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THE SOURCE AND THE IMAGINATION: THE ROLE OF THE VISUAL STIMULI ON POTENTIAL DISCOVERIES IN DESIGN

Pinar Koç

This study aims to reveal the process of knowledge production and visual thinking between visual stimuli and potential discoveries in architectural design education. In the studio environment, the physical model was presented as a visual stimulus and a design task related to the model was given. While the elements that make up the physical model were used as a melting pot of information by the students, the design task revealed the students' method of using design knowledge and their approach to generating ideas. As a result, the study was completed in terms of producing close variants, making reinterpretations and producing designs at the intersection of close variant and reinterpretation, making reinterpretations and producing designs at the intersection of reinterpretation and close variant, producing designs at the intersection of reinterpretation and a completely different idea, and the production of completely different ideas.

Keywords: *design knowledge, design thinking, form, physical model, visual stimuli*

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INTRODUCTION

This study aims to reveal the process of knowledge production and visual thinking between visual stimuli and potential discoveries in architectural design education. While the visual stimulus marks the first information for the designer, potential discoveries represent creative and innovative imagination. Since the experiences of the learning environment in the architectural design studio are mostly designed to expand, diversify and enrich, the dynamics of the learning environment should also include content that increases motivation and awareness from a pedagogical point of view. Although the visual stimulus is initially understood as a given condition and/or a limiting/formative/restricting/standardizing pattern in the design, the individual experiences and previous learning outcomes of the architecture student also constitute an initial knowledge for the design. What is important in the studio is the necessity of providing an effective learning environment. Because effective learning environments allow students to build their own understanding and knowledge [Crowther 2013]. In the process leading to potential discoveries through visual stimuli, cognitive processes are activated with organizations based on selection, sorting, decreasing, reducing, separating, combining and integrating. This means that in the production of design knowledge, a new process emerges in which the student constructs knowledge, approach, method and understanding in the design process, as well as his individual experiences and previous learning outcomes.

The cognitive processes activated by the visual stimulus and the resulting self-construction of the student's own knowledge mark a learning environment with high awareness. Such that the visual condition has been shown to be an effective pedagogy that encourages the student to deep learning and improves his performance [Lau 2021]. [Finke 1996] also states that creative imagination is structured by prior knowledge, typical features of similar categories, or examples that have just been seen. In this study, visual stimuli were used as the dynamic of an effective learning environment and imagination. The visible/tangible results of design thinking triggered by visual stimuli are potential discoveries. The physical model was the visual stimulus used in this study, and a design task was created for potential discoveries. Within the scope of the study, the relationship between visual stimuli and potential discoveries was examined in terms of process. The production of design knowledge and visual thinking processes mark the processes of selection, sorting, decreasing, reducing, separating, combining, integrating and organizing that lead from the design task to potential discoveries. The study was applied to fourth-year architecture students at the architecture school where the authors worked. One reason for this is that fourth-year architecture students have developed spatial comprehension competencies due to their education, while the other reason is that fourth-year students' ability to see and transform between the second and third dimensions has diversified with their previous experiences. This study, which examines the process of knowledge production and visual thinking between visual stimuli and potential discoveries in architectural design education, also aims to develop learning awareness in the architectural design studio.

LITERATURE CONTEXT: VISUAL STIMULI AND IMAGERY IN ARCHITECTURAL DESIGN EDUCATION

Architectural design education is a complex process that includes cultural, social and contextual values as well as spatial, formal, structural and tectonic relations. Despite the complexity of design inputs and the design process, modeling, design, and problem solving are not separate processes; on the contrary, there are relations between each other [Akalin 2009]. On the other hand, one aspect of architectural design education is to make learning processes clear in the studio or to increase awareness of learning. This orientation focuses on the cognitive mechanism of the design process and design thinking. In this orientation, where learning by doing comes to the fore, the studio coordinator explicitly conveys information about the process in order not only to target the final product, but also to teach the student the 'designerly' way of thinking [Vandooren 2014].

In architectural design education, talking about the process and/or designing the studio with content that makes the process evident can improve learning awareness. In this study, which aims to reveal the process of knowledge production and visual thinking between visual stimuli and potential discoveries in architectural design education, the process is designed to clarify design thinking. The main theme of the study is visual stimulus, imagination and design thinking.

