An Instruction Guide for the First-Year Design Studio: Modelling of Visual Thinking

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ABSTRACT
Abstraction is an important practice in the first-year design studio and it is directly related to visual thinking. In addition, abstraction skill as a tool of visualisation in architectural design can accommodate certain connections between the two-dimensional and three-dimensional thinking. Hence, this study aims to model relationship between the visual thinking and abstraction. For this purpose, an instruction guide has been developed and applied in the studio. The guide consists of 'find a source-analyse it-interpret it-synthesise it-transform' phases.

Main finding of this study is that research methodology reveals two main interrelated issues in the relationship between the visual thinking and abstraction. The first relationship is the nature of abstraction and the second is the transfers between the second and third-dimensions. While the nature of abstraction is established by reductive, descriptive, or discriminative approaches as common tools in the studio, individual differences come into play in the second and third-dimension transfers of abstraction. Consequently, abstraction practice results in different design behaviours and representations. Also, this conclusion reveals the importance of individual differences in the first-year studio.
Keywords: abstraction, architectural education, first-year design studio, visual thinking.

INTRODUCTION

This study aims at modelling the relationship between visual thinking and abstraction in the first-year design studio. Modelling does not mean the physical model rather it implies conceptual thinking and architectural ideas in the mind. For this purpose, an instruction guide has been developed by using the hands-on activity: find a source-analyse it-interpret it-synthesise it-transform. The aim of this guide is to restrict multi-component actors of studio, to sort out the variables in the studio, and to activate hand-eye-brain coordination. The topic directly indicates that design exercises in the first-year studio is crucial in terms of visual thinking. This is important on several counts. Firstly, basic design studio in the first year offers a kind of new learning culture from the point of architectural education. Basic design studio in the first-year differentiates itself from other architectural studios in terms of context, process and outcomes. In the first phase, while this course is adapted by the orientation of students to architectural education, design exercises in the studio, gradually build visual thinking of architecture students. This building process is tested, expanded and experienced by design exercises. Pedagogical techniques of the studio enhance the experiences of visual thinking, perceptual ability and representation skills. This means that architecture students in the studio setting learn how to think architecturally and they practice making decisions (Attoe & Mugerauer, 1991, p. 41). In other words, visual thinking in the architectural education is strengthened through design exercises which are set by various concepts and tools. Among them, the mostly applied method is abstraction.

Abstraction is a reasoning process that allows reality or actuality to be coded independently of its properties and therefore helps the communication of concepts (Johnson, 1994). On the other hand, in his book, titled "Visual Thinking", Arnheim (2009)

does not give a definition for abstraction. On the contrary, he makes inferences about what abstraction is and is not. According to Arnheim (2009), abstraction is not a sign, clue or example of features and is not about taking one or more elements from a self and extracting random features. Rather, abstraction is a link between perception and thinking (Arnheim, 2009, p. 213). Based on his characterization of the link between perception and thinking, it can be said that abstraction emerges as a result of a kind of reasoning process. In formal logic, different reasoning processes are described as deduction and induction; hereof, inductive reasoning notifies a 'discovery' while deductive reasoning informs 'justification' (Dorst, 2011, p. 523). The reasoning process, which is described as a mechanism that enables the production of ideas, is also closely related to the visual thinking skill. In addition, idea generation is directly fed by the designer's own experiences and internal-external stimuli (Goncalves et. al. 2014, p. 32). In this context, abstraction takes place through the designer's reasoning, and the process results in a flow of information about how the object looks.

This is a kind of information processing. In this process, a regular sequence of projections is reached as the observer wanders around an object or the object comes before the observer's eyes, and the consistency of this sequence allows the object to be defined (Arnheim, 2009, p. 111). In other words, the designer physically moves around the content and begins to place interrelated elements; it is more about finding good relationships rather than finding the right ones (Kolko, 2010, p. 19). Accordingly, there is no clear image of how the object looks during abstraction. Instead, the perceptual potential of visual thinking on the object is important. The difference between seeing and perceiving is that perceiving is a form of interpretation of "right" seeing; in this context, visual thinking can be regarded as the production of thoughts through visual imagery (Goldschmidt, 1994). Namely, while the object is processed in visual thinking through perception, the subjective structure of the object is described and reframed through imagery.

