Research Article

Mimetic Teaching Strategy in Design Education: Relationship Between Students' Learning Style And Creativity

Dilek Aybek Özdemir[1] , **Aysu Akalın**[2]

[1] Lecturer, Bingöl University, Faculty of Engineering and Architecture, Department of Architecture, Bingöl, Türkiye.
[2] Prof. Dr., Gazi University, Faculty of Architecture, Department of Architecture, Ankara, Türkiye.

Abstract

This research explores the connection between changes in students' learning styles and the components of creativity in a design studio setting that utilizes mimetic teaching strategies. The study assumes that the change in learning styles is related to the level of creativity exhibited in the design process and final product. The theoretical framework of this study, which focuses on the learning strategy of 13 students taking the second-year architectural design project course in the architecture department throughout the semester, is formed by Rhodes' 4Ps (Person, Press, Process, and Product). Accordingly, the skill of reasoning (person) by Sloman and Pahl & Beitz (associative-variant / hybrid-adaptable / metaphorical-original); resource utilization in the design process (press) by Casakin, Akalın and Özkan & Akalın (within domains –hybrid- between domains); design process (process) by Rittel (linear/non-linear) and the created product (product) by Gentner and Markman and Welling (application-analogy-combination-abstraction) were analysed based on the theoretical framework. The study found that students who experienced different learning styles throughout the semester utilized a non-linear design process to reach the original design, using metaphorical reasoning. On the other hand, students who used associative reasoning with a linear process struggled to analyse abstract and undefined design problems, resulting in variations of already solved designs. To overcome this, learners should be guided to find examples that promote metaphorical reasoning, activate their connection to the context, and encourage alternative thinking. Encouraging the use of metaphorical reasoning as a tool for creative restructuring and reinterpretation facilitates the development of original and adaptable designs.

Keywords: Architectural Design Studio, Creativity, Learning Style, Metaphorical Reasoning, Mimetic Approach.

Corresponding Author: dilekozdemir@bingol.edu.tr

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Araştırma Makalesi

Tasarım Eğitiminde Mimetik Öğretim Stratejisi: Öğrencilerin Öğrenme Stili ve Yaratıcılıkları Arasındaki İlişki

Dilek Aybek Özdemir[1], Aysu Akalın[2]

[1] Öğr. Gör., Mimarlık Bölümü, Müh.-Mimarlık Fakültesi, Bingöl Üniversitesi, Bingöl, Türkiye.
[2] Prof. Dr., Mimarlık Bölümü, Mimarlık Fakültesi, Gazi Üniversitesi,Ankara, Türkiye.

Özet

Bu araştırma, mimetik öğretim stratejilerinin kullanıldığı bir tasarım stüdyosu ortamında öğrencilerin öğrenme stillerindeki değişiklikler ile yaratıcılığın bileşenleri arasındaki bağlantıyı araştırmaktadır. Çalışma, öğrenme stillerindeki değişimin tasarım sürecinde ve nihai üründe sergilenen yaratıcılık düzeyiyle ilişkili olduğunu varsaymaktadır. Mimarlık bölümü ikinci sınıf mimari tasarım projesi dersini alan 13 öğrencinin dönem boyunca öğrenme stratejilerine odaklanan bu çalışmanın kuramsal çerçevesini Rhodes'un 4P'si (Person, Press, Process, and Product) oluşturmaktadır. Buna göre, Sloman ve Pahl & Beitz tarafından akıl yürütme becerisi (kişi) (çağrışımsal-varyant / karma-uyarlanabilir / metaforik-orijinal); Casakin, Akalın ve Özkan & Akalın tarafından tasarım sürecinde kaynak kullanımı (ortam) (alan içi - alanlar arası- karma); Rittel'in tasarım süreci (süreç) (lineer/lineer olmayan) ve Gentner & Markman ve Welling'in yaratılan ürün (ürün) (aplikasyon-analoji- kombinasyon-soyutlama) kuramsal çerçevesi temel alınarak analiz edilmiştir. Çalışma, dönem boyunca farklı öğrenme stillerini deneyimleyen öğrencilerin metaforik akıl yürütmeyi kullanarak özgün tasarıma ulaşmak için doğrusal olmayan bir tasarım süreci kullandıklarını ortaya koymuştur. Öte yandan, doğrusal bir süreçle çağrışımsal akıl yürütmeyi kullanan öğrenciler soyut ve tanımlanmamış tasarım problemlerini analiz etmekte zorlanmış, bu da daha önce çözülmüş tasarımların varyasyonlarıyla sonuçlanmıştır. Bu durumu aşmak için, öğrencilerin, metaforik akıl yürütmeyi teşvik eden, bağlamla bağlantılarını harekete geçiren ve alternatif düşünmeyi teşvik eden örnekler bulmalarına rehberlik edilmelidir. Metaforik akıl yürütmenin, yaratıcı yeniden yapılandırma ve yeniden yorumlama için bir araç olarak kullanımını teşvik etmek, özgün ve ayarlanabilir tasarımların geliştirilmesini kolaylaştırır.

Anahtar Kelimeler: Metaforik Akıl Yürütme, Mimari Tasarım Stüdyosu, Mimetik Yaklaşım, Öğrenme Stili, Yaratıcılık.

Sorumlu Yazar: dilekozdemir@bingol.edu.tr
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INTRODUCTION

Architectural Design Education and Creativity

Architecture is a discipline that creates healthy, livable, and aesthetic spaces for users by utilizing the natural environment to meet users' needs and desires within certain criteria. As in other design-based disciplines, the importance of theoretical and applied studio courses that impart design skills and creativity to students is significant in architectural education. The aim of the instructor teaching design courses is to instill in students the ability for creative and critical thinking (Dizdar, 2015, p. 276-283; Milovanović et al., 2020, p. 8-21). Design education concerns the teaching methods or strategies through which students are trained to acquire knowledge and skills related to design (Park and Kim, 2021, p. 91-109; Choi and Kim, 2017, p. 29-41). The process of design education progresses with oscillation between reality and fantasy, reflecting students' future practices after leaving school and thus serving as a pre-training function for their future professional lives (Dinç Kalaycı, 2018; Murphy et al., 2012, p. 530-556). Therefore, creating an educational platform that encourages students to think creatively is essential (Choi, Kim, and Cho, 2013, p. 119-138; Salama, 2005; Wong and Sui, 2012, p. 437-450; Khakzand and Azimi, 2015, p. 67-75). Since creativity is a key concept when evaluating a designer or design solution, the main question to be answered is how the knowledge that fosters creative design can be taught using clear guidelines (Christiaans and Venselaar, 2005, p. 217-236). Design studios should focus on approaches that bring out creativity, illuminate problems, generate different and unusual solutions, foster imagination and develop original thinking skills. Little is known about how the designer's (novice) knowledge base affects the quality or creativity of the design (Choi et al., 2013, p. 119-138; Dizdar, 2015, p. 276-283; Frascara, 2020, p. 106-117; Christiaans and Venselaar, 2005, p. 217-236).

According to Piaget's constructivist theory, knowledge is acquired through interaction with the world, people, and objects (Ackermann, 2001, p. 438-449). The knowledge structures of the modern world are fundamentally different from those known in the old world systems (Wallerstein, 2013, p. 24). Recognizing the ambiguity of knowledge in the modern world, we must also acknowledge that the knowledge involved in the design process is ambiguous, and the pieces of knowledge grasped by the designer vary according to the situation of the problem found and their own prior knowledge. Prior knowledge is not only something to be taken into account but also an important element that guides and integrates learning experiences in design courses. Students enter the studio environment with conceptual misconceptions, existing knowledge, and different pieces of information. Therefore, their ways of looking at the built environment, approaches to studio projects, or problem-solving tasks in design require the application and improvement of their previous skills and abilities. Therefore, designers should always be aware that new knowledge is built upon existing knowledge (Khorshidifard, 2011).

Knowledge has always been a key factor in productivity. However, knowledge alone may not be sufficient to solve the constantly evolving problems in the world. What is more important is how an individual, when faced with problems, selects and consolidate knowledge for combination and manipulation. This ability to combine is often referred to as creativity and is associated with the ability to generate new ideas from precedents. Based on the mutual relationship between teaching and learning, this dialogue enables students to think differently by manipulating all kinds of design knowledge and motivates them to think mimetically (Wong and Sui, 2012, p. 437-450; González-Pérez and Ramírez-Montoya, 2022, p. 26-31; Aydınlı and Avcı, 2010, p. 92). Mimetic representations as a learning strategy are thoughts and concepts that serve the designer's reasoning. The instructional strategy developed to enhance this thinking will also increase students' repertoire and contribute to the development of their creativity (Aydınlı and Avcı, 2010, p. 97; Goldschmidt and Tatsa, 2005, p. 593-611; Kowaltowski et al., 2010, p. 453-476; Bottelli, 2010, p. 456).

Design educators acknowledge that the ability to design largely depends on the pedagogical model used in design studios and that these environments need to be combined with specific tactics and strategies to facilitate critical learning practices (Casakin, 2011, p. 29-38; Newton and Pak, 2015, p. 128). Therefore, students should learn to understand the process and strategies that lead to the most efficient solution when solving a design problem (Christiaans and Venselaar, 2005, p. 217-236). As a teaching strategy, mimesis is a form of imitation that refers to specific similarities or patterns of similarity but implies a critical moment. Mimesis forms the basis of the process of revealing and concealing references during metaphorical reasoning because it is concerned with illuminating similarities and differences. The original value of the study lies in the exploration of the learner's architectural representation through mimesis as a teaching strategy during the design task process, the resolution of this tool through discursive imaging technique, and the observation of the impact of this interpretive resolution on the learning style change and creativity of the learner.

BACKGROUND

Learning Style and Learning Strategy

Students are not "objective" entities independent of a range of problems they identify themselves. At the same time, it is evident that during the most intense phase of design, some problems take on a dominant status—such is the revealing and concealing nature of mimetics. The characteristics and constraints of the current solution can become guiding new criteria. This helps to create a redefined problem domain, and thus, a new design space. We call this phenomenon discovery (Coyne et al., 1994, p. 113-125; Maher et al., 1996, p. 4). In other words, knowledge is produced as a result of design. The knowledge acquired during the design process is a by product of the process and can be used for future designs (Gero, 2000, p. 183-196). Individuals use their learning styles and learning strategies to acquire new knowledge and perform learning tasks. Learning styles are a mental preference pathway for individuals to various problems encountered. Learning strategies encompass the mental and behavioral tactics that learners can employ during the learning process.

In architectural education, reasoning through mimetics is seen as a key way to familiarize students with certain aspects of professional architecture and to test the limits of architectural knowledge (Murphy et al., 2012, p. 530-556). From this perspective, mimetic precedents provide a springboard to focus on anticipating problems, setting new goals, and creating their own challenges, thereby fostering a continuous, creative, proactive, empowering, flexible, open planning, and governance culture. They also assist the designer in analyzing and solving design problems, aiding in deriving through experimental research, metaphorical reasoning, and design thinking (Gentner and Colhoun, 2010, p. 35; Albrechts, 2005, p. 247-269; Choi et al., 2013, p. 119-138).