In design, the acquisition, production, development and conclusion of knowledge are carried out through imagination and visual thinking. Visual thinking is the production of ideas, and it is also the reasoning that leads to the formation of ideas and helps in the creation of form in design [Goldschmidt 1994]. The design knowledge that enables the emergence of the form is obtained by collecting, extracting and processing all kinds of data inherent to the design task on the axis of the design problem and its potential solutions. Imagery and visual thinking save design knowledge from being a common pot of knowledge gained from previous learning outcomes and/or shaped by the possibilities offered by the current design task. Since the important thing in design education is the development of thinking skills, knowing where to find the information, which is the specific information to apply to a given situation, and how to use the information when necessary, offers a competence [Oxman 2004]. The visual stimulus used in this study is the first source of design information. The given information in the visual stimulus is processed through visual thinking, that is, by deciding which information to use where and how, leading to potential discoveries of the design task. In other words, the position of design knowledge during cognitive processes such as selection, sorting, decreasing, reducing, separating, combining, integrating and organizing triggers the production of ideas in design.

In one of their studies, [Goldschmidt 2006] found that creative and innovative thinking is sensitive to environments that provide possible clues and contain analogical sources. [Anderson 1993] suggested that creative visual exploration involves an interaction between internal and external representations. The cognitive processes of visual thinking and previous learning experiences define a resource and knowledge area that guides the designer for the generation of knowledge and the generation of ideas in design. The ability to transform information into representational structures forms the basis of the ability to make original modifications and changes in these representations [Oxman 1997]. In this case, the transformation of design information into an architectural form can be realized through various changes and modifications such as adding, subtracting, sorting, and combining the visual stimulus given as a source. Therefore, it is accepted that the most effective visuals are those that leave the designer the widest space for transformation and interpretation [Goldschmidt 1998]. After all, the process of visual thinking, which starts from visual stimuli and leads to potential discoveries, results in an architectural form.

In the process of forming the architectural form, the production of design information from the visual stimulus is carried out through the perceptual selection of the forms on the visual stimulus. People's approach to perceptual retrieval of information is achieved by defining forms and then searching/investigating specific or discrete part-whole characteristics [Oxman 2002]. The line, contour, geometric shapes or any prominent part that makes up the form functions as a visual stimulus to the extent of its legibility. In other words, what motivates the designer is based on the way he interprets what he sees [Liu 1995]. The designer's interpretation of what he sees means that he reorganizes the components that he distinguishes and separates from others through selectivity in perception in search of a coherent whole. In this process, part-whole readability, position, orientation, shape properties of geometric elements and main figure-subshape definition lead to the transformation of form. [Prats 2009] found that designers' exploratory strategies are aimed at seeking subshapes and their recognition, and that repetition and modification in creative form transformation mark important iterations. The new discoveries that emerge in form transformation are the externalized result of the process of knowledge production and visual thinking in design. This potential result has emerged as a new form vision. Visual emergence is the representation of forms and features that are not intentionally placed and initially represented [Gero 1999]. This discovery process, in which design knowledge is produced and transformed, is the reasoning that forms the design idea, in other words, visual thinking.

This study, which aims to reveal the process of knowledge production and visual thinking between visual stimuli and potential discoveries in architectural design education, has an exploratory orientation and contribution in terms of visual thinking and the formation of forms. The contribution of the study in terms of visual thinking is to provide a clear direction and basis for the process of producing and transforming information and the determination of the approach to receiving information by following the production and processing of design information. The contribution of the study in terms of the formation of forms is to reveal the capacity of form to shape visual thinking and to offer a method for investigating the part-whole characteristics of the form.

DISCUSSION OF PROCEDURE: STUDIO SETTING AND SETUP

The architectural design studio is where architecture students experience various architectural projects and professional qualifications are given, and architecture is the core of the program [Priya 2020]. This environment is designed by producing design knowledge, developing design thinking and learning by doing. In this study, which examines the relationship between visual stimuli and potential discoveries in design, the studio was built with a process that focused on the process of visual thinking with the production of knowledge. Since the main theme of the study is visual stimuli, imagination and design thinking, the studio environment started with the visual stimulus that supports form and formal transformation and was completed with the final product. The first element that rationalizes the study is the physical mock-up that is given as a visual stimulus. The model is the source that directs design thinking and reveals the clarity of the visual thinking process. Despite the strict limits of such a formal approach, the infinite variety of designing and different individual experiences allow architecture students to make potential discoveries in design. The other element that drives the studio environment is the design task. The design task consists of the renovation of the facade of any existing building located on a cramped, adjacent and/or corner parcel in the urban space. In this facade renovation task, the source, that is, the visual stimulus, is the physical model. Potential discoveries are the possible results of the production of design knowledge, formal transformation and visual thinking process. It should be noted right away that function, context, or other similar design components are postponed in this task. Because what is investigated in the study is what and how the visual stimulus is transformed. A quick questionnaire was also applied in the studio environment in order to produce design information and understand the visual thinking process.

