Role of Form-making Exercises in Design Education for Creative Thinking

-Based on analysis of art workshops with primary and secondary school design and art teachers-

Topic Area:

Art Education

Format of Presentations:

Paper Session

Paper Description:

Design Thinking is nowadays widely applied not only in design industry but also in other areas such as business, healthcare and so on. Based on this trend, design is considered as a problem-solver, while role of form-making before concept development is scarcely considered and studied. This paper suggests, under this condition, to explore the possibilities of various form studies and connect form and function in education to extend students' creativities and applications in professional fields.

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* This research was supported by Korea Arts and Culture Education Service (KACES) as part of the KACES Certificate Program initiatives.

Abstract

Recently people consider design as a problem solving process. Therefore, today's design approaches and processes are focused mainly in finding out the problems in our daily lives, proposing the necessary design concepts and making the objects to solve those problems. However, looking back how living culture has been shaped around our daily objects, it is far from the design process as we usually think of as mentioned above. At the beginning of human civilization, primitive men found objects around them which fit their purposes and utilized them as tools. That is, people designed the tools by taking advantages of properties of diverse objects around them. These days, however, by taking design as a problem solver, designers try to create a novel form that follows functions assigned by them. Thus there are relatively insufficient studies and practices regarding form-making exercises to build ideas upon naturally shaped forms. Therefore, the purpose of this study is to explore practicability of form-making exercises in design education and professional fields, and suggest a design ideation toolkit to develop further design concepts. We conveyed four workshops with primary and secondary school design and art teachers in order to see how form-making exercises along with the design ideation toolkit can be applied in art classes, as well as a workshop with elementary school students in fifth grade. Throughout the five workshops, we referenced cognitive psychology theory of affordances, to explain actions inherent on natural objects and environments. At the workshops, we tested the design ideation toolkit which take use of 1) Different Viewpoints and Scales, 2) Properties and Functions, to imagine various affordances of forms. By making patterns out of creative thinking processes and outputs of participants from the five workshop sessions, we will discuss how these combinations of form-making exercises followed by the design ideation toolkit have educational effects in schools to develop students' creativities. Furthermore, we will find possibilities of design education methods that apply abstract forms of objects into solid design concepts which could be used in the professional fields.

keywords: form-making, design thinking, affordance theory, ideation toolkit, creative thinking, design education

1. Introduction

As design has been regarded as a problem solving process, several design thinking methods have been developed and utilized. That is, today's systemic design approaches and processes are focused mainly in finding out the problems in our daily lives, proposing the necessary design concepts and making the objects to solve those problems. However, tracing back how tools have been designed in human civilization, it is also true that living culture was built upon discoveries of surrounding natural objects. At Triennale di Milano in 2016, Japanese designer guru Kenya Hara and Italian architect Andrea Branzi have co-worked to hold an exhibition called "Neo Pre-History - 100 Verbs." The show displayed the design history of tools with

verbs describing them from Stone Age till today. And the show has shared the perspective that people designed diverse tools by taking advantages of natural forms of objects around them, and this is the beginning of design. In this context, the purpose of this study is to explore practicability of form-making exercises in design education and professional fields, and suggest a design ideation toolkit to develop further design concepts. To this end, we reviewed the existing design education and toolkits, and cognitive psychology theory of affordances which is to explain actions inherent on natural objects and environments, to set the theoretical foundation. And to imagine various affordances of forms, we suggested the design ideation toolkit which take use of 1) Different Viewpoints and Scales, 2) Properties and Functions, to imagine various affordances of forms. To test the toolkit, we conveyed five workshops with art and design educators of primary and secondary school and primary school students.