The contextual conditions within the built environment are always different from one another because the existing structure is dependent on and unique to the environment it resides in (Brooker and Stone, 2012, p. 14). Treating mimetics as a learning strategy will open the way for the learner to engage with the context through within-domain/between-domain resources. An architect can understand, interpret, develop, and rejuvenate a place by understanding the essence of the place and the unique context it resides in, thus using the existing structure as a source of knowledge, examining its qualities, and using it as a starting point or the foundation of the design's next stage (Brooker and Stone, 2012, p. 22). Leveraging the knowledge of precedents in architectural design to create a new design and establish a new source of knowledge is a particular form of imitation. Within mimesis, there is a process of imitation from the heap of knowledge acquired from the example, and resorting to mimetics is a helpful tool in explaining the reasoning process within the spectrum of concrete and abstract (Coyne et al.,1994, p. 113-125; Özkan Yazgan and Akalın, 2019b, p. 1193-1206). When solving a design problem, designers often resort to reconstructing partial solutions based on familiar previous solutions, analogies, combinations, or abstractions in the context of the ambiguity of knowledge. Thus, they find it reasonable to limit their actions through shortcuts (Akın, 2001, p. 118; Casakin and Goldschmidt, 2000, p. 105-119; Gero, 2000, p. 183; Newland et al., 1987, p. 2-16; Redström, 2020, p. 83-100).

There is a limited number of research studies on the development of creativity and the contribution of educational methods in design education (Ürey, 2021, p. 53-80). Furthermore, the evaluation of students' problem-solving skills within studio processes is an under-researched area (Acar et al., 2021, p. 212-222). On the other hand, although there are studies on mimetic reasoning in the literature (Casakin and Goldschmidt, 1999, p. 153-175; Casakin and Goldschmidt, 2000 p. 105-119; Casakin, 2004b, p.197-217; Casakin, 2004a; Casakin, 2006, p. 253-268; Casakin, 2007, p. 21-33; Casakin and Miller, 2007; Tezel and Casakin, 2010, p. 262-272; Casakin and Kreitler, 2011, p. 159-168; Casakin, 2012, p. 329-344), there is a need for more comprehensive experimental studies attempting to establish a connection between mimetic approaches and coping with epistemic uncertainty and learning styles. With this perspective, the details of the study are provided below.

RESEARCH QUESTIONS

- In a design studio where mimetics are used as a teaching strategy, how does creativity differ in the context of the relationship between learning style change and learning strategy?

HYPOTHESES

- Those who follow a linear path in design are less likely to exhibit changes in their learning styles. Considering that adhering solely to linear thinking with only associative reasoning throughout the design process leads to a series of repetitions along this path, richness in design will decrease.
- Learners who experience a change in learning style between pre-test and post-test results will generally cope with more information. Consequently, creativity levels in design will likely be higher. It is assumed that these individuals will not follow a linear path in the design process, leading to a greater exploration of design alternatives. As a result, original interpretations in design are expected to be higher, as the amount of inspired imagery in design increases, the originality of the product will also be positively affected.
- It is assumed that those who do not follow a linear path in design and utilize interdisciplinary mimetics will have a high ability to produce original designs.

METHODOLOGY

Design Experiment

During the educational term, systematic weekly observational follow-ups were conducted on the architectural design process and the products produced at the end of the education by 13 students who took the Architectural Design IV course. In order to enable the participating students to express their architectural projects, a two-week architectural modeling program training was provided initially. Following that, explanations were given in the context of modern and traditional mosques for the next two weeks. The site for the Architectural Design IV project was selected in Ankara, and the design topic was the reinterpretation of a post-Covid-19 public space, namely the worship spaces (Mosques). Due to the pandemic, participants were provided with site data digitally, and all constraints related to the development of mosque architecture, contemporary examples, and spatial arrangements were conveyed by the instructors. According to Ritter, who emphasizes the necessity for designers to reflect their personal perceptions and be relevant to them for successful application of knowledge and correct format (Ritter et al., 1981, p. 3), after the explanations, students were asked to find mimetics related to the subject and place context and then interpret these mimetics along with their own projects. The selected project area is a triangular parcel with an 18-meter slope in the Serhat neighborhood of Yenimahalle district in Ankara, which has been zoned as a religious facility area, mostly consisting of residential buildings in a new settlement area. The biggest input that will refer to the project design for the area is the park located across the field. Throughout the process, it was expressed that students needed to conduct research to more easily transfer the problems they identified regarding the place and subject to their designs, and they were informed that they could refer to both within and between domains sources in these researches. After researching within and between domains sources, students were asked to design a mosque mass covering at least 1/3 and at most 1/2 of the provided land. Throughout the semester, 13 students attended the course and presented their projects at the end of the term.

For this research, the method of using surveys and observations has been adopted for collecting research data. The use of both quantitative and qualitative[1] tools captures design behaviours comprehensively, allowing for a detailed analysis of the processes underlying students' task performance. To enable a detailed analysis of observational method[2] analysis in the study, drawings produced by students were systematically recorded on a weekly basis.

Learning Style, Kolb LSI (Kolb, 1984)

In its simplest definition, learning style is the path each individual follows for enduring learning (Gülbahar, 2005, p. 10-17). It is suggested in the literature that administering a learning style inventory before or after the initial session would be beneficial to determine students' learning preferences (Khorshidifard, 2011). Therefore, in the study, the experiential learning style inventory developed by

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1 The dialogue between the instructor and the learners, covering the entire period of this studio study, was qualitatively analysed. While the qualitative findings supported the quantitative data, they were not included in this article due to word limitations.

2 In the literature, observation is regarded as examining an event or phenomenon in phases according to a plan as it occurs. Kuru Turaşlı (2003) categorizes observation into three headings: observation based on its method and purposes, observation based on physical proximity and relationship, and observation based on time (p. 63-80). Here, Kuru Turaşlı (2003) divides observation based on its method and purposes into two different categories: natural observation and systematic observation. She defines systematic observation as observing an event that occurs within the conditions we have prepared. Additionally, in systematic observation, the researcher is interested in a specific topic(p. 63-80). Accordingly, behaviours are subjected to scrutiny, and only behaviours related to the topic are observed (Kuru Turaşlı, 2003, p. 63-80).

Kolb and adapted into Turkish by Aşkar and Akkoyunlu was applied in a pre-test-post-test format to observe changes before and after the mimetic education approach. In their study, Aşkar and Akkoyunlu (1993) introduced Kolb's Learning Style Inventory and provided information about the statistical studies conducted with the questionnaire, stating that the questionnaire was suitable for use in Turkey after its translation into Turkish (p. 37-48). In Kolb's LSI, individuals' learning styles are considered as a cycle, and the inventory determines where individuals are in this cycle. Within this cycle, there are four learning modes: Concrete Experience (CE), Reflective Observation (RO), Abstract Conceptualization (AC), and Active Experimentation (AE). Concrete Experience involves learning "by feeling," Reflective Observation involves learning "by watching," Abstract Conceptualization involves learning "by thinking," and Active Experimentation involves learning "by doing." According to the inventory, there is not a single form that determines an individual's learning style. Each individual's learning style consists of components of these four basic forms. Therefore, various situations are placed within a learning situation. The individual's most appropriate learning style is determined by the sum of their scores. These learning styles are "Converger, Diverger, Assimilator, Accommodator." The Learning Style Inventory consists of a short test of 12 questions with four options each. Each option in the test is arranged as follows: Option 1: Concrete Experience (CE), Option 2: Reflective Observation (RO), Option 3: Abstract Conceptualization (AC), Option 4: Active Experimentation (AE), and the individual assigns 4 points to the option they feel closest to, 3 points to the next closest option, 2 points to the next, and 1 point to the least preferred option. After answering the questions, a score between 12 and 48 is obtained. Then, to obtain combined scores, the score of AC is subtracted from the score of CE, and the score of AE is subtracted from the score of RO. The combined score falls within a range of -36 to +36. Using the table below, the individual's AC-CE score is accessed from the y-axis and the AE-RO score from the x-axis to determine the individual's learning style.

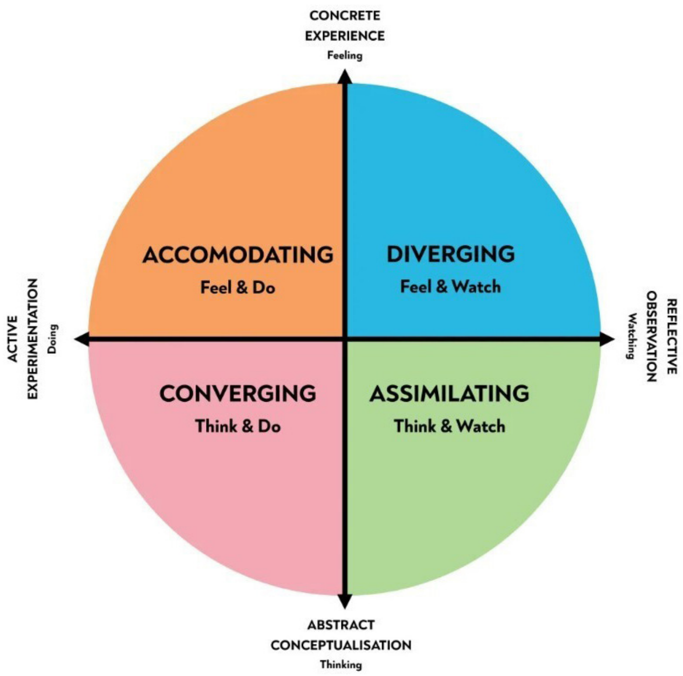


Figure 1. Kolb Learning Styles Graph (Mcleod, 2024)

Kolb's Experiential Learning Style Inventory has been the subject of numerous studies in the fields of architecture and design (Demirbaş and Demirkan, 2003 p. 437-456; Carmel-Gilfilen, 2012, p.47-68; Bender, 2004; Demirkan and Demirbaş, 2008, p. 254-266; Nussbaumer and Guerin, 2000, p. 1-15; Kvan and Jia, 2005, p. 19-34; Özdemir, 2015, p.10-21; Ayalp et al., 2015, p.68-82; Tucker, 2007, p. 246-255).

However, these studies do not address the relationship between changes in learning style and the components of creativity.

In the study, the Learning Style Inventory (LSI) developed by David Kolb was administered to students in a pre-test-post-test format to observe changes throughout the term. The inventory data were calculated according to the inventory's calculation method to determine which learning styles (Assimilator, Diverger, Converger, Accommodator) the students possessed. The information of the 13 students was coded as Ö1, Ö2, etc., and transferred in the study.

Below are the learning strategy and the analyses of the product produced with it. These findings, along with the pre-test and post-test LSI (Learning Style Inventory) results, were examined to evaluate the correlation between the learner's changing and unchanging learning styles in the learning strategy.