FINDINGS AND RESULTS

Source: Physical model and survey application

In this study, the source that enables the production of information in design, that is, the visual stimulus, is the physical model. In other words, the physical model is the element that triggers the design idea. To reveal the source-based knowledge production in potential discoveries, the physical model has been made the main subject of a design task. The physical model is depicted to determine where, how and for what purpose its components are used. The physical model, which was selected from the studies commissioned by first-year architecture students as a facade-mass-section assignment in the Basic Design course, was a rectangular prism closed on three sides and designed with various surface relations only on the front. Accordingly, the front-face layout of the model was divided into two unequal parts, and each part was organized with multiple and plural components. The lower part of the model consisted of one large and ten small pyramids. The large piece clearly held the edge surface of the model, while the small pyramids were placed in a sequential arrangement leaning against the large pyramid. While each pyramid had the same texture and material, the

color scheme of the pyramids differed and three different colored pyramids were used in the same orientation with variable repetition. The upper part of the model was bordered by a thick frame that differed angularly from the main body and protrudes outward. This boundary formed a partial niche in the front-end layout. The interior of the frame was completed by dividing it into two vertically. In addition, the inside of the frame was randomly interlaced with wooden slats. The last element that formed the upper part of the model was three prismatic components that were at different angles, orientations and positions and protruded outwards from the front face. These prismatic components were connected to the wooden slats in the frame, giving the model dynamism and rhythm. Thus, the physical model stands out with four distinctive elements, consisting of pyramids in the lower part and the frame in the upper part, wooden slats, prismatic components. The reason for the transition from the descriptive description of the physical model to design research is to determine the contribution of visual stimuli to the production of design knowledge and visual thinking and its role on imagination. This means that the physical model is saved from being a melting pot of information and turns it into a dough from which new information is derived by processing information. Accordingly, the facade renovation given as the design task includes the relationship between source and final product. It also covers the stages of knowledge production and visual thinking process in design.

This physical model, made by first-year architecture students, was given to fourth-year architecture students as a visual stimulus. In other words, the group that realizes/makes/designs the model is the first graders, while the group that uses the model as a visual stimulus is the fourth graders. Therefore, a quick survey was applied after the design task was completed in the studio in order to reveal the relationship between source and result product. The purpose of the questionnaire is to decipher the process of knowledge production and visual thinking in design. The approach applied in interpreting the survey answers and transforming them into findings consists of comparing the analytical answers given in the survey with the physical model and result products. This includes whether coherent and realistic tectonic relationships can be established, the aspects of the facade proposals that are open to development, the effect of three-dimensional and two-dimensional separations on facade formation, the harmony and coordination of the components, the contributions of the physical model in the relationship between facade and mass formation, textural harmony and the organization of the components. In this analysis, the transformation of the visual stimulus is the pattern of the design process in terms of imagination and potential discoveries (Table 1).

Table 1: A questionnaire applied in the studio to comprehend the process of knowledge production and visual thinking in design in line with the design task

You have developed a new facade design for the facade of an existing building from the model you used as a design source. Within the scope of this process, which includes the production of design information, answer the following questions (more than one answer can be marked).
1. Which of the following was your general design approach while producing the design information from the model given as a source? (How did you transfer the elements that make up the model to the new design?)
a. direct adaptation b. simulation/homogenization c. interpretation d. abstraction
2. Which of the following is the method of producing and using design information?
a. To design separator/divider/shredder facade elements from the elements in the model. b. To emphasize the structural setup on the facade by creating new structural components from the elements in the model.

c. To create new spatial units on the facade by making the elements in the model a part of the interior.
d. to obtain a new and different component in the facade by analyzing the existing tectonic and spatial relations in the second and third dimensions.

3. How did you decide which of the elements in the model given as a source will be used where in the new facade design?

a. I used the elements in the source model in the same formal order and similar position.
b. In the new facade design, I used the elements in the source model to regulate the occupancy-space balance.
c. I used one, several or all of the components that make up the source model whole as a producer of a completely different architectural content in the new facade.
d. I stylistically transformed the elements in the source model and used them in different positions and layouts by duplicating them.
e. I obtained new formal elements by abstracting the elements in the source model.
f. I transformed the elements in the source model in form and dimension and used them in different positions and in different order on the new facade.
g. I used the elements from the source model as the main fictional component on the new front.
h. I acted with the concern of using all the elements in the source model, and for this reason, I created completely different contents that ignore semantic, spatial, functional and structural relations on the new facade.