2. Theoretical Review

2.1. Design Curriculum

Current design curriculums are comprised of two core courses; one is a foundation course to study three-dimensional form and train five senses to exercise visual relationship of forms in space, and the other is a professional practice course to exercise systemic thinking process of problem recognition and solution in design. Foundation curriculum at Pratt Institute in New York, which became famous by Rowena Reed Kostellow's revolutionized curriculum to bring abstract elements emulating Bauhaus tradition in 1939, defines three-dimensional form into six presentations as Rectilinear Volume, Curvilinear Volume, Planar Construction, Lines in space, Convexity, and Concavity. Then the presentations are practiced with concepts, ratios, and modules which later are integrated into projects [1]. Charles L. Owen, a Distinguished Professor Emeritus at Institute of Design, the Illinois Institute of Technology (IIT) in Chicago, the incubator of neo-Bauhaus, has taught and conducted research on Structured Planning of design, which emphasizes human-centered creative thinking process. The goal of Structured Planning is to deduct design concepts of more complex product systems by defining, analyzing and reconstructing problems. Furthermore, there are growing interests in design thinking process to become innovative for winning business [2,3]. While there are several toolkits developed to help design thinking process for innovative solutions [4], there are relatively less pursuit in design research in the process of making concepts with form visualization.

2.2. Affordance in Object

Affordance, which explains the relationship of form and function, is a theory that describes information of the perception of surfaces in an object which function the form affords [5]. The information afforded by objects are not only dependent on its properties, but also the experience, knowledge, or culture of the user [6]. In other words, depends on users' experiences and needs, there are a lot of possible ways that affordance of objects can be interpreted and practiced. Affordance appears when a direct link between perception and action is found and utilized [7]. It can be applied as a methodical frame to draw a design

concept from two core axes of design curriculum; 1) three-dimensional form, and 2) process of solving problems. This is because affordance provides a fundamental theory to connect the properties of objects and function as a problem solution.

3. 'Form to Function' Ideation Toolkit

Based on affordance theory, we have composed the ideation toolkit into three tools(as a form of worksheet) to connect form(unintended product) to function in order to discover new possibilities of the object. With the first worksheet, participants imagine the object from different viewpoints in order to perceive information afforded by its form. Then, with the second, they examine it from anthropometry perspective whether there are other possible functions the object can afford depends on scale changes. At last, in the third stage, participants are able to connect people's actual daily behaviors and functionality inherent in the form deducted from imagination exercises through previous processes. Thereby, the third sums up the toolkit. By taking use of this ideation toolkit following three stages, we believe that form to function connection link can be made.

