The Hands-on Basics of Contemporary Design Education

Benay Gürsoy
Istanbul Bilgi University, Turkey
benay.gursoy@bilgi.edu.tr

Abstract. *Learning in the design studio is usually fostered by* doing *and reflecting on what is done. This paper firstly reiterates that the* doing *in design is computing, in order to argue for the need for a hands-on design learning even more so in the age of digital curricula. Secondly, it corroborates the importance of tactile involvement in* doing, *and thus computing, to foster design learning. An experiment is conducted with 15 first year students of architecture the results of which support the argument that hands-on involvement and its interpretation as computing is essential to learning in the studio.*
Keywords. *Basic Design; digital curriculum; design computing; design cognition; physical interaction.*

INTRODUCTION: BASIC DESIGN COMPUTING

Doing and *reflecting on what is done* are the means of learning in most studio environments. Talking with instructors and peers, in panel crits or one-to-one conversations provokes students to get in a critical distance with and reflect on their work. As much as how these conversations are moderated, the essentials of doing differ and distinguish the nature of each design studio.

The context of this paper is particularly the pedagogy of the first year in a design curriculum. The foremost claim is that *doing* in the first year basic design is closely related with computing which, as put forward by Stiny (2001), is recognized as a way of thought, reasoning, and does not only refer to the use of digital tools but rather, refers to the investigation of the relations between design and the logic behind digital tools. In this sense, basic design education can be considered as an initial integration of a computational perspective to design education (Ozkar 2004; 2007). Talking and reflection in the studio are mostly analytical and hence may naturally serve to see the computational aspects of design (Ozkar 2011). Nonetheless, in an expanded definition of computing which stems from reasoning in a pragmatist and phenomenological perspective, it is the *doing* that is scrutinized here as the computational aspect. Moreover, the current computational paradigm also expands into the material world of fabrication, production, and 3d modeling tools, consolidating its relation to doing. Hence, the motivation behind this paper is to see *doing* as a computational aspect of design learning.

Today, basic design is offered as the introductory studio within the curriculum of many design schools. It has its origins in *Vorkurs*, or basic course of Bauhaus, established in 1920 where Johannes Itten used unconventional teaching methods with the aim of "unlearning" the students and bringing them into a zero state from which true learning could begin. With this aim, *Vorkurs* was founded as the basis for all further development and was conceived as "*a general introduction to composition, color, materi-*

als, and three-dimensional form that familiarized students with techniques, concepts, and formal relationships considered fundamental *to all visual expression, whether it be sculpture, metal work, painting, or lettering*" (Lupton and Miller 1993).

The ideal of an introductory, universal studio for diverse design disciplines of *Vorkurs* is still inherent in basic design studio but short of the Modernist ideal. The basics are introduced as tools rather than doctrins and universality is limited to what students perceive in common. Nevertheless, as in *Vorkurs*, basic design has an abstract and *abstracting* visual language that can provide a theoretical and practical basis for any design discipline. However, most of the first year design students are not familiar with working with an abstract visual language of basic design prior to their design education. After an education fostering vertical thinking, most of them confront intensive reflective thinking for the first time through basic design. Therefore, they require new knowledge, competences and attitudes of "*doing and reflecting on what is done*".

Through the transformation students experience in basic design studio, they are encouraged to grasp that design, as a creative process, incorporates different forms of reasoning as opposed to the romantic view of design shared by most of the beginning year students, which excludes any kind of reasoning from the creative process. In principle, what basic design education aims, is to create a consciousness in students for their own reasoning processes. Thus, approaching design as a computable process promotes systematic and relational thinking through analysis and synthesis processes which increase students' awareness of their design ideas and operations (Ozkar 2004; 2007). Becoming analytically aware of design makes it something that can be talked of in the studio by creating a common ground for instructors and students (Ozkar 2011). It is, however, not possible to instruct this consciousness only through discussions and crits in the studio. It can only be developed through experience and experimentation. According to Josef Albers, one of the subsequent masters of *Vorkurs*, the course is a form of play and experimentation where students are claimed to be "*gathering experience*" (Wingler 1978).

Aspiring for Computational Doing *in Basic Design*

A basic design studio, in the experiences of the author, operates through several take-home and in-class design exercises where students deal with problems of ever increasing complexity. Generally, the sequence is as follows: two dimensional studies followed by intermediary relief studies that end with three dimensional studies. Form is not the objective of these exercises of which abstractness is a common feature. Rather, as Ozkar (2004) states, consciousness in producing it is the aim of basic design and the simplicity of the abstract forms helps students achieve this goal by keeping them focused on their reasoning processes.