Thus, a manifestation of the object arises. In the architectural sense, this manifestation is a formal representation. The main visual stimuli derived from the legibility of the contour, geometric form, and texture of the object are important, as we obtain information by searching for distinctive or part-whole characteristics in defining the shapes (Oxman, 2002, p. 146). This means that the individual perception of the prominent features of the object in visual thinking and their interpretation in the information processing both portray abstraction as a link and reveal individual differences. Then, what determines how the object looks and resembles in the mind is the characteristics that emerge depending on the effect of the object on the individual. Finke and Slayton (1988) showed that creative visual explorations can be made by imagining new combinations of simple parts. According to Arnheim (2009, p. 110), visual perception and imagery are not limited to optical images, on the contrary, the sense of sight organizes, completes, and synthesizes the features found in images. This directly implies the generation of ideas.

The motivation of this study, which aims to model the relationship between visual thinking and abstraction, stems from exploring the orientations of visual thinking that provide idea generation. Of course, this marks in-depth cognitive work. However, since architectural education is also an expression and communication activity, there are many tools to describe the movements that take place during visual thinking. This is why abstraction has been used as a pedagogical discovery tool. For this purpose, an instruction guide has been developed to categorize the stages of visual thinking to ensure the intelligibility of two-dimensional and three-dimensional transfers on the axis of abstraction. Due to the flexible and adaptable nature of first-year architectural education, this guide has been applied to first-year architecture students as a kind of abstraction practice. In the next chapter, the research method will be presented. In the method, definitions are given for the stages that will reveal the relationship between abstraction

and visual thinking, and the contextual content to which the method is applied as a design exercise is presented, as well as the general content of the first-year education.

RESEARCH METHODOLOGY

The main issue of research methodology is to reveal the relationships between the two-dimensional and three-dimensional transfers in terms of abstraction skill as a tool of visual thinking. For this purpose, an instruction guide has been developed. This guide provides an insight for categorisation of visual thinking phases. Also, Lau et al. (2021, p. 179) emphasises that visual instruction is an effective pedagogy with regards to improve student learning. The instruction guide in this study bases on abstraction and it is coded as 'find a source-analyse it-interpret it-synthesise it-transform'. According to this;

Find a source: It means a selection of an object. The object is the self of the source for abstraction. The source as an object can be anything for instance a machine, an animal.

Analyse it: The second phase is to analyse the source. This means that the source as an object is separated into its components. Textural, dimensional, structural, morphological features of the source are identified one by one.

Interpret it: Interpretation is a kind of a filter mechanism. In this phase, perceptual ability is activated. Parts which come from the analyse phase, here, are processed. Thus, a connection between the visual thinking and abstraction begins to set.

Synthesise it: In this phase, design knowledge begins to be produced. Analysis and interpretation phases are wholly integrated. Visual thinking is activated after abstraction practice is completed. Thus, a new imagination is created in the two-dimensional manner.

Transform: After the two-dimensional image is derived from the source, this imagination is transformed into a three-dimensional physical model. This phase is concluded with a final product. In this phase, transfers from two-dimensional to three-dimensional reflect the relationship between visual thinking and abstraction. This enables a modelling which implies conceptual thinking and architectural ideas in the mind.

Instructions above provide an expanded guide for grasping the design mind. The instruction explores how the students think two-dimensionally and three-dimensionally while they make an abstraction for gaining design knowledge. For this reason, research methodology of this study bases mainly on basic design exercises.

The study has been conducted in the first-year design studio of the Department of Architecture in Sivas, Turkey. First-year Design Studio in Sivas is structured by a specific curriculum. It includes a variety of design exercises. At first, it should be stated that first-year design studio in architectural education is generally accepted as a meeting, encountering and adaptation space. Also, first-year design studio considers creative three-dimensional representations and during this period it leads students to learn and advance techniques, as tools for design representation (Acar et. al., 2017, p. 203). For that reason, first-year design studio in Sivas aims mainly to help students adapt to architectural education, and to enhance their hand-eye-brain coordination relating to design issues. On the one hand, the studio in Sivas consolidates student's ability of design and on the other hand, the design exercises in the studio are associated with spatial analyses. The curriculum of the studio involves drawings and physical model making ranging from ground-surface-cover exercises to constructional practices. In addition, issues such as form, proportion, scale, orientation, compositional balance, texture, material, rhythm and structure are studied during the studio process. The aims of all these are to enhance student's visual thinking, and to grasp the architectonic relations, as well as to develop spatial design ability. This content is the main influence that has determined the research methodology of this study, because the only constant

matter is the ability and practice of abstraction. Exercises on abstraction are chosen for particular samples of this study because of the obviousness and apprehensibility of a design mind.