4. Is each architectonic component you use in the new facade design completely derived from the model given as a source?

YES..... **NO**.....

If no, what are the components you added or removed? What is the reason for adding or removing these components?

There were 80 architecture students in the studio environment where the study was carried out, and design research in the studio resulted in active research, passive research, and designs that did not comply with the procedure. Active research marks the strong connection with visual stimuli and strong formal transformations. Passive research, on the other hand, represents the weak relationship of potential discovery with visual stimuli and the formal approach based on sameness. The design that does not comply with the procedure contains results that do not establish any connection with the physical model as a visual stimulus. Within the scope of the study, the designs that emerged as a result of active research were discussed and these were evaluated in terms of expression, expression style, visualization competence and representation ability, and the initial 80 students were reduced to 8.

In sum, the design tasks of 8 students will be evaluated and presented together with the questionnaire answers. Of the survey questions, questions one and four investigate the general trend in design behavior, while questions two and three show how individual decisions proceed in design. Accordingly, 7 out of 8 students answered the survey question questioning whether each architectonic component used in the new facade design is completely derived from the physical model, stating that each component of the new design is derived from the physical model; only 1 student (Student 5) stated that he made other types of additions/subtractions independently of the model given as a source. In the design behavior made independently of the physical model, irregularly distributed coatings were added to the facade surface. In this design behavior, it is stated in the survey answers that the student is based on the concern of adding movement to the facade. The other questions of the survey will be discussed under the following heading together with the new facade design that emerged as a result of the design task.

Imagination: The role of visual stimuli in potential discoveries

The physical model used as a source served as the starting point for potential discoveries through a design task consisting of facade renovation. While which components of the physical model are transformed into what and how as visual stimuli mark the production of information in the design, the extent to which the produced information is transferred to the new facade design reveals the imagination and design process. When the results of the design task were evaluated together with the survey responses, the approach to producing the design knowledge was direct quotation and simulation in only 1 student (Student 1), while the other students worked on simulation and interpretation (Table 2). Such an approach to generating design knowledge is completed with stages that bring the results of the design task closer or further away from the physical model. This includes the proposal for a new facade as a close variant of the physical model, a proposal for a new facade designed with the knowledge of a reinterpretation of the physical model, and a proposal for a new facade that emerges from the physical model. Certain criteria have been established that determine whether the results of the design task are a close variant or reinterpretation of the physical model, or the product of a completely different idea. For example, the decrease in the intensity of use of the parts of the physical model has triggered reinterpretation or the generation of a completely new idea. In other words, as the degree of abstraction increases, visual thinking becomes stronger. The consolidation of the tectonic content of the fragments of the physical model in the second and third dimensions also emphasizes abstraction and reinterpretation in the new facade proposals. On the other hand, leaving the main frame of the parts of the physical model fixed and using each component as it is and/or in close proximity resulted in the production of close variants in the new facade proposals.

Table 2: Answers to the first question of the survey.

Which of the following was your general design approach while producing the design information from the model given as a source?				STUDENT	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
a. Direct adaptation		c. Interpretation										
b. Simulation/homogenization		d. Abstraction										

The results of the design task will be examined comparatively in terms of 8 students selected as a result of the studio study. The stages that move closer or further away from the physical model are completed with the production of close variants, reinterpretations and completely different ideas. For example, Student 1 produced close variants in both proposals. The prominent parts in the physical model were dismantled based on the balance of size and smallness and turned into the source of design information. While large parts are used as large architectural components in the new design, small parts have emerged both as weak components and as new elements derived from these weak components. Although Student 1 declares that she aims to make these pieces a part of the interior at the same time, there is no element that gains spatial depth between the interior and exterior in the new facade proposals. The dynamism in the front-facing layout of the physical model has been the source of a similarly asymmetrical dynamism in the new facade design. Student 3, on the other hand, developed five different proposals, but only the first proposal ended up as a close variant. In her first proposal, in which she also used the frame of the physical model as a design component, a close variant was obtained because the other parts of the model were positioned with similar relationships. The other four proposals are representations of reinterpretation, and in these, they were based on the concern of obtaining new and different components on the front. Student 3 tried to transform the other three elements of the physical model outside the frame in line with the composition of each proposal. According to the project report, the main theme of the design idea in each proposal is rhythm, and the reason for this is that the