The outcomes of basic design exercises are generally tangible and the discussions in panel crits are made through examining these tangible designs. In fact, the physical representation of design ideas is important not only for basic design, but for design activity in general. With current developments in fabrication technologies, it is definitely much faster and easier to physically represent generated designs using digital tools, with also much more accuracy. However, where the accuracy and precision of the outcomes of digital fabrication tools can serve for the good of representing most design ideas, in basic design, on the contrary, it can become a negative feature by causing early and immature crystallization of design ideas. This difference is due to the fact that in basic design the outcome of an exercise is generally the design itself rather than a representation of it. Therefore, an early accuracy obtained through the use of fabrication technologies may block the road for further investigations and also for the accidental discoveries.

Therefore, the tangibility of the final products alone, without physical involvement during the process of designing, is not enough to achieve the goal of basic design, which is to increase students' awareness of their reasoning processes. Thus, this study prioritizes the common aspect of basic design exercises to encourage tactile involvement of the students besides their visual involvement. Most exercises enforce them to get in a physical interaction with their work. This is an important aspect of doing in basic design studio that differentiates it from the subsequent studios. In basic design, both two and three dimensional studies are developed through certain physical acts. Among these physical acts, touching, grasping, squeezing, pulling, stretching can be cited as acts that develop knowledge about the nature of the materials. There are acts that create parts such as carving, cutting, folding, rolling, gluing, ripping off and acts that create wholes such as rotating, placing, etc. This experimentation through physical interaction is a feature that basic design inherited from *Vorkurs*. As Albers cited: "*Instead of pasting [paper], we will put it together by sewing, buttoning, riveting, typing, and pinning it, in other words, we fasten it in a multitude of ways. We will test the possibilities of its tensile and compression-resistant strength... we construct with straw, corrugated cardboard, wire mesh, cellophane, stick-on labels, newspaper, wallpaper, rubber, match-boxes, confetti, phonograph needles, and razor blades...*" (Wingler 1978). Even though today, different than Albers' times, students have digital design tools in hand to generate ideas and create forms along with fabrication technologies cited above, doing in basic design is still mostly physical media dependent.

A reason to this dependency for physical media of basic design can be the insufficiency of current digital design tools to fully support basic design process. Ambiguity is claimed to be a positive drive for the generation of novel ideas (Goel 1992). Contemporary digital design technologies, on the other hand, are frequently criticized for lacking ambiguity and for their mouse-screen interaction which is deemed to be unnatural (Cannaerts 2009; Sener 2007; Sener and Wormald, 2008). Therefore, one other reason why current digital design tools cannot fully replace tactile involvement in basic design is that the majority of the physical interactions cited above that basic design makes use of, does not have a direct equivalent as a command in these tools. The most obvious disassociation is with physical acts that develop knowledge about the nature of the materials. The current equivalents of these acts within the digital design software cannot comply with building experience concerning materials' nature. They only serve to make formal changes which is not sufficient for basic design education where form creation is not the sole objective. As a response to these deficiencies expanding beyond basic design context, there is a rising tendency to value the haptic feedback for being more intuitive (Aliakseyeu et al., 2006). More tools are being developed to capture spatial thinking processes. Soon we might be able to use sophisticated tools that represent our three dimensional actions/decisions. This inclination of computation towards the physical world of fabrication and bodily interactions, again, consolidates its relation to doing.

Underlining once again the physical interaction dependency of basic design and its relation with computing, this study claims that *doing* in basic design corresponds to computing through physical interactions. Therefore, it is argued that computing has multiple facets one of which is closely related with our kinesthetic senses. This paper, thus, questions the place of physical interactions within this understanding of computing in the context of basic design education. It aims to understand why *doing*, in the sense of computing through physical acts, is necessary to develop an understanding that design is a form of reasoning. It inquires why being present in the studio, listening to the crits given and seeing other's works is not sufficient to learn in basic design. An experiment is conducted for this purpose.