A study, conducted previously by Besgen Gencosmanoğlu and Nezor (2010) examined the differences of abstraction between the novice and advanced students. In that study, change in the thinking system of architectural students was observed by some typical house interpretations between the first-grade and fourth-grade students. According to that study, architectural education increases the ability of abstraction therefore, abstraction should be taught and performed in order for architectural students to make original designs (Besgen Gencosmanoglu & Nezor, 2010, p. 1340). This led us to encourage more practice of abstraction in the first-year studio. For this reason, an instruction guide has been developed in order to make clear the visual thinking and abstraction phases. The relationships between the two-dimensional and three-dimensional transfers in the abstraction were revealed with the help of the instruction guide. The guide was applied in the fall semester of 2021-2022 in the Department of Architecture in Sivas, Turkey. The first-year studio was comprised of 100 students and it was only illustrated with a tenth of them.

FINDINGS

The main finding of this research, which has been developed by an instruction guide, is that abstraction shows different representations in the second and third dimensions in the axis of the same application and the same method. It should be noted that it is difficult to relate the concept of experience to abstraction since the practice is carried out as part of a first-year studio. However, developing experiences through abstraction as a part of basic design education in the first-year means gaining a design skill that directly affects the visual thinking of the student. For this reason, the instruction guide, applied as research methodology, proves how design outputs are diversified through visual thinking despite acting on a fixed component. In this sense, the most important finding of the research is that descriptions about how the abstraction mechanism works in the minds of first-year students were achieved. Moreover, it has been revealed that the similarities and/or differences between the way the same abstraction mechanism is expressed in the second dimension and its representation in the third dimension develop through individual thinking skills.

The findings of the study point to two main interrelated issues. The first is the nature of abstraction and the second is the transfers between the second and third dimensions. What is meant by the nature of abstraction is how abstraction is used as a design tool. Within the scope of the study, reductive, descriptive, or discriminative approaches can be common tools that provide object abstraction. However, when the object is represented in the second dimension with a physical model in the third dimension, the changing nature of abstraction emerges. Transfers between the second and third dimensions mark a visual thinking skill that diversifies with individual orientations. This point models the relationship between visual thinking and abstraction.

The study was carried out in the fall semester of 2021-2022. 10 samples were selected among the applications made to a student group of 100 students and evaluated in the findings section. Thereafter, the objects were chosen for the "find a source" part of the instruction guide as the first step are a sewing machine, pelican, ballerina, violin, eagle, acrobat, piano, camera, pumpkin, and watch. The choice of objects is entirely left to the student and the trainer has no influence on the choice of objects. The "analyse it" and "interpret it" parts of the instruction guide resulted in similar abstraction behaviour and process throughout the studio and in all selected examples. The "Analyse it" part of the guide is based on disassembling the object formally, dimensionally, structurally, or mechanically. The dominant tendency in the abstraction process is the desire to dominate the smallest part of the object. On the other hand, the method of separating the object into its parts has been differentiated. While some of the students made a reductionist

abstraction by considering the prominent components in the object, some of them performed a holistic discrimination on the object. At this stage of the abstraction process, expression techniques were also differentiated. In the majority of the findings, the abstraction process was expressed by using a linear technique, while in the other part, schematized figures appeared as a form of representation. This difference in practice forms is directly mediated by the subjective characteristics of the object. For example, objects with the content of a machine, such as the sewing machine, violin, piano, camera, and watch, are abstracted through the tendency to be mechanically studied. In particular, the intelligibility of objects such as camera and watch has been enhanced by the strong deconstruction technique and abstraction has been realized as a result of a detailed mechanical disassembly. In the example of ballerina and acrobat, the rhythmic cycle of the object is handled and dynamism is created through the posture and movement of the source. Thus, abstraction emerges as a holistic set of relations. In the pelican, eagle, and pumpkin examples, the abstraction is realized through prominent components or the skeletal system. In each abstraction technique, the mind has performed an abstraction process in accordance with the "what it is" of the object. Namely, the subjective properties of the object determined the nature of the abstraction (Figure 1).