3.1. Tools to Generate Ideas with Viewpoint & Scale Tools

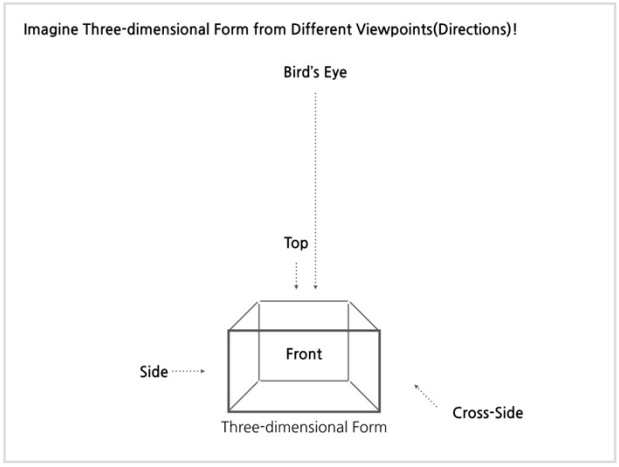


Figure 1. Viewpoint Tool

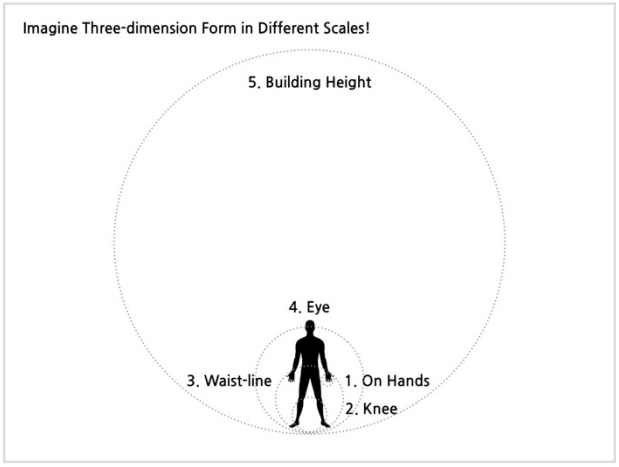
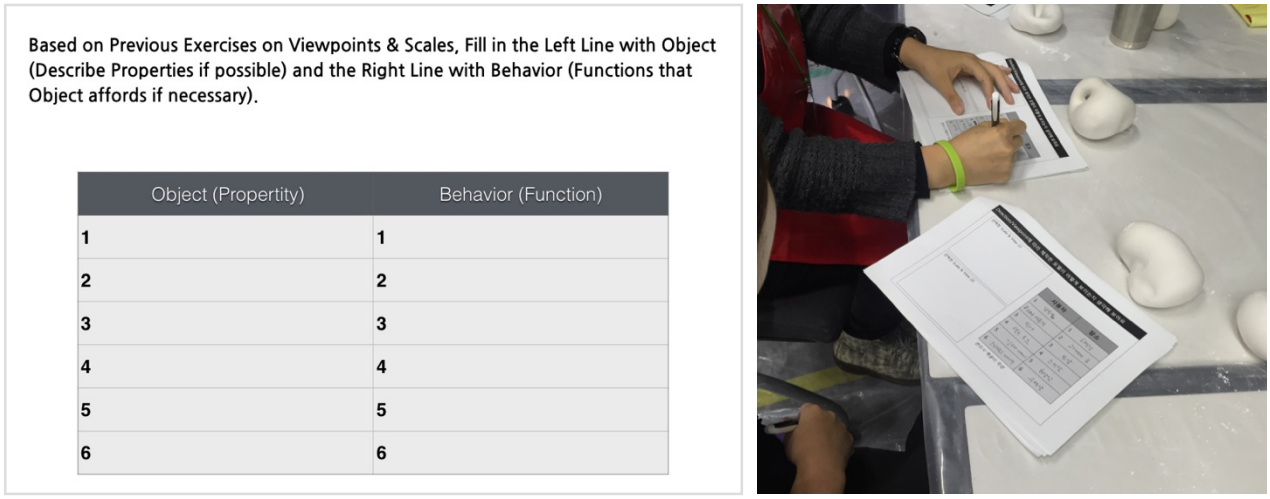


Figure 2. Scale Tool

Seen from Fig.1 and Fig. 2, viewpoint and scale tools of the 'form to function' ideation toolkit is lenses to perceive mundane objects with a fresh look. Viewpoint tool allows us to examine objects from five different viewpoints (bird's eyes, top, side, cross-side and front view), and Scale tool let us imagine the objects from five different scale-levels (on hands, knee, waist line, eyes and building-height levels). Through these lenses, we are able to discover what affordances could exist on the object when conceived from different views and scales. These tools were suggested in this study to help people to extend their boundaries of imagination on 'offerings or action possibilities in the environment' of Gibson[2], and 'suggestions or clues as to how to use the properties in objects' by Norman[6].

3.2. Tools to Discuss Properties and Behaviors of Objects

Design is in the process of shaping our daily lives on the basis of the available properties of objects. There may be errors or failures in this process of users interpreting the information afforded by the objects in different ways [8]. For this, in this study, we have provided the Property and Behavior of Object Tool [Fig. 3] to create a link of properties of the objects drawn from previous exercises to actual daily behaviors. Also we asked participants to use this toolkit that a group of two people could discuss and develop concepts together. Having a chance to consider different perspectives of others to discuss about practicability of the product from the workshop has widen views of participants, and each pair completed the form together as Fig.3.



Based on Previous Exercises on Viewpoints & Scales, Fill in the Left Line with Object (Describe Properties if possible) and the Right Line with Behavior (Functions that Object affords if necessary).

Object (Propertity)	Behavior (Function)
1	1
2	2
3	3
4	4
5	5
6	6

Figure 3. Property and Behavior of Object Tool

4. Case Studies: Art and Design Workshops

We have conducted five workshops; four with educators and a workshop with primary school students to review availability of the suggested ideation toolkit. Each workshop was delivered for four-hours. During this time, participants produced three-dimensional form using plaster of Paris and ballon to exercise concavity and convexity, referencing form presentations of Rowena Reed's curriculum for form-making design [9]. As a result, we tried to seek a possibility of the 'form to function' ideation toolkit into use. Fig. 4 shows a production process of three-dimensional balloon plaster form that we did as an *easy-and-quick* form-making exercise in workshops.