Analysis Method Rhodes (1961): Person-Press-Process and Product

In the study, the theoretical framework is based on Rhodes' (1961) four fundamental dimensions of creativity, which are person-press-process and product (p. 305-310). Person: The term 'person' encompasses information about personality, intellect, temperament, physical characteristics, habits, attitudes, self-concept, value systems, defense mechanisms, and behavior. Press: It denotes the relationship between individuals and their surroundings. In the study, contextual depth related to creativity in the area where the design will be conducted is considered in relation to the mimetic approach. Process: It is relevant to motivation, perception, learning, thinking, and communication. Key questions related to the process include: What causes some individuals to attempt to find original answers to questions while the majority are satisfied with traditional responses? What are the stages of the thinking process? Are problem-solving and creative thinking processes the same? Product: The term 'product' refers to an idea conveyed in the form of words, paint, clay, metal, stone, fabric, or any other material to other individuals. When we talk about an original idea, we imply a degree of novelty in the concept. When an idea is materialized, it is called a product. In the context of the study, the product is characterized as the final design solution that an individual puts forward after a certain process.

The study aims to describe the relationship between:

Reasoning Skills (Person) (Associative-Variant/Mixed-Adaptable/Metaphoric-Original),

Resource Utilization in the Design Process (Press) (within-domains/Mixed/between-domains),

Design Process (Process) (Linear/Non-linear), and

Created Product (Product) (Application-Analogy-Combination-Abstraction)

and to provide insights into the teaching approach effective in fostering a culture of creativity.

Reasoning Skills: Associative (Analogical), Mixed (Adaptable), and Metaphoric (Original)

Sloman (1996) uses the term associative system in reasoning to refer to a cognitive system that makes inferences based on similarity and proximity (p. 3-22). He mentions that rule-based reasoning systems have computational principles underneath them and are productive because they can encode an unlimited number of propositions. He also states that associations are associated with similarity, while rule bases are associated with contiguity. An distinguishing feature of rule-based inference is that it involves transitions in a conceptual hierarchy (Sloman, 1996, p. 3-22).

Similarly, Pahl and Beitz (1984) examine creativity through product design and categorize design outputs into three categories: variant (variable) design, adaptable design, and original design (p. 617).

- Variant (variable) design refers to leaving certain aspects of the system unchanged while modifying others, without altering the function and solution principles. In this study, if the final product produced at the end of the design process is analogically related to mimetic sources, it is classified as variant design. In variant design, the dimensions and arrangements of parts and mechanisms vary within specified limits. The design produced is derivatives of what already exists. Therefore, variant design is the type of design with the lowest level of creativity and is based on fixed principles
- Adaptable design refers to using a known solution principle to fulfill a new or modified task. In this study, if the relationship between mimetics and the final product both resembles rule-based and carries visual similarity, it is considered adaptable design. In adaptable design, known established solution principles are adhered to, and adjustments are made within the framework of changing requirements
- Original design refers to determining an original solution principle for a system belonging to the same, similar, or new task and presenting a new design output. In this study, if design products are related to mimetics in a rule-based manner, they are considered original. According to Pahl and Beitz (1984), original designs involve new tasks and problems, as well as new solution principles (p. 617). These can be achieved by either selecting and combining known principles and technologies or inventing entirely new technologies. The term original design is also used when existing tasks are solved using new solution principles. Original designs can involve the entire product as well as its assembly or components.

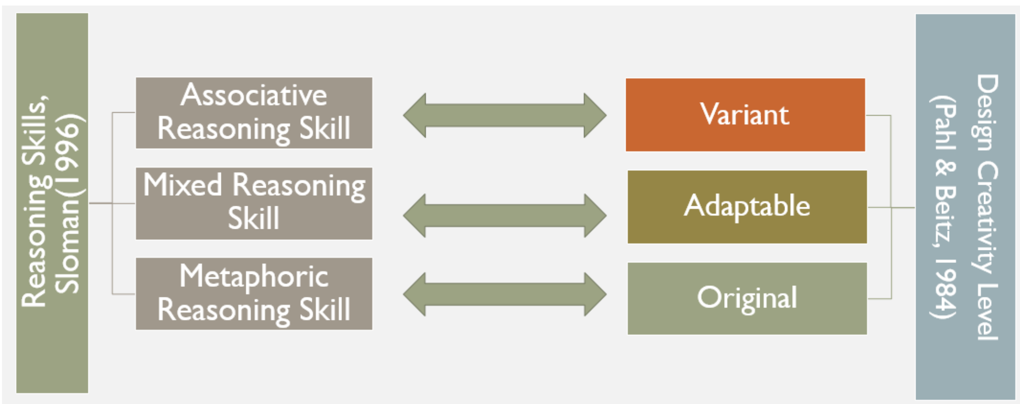


Figure 2. Cognitive Processing Skills in the Design Process

Resource Utilization in the Design Process (Press) (Within-domains - Mixed-Between-domains)

Casakin (2004a) emphasizes that blending within-domains and between-domains resources requires expertise. Between-domains resources are based on structural commonalities, making them more difficult to access (Casakin, 2004b, p. 197-217). However, successful mimetic approaches can be achieved when accessed (Vosniadou & Ortony, 1989, p. 199). Akalın (2018) and Özkan & Akalın (2019b) exemplify successful mimetic interpretations of final-year students who possess the skill to use between-domains resources in their studies (p. 1193-1206).

Özdemir and Akalın (2022) demonstrate the relationship between contextual depth and metaphoric reasoning through cross-sectional analyses in their study (p. 113-126).

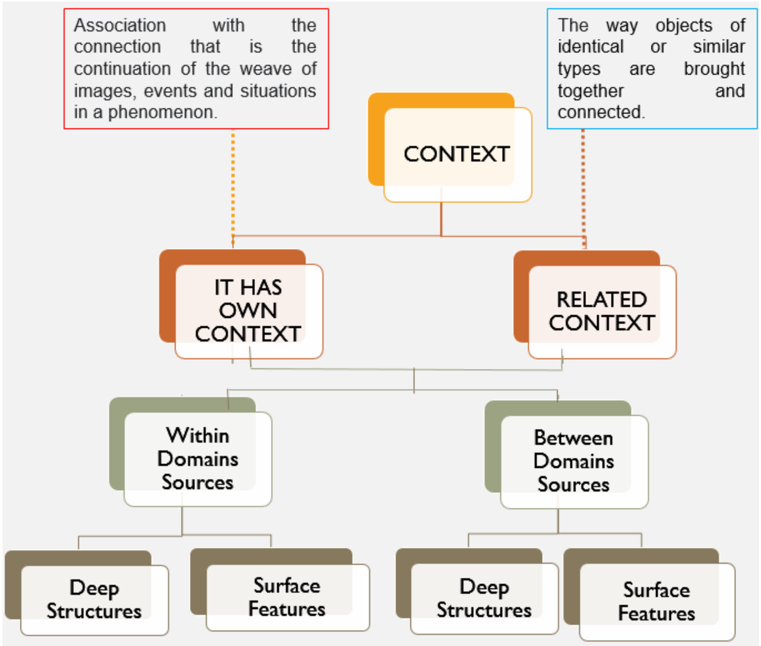


Figure 3. Conceptual Structure Explaining the Mimetic & Context Relationship (Inspired by Akalın 2018)

Akalın (2018) and Özkan Yazgan and Akalın (2019a) aimed to understand the relationship between mimetics used in the produced product based on the context of subject and location, which involves within-domains and/or between-domains resources (p. 183-202). Since the subject context of the study is the design of a worship space, designs related to worship structures are expressed as within-domains resources, while other types of structures outside of worship are considered between-domains resources.

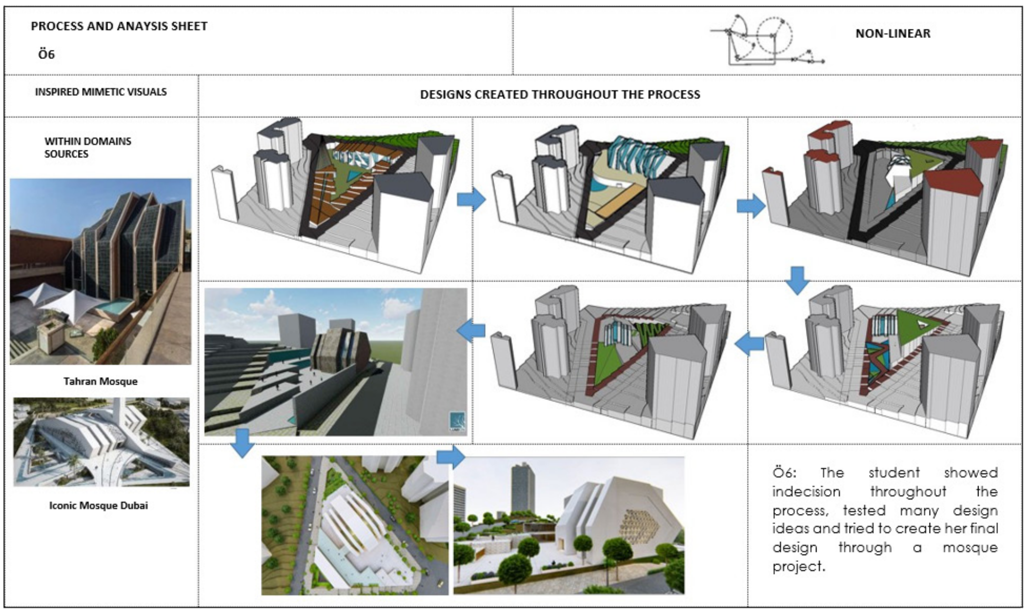


Figure 4. Within-domains Mimetic Sources Used by Ö6

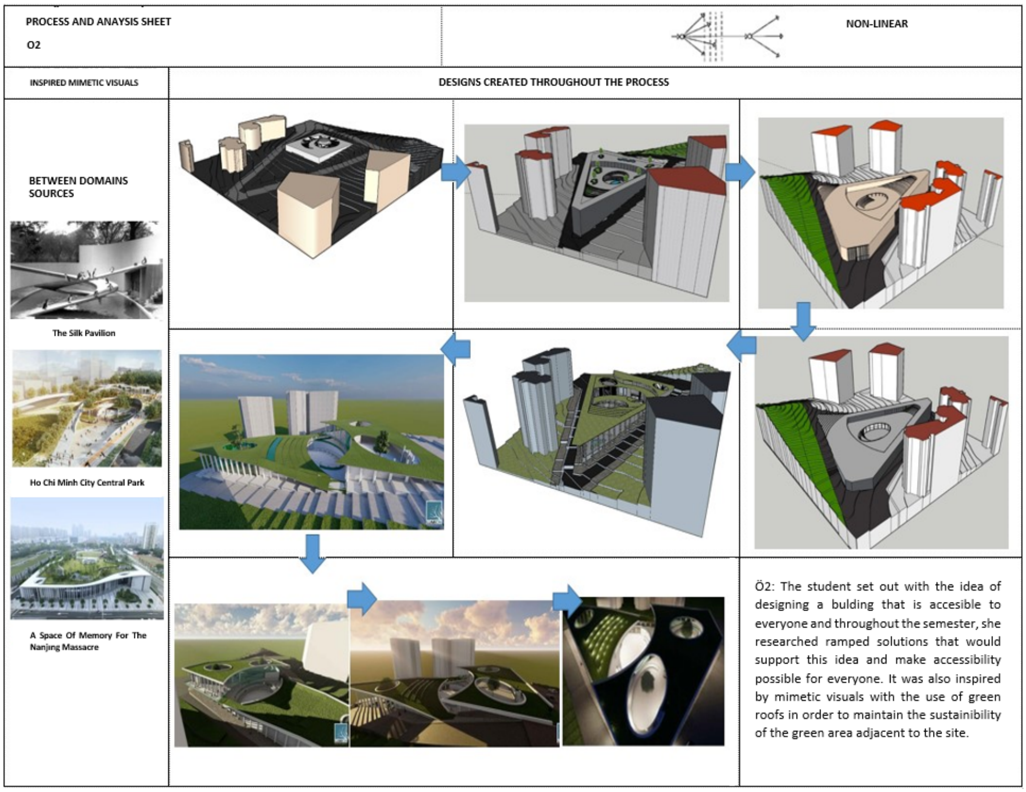


Figure 5. Between-domains Mimetic Sources Used by Ö2

Design Process (Process) (Linear / Non-linear)