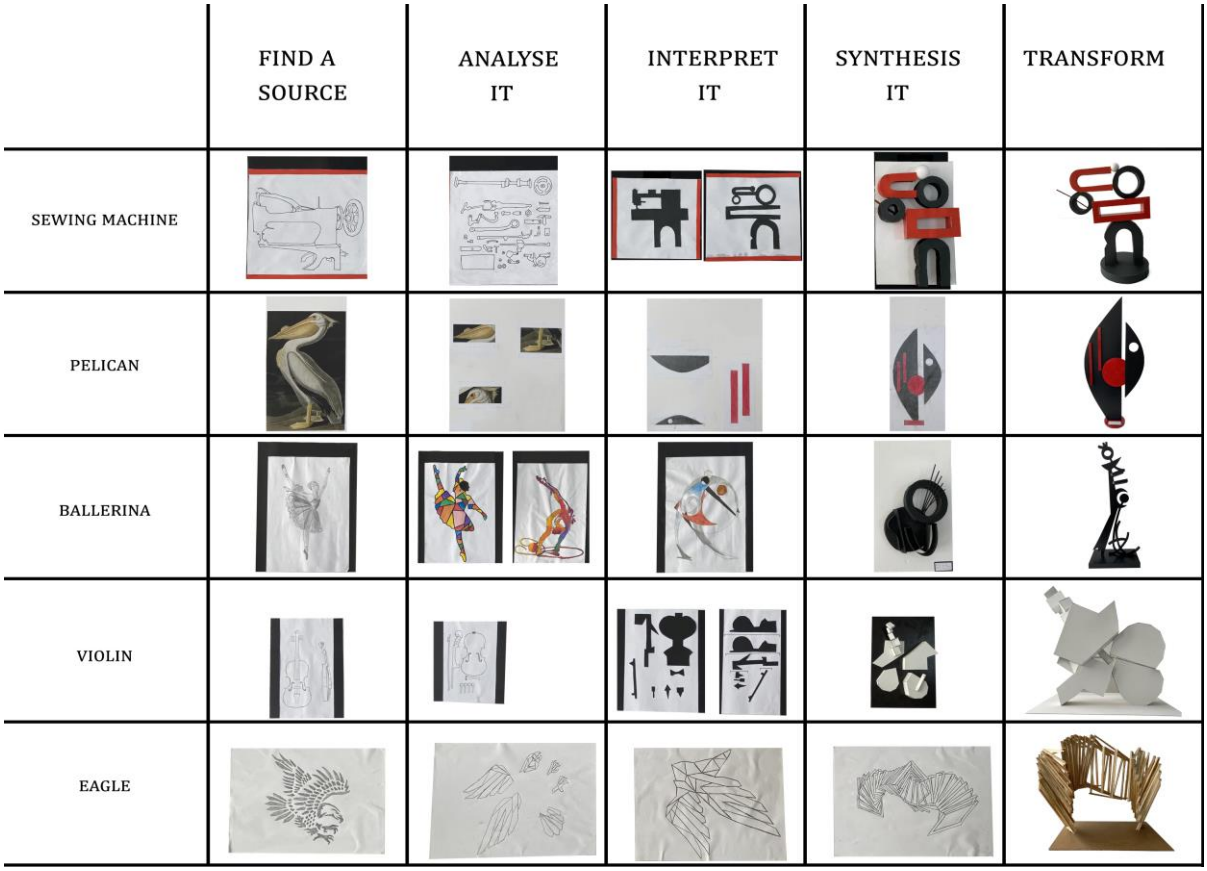

Figure 1. Objects and the abstraction practice, conducted by the instruction guide.