facade design is placed in the dynamic context of the urban space in relation to the neighborhood relationship. Among the two suggestions developed by Student 8, who showed similar design behavior to Student 3, the first was a close variant and the second was a reinterpretation. Although Student 8 developed two different types of suggestions, she preferred an unrationalized dynamism in her design behavior. This means that Student 8 puts forward a constructive approach in both facade proposals by prioritizing the dynamism, rhythm and angular dominance of the parts in the physical model. However, her first proposal as a close variant was complemented by relationships that fit the main frame of the physical model, while her second proposal resulted in a redistribution of the parts on the facade surface. Student 1, Student 3 and Student 8 gave the same answer to the survey question questioning the stage of deciding where which of the elements in the physical model will be used in the new facade design. In other words, the way all three students benefit from the elements in the physical model is based on regulating the balance of fullness and emptiness, transforming these elements stylistically, multiplying them based on different repetitions, and using them in different positions and orders. Student 1, Student 3 and Student 8 gave a common answer to the survey question questioning the method of producing and using design knowledge, creating new structural components and thus emphasizing the structural setup on the facade. In addition, making the elements in the model a part of the interior space was also used as a method for Student 1 and Student 3, and Student 3 also aimed to analyze the existing tectonic/spatial relations in the second and third dimensions. In summary, in different attempts of the many proposals they developed, Student 3 and Student 8 saw deriving new things from the source, transforming knowledge and abstraction, while Student 1 designed new facade proposals with the understanding of rationalizing the direct source (Figures 1-3).

Reinterpretations include applications that transform the tectonic content of the parts in the physical model in the second and third dimensions and/or the number, position and orientation of the parts. For example, Student 7 used all four elements in the physical model in different content, position, size and order on the new facade. Such that the use of the same formal order/similar position, the balance of fullness and emptiness and the presence of source elements as the main fictional component on the new facade guided the design behavior of Student 7. According to the project report, the common starting point in all four proposals of Student 7 is to be compatible with the physical model, to provide integrity and to establish a relationship with the side facades. Although Student 2 improves the design behavior by reinterpreting, the final products are similar to the close variant in some respects. The main element that provides this similarity with the close variant is the framework that emphasizes the limits of the new facade proposal. While the frame stabilizes the suggestions as an element taken directly from the physical model, the final product is differentiated by subjecting the surfaces within this frame to reinterpretation. In facade proposals, the pyramids in the lower part of the physical model and the frame, wooden laths and prismatic components in the upper part have become new elements of a holistic facade surface that has no division in the new facade proposals. In both proposals, the transfer of the pyramids in the lower part of the physical model to the upper surface of the facade and their arrangement in the form of a window opening marks the relationship between the interior and the exterior. On the other hand, the other components in the upper part of the physical model try to organize the remaining surfaces of the pyramids in the balance of occupancy and space in the new facade design. Student 6, on the other hand, concluded her first three suggestions as a reinterpretation and the fourth proposal as the product of a completely different idea. According to the project report, Student 6 states that the protruding curvilinear and flat layers used in all four proposals reflect indoor mobility and circulation to the outside. In the use of the elements in the physical model, the outer frame was left the same and the large prismatic components were reinterpreted in different sizes and shapes, while the wooden slats remained weak elements. The pyramids, on the other hand, although their position, number and layout have changed, they have been handled in a fragmented manner and organized in different orders reflecting the interior. In her fourth proposal, the changing design behavior can be described as creating stronger tectonic components between the interior and exterior and revealing the third dimensional relationship.