A PAPER FOLDING EXERCISE AND AN EXPERIMENT

The effects of physical interaction on learning is previously investigated by several studies on haptic cognition from diverse disciplines. Morris et al. (2007) examine the impact of haptic feedback on the ability to learn an abstract motor skill via three training modalities: visual, haptic and combined visuohaptic. Their results accentuate the supremacy of combined visuohaptic training over visual and haptic only training modalities. Jones et al. (2005) compare the influences of an interface with haptic feedback and another one with no haptic feedback on the learning process of abstract science concepts of high-school students. They conclude with the claim that the interface with haptic feedback provides a more immersive learning environment. Reiner (2008), explores the role of perception through touch on information visualization and claims that a combination of touch and visual cues is advantageous to learning since they complement each other. Stout et. al. (2000) reflect on the relation between physical interaction and learning on a deeper cognitive level. They question the possible role of stone tool-making in the course of human brain evolution by examining brain activity with brain-imaging techniques. Their research present a corroboration of the hypothesis that early stone tool-making, which can be interpreted as a form of physical interaction, played an important selective role in hominid brain evolution. Demirbas (2008) brings the debate concerning doing and learning within the context of basic design studio and explores the effects of different learning styles on design students' learning process. The results of the case study he presents accentuates the dominance of learning by doing in basic design, which, in the context of this paper, is claimed to be computing through physical interaction. These studies shed light in the development of the experiment presented below.

The study is realized with 15 randomly selected first year architecture students from the same studio. These students, during the first year of their education, are following a digital curriculum where basic design studio constitutes the core of their education. The studio is highly supported by and is in close relation with two courses offered in subsequent semesters where students are introduced to digital tools: Architectural Geometry and Design Computing courses. The aim of these two courses is not to teach a specific digital design software but instead to introduce students the idea of design computing which also constructs the basis of their studio education. Even though, with these courses, students are provided with the necessary skills to use digital tools for their design exercises, in basic design they are encouraged to compute through physical media and use digital tools only as supplementary design supports, as previously explained.

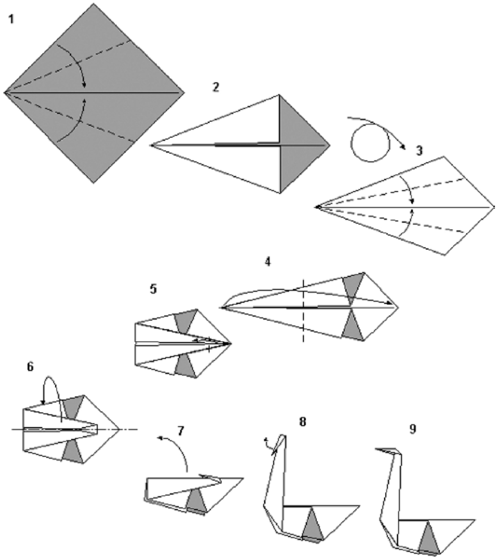

Figure 1
The folding sequence presented to the visual group.

For the study, students are divided in three groups that correspond to the three learning styles of VAK model. According to this model, learning is differentiated in three styles as visual, auditory and kinesthetic (Fleming and Baume, 2006). Within the context of basic design studio and this study, visual learning is associated with seeing peers' works, auditory learning with listening to the critiques and comments addressed to these works, and kinesthetic learning with being actively involved in *doing*, that is with computing through physical interactions. The aim of the study is to create a common ground to compare the effectiveness of these different learning processes on basic design learning.

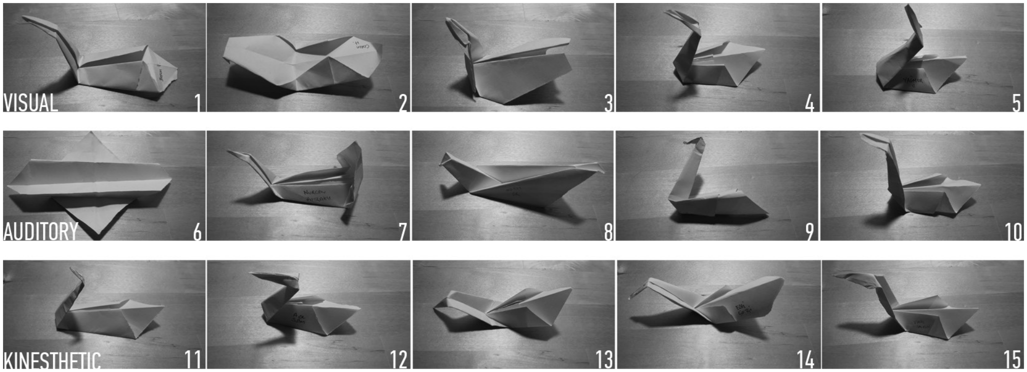

Figure 2
The three groups of 15 paper-foldings, the numbers 1-15 indicate the students in Figure 3.

The students are asked to fold a basic origami (paper-folding) pattern. In contradiction with the exercises given in basic design, the paper-folding exercise is a well-defined problem where the end product and the process are clear. Since the study is focused mainly on the learning process rather than the design process, this contradiction is not considered as an obstacle. Rather, having a clear process and an end result enables evaluating the learning processes comparatively and effectively.