Gero (2000) categorizes designs into two groups: routine and non-routine designs. Routine designs can be described as well-structured designs (p. 183-196). Non-routine designs are categorized into innovative and creative designs. Teal (2010) suggests, based on Deleuze and Guattari's rhizome theory, that the design process should not be linear and should progress rhizomatically through mapping (p. 294-302). Being rhizomatic means being productive (rhizome represents a non-linear quest process. (Teal, 2010, p. 294-302). The less regular the design processes, the less fixed or predictable they progress, they become part of a broad network. In such a network, mapping connections can reveal something about the nature of the interconnections between design movements. If the connections have recognizable structures and are repeatedly associated with the production of successful design products, it will be possible to extract productive connections (Goldschmidth and Tatsa, 2005, p. 593-611). In a non-linear design process, design aspects and alternatives are generated, presented, and evaluated simultaneously and in real-time. Moving towards non-linear design modes, allowing the production and evaluation of a greater number and variety of design alternatives, controversially increases design creativity. In creativity research, knowledge-intensive tasks are recognized as critical components of creative work (Candy and Edmonds, 1997, p. 185-194). Schuldberg (1999) discusses the application of chaos theory to the creative process and product (p. 259). The study indicates that chaotic processes exhibit flexibility and adaptability, and these processes are referred to as non-linear dynamic systems, which denote system behaviours that change over time. Additionally, the study notes that at least some of the relationships among the system components represent non-linear systems. The same study suggests that creative products emerge from dynamic processes and that creative products result from the interaction of multiple interconnected adaptable processes addressing intertwined problems.

In this study, Rittel's (1992) design process diagrams were taken into consideration in the analysis of the design process, and by focusing on a single mimetic visual, albeit fragmented, in stages such as analysis-synthesis-solution generation, the design shaping (in terms of space decisions and mass shaping) in the weekly productions made throughout the whole process is classified as linear if it reaches the final product without changing, and as a non-linear process if it changes. As Rittel (1992) states, while linear path tracing is considered as a process that "describes how the designer works, who knows in advance what needs to be done and essentially does not have to involve himself in the design adventure", non-linear approaches are classified by Rittel (1992) under 3 sub-headings;

- Testing or screening refer to a process where the designer attempts to progress by testing different ideas. In this process, if the designer cannot achieve the desired outcome, they go back to the beginning and try a different approach to reach a solution.
- Systematic design process with many alternatives: It is described as step-by-step progress on a design that has been successfully solved and tested by experimenting with multiple alternatives.
- Generating alternatives in a multi-stage process: The designer works with multiple solution proposals for a problem and then proceeds with constraints by reducing the alternatives to a reasonable number[3].

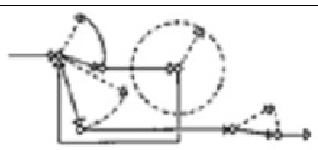
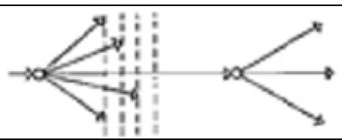
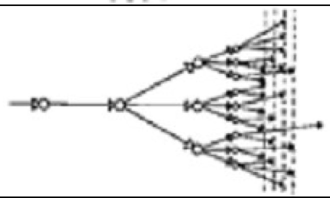
DESIGN PROCESS DIAGRAMS		Process Analysis within the Scope of the Study
	Linear Array	Linear
	Testing or screening	
	Systematic generation of several alternative approaches	Non-linear
	Creating alternatives in a multi-stage process	

Figure 6. Horst Rittel's (1992) design process analyses

The schematic diagrams seen in Rittel's (1992) table and the student's weekly productions are summarized in a table, and the path followed in the design process is attempted to be determined through these descriptions (p. 432). The following examples are provided to gradually demonstrate how each student shaped their design process, inspired by mimetic visuals, and the design followed a linear or non-linear path.[4]

3 In the conducted experimental field study, learners do not produce a single alternative for each lesson they participate in, so there is no student following this process.

4 The blue arrows in each table indicate how the process progressed for the respective student.

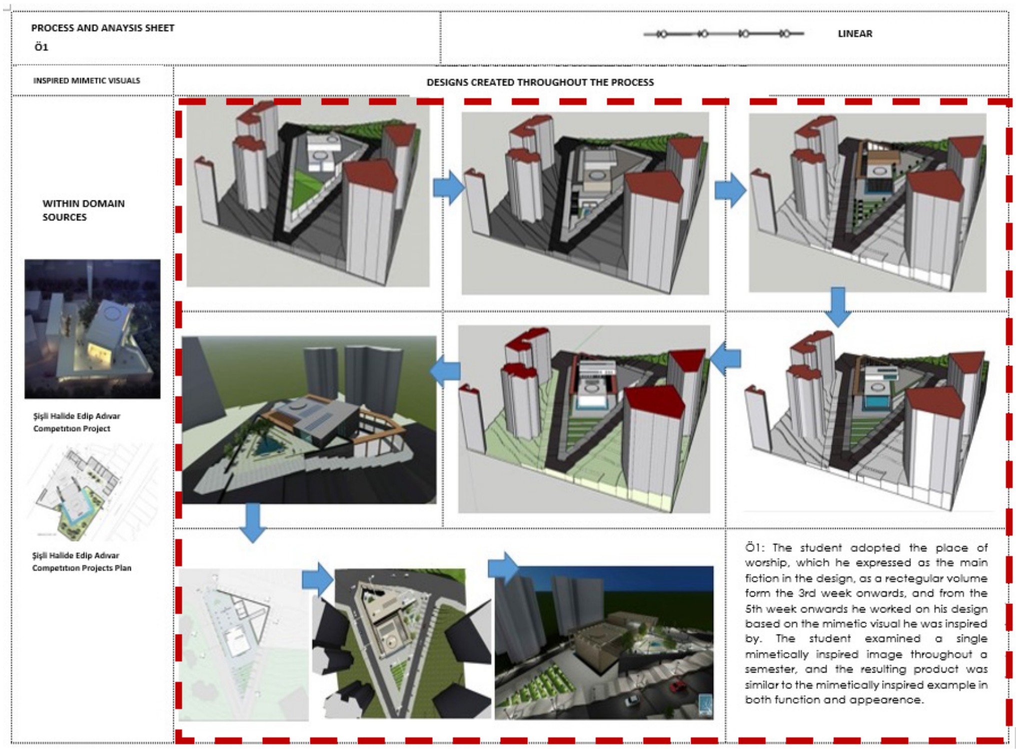


Figure 7. Linear design process used by Ö1

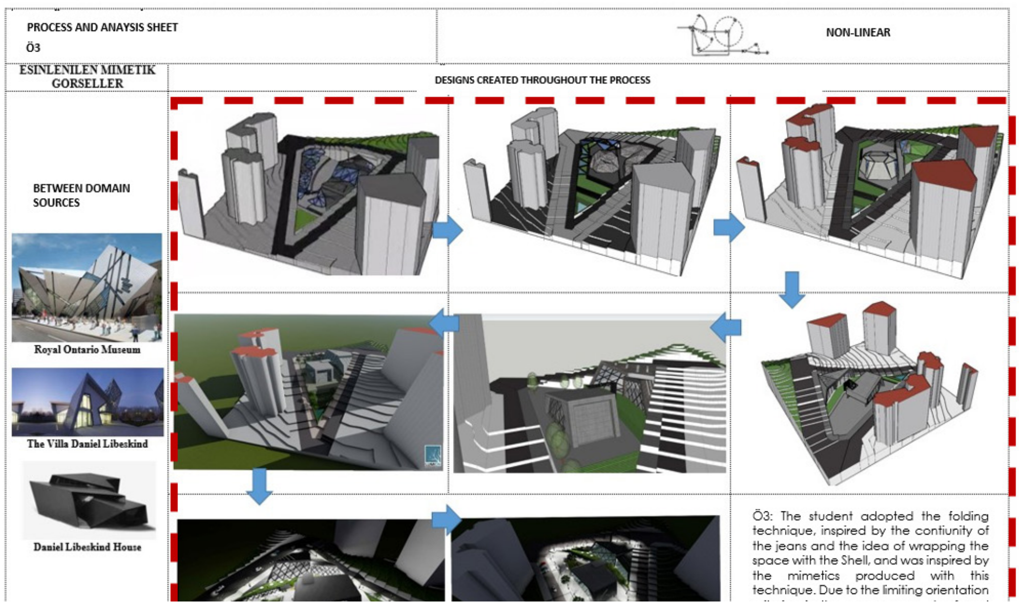


Figure 8. Non-linear design process used by Ö3

Generated Product (Product) (Application-Analogy-Combination-Abstraction)

While determining the learning strategy, in order to understand the relationship that the student established with the mimetic visuals, first of all, the codes in the designer reports were taken as a starting point, Gentner and Markman's (1997) table of overlapping similarity space-object definition showing different types of matches in terms of the degree of relationship was utilized and the level of relationship between the mimetic ones and the produced ones was tried to be understood with this matrix (p. 45-56).