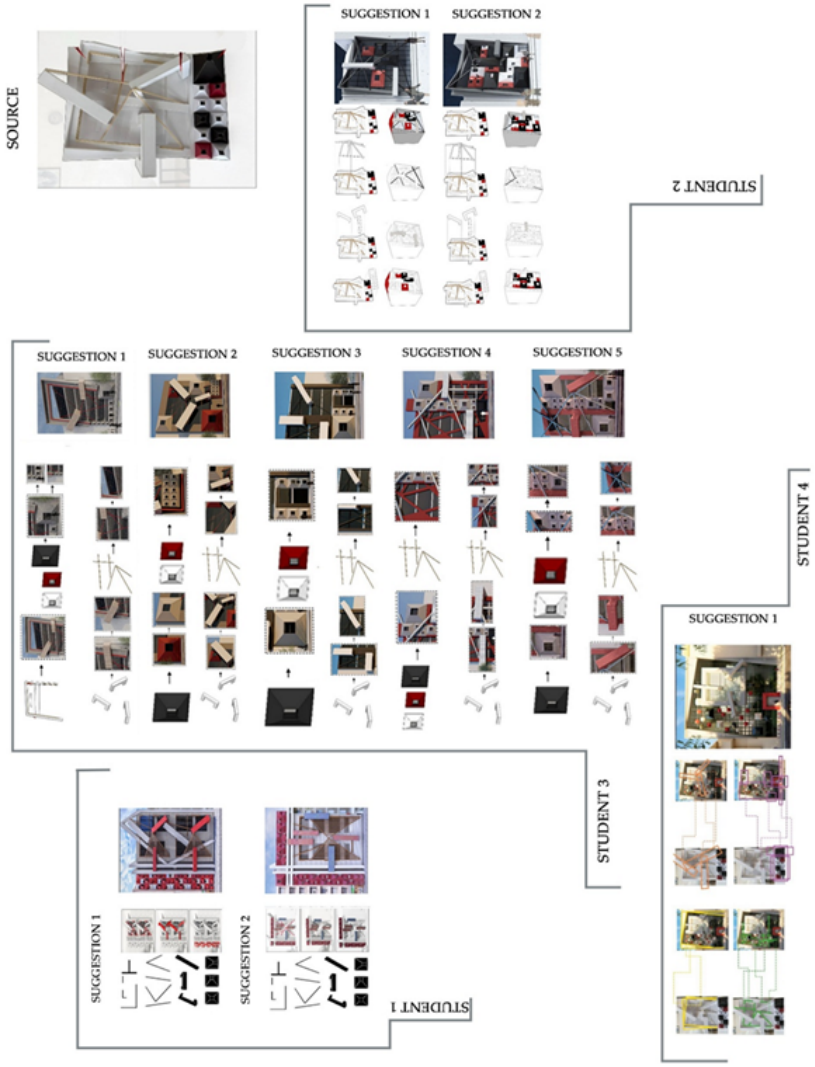

Figure 1: Different suggestions developed by students 1,2,3 and 4.

This makes the last proposal more like a reinterpretation than a completely different generation of ideas. While the method of producing design information during the reinterpretation is marked in the survey as creating new structural components for Student 7, Student 2 and Student 6, making the elements in the model a part of the interior space is seen as a part of knowledge production for Student 7 and Student 2. Student 6, on the other hand, accepts analyzing tectonic relations in the second and third dimensions as the method by which knowledge is produced, rather than the interior imagination. Student 6's approach to the production of completely different ideas in her last proposal can be seen as a result of her internalization of tectonic analysis after different trials. In summary, it can be considered that what enables reinterpretation instead of producing close variants is not only focusing on formal transformation or the balance of fullness and emptiness, but also providing dimensional transformations of forms, using them in different order on the facade surface, and making one or more of the elements in the source the main fictional component (Figures 1-3).

