REINVENTING CLASSIC DESIGN FOUNDATION EXERCISES
TO INCORPORATE THE EXPLORATION OF BEHAVIOR AND INTERACTION

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1. ABSTRACT

This study investigates the elements of classic design foundations exercises in light of an increasing need to incorporate product interaction and design for emergent behaviors in the use of products into industrial design foundations. Visual and conceptual design foundations are the basic building blocks of all design disciplines, the abstract components that structure a visual language—color, texture, shape, volume, space and line. Design foundation projects balance formal and conceptual issues while emphasizing research and the skillful execution of ideas. Foundation exercises teach students how to see, think and develop an idea, and they encourage them to refine their understanding of what a design problem can be. As a result, students experience, in a compact unit, the combination of rational, intuitive, and critical thinking, and they learn to construct meaning using visual form. Industrial designers are increasingly being asked to design products and systems that incorporate interactivity. The present study examines several design foundations exercises in the Industrial Design program at the Arizona State University that extend traditional formal foundations aspects with prompts for students to consider the users of their designs, and to understand form as a bridge that enables the dialog between users and a designed product, system, or service. Form explorations address design for affordances and how interaction-oriented design of product form supports product understanding and leads to new behaviors of use.

Keywords: Design Foundations Exercises, Industrial Design, Interaction Design, Design Education.

2. INTRODUCTION

With the shift from an industrial society towards one primarily directed toward the creation and distribution of information over the last decades (Wallschlaeger 1992), the field of industrial design has been directly affected by this shift of paradigms that started to gain traction in the early 1990s. The challenges for designers have grown exponentially in this period of transformation. The chart “Trajectory of Artificiality” (Figure 1) illustrates the traditional areas of expertise and highlights the expanded scope for today’s design professionals. Designers in the past were trained for specific core areas of skills: Industrial designers predominantly created products under considerations of utility, functionality, and universal aesthetics; Interaction designers’ core expertise is centered around interfaces, inter-actability, understandability, etc. (Krippendorff 2006). Today’s challenges for our post-industrial society therefore call for an expansion of the traditional areas of domain knowledge to include a much broader set of skills to encompass form, behavior, and interaction.

One might argue that the role for designers in today’s world goes beyond Krippendorff’s proposed trajectory – The German designer Hartmut Esslinger calls for the strategic inclusion of designers in the top levels of corporate structures by highlighting the success of companies like Apple Computer “a constant strategic focus on design can be seen as the poster child for embracing design as a strategic

element of its operation" (Esslinger 2012). Therefore we could add another level to the trajectory; strategic design.