Within the framework of Gentner and Markman's (1997) analytical perspective, the plans and views of the designs produced with the mimetics used in the teaching environment in the study were compared and compared according to the similarity (p. 45-56);

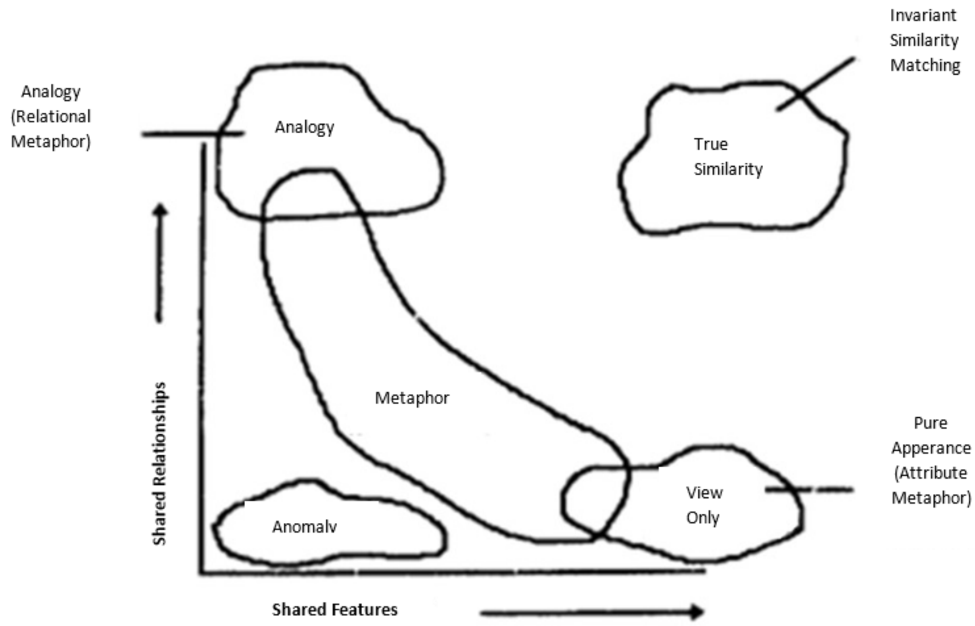


Figure 9. The overlap of the similarity space and the object definition, which show different types of matches in terms of degree of relatedness Gentner and Markman (1997, p. 45-56)

- Variant design through analogical reasoning (interpreted through imitation by changing plan / aspect ratios)
- Adaptive design through mixed reasoning (if the plan - views are transformed into mimetic by adding interpretation / if they bear traces of mimetic; if they have differences in terms of plan scheme but have similarities in appearance)
- Metaphorical reasoning is effective in the production of original design (rule-based relationships; there is no visual similarity, only relational similarities, for example, ramps circulating the building in the connection of elevations and contributing to the shaping).

Basically, analogy and similarity both involve the alignment of relational structure. The difference is that in analogy only relational predicates are shared, whereas in true similarity both relational predicates and object attributes are shared. Gentner and Markman (1997) place this distinction between analogy and similarity in a similarity space defined by the degree of qualitative similarity and the degree of relational similarity(p. 45-56). Analogy occurs when comparisons show a high degree of relational similarity with little qualitative similarity. As attribute similarity increases, the comparison shifts towards true similarity. View-only matches share object definitions, but not relations. The structure mapping engine then produces a structural evaluation of interpretations using a kind of cascade-like algorithm in which evidence is transferred from predicates to arguments (Gentne r and Markman, 1997, p. 45-56). Gentner (1989) refers to the intersection of analogy and metaphor as abstraction (metaphor) (p. 207). According to structure-mapping theory, analogical mapping is the process of establishing a structural alignment between two represented situations and then reflecting the inferences (Gentner and Colhoun, 2010, p. 35). While the main feature of analogies is relational and structural similarity, metaphors cover the spectrum of relational similarity at one end and similarity of appearance at the other end. In this context, metaphors are the transformation of current events into a figurative form of expression that has a more descriptive and explanatory character, rather than a purely abstract perception of processes that give rise to concreteness.

Welling (2007) mentioned that the first of the four mental processes used in creative cognition is the adaptive use of existing knowledge (p. 163-177). Özkan and Akalın (2019a) stated in their study that the exact imitation of existing knowledge is not preferred by architecture studio educators and students, while low place awareness is associated with analogy (formal imitation), high place awareness is associated with abstract conceptual features (abstract imitation) (p. 183-202). In addition, in the study, combination (mixed imitation) was considered as being associated with both analogical and abstract conceptual features.

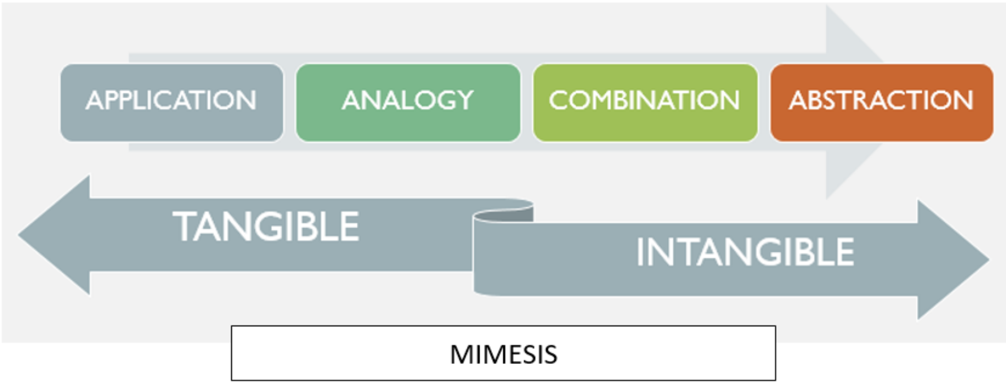


Figure 10. Product produced through mimetics in the design process

For designers, metaphors[5] are positive heuristics of working rules that they use to make things richer, to guide them to what they should choose, or to help designers avoid an ocean of anomalies (Newland et al., 1987, p. 2-16). Metaphors are considered as powerful problem-solving tools for dealing with design tasks, helping to understand the relatively abstract and unstructured as concrete and structured (Özkan Yazgan and Akalın, 2019a, p. 183-202). In metaphors, there is usually a comparison of two non-identical but concretely comparable events. The comparison is often found through creative thinking that connects different objects and discovers a new image in which the characteristics of both play a role (Gentner and Markman, 1997, p. 45-56; Ungers, 2020, p. 15). Designers make use of metaphors as an intellectual tool that bypasses logical processes and serves their opposite, clarity and vitality. As Aristotle defined and Deleuze[6] theorized, "metaphor is the intuitive grasp of similarities in differences". Metaphors do not have static, open and closed meanings, but are potentially capable of revealing multiple meanings that can be progressively revealed through the back and forth movement of the hermeneutical circle. This gradual back and forth process takes place in a context. We take cues not only from the metaphors or models themselves, but also from the situation in which they are situated, so that the conceptual environment in which they operate plays an important role in how we interpret and evaluate them. As the context changes, so does our understanding of the meaning of the models and metaphors we encounter. Thus, given a specific design reference, a student can learn to identify relevant concepts and build a theoretical foundation for design knowledge

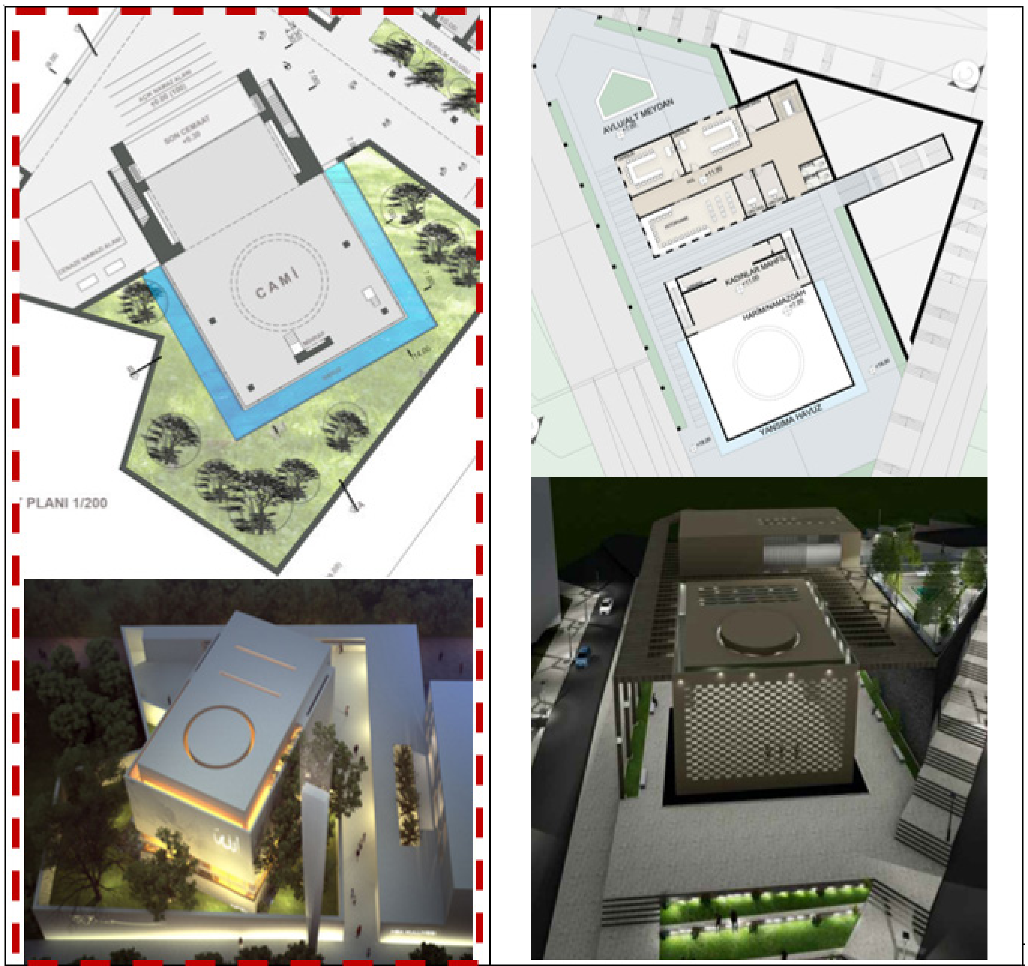
5 The Greek word metaphora is "transfer", so metaphor is the transfer of one concept to another. In a broader sense, metaphor is not only a figure of speech, but also a figure of thought. The transfer of concepts takes place between words or images, between a text and its context, between parts of a meaning and the whole, or between two networks of expression or two complex conceptual systems (Snodgrass and Coyne, 1992, p. 56-74).

6 According to Deleuze, repetition changes nothing in the repetitive object, but it changes something in the mind that contemplates it. This famous thesis of Hume takes us to the very heart of a problem. On the contrary, there is a change in the observing mind: something new in the mind, a difference. In other words, whenever we encounter a variant, a difference, a disguise, a change of place, we will say that there is a repetition, but only derivative and "analogical." (Deleuze, 2017, p. 354)

that can then generate new design solutions (Snodgrass and Coyne, 1992, p. 56-74; Kowaltowski et al., 2010, p. 473-476).