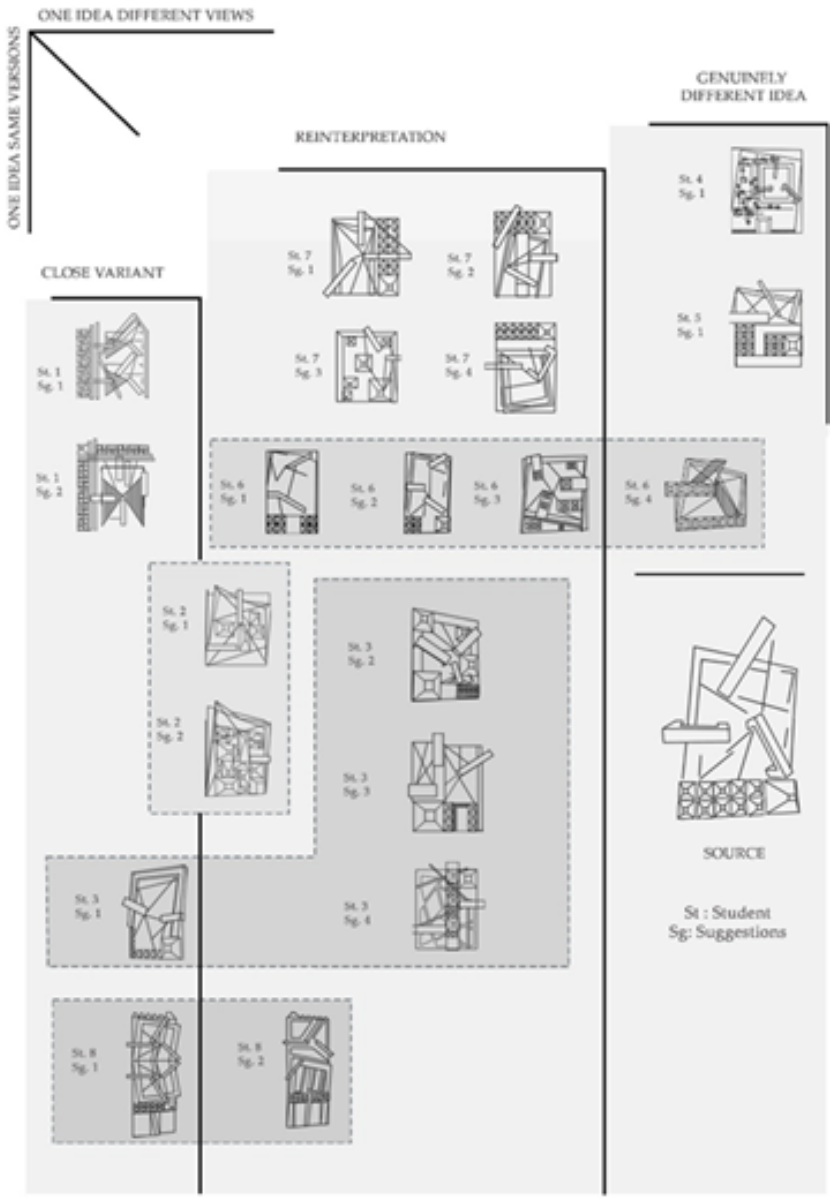

Figure 2: Different suggestions developed by students 5,6,7 and 8.

The production of completely different ideas emerged in the designs designed by Student 4 and Student 5. For example, in Student 4's single proposal, where she used all four elements in the physical model, three elements were treated in a similar character to the physical model, while only one element was reinterpreted. Accordingly, the frame forming the front-facing borders, large prismatic components and wooden laths, which are weak linear elements, were used in the new facade composition with their function and content in the physical model. The pyramids in the lower part of the physical model were added to the new design in a way that covers the facade surface and in an inauthentic form. The small or large number of parts in the physical model or the way they are used in a similar way do not affect the sameness or difference of idea production. On the contrary, what affects the sameness or difference of idea generation is the degree to which the elements belonging to the physical model are abstracted and moved away from the model. A similar situation exists in the new facade proposal of Student 5, who developed a single proposal. Student 5 also used all four elements in the physical model and sought to produce a new idea rather than interpreting it as a design behavior. For

example, the frame that defines the boundaries of the physical model is partially used to emphasize the end of mass in the new design. Likewise, the order of the pyramids in the lower part of the physical model is divided into two and arranged in different vertical and horizontal relations in separate positions. On the other hand, large prisms have turned into a new architectonic component in which the interior is strongly reflected outward. It is seen that the facade proposals of Student 4 and Student 5 resulted in an order that took its beginning from the source but gradually moved away from it. In the method of producing design information and the use of elements in the physical model in the new facade proposal, this attitude has been achieved through the balance of occupancy and space, tectonic analysis, permeability between interior and exterior, dimensional transformation of form and reproduction of form based on repetition (Figure 1-3).