Figure 4. Production Process of Plaster Balloon Form

4.1. Workshops for Educators

During four workshops with primary and secondary school art/design educators, we have led them to produce free forms as many as they want without imposing any purposes on them. This was to help them focus in the form itself rather than how it could function. Many of them made two to three three-dimensional forms within the time. The first and second workshop were done in 19 January and 15 February 2016 respectively. Fig.5 is a final image presentation of what participants had created during the workshop.

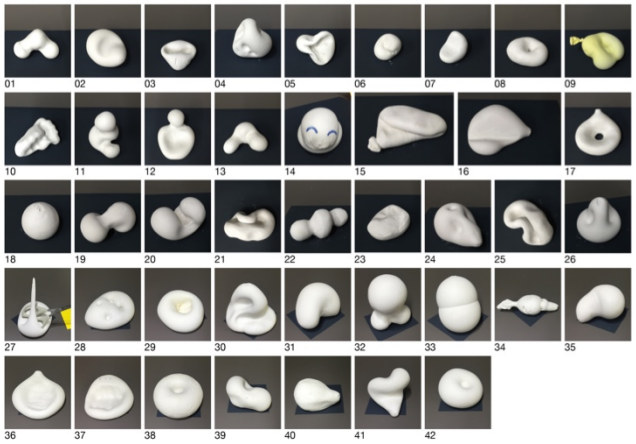


Figure 5. Outputs of Concave and Convex Forms of Workshop 01 & 02

Figure 6-1.#16 and #19

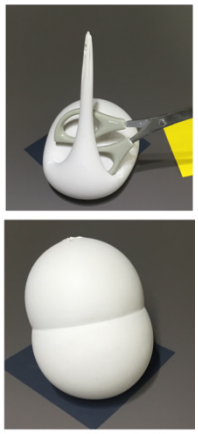


Figure 6-2.#27 and #33

Although we asked them to create forms freely without putting any intentions ahead of creating, different approaches of participants were observed. These could be categorized into three directions; Group A focused in making spontaneous forms excluding any intentions, and Group B concerned to shape objects which deliver creator's intentions. Group C utilized objects around them to shape a form. One of them designed a form that could support her smart phone, functioning as a smart phone stand. Seen from Fig.6-1., of workshop 1, #16 (B and C combined) shows a shape of a phone that a maker pushed and hardened on a balloon plaster. The maker described that she wanted to create a form that could be only shaped with a single tool (her smart phone) without putting any other artificial forces. Also she wanted to produce a form that assembles a bean bag chair. She already set several boundaries of her own before generating ideas with the object. We asked her to examine her object with the 'form to function' ideation toolkit so that she could break her rules and extend her creativity. With Viewpoint and Scale tools applied on her object, she could think of an artificial ski slope design ("Building-height Level"Scale) or a public furniture design("Eye Level" Scale) for a rest inspired by a big slopy form looks like a back support. Meanwhile, Fig. 6-1. #19 participant wholly focused in creating a form that shows asymmetric structure. Through the toolkit application on her object, she described it as a dumb bell("On hands" Perspective) that her father uses when exercising at a gym, or a ride on playground("Eve Level"Scale) that children can climb up and play. # 27 and # 33 shown on Fig. 6-2. of workshop 2 belong to Group C using scissors and hairband to shape

their forms. It was interesting to see several different forms being created when participants use objects around them not only their hands to shape the form.