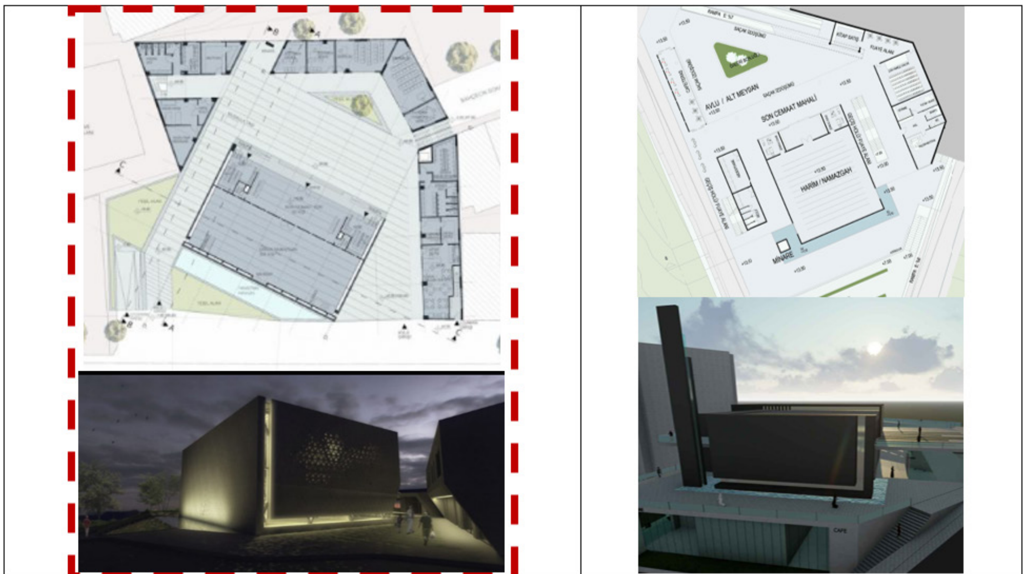
The matches that are most likely to occur most easily are true similarity matches and pure appearance matches. In pure transfer, the learner initially knows something about the base domain, but little or nothing about the target domain. Once the base domain is accessed, the mapping process takes place. To transfer knowledge from one domain to another, one needs not only to access the base domain, but also to establish the correct object correspondences between the base and the target and map predicates. At this level, a mixture of deep and surface factors operate (Gentner, 1989, p. 232). The stage of abstraction is the stage where these depth and surface features meet. This stage is handled as metaphorical reasoning by Özkan Yazgan and Akalın (2019b, p. 1193-1206). Relational structures are robust enough to allow accurate mapping without surface support. However, for novice designers, surface similarity is a key determinant of success in structure mapping. The relational abstractions extracted can then influence the encoding (Gentner, 1989, p. 233). With sufficient domain knowledge, the set of known abstractions, such as flow rate or positive feedback state, becomes robust enough to allow relational encoding and retrieval.

Following the analysis of quantitative data in the study, the understanding of the relationship established by the student with mimetic visuals started by examining the codes in the designer reports. Utilizing Gentner and Markman's (1997) similarity space - the overlap of object definitions table showing matches of different types in terms of the degree of relationship, an attempt was made to comprehend the level of relationship between mimetics and the designs produced using a matrix (p. 45-56). According to this table, as the shared relationship with mimetics increases, the design becomes more analogical, while as shared features increase, the design shifts towards metaphorical. In the table, if there is no relationship or feature sharing with mimetics, the situation is described as an anomaly, while if shared relationships and features are common, the situation results in real similarity. If shared features are abundant and relationships are few, it is indicated that only appearance similarity exists. Taking all these data into account, the ways in which designers reasoned and the productions they made throughout the process were collectively examined.



Mimetic Sample Plan and Visual found by the Student	Design by the Student

Figure 11. Example of variant design through analogical reasoning



Mimetic Sample Plan and Visual found by the Student	Design by the Student

Figure 12. Examples of adaptable design through mixed reasoning

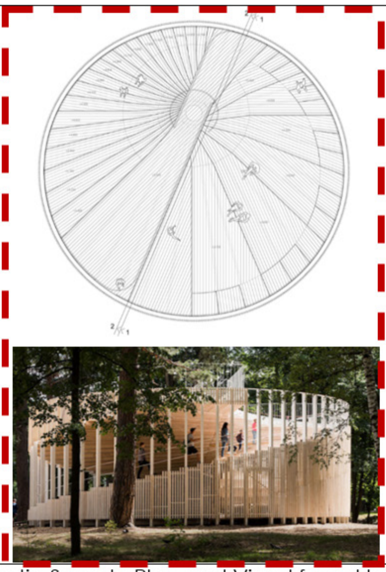
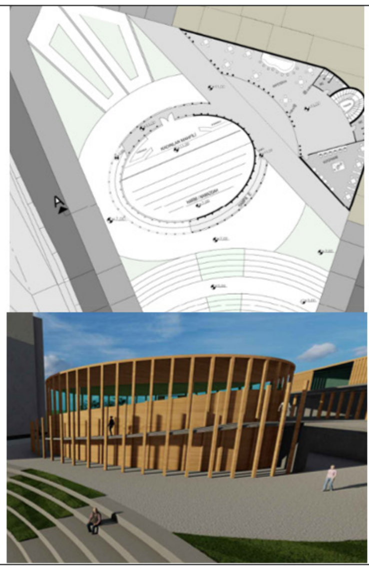
	
Mimetic Sample Plan and Visual found by the Student	Design by the Student

Figure 13. Examples of adaptable design through mixed reasoning

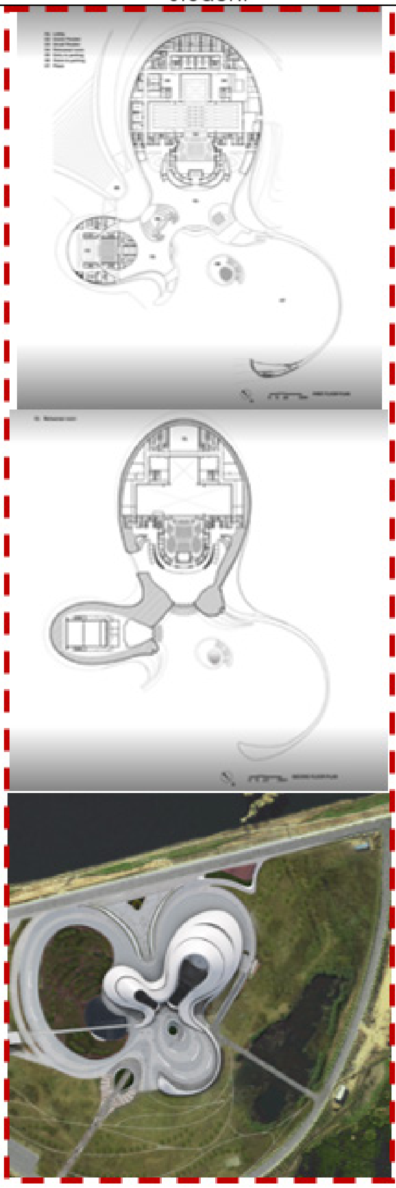
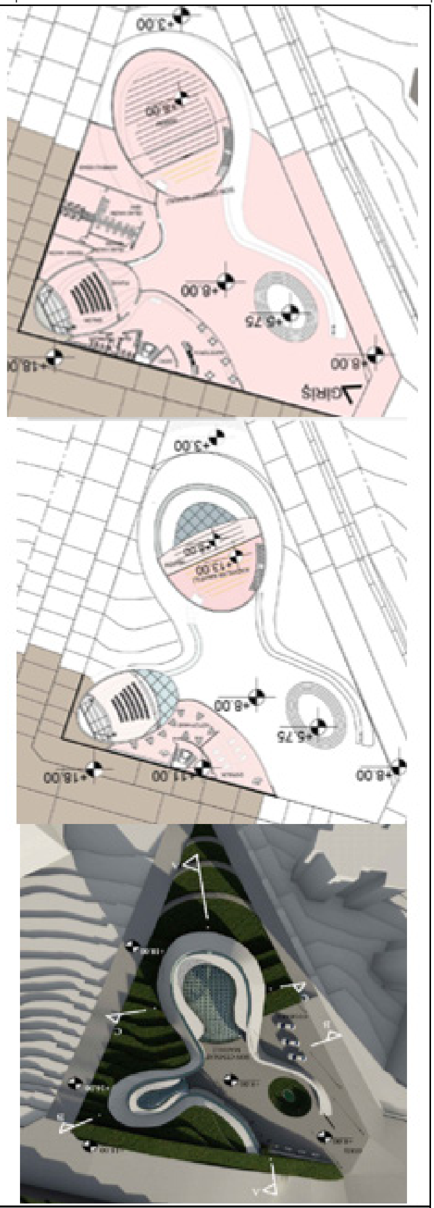
	
Mimetic Sample Plan and Visual found by the Student	Design by the Student

Figure 14. Examples of adaptable design through mixed reasoning

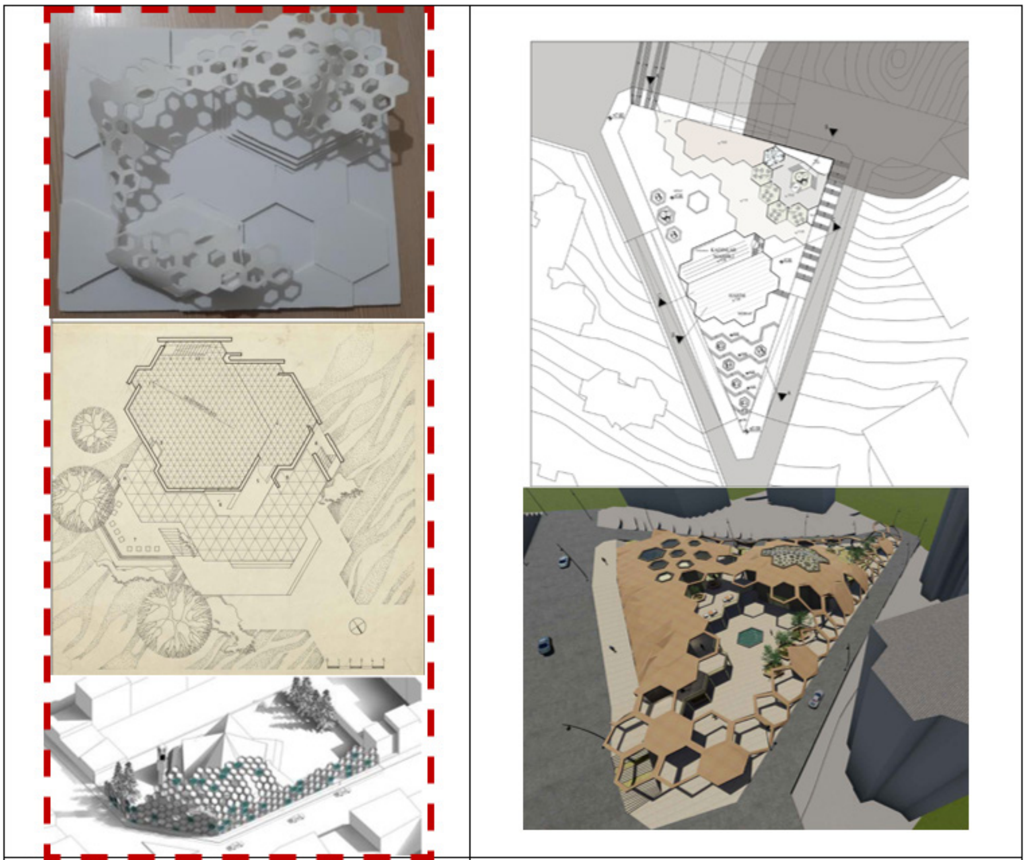


Figure 15. Example of original design through metaphorical reasoning

Findings: Learning Style, Kolb LSI (Kolb, 1984) & Rhodes (1961): Person-Press-Process and Product

