucer were offered as the focal item in the set (Figure 11). As a strategy, the items of the tea set were in harmony, sharing similar proportions and design features. Some solutions brought forth the tea glass in the set, giving

it more characteristic features, and a few examples emphasized the saucer with distinctive features.

Visual appeal: Solutions aimed for an attractive look to differentiate, surprise, and stand out among alternatives in the market, be displayed in home showcases, convey that the set is exclusive to guests, and provide a thematic visual identity for commercial environments. Solutions offered patterns for pleasing, dynamic and playful reflections; forms that provide variations in appearance from different angles (Figure 12, Left); forms that convey a stable and balanced look; forms that present a slim and elegant contour; and forms that convey generosity and luxury, achieved through their curves.

Figure 11 Left: Set with sugar bowl as the focal item. Centre: Tea glass and saucer sharing design features. Right: Design emphasis placed on the saucer.

Stackability: Solutions offered stackability for space-saving purposes, as well as for storing *in style*. Stackability was considered for the tea glasses as well as the saucers (Figure 12, Right).

Figure 12 Left: Visual appeal achieved with different optical effects. Right: Stackable saucers.

Comfortable hold of saucer: Another aspect was the ease of picking up the saucer from the service tray, table or counter, and handing it out for serving. Solutions considered easy lifting of the saucer from a flat surface with its wide and angled skirt, comfortable pinch hold for the saucer, and an appropriate diameter for the saucer for a comfortable two-finger grip from the rim. The tea serving solutions included asymmetrical saucers with one corner extending outwards for offering a lemon slice, cookie, sugar, or sweet on the side (Figure 13).

Figure 13 Tea serving solutions achieved with saucers.

3.3 Marketing of the Tea Glass Sets

The cultural significance and value laid on the tea glasses, namely, having widespread use in homes as well as in public places, being used daily as well as for special occasions, being historical as well as contemporary, and symbolising the care that the homemaker or host gives to his/her family or guests, were reflected in the marketing approaches adopted for the tea glass sets.

Sales channels for the tea glass sets: Affordability and wide accessibility of the tea set was observed to be a significant concern. The solutions suggested for the tea glass sets to be distributed through mass-market retailers. Solutions were shown on shelves displaying their convenient stackability, and that the packages of individual items belong to the same set.

Tea glass sets were also offered as a touristic gift pack with symbolic value to be sold in touristic shops and airport stores, and also as housewarming or wedding gifts to be sold in specialised shops.

Packaging of the product family items: The tea glass set solutions were offered as sets with all items packed together, only tea glasses and saucers packed together, and tea glasses, saucers, and sugar bowls packed separately.

In the Turkish market, tea glasses are generally sold in sets of six. The design solutions offered for tea glass and saucer sets included sets of two, three, and four (besides six). This strategy was offered for providing the consumers with the possibility of combining different models (e.g., three of each), buying in required amount (e.g., only two packs of four making 8 in total, instead of two packs of 6 making 12), and replacing the few broken items of larger sets (e.g., buying a set of two).

4. Design Strategies

We observed that students used several strategies while searching for origins for design ideas, generating diversified design ideas, and developing them into final design solutions. These strategies were identified from the idea content of the designs (e.g., theme, source of inspiration, the reason for a design feature), and from a morphological analysis of the designs.

4.1 Design Precedents

Employing analogies: Students employed analogies from nature, man-made things, and actions in their design ideas (Figure 14). Analogies from nature included honeycomb, leaf, water lily, tulip, pomegranate, magpie, shark fin, reptile scales, pinecone, water ripples, diamond and flame. Analogies from man-made things included the dome, minaret, and envelope vests. Analogies from actions included melting, knotting, pinching, posing, flaming, whirling, wrinkling and twisting. Using this group of analogies required effort in representing the dynamic qualities of actions in a stable product, making use of the optical qualities of glass, and exploring the limits of production constraints for this material.