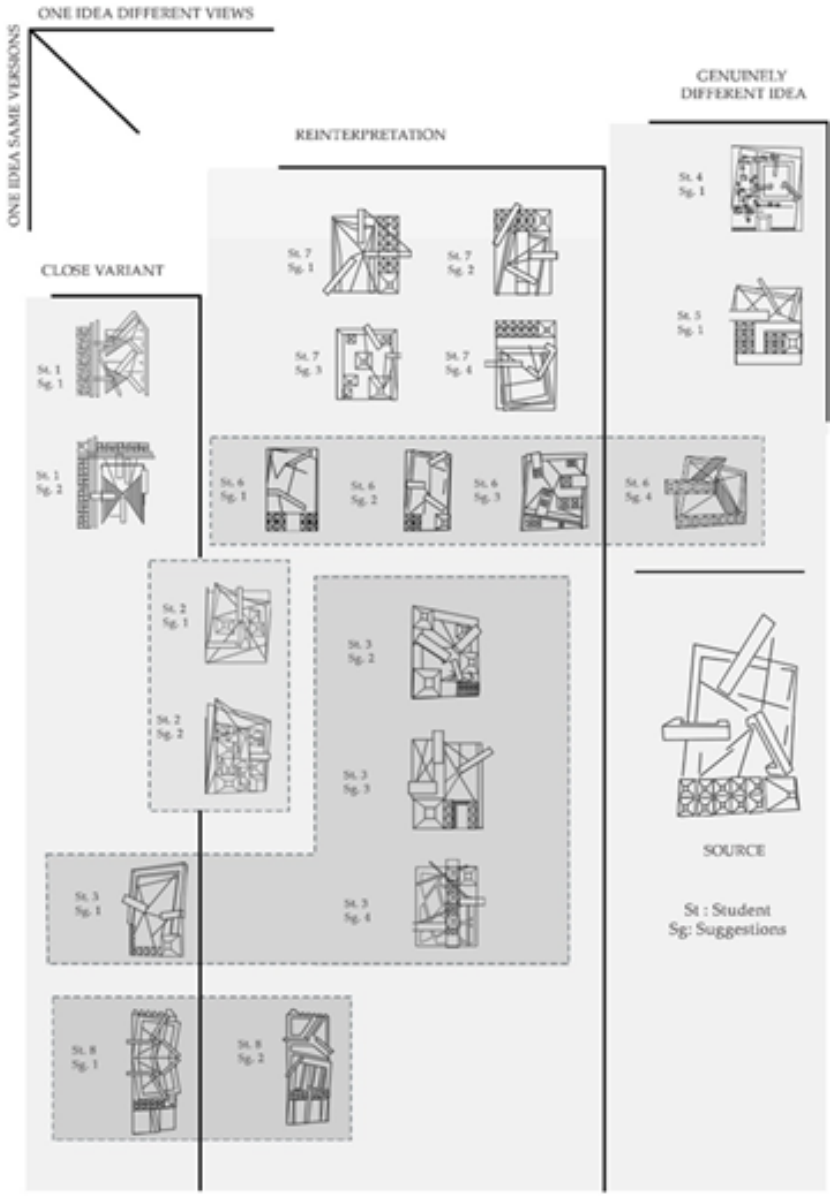

Figure 3: Proximity and distance of potential discoveries from the physical model: close variants, reinterpretations and completely different ideas.

CONCLUSION

This study, which aims to reveal the process of knowledge production and visual thinking between visual stimuli and potential discoveries in architectural design education, resulted in the proximity and/or distance of the distance between the physical model and the design task. The proximity of the distance between the physical model and the design task makes it possible to produce identical versions of an idea; distance marks the generation of different ideas from an idea. First of all, the physical model as a visual stimulus has partially taken on a binding role and has turned into a perceptual aid that reduces environmental resources for potential discoveries. All of the elements that make up the physical model were used by the students as a melting pot of information for potential discoveries. The design task represents the process that reveals the production of knowledge and the method of using information in design. The production of design knowledge from visual stimuli affected the students' idea generation methods. As a result, the study was completed in terms of producing close variants, making reinterpretations and producing designs at the intersection of close variant and reinterpretation, making reinterpretations and producing designs at the intersection of reinterpretation and close variant, producing designs at the intersection of reinterpretation and a completely different idea, and the production of completely different ideas.

Potential discoveries in terms of close variant production have emerged from the rational use of parts of the physical model. When inter-part relationships are positioned and used with similar contents, potential discoveries have emerged as a close variant of the source, as they approach the physical model. The reinterpretations were obtained through the formal, dimensional and semantic transformations of the components of the physical model. At the same time, it has been observed that the reinterpretation becomes stronger as the placement, distribution and position of the components on the facade differ. Another thing that improves reinterpretation is the reduction of parts in the physical model. In this case, what strengthens the production of knowledge in design can be considered as strong formal transformations and abstraction. This requires active research in design. The production of completely different ideas is clearly about moving away from the physical model. As the distance to the source increases in potential discoveries, it has been revealed that either the design idea is highly purified or the architectonic contents are dominant. Intersections, on the other hand, can mark some kind of transition, experiment, or intermediate process for potential discoveries. The intersection of close variant and reinterpretation, the intersection of reinterpretation and close variant, or the intersection of reinterpretation and a completely different idea can be evaluated in terms of the distance of the relationships established with the physical model. Potential discoveries that carry both proximity and distance relationships with the source can represent experiments that develop as practice in knowledge production. In addition, intersections can also be considered as a result of changing the way of thinking visually. Finally, although the fullness-void balance, or formal transformations, is the way all students produce and use knowledge, it is the process of visual thinking that diversifies the results into close variants, reinterpretations, and completely different ideas. In summary, from the perspective of visual thinking, the results of the study showed that visual stimuli can play an initial role for design, and that design information can direct the process of production, processing, and transformation through stages. From the point of view of the formation of forms, the results of the study revealed that form stretches the perceptual capacity while shaping visual thinking and that the methods of analyzing part-whole characteristics direct design behavior.

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AUTOBIOGRAPHICAL SKETCHES

Pinar Koç, Department of Architecture, Cumhuriyet University, Sivas/Turkey; pinarktuztasi@cumhuriyet.edu.tr

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