The "Synthesise it" and "Transform" parts of the instruction guide consist of the transfer of abstracted information to the second and third-dimensions. The findings at this stage of the study revealed that the transfers between the second and third dimensions were not managed in parallel with the nature of the abstraction introduced in the first two stages of the guide. So much so that the sameness or differentiation of the methods used in abstraction did not have a strong effect on the final product. Objects abstracted by the same method turned into different outputs. The findings of the study showed that what differentiated the final product was individual perception, individual motivation, and predisposition to visual thinking.

The consistent structure of the instruction guide played a role in reaching this finding. The findings showed that despite the changing nature of abstraction, the abstraction technique remained the same. All students established a figure-ground relationship, benefited from the linear description, and a figure was created with a reductionist approach. The power of visual thinking began to emerge in the last two phase of the guide, "Synthesise it" and "Transform". While the second-dimension expression of objects appeared as a copy of the "interpret it" part of the guide in some of the examples, it was characterized by sensory features such as material, colour, and basic design principles such as rhythm and hierarchy in others. Visual thinking tried to jump to the third dimension in the narrations in which the second-dimensional narrations presented strong tectonic relations. Formal depth, spatial readability, and mass integrity have been added to the synthesis. The "transform" part, on the other hand, emerged in two ways as independent and dependent on the synthesis, and the final product in the third dimension directly marks the practice of abstraction in the first phase. This means that the stronger the abstraction is as a practice, the stronger the third-dimensional physical model offers an architectonic unity, because this reveals that visual thinking defines a strong imaginary field through strong perceptual performance (Figure 2).