Employing historic precedents: Although in a limited number, we observed references to precedents. One historical reference was used in the patterns to be applied on the tea glass set items (Seljukian geometrical patterns), and one cultural reference was used for form (oriental and central Asian bottles) (Figure 14).

Figure 14 From left to right: analogies of twist, diamond and acorn; geometrical pattern and curvy form with references to precedents.

4.2 Design Morphologies

Variations in body proportions: Form explorations of the tea glass were based on how they were divided into volumetric parts (base, bowl, waist/neck and rim). The general tendency was to signify the bowl and the rim as separate parts divided with the thin waist. The waist could be a curve defining a third body part on the glass contour, or an edge between the bowl and the rim. The bases and rims were mostly left plain with radial symmetry, complying with mass production constraints.

Variations in proportions were made both horizontally and vertically, affecting the volumetric sectioning of the tea glass (Figure 15). Explorations of horizontal variations in proportions refer to the ratio among the characteristic diameters of base, bowl, waist and rim. Variations in these diameters defined the inner and outer extremities of the characteristic curves of the tea glass. Explorations of vertical variations in proportions refer to the ratio of the heights of the base, bowl, waist and rim against each other and overall glass height.

Variations in the height proportions of each part affected the volume defined for each,

emphasized the distinction between the bowl and rim in particular, raised or lowered the centre of gravity of the tea glass, and overall affected the typology of the resulting tea glass.

Variations in contour lines: The tea glass contour is what characterises the tea glass typology; this contour is constituted by various curved and straight lines and the articulations between them. Characteristic contours were defined with single curves (the arc traveling from rim to base), two or more straight lines forming zigzags, two curves in opposing directions, combinations of three curves or more used in different directions, and combinations of multiple straight lines and curves (Figure 16). A general tendency was to use curves mostly on the contour of the bowl section, and straight lines for the contour of the rim section. Subtle contours followed the characteristic contour of the tea glass typology with smoother articulation between sections. Emphasized contours used more uneven articulation between sections, following strategies such as wide rim, wide base or wide bowl diameters, in combination with narrow diameters for the waist.

Figure 15 Variations in body proportions and contour lines.

Differing inner and outer walls: Differentiating the cross sections of inner and outer forms of the tea glass body was another strategy followed. Wall sections were offered as either full with glass, or as double-walled. In both cases, the optical effect would be fully revealed when the glass is full of tea (Figure 16, Left). A similar strategy was used for the base of the tea glass by making a thick sham filled with glass for a heavy appearance. This strategy resulted in tea glasses with smaller inner volumes. It was seen that this design strategy was explored for the preliminary ideas, and was quit altogether for the final design solutions.

Figure 16 Left, two: Inner and outer walls with different cross sections. Right, three: Axial asymmetry.

Axial asymmetry: Solutions exploring alternatives to a radial symmetry included tipping the axis in an angle, and breaking the vertical axis in an angle half-way through its height. Others included making the glass base wider on one side of the axis, making rim wider and extending to one side, using a flat surface on one side, and using parallel contour curves (instead of mirrored) on both sides of the central axis. There also were forms close to a soft square. Strategies for asymmetry were explored for the preliminary ideas and were mostly abandoned for the final design solutions (Figure 16, Right).

Variations in visual and tactile patterns: Pattern was used as a strategy for forming, emphasizing or softening the contour (Figure 17). In some solutions, the pattern was the geometrical form of the glass itself. Patterns were mostly applied as a texture on the bowl and waist sections. Patterns were used along the contour, and against the contour, contributing to the visual appeal of the tea glass. Subtle patterns used less depth and lower numbers of repetitions, resulting in optical effects. Emphasized patterns used more depth and higher numbers of repetitions, resulting in a more visible and tactile texture.

Figure 17 Patterns as form, as texture, and as optical effects.

Atypical typologies: Solutions explored ways for diverging from the typical tea glass (Figure 18). Solutions showing significant divergence from central tea glass typologies can be considered as extreme variations in body proportions or in contour lines, or a unique combination of them. These explorations resulted in *atypical* tea glass typologies referring to other product categories with their own typologies (e.g., vase, jug, tumbler, bowl).