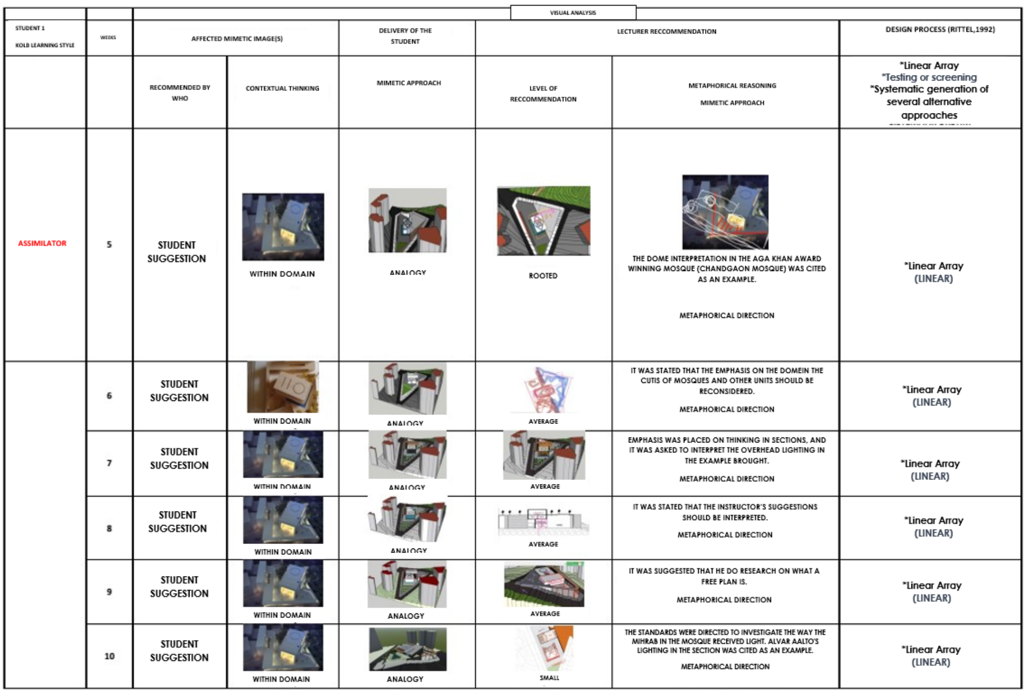
Following these basic frameworks, products produced with mimetics were considered together, and correlation analyses were conducted to explore the relationship between learning style and dimensions of creativity in the study.

STUDENT	KOLB LSI II PRE- TEST	KOLB LSI II POST- TEST	REASONING SKILLS (ASSOCIATIVE-VARIANT / MIXED-ADAPTABLE / METAPHORIC-ORIGINAL) SLOMAN (1996) PAHL VE BEITZ (1984)	RESOURCE UTILIZATION IN THE DESIGN PROCESS (WITHIN-DOMAINS / MIXED/ BETWEEN-DOMAINS) CASAKIN (2004) AKALIN (2018) OZKAN & AKALIN (2019B)		DESIGN PROCESS (LINEAR / NON-LINEAR) RITTEL (1992)	MIMETIC SOURCES INSPIRED	LEVEL OF INSPIRATION IN DESIGN GENTNER & MARKMAN (1997)		DESIGN CREATED ASA RESULT OF INSPIRATION AND CRITISISM	DESIGN REPORT
				WITHIN DOMAINS	BETWEEN DOMAINS			SHARED RELATIONSHIPS	SHARED FEATURES		
Ö1	ASSIMILATOR	ASSIMILATOR	ASSOCIATIVE-VARIANT	WITHIN DOMAINS (MOSQUE)		LINEAR (LINEAR ARRAY)	 Şişli Halide Edip Adıvar Competıtıon Project [13]	*MOSQUE FUNCTIONAL PLAN	*EXTERNAL APPEARANCE FEATURES OF THE FORM		IN THIS PROJECT, A MOSQUE, WHICH IS A PLACE OF WORSHIP FOR MUSLIMS, AND IN ADDITION TO IT, SOCIAL SPACES WERE BUILT. EVEN IF THE MAIN PICTURE IS WORSHIP, THIS PROJECT ALSO HOSTS AREAS WHERE PEOPLE CAN SOCIALIZE AND SPEND TIME. THESE AREAS ARE UPPER SQUARE, CAFE, LIBRARY, AMPHITHEATER SEATING AREA, ETC. IT CONSISTS OF SOCIAL SPACES. DUE TO THE SLOPING OF THE LAND, ACCESS TO THE SPACES IS PROVIDED FROM DIFFERENT ELEVATS. THE PLACE OF WORSHIP AND THE SOCIAL SPACES CONSIST OF TWO SEPARATE MASSES, AND THE PURPOSE OF THIS IS TO ENSURE THAT THE PLACES PROVIDE SIMULTANEOUS SERVICE.
Ö2	DIVERGER	ASSIMILATOR	METAPHORIC-ORIGINAL		BETWEEN DOMAINS (POOL, CENTRAL PARK, MEMORIAL HALL)	NON- LINEAR (SYSTEMATIC GENERATION OF SEVERAL ALTERNATIVE APPROACHES)	 The Penguin Pool [14]  Ho Chi Minh City Central Park[15]  Nanjing Massacre Victims Memorial Hall [16]	*FLUID DESIGNS THAT CONNECT ELEVATIONS TOGETHER	*USE OF RAMPS *CREATING GREEN ROOF AND INTERNAL COURTYARDS		WHEN STARTING THE PROJECT, WE STARTED WITH THE UNDERSTANDING OF DESIGN FOR EVERYONE. THE DESIGN IS AIMED TO BE NOT JUST AS A MOSQUE, BUT TO BE A PUBLIC SPACE OFFERING MANY OPPORTUNITIES FOR THE NEIGHBORHOOD. THUS, THE DESIGN HAS BECOME A PLACE WHERE VARIOUS ACTIVITIES ARE HELD. THERE ARE ENTRANCES FROM DIFFERENT ELEVATS IN THE DESIGN, AND THERE ARE ALSO RAMPS THAT PROVIDE PASSAGE BETWEEN THE LEVELS. AN NATURE-FRIENDLY GREEN ROOF SYSTEM WAS USED ON THE TOP COVER. WHITE CONCRETE AND GLASS FACADES WERE USED IN MATERIAL SELECTION, BASED ON THE IDEA OF SIMPLICITY AND TRANSPARENCY, WHICH WE BELIEVE TO BE AT THE FOUNDATION OF THE ISLAM RELIGION. THE MESH ON THE MIHRAB FACADE, WHICH IS IN HARMONY WITH THE ORGANIC FORMS IN THE DESIGN, HAS ENABLED THE LIGHT TO FILTER AND REACH THE AREA OF WORSHIP. ALSO, IN THE SECTION WHERE THE WORSHIP AREA IS LOCATED, LIGHT HAS BEEN BROUGHT IN THROUGH STAGED COVERINGS.

Figure 16. Table of analyses obtained from the study

[13] https://www.arkitera.com/proje/esdeger-mansiyon-sisli-halide-edip-adivar-kulliyesi-ulusal-mimari-proje-yarismasi-3/
[14] https://www.iaacblog.com/programs/silk-pavilion-multispecies-empower-animals/
[15] https://worldlandscapearchitect.com/lava-and-aspect-studios-win-ho-chi-minh-city-central-park-design-competition/?v=3a1ed7090bfa#.Yn2DOuhBxPY
[16] https://kienviet.net/2019/12/18/nha-tuong-niem-nan-nhan-cua-vu-tham-sat-nam-kinh-p1/

After this fundamental finding, the products produced throughout the process were arranged through chronological matrices, and considering formal/ functional changes, an attempt was made to identify the strategies followed in the process.



		VISUAL ANALYSIS					
STUDENT 1 KOLB LEARNING STYLE	WEEKS	AFFECTED MIMETIC IMAGE(S)		DELIVERY OF THE STUDENT	LECTURER RECCOMMENDATION		DESIGN PROCESS (RITTEL,1992)
		RECOMMENDED BY WHO	CONTEXTUAL THINKING	MIMETIC APPROACH	LEVEL OF RECCOMMENDATION	METAPHORICAL REASONING MIMETIC APPROACH	*Linear Array *Testing or screening *Systematic generation of several alternative approaches
ASSIMILATOR	5	STUDENT SUGGESTION	WITHIN DOMAIN	ANALOGY	ROOTED	THE DOME INTERPRETATION IN THE AGA KHAN AWARD WINNING MOSQUE (CHANDGAON MOSQUE) WAS CITED AS AN EXAMPLE. METAPHORICAL DIRECTION	*Linear Array (LINEAR)
	6	STUDENT SUGGESTION	WITHIN DOMAIN	ANALOGY	AVERAGE	IT WAS STATED THAT THE EMPHASIS ON THE DOMEIN THE CUTIS OF MOSQUES AND OTHER UNITS SHOULD BE RECONSIDERED. METAPHORICAL DIRECTION	*Linear Array (LINEAR)
	7	STUDENT SUGGESTION	WITHIN DOMAIN	ANALOGY	AVERAGE	EMPHASIS WAS PLACED ON THINKING IN SECTIONS, AND IT WAS ASKED TO INTERPRET THE OVERHEAD LIGHTING IN THE EXAMPLE BROUGHT. METAPHORICAL DIRECTION	*Linear Array (LINEAR)
	8	STUDENT SUGGESTION	WITHIN DOMAIN	ANALOGY	AVERAGE	IT WAS STATED THAT THE INSTRUCTOR'S SUGGESTIONS SHOULD BE INTERPRETED. METAPHORICAL DIRECTION	*Linear Array (LINEAR)
	9	STUDENT SUGGESTION	WITHIN DOMAIN	ANALOGY	AVERAGE	IT WAS SUGGESTED THAT HE DO RESEARCH ON WHAT A FREE PLAN IS. METAPHORICAL DIRECTION	*Linear Array (LINEAR)
	10	STUDENT SUGGESTION	WITHIN DOMAIN	ANALOGY	SMALL	THE STANDARDS WERE DIRECTED TO INVESTIGATE THE WAY THE MIHRAB IN THE MOSQUE RECEIVED LIGHT. ALVAR AALTO'S LIGHTING IN THE SECTION WAS CITED AS AN EXAMPLE. METAPHORICAL DIRECTION	*Linear Array (LINEAR)

Figure 17. Weekly chronological process chart for Design Ö1

Analysing the weekly chronological charts:

• A student with an unchanged learning style, despite the metaphorical guidance from the instructor, utilized associative reasoning by using in-field resources and followed a linear process to produce an analogical product (see Ö1 and Ö8).

• Another student with an unchanged learning style, using interdisciplinary and mixed sources, benefitted from mixed reasoning, and despite the metaphorical guidance of the instructor, followed a linear process to produce a combination product (See Ö5, Ö7, and Ö13).

• A student with a changing learning style, despite using in-field resources and benefiting from associative reasoning, followed a non-linear path but produced an analogical product (See Ö6).

• Students with a changing learning style, using interdisciplinary or mixed sources for metaphorical reasoning, followed a non-linear process to produce abstraction products (See Ö2, Ö9, Ö10, Ö11, Ö12). Here, Ö2 and Ö9 progressed through the process individually, advancing their ideas rather than following the metaphorical guidance of the instructor. Ö10, Ö11, and Ö12 progressed by modifying mimetics through testing during the process, abstracting an idea from mimetics towards the middle of the process, and combining it with their own design ideas.