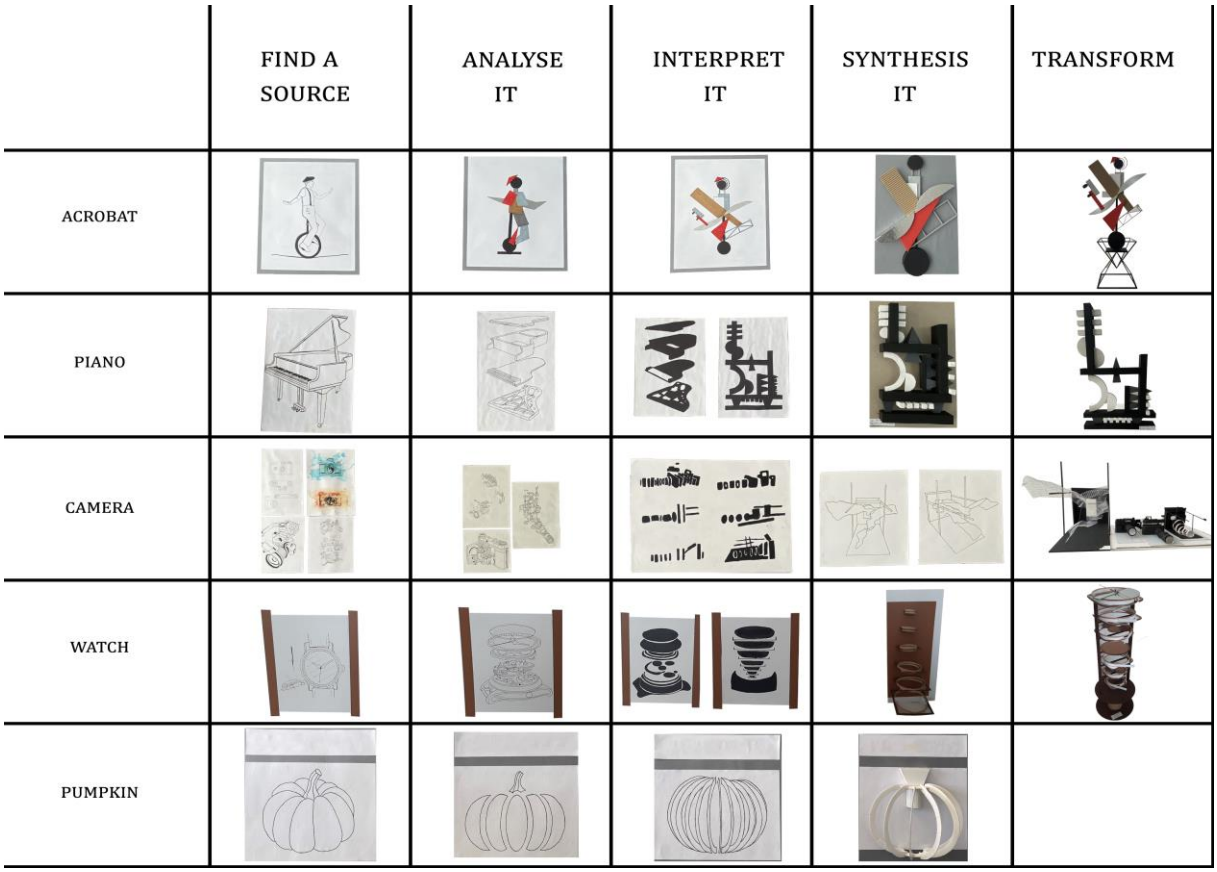

Figure 2. Objects and the abstraction practice, conducted by the instruction guide.

On the other hand, the transfer from the second-dimension to the third-dimension also presents the individual differences in the studio and the changes in the way the mind works. The findings of the study show that the process from the abstraction of the object to the construction of a physical model is mainly clustered around the transfer from interpretation to synthesis. The relationship between visual thinking and abstraction and the functioning of the mind was revealed in the guide's "interpret it" and "Synthesise it", and the transfers from the second-dimension to the third-dimension were made directly. Another finding is about the correlation between the structural setup of the physical model in the third-dimension and the practice of abstraction. Accordingly, in the examples where the transfer from the second-dimension to the third-dimension is

differentiated from each other, abstraction is the result of a detailed search. The nature of abstraction is stuck between the desire to master the thinnest detail of the object and the dynamism produced from the object. The phases of analysis, interpretation, and synthesis were carried out entirely through the pieces detached from the object. While the existence of the physical model in the third-dimension is created completely independently from the first phase, the architectonic components that make up the model are shaped with convergent relationships. For example, the violin has been separated down to its mechanical parts that make up its structural setup, and its elements have been interpreted in a figure-ground relationship. The way abstraction is expressed in the second-dimension is a fragmented and multi-component organization in terms of composition and orientation. Moreover, no matter how much the production in the third-dimension is strengthened in terms of structural and spatial depth, it creates a similar perception to the production in the second-dimension in terms of the frame, linear dynamics, and formal orientation of the physical model. The same is true for the watch. The physical model in the third-dimension is supported by components containing parts of the object in the primary interpretation, and the resulting product has gained depth, thickness, and structural staticity. However, in the transfer from the second-dimension to the third-dimension, a single example was separated from the others. In this example, in which the camera is abstracted, the physical model representing the third-dimension has emerged as a complete abstract vision, disconnected from the previous phases (Figure 3).