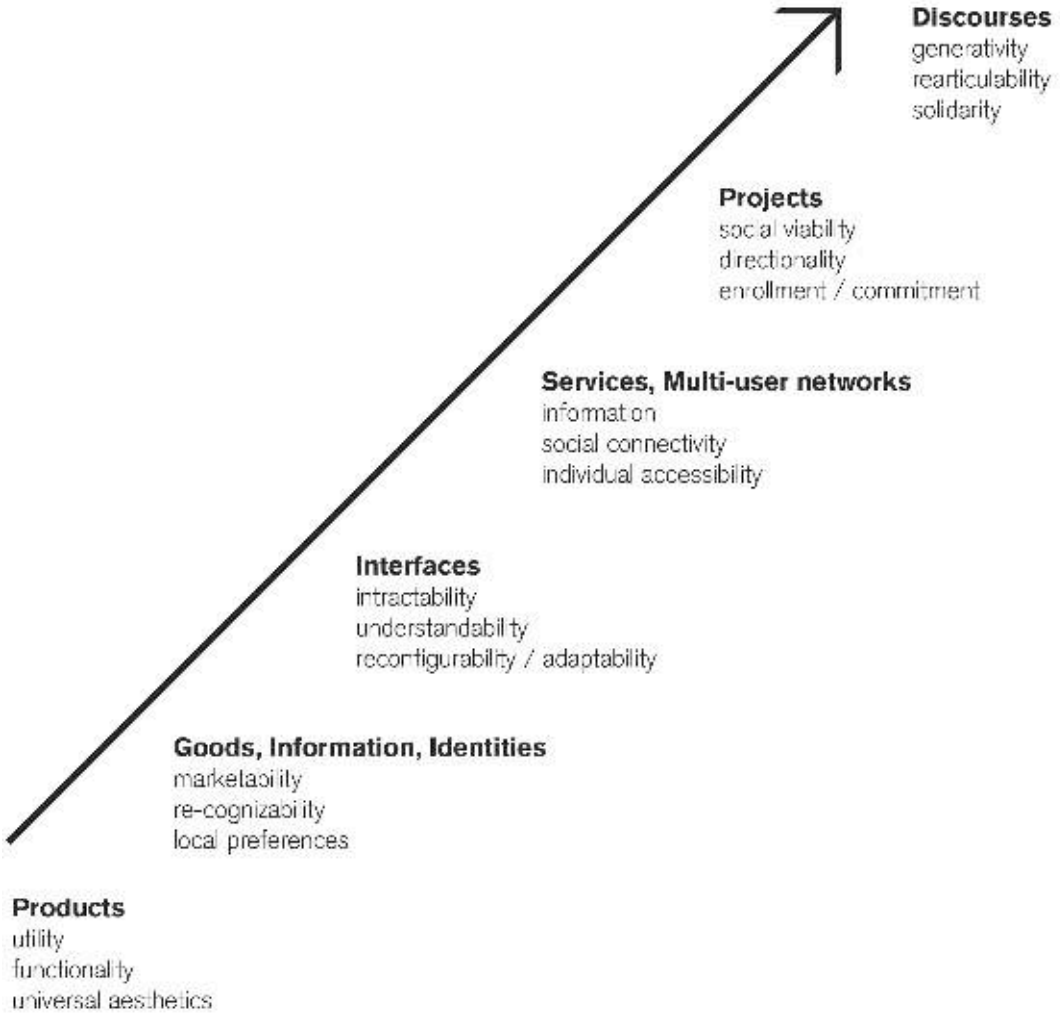

Figure 1. *Trajectory of artificiality. Source: Krippendorff (2006).*

Apple Computer is seen as a highly successful model for corporations to emulate. Left-brained stakeholders "rational power & money people" are starting to recognize the valuable contributions of that right-brained designers will bring to the table if they become involved from early on in the strategic decision making of the development cycle (Esslinger 2012).
These trends are encouraging news for the field of design that is finally beginning to overcome its partially self-inflicted identity crisis of the last decade. For designers on the other hand, this means that operating on a traditional set of skills will not be enough to take on this larger role. For design educators, this is an urgent wake-up call to re-evaluate curricula.

Design is a funny word. Some people think design means how it looks. But of course, if you dig deeper, it's really how it works. (Steve Jobs 1996)

3. CHANGING ROLES OF DESIGN EDUCATION

In the process of envisioning new concepts, designers intuitively rely on a set of skills to ideate, understand the thematic, synthesize the discovered challenges, visualize ideas for brainstorming and communication, construct tangible mock-ups for form-evaluation, and ultimately build high-fidelity models of their concepts to communicate their designs to stakeholders. These are some of the unique values that right-brained designers can bring to the table, enabling them to innovate, visualize ideas, and mediate with left-brained team members such as engineers and corporate management. Designers have the inherent potential of contributing more than just giving form to artifacts.
While past generations of designers approached challenges predominantly in a singular product-centric fashion, the increasing complexity of everyday artifacts has changed the paradigm and now calls for a much broader sensitivity of designing concepts. Today's challenges must predominantly reflect interactions across users and systems, and address concerns about the sustainability of materials, without sacrificing any of the characteristics of traditional design aesthetic.

For educators, this paradigm change poses an additional challenge: More has to be taught to prepare students for these new challenges, while in most cases the timeframe to graduation will remain, at best the same. As stated in the introduction, it has become an urgent call to action for design institutions to educate students with broader skills to become versed across Krippendorff's trajectory of artificiality. Instead of labeling foundation studies outdated or obsolete, I see them as a highly potent opportunity to sensitize students from the ground up to develop a portfolio of design skills that must go beyond the traditional values of aesthetic form giving. Design foundation exercises traditionally consist of carefully orchestrated challenges to establish a core set of design skills.

Construction-, and design-exercises are studies on practical doing, observing, and comparative analysis with the intention of leading the student towards a lingo of design. They are derived from real design challenges, and each cover pivotal partial-aspects. They have to be easily understandable, rationally comprehensible, and of a general nature. The outcome lies in the way of how a problem is being looked at, and ultimately the student should have the ability to derive design criteria. (Lehmann 1986).

4. CASE STUDY: ADAPTATION OF CLASSIC DESIGN FOUNDATION CHALLENGES

Everything starts from a dot (Wassily Kandinsky)

The design foundation exercises that I have introduced intend to balance formal and conceptual issues while emphasizing research, the design process, and the skillful execution of ideas. "Design is generally learnt through practice because it simultaneously involves making, seeing (often with the whole body), reflecting and forming habits." (Özkar, Steinø 2012).
Good foundations projects teach students how to see, think and develop an idea, and encourage them to refine their understanding of what a design problem can be. Most importantly, the students experience, in a compact unit, the combination of rational, intuitive, and critical thinking, and they learn to construct meaning of using visual form. As form-making is as much about doing as thinking, the pedagogical set-up for teaching form-making must reflect this (Özkar, Steinø 2012).