• Students with a changing learning style, using interdisciplinary or mixed sources for mixed reasoning, followed a non-linear process to produce combination products (See Ö3 and Ö4).

From the information in the table below; learning style is obtained from the learner's responses to the survey questions, and other headings are derived from the process-product analysis evaluations conducted by the observer based on the theoretical framework described above.

Table 1. Summary Table

	LEARNING STYLE		Rhodes (1961) 4P			
			LEARNING STRATEGY			RESULT PRODUCT
STUDENT	KOLB 1	KOLB 2	**Reasoning Skills (Person)** Sloman (1996) Pahl ve Beitz (1984)	**Resource Utilization in the Design Process (Press)** Casakin (2004) Akalın (2018) **Özkan** and Akalın (2019b)	**Design Process (Process)** Rittel (1992)	**Produced Product (Product)** Gentner and Markman (1997) Welling (2007)
	Accommodator Assimilator Diverger Converger	**Accommodator Assimilator Diverger Converger**	**Associative-Variant / Mixed-Adaptable / Metaphoric-Original**	**Within-domains / Mixed/ Between-domains**	**Linear / Non-linear**	**Application-Analogy-Combination-Abstraction**
Ö1	Assimilator	Assimilator	Associative-Variant	Within-domains	Linear	Analogy
Ö2	Diverger	Assimilator	Metaphoric-Original	Between-domains	Non-linear	Abstraction
Ö3	Accommodator	Assimilator	Mixed-Adaptable	Between-domains	Non-linear	Combination
Ö4	Diverger	Assimilator	Mixed-Adaptable	Within-domains	Non-linear	Combination
Ö5	Converger	Converger	Mixed-Adaptable	Mixed	Linear	Combination
Ö6	Assimilator	Converger	Associative-Variant	Within-domains	Non-linear	Analogy
Ö7	Converger	Converger	Mixed-Adaptable	Between-domains	Linear	Combination
Ö8	Converger	Converger	Associative-Variant	Within-domains	Linear	Analogy
Ö9	Converger	Assimilator	Metaphoric-Original	Mixed	Non-linear	Abstraction
Ö10	Converger	Diverger	Metaphoric-Original	Between-domains	Non-linear	Abstraction
Ö11	Accommodator	Converger	Metaphoric-Original	Between-domains	Non-linear	Abstraction
Ö12	Accommodator	Assimilator	Metaphoric-Original	Between-domains	Non-linear	Abstraction
Ö13	Assimilator	Assimilator	Mixed-Adaptable	Between-domains	Linear	Combination

When looking at the correlation in the Pearson correlation analysis of this data;

1. A significant relationship was found between the change in learning style and the reasoning style in the design process. (A1XA2)

2. A strongly significant relationship was found between the change in learning style and the path followed in the design process. (A1XA4)

3. A strongly significant relationship was found between the reasoning style in the design process and the contextual relationship in the design process. (A2XA3)

4. A significant relationship was found between the reasoning style in the design process and the path followed in the design process. (A2XA4)

Table 2. Correlation Analysis Table

			A1	A2	A3	A4
			LEARNING STYLE Changing/ Unchanging	**REASONING SKILLS** Associative-Variant / Mixed-Adaptable / Metaphoric-Original	**RESOURCE UTILIZATION IN THE DESIGN PROCESS** Within-domains / Mixed/ Between-domains	**DESIGN PROCESS** Linear / Non-linear
A1	**LEARNING STYLE** Changing/ Unchanging	Pearson Correl.	1	**,569***	,296	**1,000****
		Sig. (2-tailed)		,042	,326	,000
		N	13	13	13	13
A2	**REASONING SKILLS** Associative-Variant / Mixed-Adaptable / Metaphoric-Original	Pearson Correl.	**,569***	1	**,777****	**,569***
		Sig. (2-tailed)	,042		,002	,042
		N	13	13	13	13
A3	**RESOURCE UTILIZATION IN THE DESIGN PROCESS** Within-domains / Mixed/ Between-domains	Pearson Correl.	,296	**,777****	1	,296
		Sig. (2-tailed)	,326	,002		,326
		N	13	13	13	13
A4	**DESIGN PROCESS** Linear / Non-linear	Pearson Correl.	**1,000****	**,569***	,296	1
		Sig. (2-tailed)	,000	,042	,326	
		N	13	13	13	13

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Evaluation

This study has shown that the learners' non-linear approach in the design process is influenced by the change in learning style. It has been observed that the way learners establish a relationship with the context in the design process affects metaphorical reasoning skills and thus the level of product creativity.

- It has been found that in the case of an unchanged learning style, adaptable production with mixed reasoning comes to the forefront, while in the case of a changing learning style, original production with metaphorical reasoning comes to the forefront.

- Learners following a linear path were found to have unchanging learning styles at the beginning and end of the term. Those following a non-linear path, on the other hand, switched their learning style throughout the term. This variable condition has increased the creativity level in design as it allows designers to work in a versatile manner. These individuals have the ability to use different sources. Similarly, Casakin (2004a) and Özkan Yazgan and Akalın (2019b) have stated that the creativity level will be high in the use of between domains sources in design (p. 1193-1206).

- It has been observed that learners who follow a non-linear path in the design process mostly produce original designs (See Ö2, Ö9, Ö10, Ö11, Ö12). Indeed, in the literature, it is suggested that forming a strategy based on a combination of different specific exercises can be a useful method for improving the design skills of architecture students (Ceylan and Soygeniş, 2022, p. 320-340).

- In associative reasoning (See Ö1, Ö6, and Ö8), the use of within domains resources is prominent, while in mixed and metaphorical reasoning, the use of between domains resources is more prominent. Relationships abstracted from the inspired source become pieces of information that can be derived in different ways for design, allowing the production of innovative solutions, and this enables the designer to reflect their own perspective. It is known that abstraction will increase shared features with the mimetic and that in this case, it will become a metaphor object rather than appearance similarity (Gentner and Markman, 1997, p. 45-56).

CONCLUSION

This study has been conducted to describe the relationship between the components of creativity in design and changes in learning styles by closely considering the potential role of mimetic strategies in dealing with epistemic uncertainties typically encountered in design contexts.

- The study shows that changes in learning styles are associated with the reasoning style used in the design process. There is also a strong correlation between the reasoning style and the product produced. This situation is in line with Sloman's (1996) use of the term associative system in reasoning, meaning a cognitive system that makes inferences based on similarity and proximity; rule-based reasoning is underpinned by computational principles, rule-based systems are productive because they can encode an unlimited number of propositions, and associations are associated with similarity, and the rule base is associated with contiguity (p. 3-22).
- The study shows the importance of the way of reasoning and utilizing resources in design processes.
- In the associative reasoning style, progressing linearly within domains resources has forced the student to abstract information from the mimetic source, leading the student to produce analogical designs.
- Even if the path followed is linear, students who use mixed reasoning by using between domains and mixed resources have reached a more creative end product by producing combination products. This finding is consistent with data on the relationship between resource use and creativity in the literature (Casakin, 2004b, p. 197-217; Vosniadou and Ortony, 1989, p. 199).
- In the study, it was found that students who did not show a change in learning styles followed a linear path, while students who showed a change in learning styles followed a non-linear path.

These findings indicate that following a linear path reduces the likelihood of reaching an original outcome in creativity, and that rhizomatic processes in design enhance creativity in the resulting product.

Learners experiencing a change in learning style often exhibit higher creativity levels in design, mostly due to their ability to transform and utilize knowledge with greater information handling capacity. These individuals tend to follow a non-linear path in the design process, exploring more design alternatives and achieving higher levels of original interpretations. In other words, the study establishes that as the amount of inspired imagery in design increases, the originality of the product is positively affected. However, those following a partially linear path generally do not exhibit changes in their learning styles.

The study also finds that the use of between domain sources in design contributes to abstract product generation through metaphorical reasoning. Casakin (2004a) emphasized the expertise required to blend and use both within domains and between domains sources effectively. Between domains sources are based on structural commonalities, making them more challenging to access (Casakin, 2004b, p. 172). Nevertheless, successful mimicry can be achieved when accessed (Vosniadou and Ortony, 1989, p. 199).

A design studio is a microcosm that involves a process and is centred around the production of a product. Understanding the impact of the teaching strategy used in this microcosm on student creativity becomes crucial. This study serves as an indicator of how this understanding can be approached. By analysing the actors, actions, productions, and behaviours in the process, the theoretical framework that determines how creativity develops in studio education has been outlined. Mimesis, as a teaching approach that activates creative thinking, directs learners to explore, discover, internalize what they discover, and synthesize the knowledge they have learned in product production. Design studio instructors should support learners in developing their creative thinking in the process by conducting interdisciplinary research that enables contextual thinking with between domains sources. They should adopt an approach and attitude that moves away from being instructor-centred.

Creativity input is the precursor to producing creative output through the necessary process. Moreover, creativity input includes various components of creativity, including creative process and creative application behaviours. Design creativity performance (creative idea generation during the creative process and product creativity in the creative output) is influenced by creative components, situations (the path followed in the process), and behaviours (planned behaviour or logical action such as thinking style). Therefore, comprehensive design processes that trigger these stages should be investigated to realize design creativity. This study has shown that both creative components and planned behavioural components significantly affect idea creativity. Among creative components, creative thinking skills have been supported in the literature as having the highest impact on creativity. The most significant result obtained from the study is that when educating students with the metaphoric reasoning method, it is essential to help them explore mimetic solutions by moving away from linear thinking structures.

The study emphasized the importance of design studio facilitators directing students to think metaphorically when using the mimetic education approach, and revealed that adopting an approach that emphasizes relating to between domains resources in the process will affect creativity. Proceeding in a way that moves the student away from linear design and enables him to find examples that relate to his original idea will increase creativity. When the findings are examined, it is seen that the participants exhibited a number of common tendencies regarding both their contextual engagement with mimetics while producing projects and the process they follow when mobilizing design decisions. The study also showed the importance of the instructor's need to direct the linear student to do between domains research in order to encourage him to think metaphorically in relation to the context of place. In order to provide students with different thinking skills, an appropriate teaching strategy should be adopted in design studios by taking into account many factors such as the student's change in learning style, reasoning style, and use of resources.

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BIOGRAPHY OF AUTHORS

Dilek Aybek Özdemir is currently an Instructor of Architecture at Bingöl University. She received her B.Arch. from Gazi University. She is scholarly interested in, architectural design; design education and creativity; theory- criticism and method in architecture- planning and design. She is currently continuing her doctoral studies at Gazi University.

Aysu Akalın, B.Arch, M.Sc., PhD. Received her B.Arch from Gazi University Faculty of Architecture in 1986, M.A. in restoration from Middle East Technical University in 1991 and her Ph.D. degree in architecture from the University of Manchester School of Architecture in 1996. Her research interests include environmental psychology, environmental aesthetic, sensation and perception, creativity in architectural education, memory- collective memory, regionalism, contemporary contextualism, mutations, symbolism & representation, and place identity. aysuakalin@gazi.edu.tr. https://avesis.gazi.edu.tr/aysuakalin