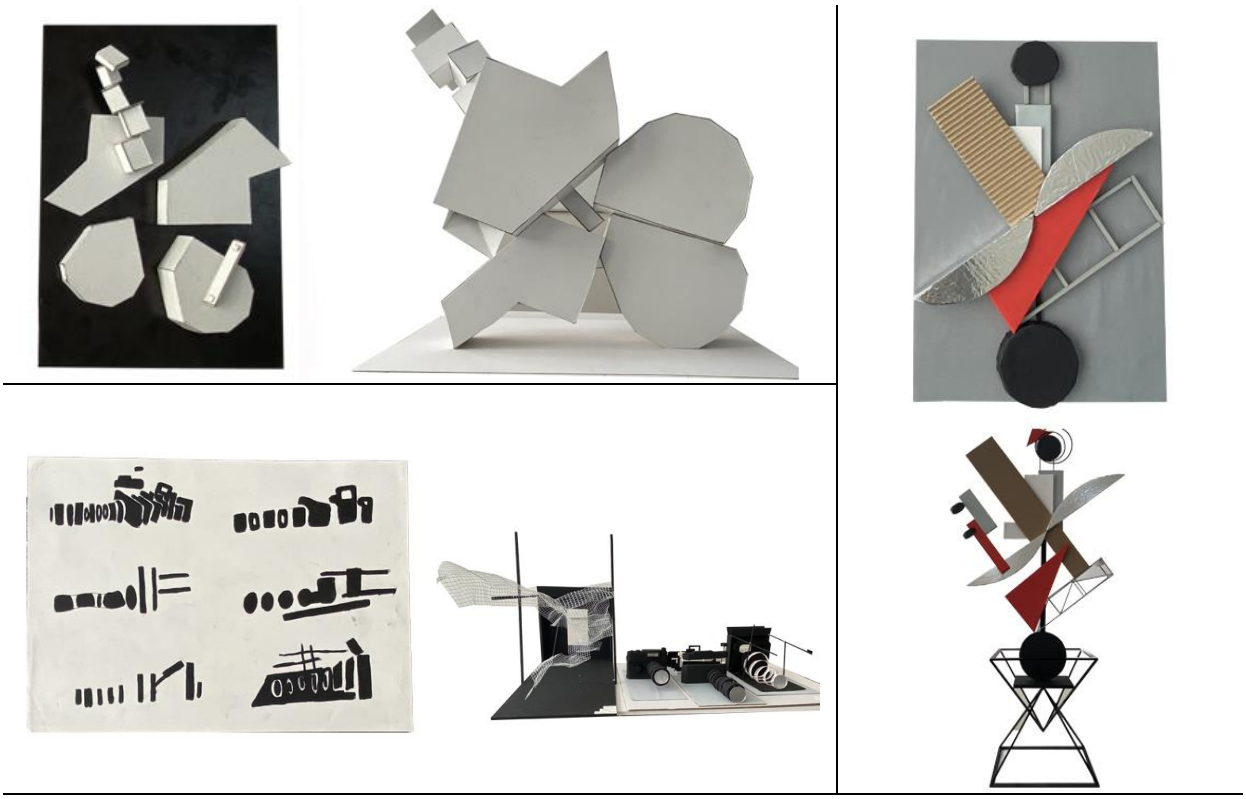

Figure 3. Some examples of transfers from the second-dimension to the third-dimension in abstraction practice (violin, camera and acrobat).

CONCLUSION

This study has been carried out to model the relationship between visual thinking and abstraction. What is meant by saying modelling is the way of architectural thinking. Also, abstraction practice has been preferred as the tool that makes modelling possible. An instruction guide has been developed to understand the transfers from the second-dimension to the third-dimension in the abstraction process. Since the abstraction practice is an important part of basic design education, this guide has been applied to

first-year architecture students. Another reason is the practice-based nature of first-year education and multiplied by design exercises. The main argument of the study is that there are various transfers between the two-dimensional and three-dimensional representation of the abstraction skill in terms of visual thinking. The instruction guide developed to model these transfers consists of five phases. The last two of these phases are the second and third-dimensional visualisations of the other three initial phases. The final products have clues to reveal the relationship between visual thinking and abstraction. Accordingly, the first result of the instruction guide developed in the study is that a fixed practice technique results in different perceptual performances for the multiple participants in the studio. Of course, the diversity of the final products does not only imply that there are different participants in the studio, but also that diversity can be produced by endless mental combinations, even within the limited technique (Figure 4).