15 students are randomly divided in three groups of five. These groups are the visual, the auditory and the kinesthetic group. All the groups are asked to fold the same origami pattern consisting of eight simple steps, however the problem is presented differently to each group. At the end, the degree of folding the correct pattern is compared among these three groups.

The students in the visual group are given a sheet of paper clearly showing the folding steps as drawings to obtain the origami swan which they observed for two minutes (Figure 1).

The students in the auditory group are shown the actual paper-folded swan and consequently listened while the verbalized process of folding the origami swan is read. The students in the kinesthetic group are asked to follow the author and do the same folds while she is folding the origami swan for once without any drawings shown and any words spoken. Each group, after these introductory steps, waited for one minute and then are asked to fold the origami swan. Figure 2 shows the 15 paper-foldings made by the three groups of students.

RESULTS

Each of the swan foldings are examined to see how many of the eight folding steps are realized correctly and how many of them are incorrect or forgotten. Figure 3 shows the correct and incorrect/forgotten steps from each student's folding exercise. The total of the correct steps of each group is indicated.

The results between three groups are compared according to the ratio of the sum of groups' total correct steps to the total folding steps. According to this comparison, the kinesthetic group is the most successful one in folding the correct origami swan with a ratio of 35 correct steps out of 40 where the auditory group scored 24, and the visual group 23.

These results accentuate the importance of kinesthetic learning in this paper-folding exercise which was expected prior to the study in the light of previous studies on haptic cognition cited above (Morris et al., 2007; Jones et al., 2005; Reiner, 2008; Stout et al., 2000; Demirbas, 2008). The kinesthetic setting in the study differs from visual and auditory settings in several manners. Both in visual and auditory settings, the students have to realize a cognitive translation: they have to carry out a mental imagery task, have to imagine in three dimensions the folding diagrams they are shown or the descriptions

	STUDENTS	1st STEP	2nd STEP	3rd STEP	4th STEP	5th STEP	6th STEP	7th STEP	8th STEP	correct steps	incorrect steps	GROUP TOTAL correct/total steps
VISUAL	1									4	4	23/40
	2									4	4	
	3									1	7	
	4									7	1	
	5									7	1	
AUDITORY	6									1	7	24/40
	7									6	2	
	8									2	6	
	9									7	1	
	10									8	0	
KINESTHETIC	11									6	2	35/40
	12									7	1	
	13									7	1	
	14									7	1	
	15									8	0	

Figure 3
Table showing the correct steps from each student's folding exercise and the group total.

they are read. However, in kinesthetic setting, since they are physically involved with the folding activity, there is no need for a translation. The lack of the cognitive load due to mental imagery might have helped the kinesthetic group members to fold the pattern more correctly.

Moreover, both the auditory and visual settings can be considered to be the representations of what is actually done in the kinesthetic setting. Depending how accurate these representations are, the results can vary in these settings. Some visual representations in the sheet provided to participants of the visual group (Figure 1), for example, might have led to misinterpretations. Similarly, it is possible that students imagined the folding stages differently than what they are instructed in the auditory setting. Kinesthetic setting, in this manner, is not subject to misinterpretations since what is presented to the participants is the actual process.

The success of auditory group compared to visual group, on the other hand, is surprising. It was expected prior to the study that the participants of the auditory group would not be able to realize the folding exercise correctly due to the discrepancy between the auditory perception and sensorial perceptions thought to be required for the exercise, which are basically the visual and haptic perceptions. It reveals that hearing, without neither seeing nor touching, also enables complex spatial transformations to be realized through mental imagery. This aspect of the auditory perception can be further elaborated along with haptic and visual cognition studies.

DEDUCTIONS FOR DIGITAL CURRICULUM

The experimental study presented in this paper is very basic but supports the role of doing in learning. Even though the exercise given for the study is not a design exercise, the results of the study can be related to basic design education.

It is claimed that participants were more successful in the kinesthetic setting of the experiment because of its decreased cognitive load due to the lack of cognitive translation. Same assumption can be valid for basic design studio which is different than the consequent design studios in several manners. As cited, it is through basic design that students confront with design thinking for the first time. At the same time, they are expected to communicate through an abstract visual language that they are not familiar with. Therefore, for the first year design student, it may be hard to cognitively handle this intensive reflective thinking process along with learning to design, to reason, to communicate designerly. Getting involved in doing, which in this context means computing using physical media, might be decreasing this cognitive load and thus promotes better learning and the generation of tacit knowledge.