Figure 18 Atypical tea glass typologies.

5. Discussion

Making a general overview of the process adopted for the project and the outcomes of each stage, we observed that the students were able to offer variety in their designs and bring novel solutions to the design of tea glasses, saucers and sugar bowls. We also observed that the design detailing and finalisation level of the projects were high. Many flaws in the preliminary designs making them inappropriate for industrial glass production were resolved for the final submissions. The quality of 2D and 3D presentation was mostly high, demonstrating that the technical aspects of the glass items were committed to production standards. The eight-week duration allocated to the project was a factor in this, but we observed that the strategies followed in the planning and carrying out of the design process have also contributed.

The research activities carried out in the early stages of the process supported the development of engaging and sustainable ideas. Students reflected on practices, habits and rituals, and were able to associate cultural values with them, and then transformed into engaging and sustainable themes.

The methodical design activities carried out with regular expert feedback supported a strong technical foundation. The project had many constraints related to material properties and production. The technical background set the project limits, but with more information, students were able to work around the constraints for variety in tea glass set design solutions. Regular expert feedback allowed students to test their designs, evaluate them and make timely critical decisions.

We observed that an in-depth 2D and 3D design exploration, and thinking with numerous alternatives supported the students in achieving diversity in their design solutions. A product form analysis combining technical drawings and freehand drawings worked well for understanding contour geometry, glassware sections, and consequently tooling considerations for the removability of glass items from the production mould. The morphological analysis helped identify the decomposition of a mono-body product in terms of its function as well as its production constraints. The product decomposition allowed the identification of various formal qualities that can be explored in terms of design and how they correspond to the functions and usage of the tea glass. Combining the partial design solutions for the decomposed features of the tea glass into alternative design solutions required a synthesis on the students' part, and in this stage of the process, students made use of the technical background they acquired.

The explicit focus of the project on local values, usage patterns and rituals offered a challenge to student designers to reinvent and reinterpret the local tea practices they were blindly familiar with, and develop engaging design solutions reinforcing product value, meaning and longevity. The collaboration with the industry, on the other hand, brought in the perspectives of external experts, and manufacturing and marketing concerns to form-giving process. These challenges coupled with the methodological approach adopted for the project resulted in i) highly specialized tea glass forms that, for example, afford precise

guidance for adjusting tea strength, comfortable pick through dimples on opposite sides, or safe sipping from a dedicated lip contact area, and ii) diverse tea glass typologies combining various strategies, for example, combining a variation in body proportions or a variation in contour lines with visual and tactile patterns.

As a final note, we need to address the complex relationships among the actors involved in the project. Kaygan (2016) posits the form-giving process as a material-semiotic practice. Reinforced with perspectives from science and technology studies and actor-network theory he offers a Foucauldian analysis of “the curve” (in the case of Turkish coffee pots) as “an idea and a guiding principle of design” mediating the design process “from beginning to end” in multiple ways, and for multiple actors. In a similar fashion, the form-giving practice experienced in this project was more than design students’ engaging with affordances or typologies; the process involved a unique web of interactions, interventions, negotiations and compromises on the part of tutors, students, and experts.

Acknowledgements: We would like to thank LAV, one of our long-term partners in collaborative educational projects, and its dedicated members involved in this project: Design Manager M. Direnç A. Gül, Product Design Specialists İsmail Malçok and Çağrı Mercan, and Product Development Engineer R. Ergin Sağlam. Their expertise and unfailing support have made this collaboration experience an exemplary one. We owe warm thanks to our colleagues and PhD research fellows, Levent Burgazlı of Eskişehir Technical University for conducting a one-day sketching workshop, and Milad Hajiamiri of Karabük University for giving a seminar on 3D modelling and rendering of glass. We would like to extend special thanks to the teaching assistants of our studio, İtir Güngör Boncukçu and Başak Topal for their outstanding support. And finally, we are grateful to our students for their commitment and excellent work that kept us challenged.

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