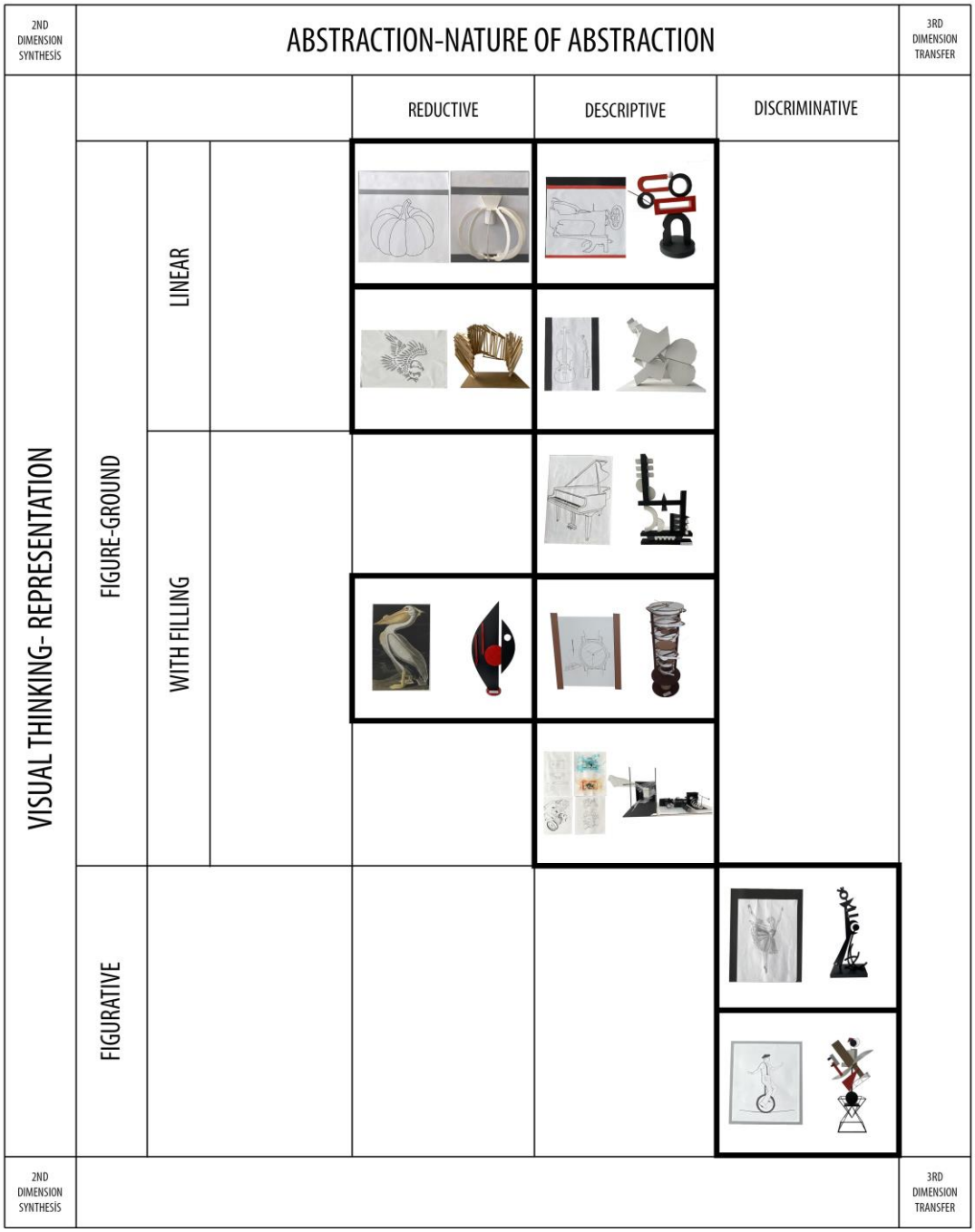

Figure 4. A classification for the process.

Another result and most important output of the study is that although the nature of abstraction is established with similar relations, individual differences come into play in the second and third-dimension transfers of abstraction. In this, the role of individual experiences in visual thinking is important. For the first-year, although experience defines an open space for improvement that is still in contact with architectural design, which charts the trajectory of individual motivations and orientations. This means that despite the nature of abstraction shaped by similar contents, the transfers between the second and third-dimensions are directly defined by the visual thinking mechanism. This indicates the necessity of new searches to increase students' visual thinking skills and capacities. Conceptually modelling these transfers has revealed individual differences that attempt to jump from the second-dimension to the third-dimension or present a poor physical model with their third-dimensional representation. Thus, the findings of the study reveal that first-year architectural education should evolve into a process in which individual differences are discovered. It may be natural for a fixed application technique to result in different products, but this modelling contributes to the field of education by providing an infrastructure for how and in which direction students' individual skills should be developed.

The most obvious limitation of the study is that the instruction guide was applied once and for a limited number of participants. It should not be ignored that the results will change as the participants of the studio change. For further studies, it may be possible to apply the instruction guide periodically and measure the variability of results. The overlapping of modelling data provided by different participants can provide more consistent results in terms of transfers in the second and third-dimensions abstraction. In addition, applying the same guide to the same participant group at certain periods can provide a pedagogical tool for measuring the individual skills of students.

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