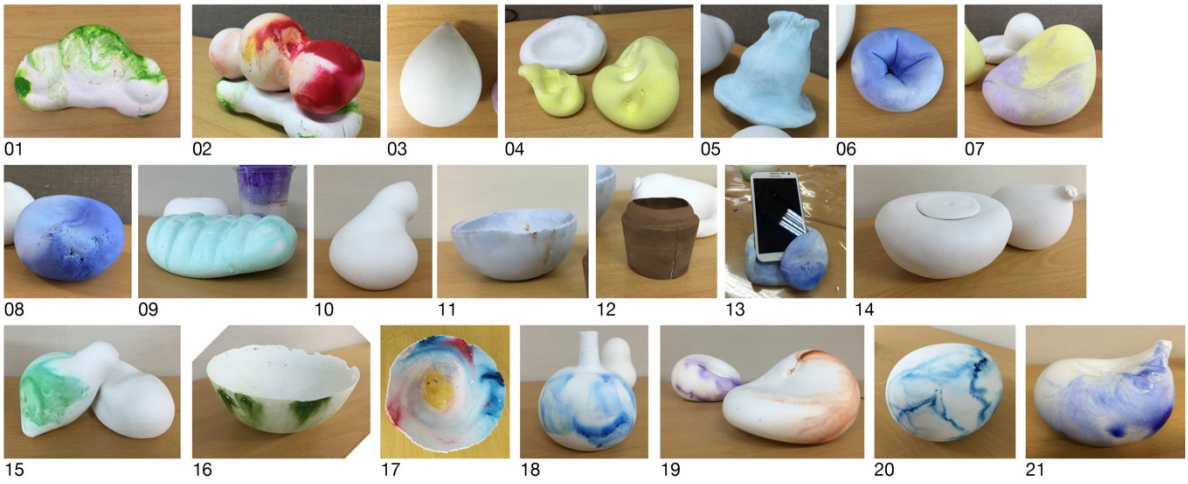


Figure 7. Outputs of Concave and Convex Forms of Workshop 03 & 04

Fig. 7 is the result of the third and fourth workshop conducted in 2 July. We suggested them to use watercolors to mix them with liquid plaster as seen from the left image of Fig.8. Furthermore, we added a new manufacturing method to use a second balloon to blow into the mixture of plaster [Fig.8; center image] which created a vessel shape [Fig.9]. In these workshops, some created their own way of producing a form. Seen in the right image of Fig. 8, one of the participants used a hardened plaster mold to shape the form. Through these workshops of which a couple of tools of expression were added, we discovered there are more possibilities to generate creative ideas than just proposing a toolkit composed of guideline worksheets.

Figure 8. (Left to Right) Mix Color and Liquid Plaster, Blowing Second Balloon into the Mixture, use a Hardened Plaster as a Mould

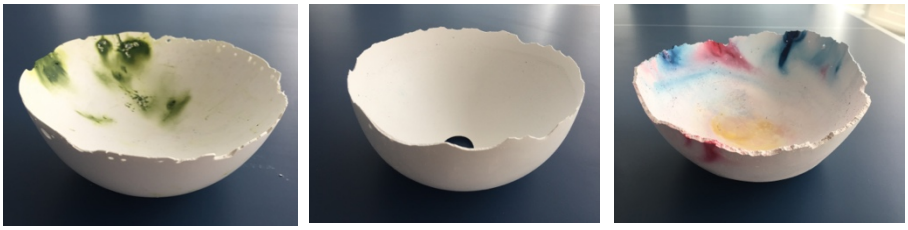


Figure 9. Outputs of Double Blown Balloon Manufacturing Method with and without a Mixture of Watercolors

4.2. Workshops with Primary School Students (5th grade)

In 28 May 2016, we had an art workshop with 5th grade students. The results are shown in Fig.10. They were allowed to use their watercolors and brushes to draw on their plaster form. This was an attempt to provide a new tool besides their hands and objects around them (mostly smart phones which is most adjacent to our body)to express their ideas and display their imagination. However, in the end, this tool limited down their creativities resulting into only illustrating characters they like or coloring the form that instantly inspire them with their organic shapes [Fig. 11].

Figure 10. Students with their own work of art

Figure 11. Donuts and Charater Illustration by Students

5. Conclusions

This study proposed a ‘form to function’ ideation toolkit which is composed of three parts to connect and show directions for 1) form-based design education, and 2) problem recognition and concept driven-based design education. The toolkit was explored in its practicability through five workshops with educators and primary school students. Through examining workshops, this paper suggests that the toolkit could show the way for design education to create a link between form-making and people’s daily life. Namely, this is a method to turn problem finding, analyzing, abstract conceptualizing into a solid design concept. However,

the toolkit and facilitation guide have to be more specified to reflect the process of perception for interpretation and utilization of information inherent in the object affordances. Furthermore, by exploiting various forms, we need to conduct more researches on form production and composition that extend availabilities of design.

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