The following three examples of design foundation exercises in this study were conducted with entry-level. They are intended to exemplarily depict my approach of re-envisioning traditional educational challenges with the re-framed purpose of expanding the students' skills beyond the visual towards creating artifacts for interaction. These exercises are embedded in a broader framework of foundation studies that also entail various studies in two-dimensional exploration such as perspective drawing, typography, as well as exercises in color- and composition. An underlying objective across the board is a strong emphasis placed on the complex process of ideation and creation, rather than just the well-crafted final design. To underscore this important requirement, Students are asked to continuously maintain a process-book to capture discoveries and emerging ideas along the course of the projects.

4.1. ORIGAMI TESSELLATION EXERCISE

Origami tessellations are geometric designs folded from a single sheet of paper and creating a complex repeating pattern of shapes from folded pleats and twists. They range from simple square tiling to extremely intricate pieces inspired by Islamic art, from twisted architectural flourishes to realistic faces formed from tessellated shapes. (Gjerde 2008)
Up front, this simple exercise seems to have nothing to do with concepts of interaction and behavior. Students start by understanding how to turn a simple piece of paper into a square or triangle grid structure. Once the grid has been folded, the piece of paper "memorizes" the basic shape and becomes receptive for more complex repetitive origami tessellations (Figure 2.0). This exercise teaches students the significance of precision and rewards them with aesthetic structures derived from flat paper. In order to achieve complex tessellation patterns, one needs to understand complicated folding instructions, intrinsically interact with the medium and develop strategies to simultaneously shape the intertwined twists throughout the work piece to achieve a system of connected folds. The process of creating and manipulating origami tessellations is hereby as important as the final results per se. "*The process of making is the point of it. The object looks good, if the process felt good. This needs to be a kind of ballet*." (Paul Jackson; Between the Folds 2010).

On completion of this exercise, students will be able to:

- Understand the terminology of origami tessellations
- Understand the concept of connected origami molecules, and their spatial array on grids.
- Transform a blank piece of paper into square- and triangle grids.
- Understand the basic pleat- and twist techniques as the underlying structure of origami tessellations.
- Understand the importance of accuracy in folding of grids, pleats, and twists.
- Visually interpret folding diagrams and instructions.

Figure 2: Student work; Origami tessellations. Source: Feil 2017

4.2. PING-PONG BALL CARRIER EXERCISE

Students are challenged to develop packing concepts for six ping-pong balls out of thin card-stock. During the project introduction, they are reminded of the diverging interests of the three main stakeholders that will interact with the product: the manufacturer, retail, and the customer. In the first phase of this three

week long project, solutions are developed to hold/contain one single sphere under considerations of functionality, visibility of content to potential customers, efficient use of resources/material, and the feasibility for hypothetical mass production. Once promising concepts are identified, students expand their ideas to encompass all six spheres in the final designs (Figure 3).

The step towards a packaging isn't far fetched, and the exercise demonstrates – with simple means by practical doing – that a bundle of tangible criteria can be created that doesn't simply apply for just this exercise, but are of general value/nature.
With the realization that a satisfactory step has been accomplished, once formal and functional requirements create one unity, the student has mastered a critical learning goal. (Lehmann 1986)

On completion of this exercise, students will be able to:

- Identify the most promising concepts that will meet the instructional objectives.
- Understand the diverging expectations/needs for the different stakeholders.
- Explore and evaluate concepts in regard of to complexity, aesthetic, functionality, efficiency in manufacturability and use of resources.
- Construct a detailed, final model as the synthesis of the conducted form explorations.
- Utilize paper models to share and develop their visual ideas, without limitations imposed by building skills.
- Students will be able to tell a good design from a weak one.