It is previously argued that misinterpreting the visual (drawings) and auditory (spoken words) representations of the folding pattern can be one of the reasons why auditory and visual group members were less successful. Visual setting is previously associated with seeing peer's works, and auditory setting with listening to the critiques and comments addressed to these works. Therefore, expanding this result to basic design context, we can argue that there is a strong possibility that students misinterpret what their instructors say and what they see in front of them during panel crits. However, being involved in doing can prevent these misinterpretations since students can make the necessary connections through their previous experiences.

To sum up, this paper contributes to expand the definition of computing by underlining that computational thinking can also be incorporated in a design process where physical interaction constitutes its core. Through these interactions, not only form manipulation, but also development of a knowledge concerning materials, their affordances and constraints is possible. Available digital design and fabrication tools are not sufficient in fulfilling this need. Therefore, tools able to capture the spatial thinking processes need to be developed considering the inclination of current computational paradigm into the material world of fabrication, and bodily interactions.

ACKNOWLEDGEMENTS

All students who participated in the study are students of the Faculty of Architecture at Istanbul Bilgi University. The study was firstly developed to fulfill the requirements of a graduate course conducted by Mine Ozkar and Yuksel Demir at Istanbul Technical University. I would like to express my gratitude to Mine Ozkar for her constructive comments during the writing of this paper and for her constant support.

REFERENCES

Aliakseyeu, D, Martens, JB, Rauterberg, M 2006, 'A computer support tool for the early stages of architectural design', *Interacting with Computers*, pp.528-555.

Cannaerts, C 2009, 'Models of/ Models for Architecture', *eCAADe 27*, Istanbul, pp. 781-786.

Demirbas,OO 2008, 'An Experiential Learning Journey: Basic Design Studio', *Proceedings Designtrain Congress Trailer II*, pp.137-146.

Fleming, N and Baume, D 2006, 'Learning Styles Again: VARKing up the right tree!', *Educational Developments*, 7(4), pp.4-7.

Goel,V 1992, 'Ill-Structured Representations for Ill-Structured Problems', *Proceedings of the Fourteenth Annual Conference of the Cognitive Science Society*.

Jones, M, Minogue, J, Tretter, T, Negishi, A and Taylor, R 2005, 'Haptic Augmentation of Science Instruction: Does Touch Matter?', Wiley, pp. 111-123.

Lupton E and Miller JA (eds) 1993, *The ABC's of [triangle, square, and circle]: The Bauhaus and Design Theory*, Thames & Hudson, London.

Morris, D, Tan, H, Barbagli, F, Chang, T and Salisbury, K 2007, 'Haptic Feedback Enhances Force Skill Learning', *Second Joint EuroHaptics Conference and Symposium on Haptic Interfaces for Virtual Environment and Teleoperator Systems (WHC'07)*.

Ozkar, M 2004, *Uncertainties of Reason: Pragmatist Plurality in Basic Design Education*, unpublished PhD dissertation, Design & Computation Unit, Massachusetts Institute of Technology MA, USA.

Ozkar, M 2007, 'Learning Computing by Design, Learning Design by Computing', *Proceedings Designtrain Congress Trailer I*, pp.101-111.

Ozkar, M 2011, "Visual Schemas: pragmatics of design learning in foundations studios," *Nexus Network Journal*,13(1), pp. 113-130.

Reiner, M 2008, 'Seeing Through Touch: The Role of Haptic Information in Visualization', *Visualization: Theory and Practice in Science Education*, Springer, pp. 73-84.

Sener, B 2007, 'Rethinking digital industrial design: a mandate for virtual workshops and intelligent environments', *Digital Creativity*, 18 (4), pp.193-206.

Sener, B and Wormald, P 2008, 'User evaluation of HCI concepts for defining product form', *Design Studies*, pp. 12-29.
Schon, DA 1987, *Educating the reflective practitioner: Towards a new design for teaching in the professions*, Jossey-Bass Publishers, San Francisco.
Stiny, G 2001, 'How to calculate with shapes', in E. Antonsson and J. Cagan (eds), *Formal Engineering Design Synthesis*, Cambridge University Press, New York, pp. 20–64.
Stout, D, Toth, N, Schick, K, Stout, J and Hutchins, G 2000, 'Stone Tool-Making and Brain Activation: Position Emission Tomography (PET) Studies', *Journal of Archeological Science*, vol. 27, pp. 1215-1223.
Wingler, HM 1978, *Bauhaus: Weimar, Dessau, Berlin, Chicago*, MIT Press: Cambridge, Mass.