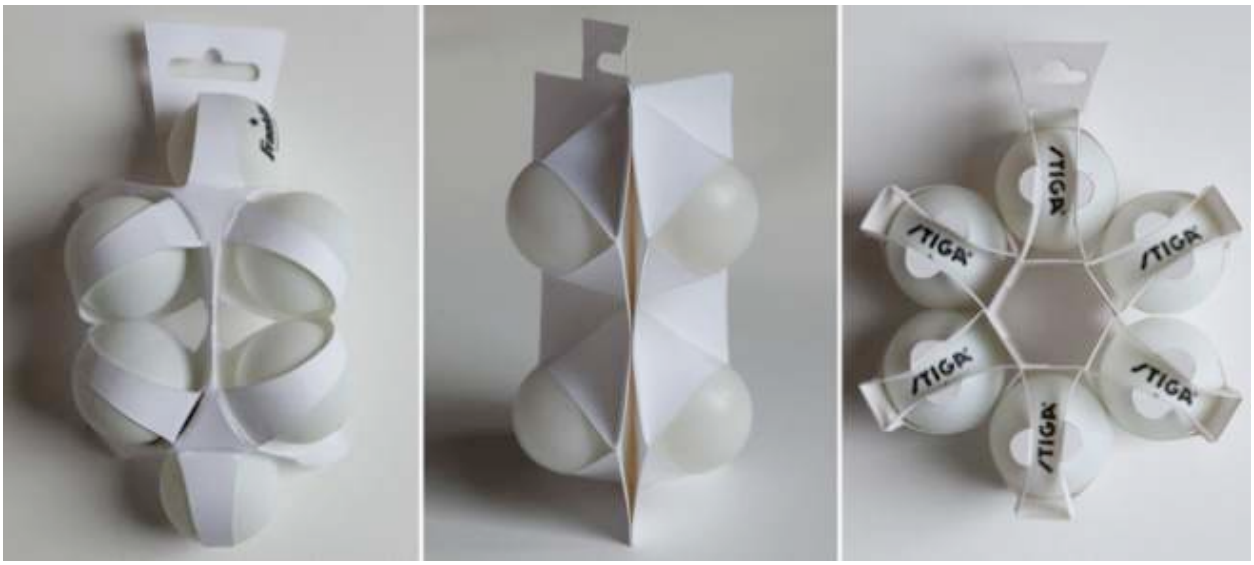

Figure 3: *Student work; Packaging concepts for six ping-pong balls. Source: Feil 2013-17.*

4.3. PARKING METER REDESIGN EXERCISE

This third design foundation module challenges students to redesign the ubiquitous parking meter terminals in regard to physical- and interactional design. The project begins with observations in the field: Students are asked to carefully analyze (and document) the existing solutions for metered parking. They record how many steps it takes to make transactions on the different solutions that nowadays co-exist on streets: coin-operated meters for single stalls, parking terminals for on-street parking, or private lots/garages. Students quickly discover the inherent complexity of modern parking terminals that have

become far less intuitive compared to the old style coin-operated parking meters. I challenge Students are challenged to experiment with a better visual representation of the discovered relationships between time and money (parking rate). I also ask the students Students are also asked to explore potential design solutions around these frames of reference for their interfaces. Once a concept for interaction has been developed, students follow the credo of “form follows function”, and direct their attention towards the physical design of the proposed parking terminals. Driving factors for the designs are accessibility and ergonomics, semantic of the control elements to support the physical interaction with the interface, as well as, the aesthetics and visibility on the street.
At this point in the quarter, students are already well versed in building high-fidelity paper models; their creativity and formal expression are no longer constrained by the limiting factors of shaping three-dimensional paper models (Figure 4).

On completion of this exercise, students will be able to:

- Understand the basic concepts of designing for user interaction.
- Understand the basic terminology of interactional design.
- Abstract frames of references and develop relationships between data.
- Conduct research and observations in the field.
- Understand the basic concepts of ergonomics and product semantic.
- Construct a high-fidelity final model.

Figure 4: *Student work; Concepts for parking meter re-designs. Source: Feil 2013*

5. CONCLUSION

Traditionally, design foundation exercises represent carefully crafted studies to convey a broad spectrum of visual and conceptual skills to aspiring designers. By introducing students to the abstract components that structure a visual language, design foundation exercises represent important stepping-stones of didactic significance in the early phase of design education. The successful completion of foundation exercises rewards students with a broad repertoire of aesthetic and technical skills that enables them to address challenges of higher complexity.

This study reflects upon the ongoing changes in the profession of industrial design with an increasing necessity to approach design challenges in a holistic fashion to encompass form, systems, and interactions. This dramatic redefinition of the very core principles of industrial design represents a daunting challenge to educators, and has often resulted in drastically revamped design curricula of institutions that place less emphasis on foundation exercises in exchange for a much broader, yet far shallower, umbrella of knowledge.
Instead of letting design foundation exercises fall by the wayside, I see them as a powerful didactic tool for teaching knowledge beyond aesthetic and technical skills. The provided work samples illustrate an initial step of carefully re-framing and orchestrating selected classic design foundation challenges to convey critical knowledge on both form and interaction.
As much as this paper intends to be a manifesto for rediscovering classical design foundation exercises as a model for a comprehensive design education, it is also a call for action directed at fellow educators to rediscover and expand upon the potential of classic design foundation exercises.

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